

# INNODOCT/19

INTERNATIONAL CONFERENCE ON INNOVATION,  
DOCUMENTATION AND EDUCATION

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**Editorial**  
Universitat Politècnica  
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UNIVERSITAT POLITÈCNICA DE VALÈNCIA



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In memory of Isabel Estellés Miguel







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## PROLOGUE

In the 21st century, there are significant changes of educational culture in particular culture of learning leading to employability and creating innovation for entrepreneurship, therefore, the learning outcome need to be focus on 1) applying knowledge to create innovation 2) creative learning by active learning 3) learning for public and participation on making social responsibility and awareness 4) leaning for practice in real life.

School of Management, Walailak University, Thailand aims to manage education by using "Work Integrated Learning and Engagement with Community". We integrate learning by using projects and utilize in reality. The Project Planning and Management for Tourism Industry subject is one example from many subjects in our faculty to apply theories in the class approaching in reality at the fields. The local communities get involvement in learning together with students. The project assignments are delivered by students using real case in the field. The significant successful projects can lead the development in the communities, otherwise, the less successful project can be lesson learnt for students and local people for improving in the future learning. We use digital environment both in the class and satellite place to pursue the students learning from the starting of the subject in particular "Zeetings" using for collaborate students' motivation and "Google form using for formative assessment in each topic. Moreover, we use other social network to be close with students 24hs 7 days e.g. "Facebook and Line Chat". We have done the project by using field work and real communities to practice. Students are assigned to do the real thing for developing the real community. Local people would work with students, they can learn and exchange knowledge each other. The lecturer would be as a facilitator. When students obtain collaborative learning tools from lecturer who roles as a felicitor, and using digital environment that suites for new generation, it clearly positive impacts to tri-participants: students, lecturer and local people in the scenario of the subject. As the result, students more understand about applying theory to real life and can give benefits to local communities who join in learning process to develop their area and careers at the same time.

This is a great opportunity that International Conference on Innovation, Documentation and Education (INNODOCT) provide a forum for academics and practitioners to share innovations, research, results and experiences in innovation, documentation or education related to new information and communication technologies, innovations and methodologies applied to education and research. Tourism and Hospitality is one of many fields need to contribute efficient learning and apply technological tools for encouraging innovation of learning in the current century. In this regard, INNODOCT can be a good platform for various scholars to share and exchange good practices from around the world by using digital environment without barrier.

Assistant Professor Dr. Rungrawee Jitpakdee  
Head of Research unit, School of Management  
Walailak University, Thailand





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# PAPERS





**ENGLISH**





## What the Brand brands: A reading from the contribution of Sectoral Brands to the competitiveness of the regions.

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### **Abstract**

*Global brands have encouraged the penetration of products in markets, but new contexts have emerged, where brands add value to the productive sectors and promote the creation and growth of new companies. An approach and analysis of the contemporary construction of the sector brand and the value it provides to insert countries, territories, cities and products in global markets is carried out. On the other hand, in the Latin American context, we can observe the emergence of emerging brands that have their origin in the need to meet the demand of priority sectors or undertakings derived from the identification of unattended market niches, with the potential to become trademarks in a higher level.*

**Keywords:** *sectoral brand; country brand; commercial brand; brand territory; brand product; brand city; nation brand; global brand.*

### **1. Introduction**

The etymology of the word BRAND comes from the old Norwegian word BRANDR, which means to burn, as a representative symbol through the marking of fire, with the purpose of distinguishing one cattle from another through the brand; in classical Rome, potters marked the vases to be linked to the quality of the object, a practice that can be associated with exoteric and esoteric words, which represents the exterior or the visible for all, what we see of the brand, and the interior as the hidden, what we understand or transmit, respectively (Keller, 2005). The brand is "a name and / or signal whose purpose is to identify the product of a vendor or group of sellers, to differentiate it from rival products" (Stanton, Etzel and Walker, 2000:264). Therefore, the brand sector or sectoral brand is a group of products of a specific sector of a country; For example, we can say Fruit of Chile (it brings together several products), relating certain standards (quality, taste, price,



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among.) with the origin. Lazo makes a reference of the sectoral brand in the aspect of its positioning, where it indicates that the brand works based on "comparative advantage" and "competitive advantage", from an initial perspective of production to international distribution. Lazo also associates the sectoral brand with "the existence of a territorial concentration", which is related to the grouping of a product or a sector (Lazo, 2006: 37). These brands also have the impact of projection and perception; according to Crompton (1979) and Kotler, Haider and Rein (1994), the image is the sum of beliefs, ideas and impressions, so that the image of a country or a product allows a mental and social construction (Crompton, 1979) (Kotler, Haider, & Rein, 1994).

The region brand is the brand designated by regions of countries or regions of production, the basis of city-marketing, which shows the values of a product-destination and positions the territorial identity through its brand, for example, the Coffee Cultural Landscape. The information available on the creation process and methodologies for the implementation of sectoral brands is limited and, in some cases, restricted. The methodology used corresponds to theoretical works, and a review of the literature related to the brands will be carried out, from the macro aspect in the global sense, and then the contemporary construction of the micro of the sector or sectoral brand will be addressed. This article incorporates some of the concepts referred to brands of: country, territory, city, trade, sector, product and its link with the competitiveness of the regions, based on the bibliographic review and the critical and interpretative analysis of the most relevant contents.

## **2. Decomposition of the Global Brand to the Country Brand: Construction process**

Based on the contributions presented by Lazo (2006: 37), and the previous investigations that we carried out, we have proceeded to delimit the levels according to the position of the brands:





*Fig. 1 Brand Position*

*Font: Based on Lazo (2006: 37)*

The global brand can be perceived differently by each culture, which allows some products to distinguish themselves from others (Hernani, 2008: 44-45). As can be seen in figure 1, the global brand functions as an umbrella brand of all the others until it reaches the emerging brand. The role of brands is to present a differentiating concept that satisfies the needs of consumers and enhances a positive image of a country's identity, contributing to the improvement of competitiveness and its positioning in global markets, which is a goal for modern states. The term Nation Brand or Country Brand was employed academically by Simon Anholt in 1998; the Country Brand of the 21st century is not entirely defined by the author, who refers to the term by means of cases and examples, indicating that the majority of successful brands really come from countries that in turn are a brand. In this sense, the association of the brand of a product given to a nation certainly gives a positive image and generates mutually reinforcing relationships. Anholt believes that:

“At its simplest level, this association between commercial and national brand is merely a case of positive associations with national products: a country is famous for producing certain items, and brands in related product categories benefit by association” (Anholt, 1998: 396).

Building a positive image for the country, based on identity attributes that gives value to products and services in a global context, is a state policy in many countries, with specific rules and goals established by agreements and public-private partnerships. This idea is driven by the new commercial relationships and policies that are established precisely through globalization. The country brand concept, therefore, gains strength as an indicator of positioning that contributes to the competitiveness of countries, and becomes part of government programs, transcending ideological or political differences. At the brand and country image observation, Echeverri indicates that:

“the image of a country is the perception that direct, indirect, real and potential countries consumers have; and it is equivalent to the sum of all the elements that make up the country,

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plus those that are generated to communicate its characteristics; these perceptions contain differentiating connotations. All countries are different, that's how they share common elements" (Echeverri Cañas, 2015).

In this scenario, the products, in addition to the intrinsic quality that they must have, must also be capable of providing significant experiences based on the production traditions that link the product with the country of origin. Before addressing this, we must point out that culture can be defined as "the collective programming of the mind that distinguishes the members of one category or group of people from another" (Hofstede, 1999: 34). It is important, therefore, that the country becomes an adjective of the products, and that the products build their own associations as a nation's culture of making. This means moving from a "Made in" product to a "Made by" product. In other words, it means designing, in a systemic way, the attributes and relationships that allowed us to pass, for example, from chocolate of Swiss to Swiss chocolate, from wine of Chile to Chilean wine, from cocoa of Ecuador, to Ecuadorian cocoa. This approach makes the Product Nation or Product Country relationship an attribute reference that acts as a syllogism for other products brands from the same country.

Fan explains that country is an area of land occupied by a group of people who constitute the nation, and manifests two concepts: nation branding and nation brand; the branding focuses on marketing techniques and promotion of the image of a national space. (Fan 2006: 5) "The really innovative thing is to baptize it with the name of nation branding" (de San Eugenio Vela 2012: 152). Therefore, Country Brand refers to the country, but not to the concept of nation. Similarly, the country brand precept that includes a graphic representation are attributes of association to the place by some unique particular concept.

### **3. The focus of the developing Commercial Brand for Sectoral Brands**

The trademark is linked to the doctrines of industrial property, manufacturing and geographical indications (Schmitz Vaccaro, 2012: 11), but over time the demand for "products in all sectors" has increased (Trout, 2001: 2). It can be linked to a particular place or be a global factor that graphically represents a specific product or service.

According to Morales:

"The trademark is a legal institution that associates a sign with specific products or services and whose purpose is to distinguish the latter from other analogs in the market, which in its definition already warns of its use vocation. In this sense, a brand that is not used does not fulfill its own function and may end up being a subterfuge of paper destined to hinder commercial competition" (Morales, 2010)



Therefore, the conglomerates of determined products contribute to the development of a productive sector, from the point of view of the sector or sectoral brand, the associativity would be the motor to potentiate the productive development of a nation. We can associate the commercial brand with the product-company brand that, according to Lazo, is at the first level of international market positioning, where the products that are exported are differentiated and adapted to international requirements (Lazo, 2006: 36), these attributes being typical of the sector brand. A trademark that is from a region or an area of a country can be transformed into a sectoral brand with the right properties and the right associativity of producers to respond to a global demand, with the support of the nation and adequate state policies. It is clear that the sectoral or sectorial brand aims to expose the important points of a region or of the whole country, with particular attributes and characteristics, such as the geographical space that externalizes a productive export potential for an economic growth of a specific public. One point to be taken into account is the number of companies of different sizes around these particular sectors, which commercialize their trademarks autonomously, while through a sectoral brand the inclusion, grouping or association of small, medium and large companies linked to the same product/sector is characteristic.

#### **4. The contribution of the Sectoral Marks to the Country Brand and Territory Brand**

The territory brand, also known as brand place (Alameda & Fernández, 2012: 1), has the particularity of bringing together the differential attributes of a space, with an added value (Moneris, 2008), which is a unifying element referring to the geographical aspect, to obtain a certain positioning (López-Lita and Benlloch, 2005 and 2006), based on a strategy whose main objective is the increase of tourism, regional or national (de San Eugenio Vela, 2012: 148); the territory brand is not the same as the country brand, nor the city brand, since a territory brand could only refer to a single tourist place. If a territory possesses a single product from a fruitful sector, it contributes directly to a double diffusion, not only for the country but also for the territory in particular, which translates into an increase in tourism potential, and acquisition of that potential product, generating a double economic flow.

The territory brand can support a sectoral brand, position and relate a product to its place of origin, which contributes to the recognition of the territory associated with a product, tangible or intangible. Examples such as “empanadas salteñas” from Salta in Argentina, “deep dish pizza” from Chicago in the United States, “cocido madrileño” from Madrid, “taquitos al pastor” from Mexico, “mate” from Argentina or “calimotxo” (Kalimotxo) from



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San Sebastián in Spain can be the origin of new sectoral brands, for their realization, place of origin or product differentiation. Likewise, the link of a trademark with a specific country, for example, Juan Valdés coffee from Colombia, which is also a clear example of the association of a product with a country, allows us to infer that this type of associations can also, with an appropriate strategy, lead to the creation of sectoral brands.

## **5. The contribution of the Sectoral Brands**

Diario El Comercio del Perú exposed through an article the power of a sectoral brand and how it can become a sign of productive differentiation, analyzing how Chile has managed to increase its participation in global markets in less than five years, using positioning strategies powered by sectoral brands (El Comercio, 2015). Anholt says that the effect of the country of origin is powerful and complex, therefore, sectoral brands to promote a product from the economic point of view generate a systemic change that allows the improvement of the visibility of products, promoting exports. Chile, which is a case of interest in Latin America, has generated a change in the management of the products that it offers to the world markets. (Anholt, *Competitive Identity: The New Brand Management for Nations, Cities and Regions*, 2007). At this point it is important to point out that the sectoral brand gathers a conglomerate of perspectives, and its success is directly related to the strength of the public-private alliance that supports it.

García indicates that "Product is what the advertiser factory or distributes and, ultimately, what it offers to consumers. Brand is what consumers buy, it goes beyond the materiality of the product itself " (García Uceda, 2001: 71). The sectoral brand has two very important properties, as they are: distinguish and differentiate. According to the Merriam Webster, distinguishing is "2. tr. Make something different from something else by means of some particularity, signal, currency" (Real Academia Española, 2018) and differentiate is "1. tr. Make distinction, know the diversity of things" (Real Academia Española, 2018). Within figure 1, where the position of the brands is shown through a hierarchical structure, the sector brand is under the country brand. The evidence shows that the sector brand contributes to the improvement of the penetration of products in world markets, positively impacts the reputation of countries, fosters cooperation in a fair competition environment with clear rules, promotes economic growth, encourages to small and medium enterprises to incorporate good manufacturing practices, waste management, new technologies and social responsibility policies, in addition to adding value to products and contributing to satisfying the demand for products or services in various segments of the population.



## 6. Projection of emerging brands in Latin America

According to Merca 2.0 "emerging brands or Clean Slate Brands are those that have no past. That is, they are new, better, open and receptive." Due to the generational changes of consumers, they show greater willingness to consume new products and accept new brands. In this context, in Brazil, cataloged as an emerging market and also as a Latin American benchmark, the level of consumer confidence in emerging brands reaches 65%. (Gonzalez, 2015) Most emerging brands have their origins in ventures and the emergence of new markets, established based on new experiences for consumers, and promoted largely by the so-called influencers; They seek to differentiate themselves from traditional brands and offer new shopping experiences or products. According to a report presented by the consultancy comScore, "Latin America is the region most involved in social networks globally." (comScore, 2017) Emerging brands can be, in terms of their time of existence, seasonal or temporary brands, which they sell through social networks, conquering the centennial or Z generation, who seek options beyond the scope of traditional brands, with emphasis in the products and the properties or attributes that distinguish them from others. Could these brands arise from a new demand of productive sectors and become sectoral brands? The change in the preferences of new users is evident and imminent.

## 7. Conclusions

The sectoral brands, in their various fields of application, present several difficult adoption challenges to the states, regions, cities, industries, entities and people involved in the development, manufacture and marketing of products. The political, economic and legal implications that go hand in hand with the implementation of a sectoral brand require a firm commitment that transcends the limits of a company. How to compete and cooperate at the same time, how to resolve differences without affecting the achieved objectives and the achievement of common goals are issues to be addressed and resolved before outlining the first aspects of the sectoral brand design. In this sense, be aware that agreements imply a change in old practices, accept a set of rules, foster an environment of trust among competitors, share information and collaborate to achieve the level of expected quality that is essential.

If we take as reference, the Chilean experience, we observe that the state plays a fundamental role in the creation and promotion of sectoral brands through ProChile. It is an entity attached to the Ministry of Foreign Affairs of that country. It is enough to have a first look at its website to clearly observe its objectives: to train producers of exportable



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products, to promote the exportable offer of Chilean products to world markets, and to link potential buyers with Chilean exporters able to satisfy their demand, with emphasis on food, industries and services. According to the indicators published by the Central Bank of Chile, exports from January to September of 2018 totaled 57.651 USD million, 16.5% more in relation to the same period of the previous year.

This positive trend has been maintained in recent years—remarkable results of the effectiveness of the sectoral brands. Regarding the analysis and figures presented in relation to emerging brands, it is logical to point out that these may arise from a single sector of a region or territory, and have the potential to become sectoral brands, as well as be linked to promote—in addition to the consumption of products—tourism.

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## Evaluation of discovery learning in the field of cultural heritage

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### **Abstract**

*The theory of constructivist learning, also known as **discovery learning** is a learning methodology in which the student instead of receiving the content passively, discovers the concepts and their relationships and rearranges them to adapt them to their cognitive scheme . This method transforms students into protagonists of the learning process, who develop research skills through an inductive method. Therefore, it is configured as an ideal tool to situate students in a sociocultural dimension, favoring the understanding of the appearance and socio-historical construction of the concept of cultural heritage taking into account the transformations of late modernity and the new current situation defined as globalization This work aims to assess the degree of acceptance and satisfaction of students, in relation to the process of implementation of learning by discovery, through anonymous surveys in which the different strategies and tools used in this methodology are analyzed, with the aim of improving and optimize the design of the programming.*

**Keywords:** *discovery learning, inductive reasoning, inductive thinking, inductive strategy, guided discovery, evaluation, cultural heritage, EICE-AFA-Reality.*

## **1. Introduction**

The new conception of cultural heritage and its recent transformations, requires rethinking an important reflection on the new patrimonial action models. Tourism, globalization and the patrimonialisation of new cultural elements require the revision and proposal of new methods of intervention, in which sociocultural aspects are contemplated, their values of use, formal and symbolic / identity (Santamarina Campos, Carabal Montagud, De Miguel Molina, & De Miguel Molina, 2016).



This change in the perception and management of cultural heritage has meant a profound transformation in the design of conservation and restoration projects. This fact opens the way to the acceptance of an intersubjective participation and a consideration of the broader discipline, which transcends the limits of the object and compilation study, and gives greater prominence to the subjects receiving and the different processes of meaning, conceiving this professional activity to Starting from "their social uses, not from a mere defensive attitude, of simple rescue, but with a more complex vision of how society appropriates its history, it can involve new sectors. It does not have to be reduced to a matter of the specialists of the past [...]" (García Canclini, 1993).

In relation to the above, moving from the object of restoration to the subject that gives a set of values, as a reason to study implies the need to raise, from the analysis and reflection, a process of deconstruction, reinterpretation and redefinition of previous criteria solidly settled in the field of conservation and restoration of cultural assets (such as objectivity, authenticity, truth, materiality, ...) by others that pave the way to the path of subjectivity.

This supposes the need to discover in the student a critical and creative position regarding the importance of the social construction of heritage and its intervention, which should be enriched, questioned and rethought throughout his professional career. Therefore, in eminently theoretical subjects, in which the main objective is to provide an approach to cultural heritage from a social perspective (Santamarina Campos et al., 2016), it is necessary to implement a methodology that allows generating an active and social learning process, in which students build new ideas or concepts based on current knowledge. In this way, the student can select the information, originate hypotheses, and make decisions in the process of integrating experiences in their existing mental constructions.

The theory of constructivist learning, also known as learning by discovery is a learning methodology in which the student instead of receiving the content passively, discovers the concepts and their relationships and rearranges them to adapt them to their cognitive scheme. This method transforms students into protagonists of the learning process, who develop research skills through an inductive method (Zarza C., 2009). Therefore, it is configured as an ideal tool to situate students in a sociocultural dimension, favoring the understanding of the appearance and socio-historical construction of the concept of cultural heritage taking into account the transformations of late modernity and the new current situation defined as globalization (Santamarina Campos et al., 2016).

For this reason, the implementation of learning by discovery has been carried out in the following theoretical matters:

- Management of intangible heritage (33848). Optional. Number of ECTS: 4.5. Number of students: 35. Department of Conservation and Restoration of Cultural Property, Master's Degree in Conservation and Restoration of Cultural Property.



- Development, management and direction of restoration projects. Optional. Number of ECTS: 4.5. Number of students: 35. Department of Conservation and Restoration of Cultural Property, Master's Degree in Conservation and Restoration of Cultural Property.
- History of the Conservation and Restoration of Cultural Property (33841). Optional. Number of ECTS: 4. Number of students: 35. Department of Conservation and Restoration of Cultural Property, Master's Degree in Conservation and Restoration of Cultural Property.

These subjects offer an approach to cultural heritage and its management / intervention, in order to place the student in a sociocultural dimension that enriches the analysis and knowledge of the object to be intervened. The purpose of these subjects is to approach the student to:

- The most relevant aspects of cultural heritage in relation to different sociocultural contexts.
- The fundamental concepts of the restoration and patrimonial management practice from the different approaches: identity-symbolic, economic and political.
- Develop the ability to analyze, synthesize and evaluate the different aspects on which the notion of cultural heritage is built in the field of conservation, restoration and management.
- Appropriating heritage, assuming its role in conservation and professional training.

On the other hand, these subjects work the transversal competences of analysis and problem solving, innovation, creativity and entrepreneurship and teamwork and leadership, understanding and integration and critical thinking. For this reason, learning by discovery constitutes an ideal methodological tool to work on these competences and acquire the necessary levels of mastery (Table 1).

**Table 1. Linking Transversal Competencies with the fundamental principles of discovery learning. Source elaboración propia, based on (ICE, 2015) and (Bruner, 2006).**

Transversal Competences (ICE, 2015)	Linking with the fundamental principles of discovery learning (Bruner, 2006)
Analyze and solve problems effectively, identifying and defining the significant elements that constitute them.	The main objective of education must be the ability to solve concrete problems and practical application in real life.
Innovate to respond satisfactorily and in an original way to personal, organizational and social needs and demands with an entrepreneurial attitude.	Meaning is the product of creative discovery and not the verbalization of concepts.
Work and lead teams effectively to achieve common goals, contributing to the personal and professional development of them.	The discovery efficiently organizes what has been learned for later use.
Demonstrate the understanding and integration of knowledge both of one's own specialization and in other broader contexts.	The real and most important knowledge is the one learned by oneself. The discovery ensures the conservation of information.
Develop a critical thinking interested in the foundations on which the ideas, actions and judgments, both their own and those of others, are based.	The empowerment of students in creativity and critical thinking should be prioritized.

## 2. Objectives

The main objective of this proposal is to evaluate the degree of acceptance and satisfaction of students, in relation to the process of implementation of learning by discovery, through anonymous surveys in which the different strategies and tools used in this methodology are analyzed, with the aim of improving and optimizing the design of the programming of the subjects involved.

Therefore, the final objective will be for students to discover the transformations produced in cultural heritage in an active, constructive and collaborative way. In this way, based on

the material and tools provided by the teachers, what Bruner defines as scaffolding (Bruner, 2006), students can discover in a co-creative way the most complex and changing concepts that the field of cultural heritage presents.

Also, this experience is part of the Innovation and Educational Improvement Team (EICE) "The process of Teaching and Learning Outside the Classrooms - Reality Baths (EICE-AFA-Reality)". The Innovation and Educational Quality Teams (EICE) are an initiative of the Vice-rectorate for Studies, Quality and Accreditation (VECA), with the support of the Institute of Education Sciences (ICE) and the Commission for the Evaluation and Follow-up of Innovation Projects and Educational Improvement (CESPIME) of the Universitat Politècnica de València

### **3. Description of innovation development**

As indicated, the objective of the implementation of learning by discovery has been to modify the functions and the role of the teacher, which does not expose the content with full value, but rather the student is the one who acquires a large part of knowledge by itself (Baro, 2011), through its co-creative experience of discovery or reception of information. Thus, 85% of classroom time, is intended to perform practices in the classroom, with the aim is that the student discover in an active and collaborative way what you want to learn.

In this way the theoretical content of these subjects is structured on the basis of key questions, which pose problems to be solved, from which the students can get new ideas and the fundamental concepts of the subjects involved, based on the knowledge learned in the preceding sessions and matters.

For this, the theory is presented as questions, which students must solve collaboratively, with the help of the tools provided by the teacher. The questions are always resolved in groups of between 3 and 5 students, respecting parity. In each session, on a rotating basis, a group representative is assigned who is the one that exposes and defends the results of the question worked, so that there is a balanced and orderly participation of all the students throughout the semester. For each session a template is given to complete in group, A3 sheets or continuous paper, post-it, gometes and colored markers, to facilitate the collaborative work (Image 1 and 2), allow them to obtain models of more efficient and rich systems, by synthesizing different points of view, merging mental models (Santamarina, Carabal, de Miguel, & de Miguel, 2018). In addition, the questions are accompanied by complementary material, such as press news, TV news, a film, a short film, a report, an article of research, a story or simply an image. In this way, from the delivered material, students should try to find the answer, analyzing the information provided that is always



linked to contemporary and current issues. Once the practice is finished, each group presents its answers and a directed debate is opened, in order to lead and build the appropriate response among all. As a conclusion, the teacher presents some slides that synthesize the answer to the question posed, strengthening the most important aspects of the new concept acquired. In this way, through the answers of the key silver questions, the students construct in a directed way the theory linked and applied to contemporary issues.



*Image 1. Detail of a collaborative work session, in the subject Development, management and management of restoration projects. Source: Own photography, academic year 2018-2019.*



*Image 2. Detail of a collaborative work session, in the subject Development, management and management of restoration projects. Source: Own photography, academic year 2018-2019.*

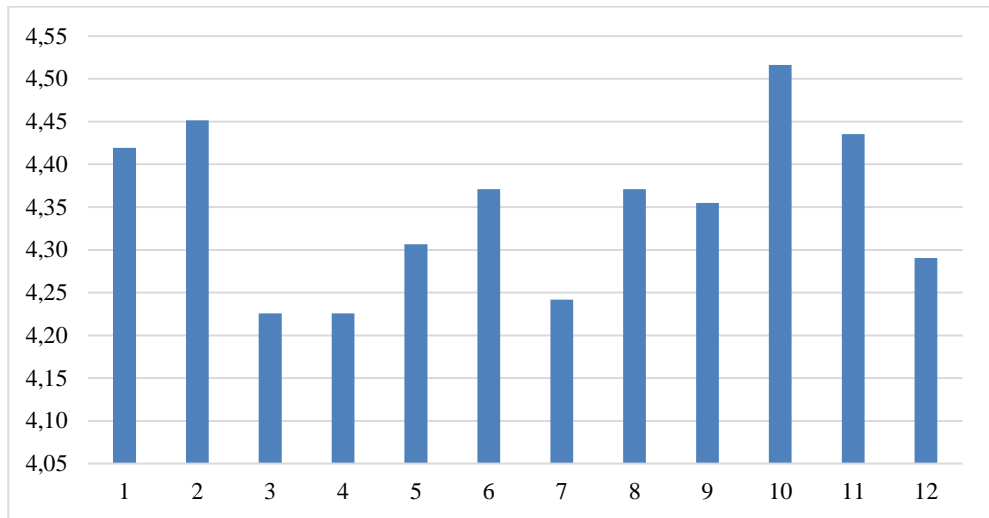
#### **4. Results**

After completing the subjects in which the methodology of learning by discovery was implemented, students were asked to fill in an anonymous online survey, composed of 12 questions that analyzed the effect of using the different tools used to achieve learning. significant, focusing mainly on:

1. The use of real cases.
2. The use of photographs, press articles, audiovisual resources, TV programs, etc.
3. The use of movies or short films.
4. The use of reflective questions.
5. The realization of manipulative and collaborative practices.

The results of the surveys confirmed the great acceptance of this methodology by the students, obtaining a global average of the surveys of 4.35 out of 5 (table 2).

**Table 2. Result of satisfaction surveys in relation to the use of learning by discovery. The rating range was from 1 to 5. There were 1 totally disagree and 5 totally disagree. Source: self made.**



Both ask that they obtained a grade equal to or higher than 4.5, were related to degree of satisfaction in relation to use real cases through press articles, video clips, movies, etc., with the aim of internalizing knowledge, remember them more easily, and understand the theoretical explanation later.

## 5. Conclusions

The transformation of heritage has brought about a new focus in its management and intervention, which makes it necessary to incorporate aspects related to the symbolic-identity, political and economical dimension. Discovering in a co-creative way the most complex and changing concepts that the field of cultural heritage presents, is a fundamental process that motivates students to solve problems independently and cooperatively, with minimal support from the teacher.

On the other hand, learning by discovering, consolidates the fundamental concepts facilitating their management and promoting the independence of the students, facilitating the development of the final master's work and promoting a flexible and exploratory learning, expanding the fields of action.

Learning through this method is relevant, and is evident in the presentations made by the students of final master projects that are presented in the Department of Conservation and Restoration of Cultural Property of the UPV, when applied in real cases that the students themselves transfer to the working world, promoting the research and innovation of the students and motivating them to present project proposals to public calls. In the academic year 2018-2019 there has been an increase of 20% in the number of proposals for final works of subject or master that have been submitted after public calls or prizes. On the other hand, the level of satisfaction of the students with the use of this technique is evident in the results of the surveys, in which after the implementation of this tool they increase between 10 and 15% the final assessment.

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## Lessons learned from the implementation of a Service Management Office: the case of a World Food company in Latin America

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### Abstract

*This paper presents the case of evolution and lessons learned in information technology service management (ITSM) of a World Food Company in Latin America, with an emphasis on their process-driven strategy for integral transformation through the Information Technology Infrastructure Library (ITIL), as well as the creation of their Service Management Office (SMO). Their experience in implementing ITIL and an SMO presenting their roadmap and main challenges. As an extra added value, service quality has been enhanced through the use of business indicators and commitments from three perspectives: people, processes and technologies. These results reveal that the SMO has become a strategic complement for IT, in addition to being a fundamental element to ensure quality and efficiency in technology service management.*

**Keywords:** Service Management Office, ITSM, IT Governance, Service Management Department, ITIL

### 1. Introduction

The shift in expectancies regarding the use of information technologies (IT) has caused that today, companies from a range of sectors and sizes seek for increasingly efficient and innovative technology solutions. And so, organizations – especially multinational ones – are increasingly recognizing that IT services are crucial and strategic assets that call for resource investment to support their provision and management. However, it is also true that, at times, the strategic role of IT services is overlooked or is not addressed with the strategic importance it entails (Adison Cartlidge et al., 2007), and, those who do recognize its importance through implementation of best practices or IT service frameworks, such as Information Technology Infrastructure Library (ITIL), have found that one of the success



factors to ensure successful outcomes in managing such services is having an adequate process not just for implementation, but also for follow-up, maintenance (Neničková, 2011) and evolution.

In light of an analysis of literature on the importance of having an office allowing supporting and following up on effective IT service management from the implementation of an IT service management framework (Cannon, 2011; Fry, 2008; ITGI, 2009; Lucio-Nieto & González-Bañales, 2019; Lucio-Nieto, González-Bañales, & Bermeo Andrade, 2016; Microsoft, 2008; Plexenet, 2011; Roller, 2009; Shamsavarani & Shaobo, 2011), the sources analyzed suggest the existence of a Service Management Office (SMO) as a mechanism responsible for delivering quality IT services to users, at both the tactical and strategic levels (Lucio-Nieto & González-Bañales, 2019; Lucio-Nieto et al., 2016; Montgomery, 2011). Such office's main responsibilities are the strategy and design of a service that delivers business value and the governance of IT processes, frameworks, methodologies and standards (Hubbert, 2008). This is empirically supported by studies conducted in 2009 and 2012 (Lucio-Nieto & Colomo-Palacios, 2012; Lucio Nieto & Gonzalez-Bañales, 2009) on a number of Latin American companies in order to know the importance and implications of the implementation of frameworks and best practices in IT service management, as well as the pertinence of the creation of an SMO, considering ITIL as the main framework for IT service management. The results from such studies and a bibliographic review, suggest that it is advisable to have an office allowing following up on and meeting the objectives of IT service management.

Although there is no standard definition for a Service Management Office (SMO), its functions and scope (Lucio-Nieto, 2011), by analyzing several definitions, (Cannon, 2011; Clyton, 2012; Hubbert, 2008; Montgomery, 2011; Roller, 2009) it can be said that it embodies an IT governance mechanism that defines, monitors and audits both operating and in-transition process, it is responsible for ensuring compliance of the “end-to-end” service strategy for all of the functions involved in its definition, design, transition, operation and continual improvement; additionally, it has three main responsibilities: strategy and design of services that deliver business value (demand, portfolio and service catalogue management), and is in charge of business relationships and responsible for the governance of IT processes, frameworks and standards.

Considering that the bibliographic review performed does not include an analysis of a company case that has implemented an SMO in a Latin American setting for a multi-national, multi-product company, a study case is presented in this work with the aim of analyzing the lessons learned in the implementation of an SMO in the context of IT

services, as a means to ensure efficiency and permanence in the implementation of frameworks in the IT service management area, specifically for ITIL.

## **2. Lessons learned from the implementation of a Service Management Office (SMO)**

### **2.1. Company Background**

World Food Company<sup>1</sup> (WF) is a leading company in the food (snacks, candies, cookies) and drinks sector, founded in 1898 and operating in over 200 countries and regions. It is a company valued at 178.47 billion dollars, with over 267,000 employees worldwide (Source: <https://www.macroaxis.com/invest/market/PEP--valuation--WF> **2018**). WF Company is one of the largest food and drink company in North America and the second largest in the world, and is one of the three largest companies in this sector in Latin America. WF Company's presence in Latin America traces back to 1907, when the company registered the WF brand in Mexico. In 1938, it opened its first bottling plant in Mexico (WF, 2018). Regarding business units, the main four are: (1) WF Company America Foods (AAF) (WF Snacks North America (ASNA), WF Foods North America (AFNA) (2) WF Americas Beverages (AAB) (North American and Latin American beverage business) (3) WF Europe (beverage, food & snack) (4) WF Asia, Middle East and Africa (AMEA) (beverage, food & snack) (WF, 2014, 2017).

WF Company wide portfolio includes 22 brands, each generating over one billion U.S. dollars in annual retail sales (Source: <https://www.statista.com/statistics/536974/wf-s-number-of-employees-worldwide/>). In 2017, it's operating profit in Latin America was around \$1.000 billion US Dollars, which accounted for 11% of the company's operations worldwide. Over the course of more than 100 years, WF America business has grown to become one of the strongest foods and beverage manufacturers in the Latin America region, WF Latin America sells beverages, food and snacks throughout the region employing more than 70,000 employees in 34 countries and generating \$7.2 billion dollars in sales (WF, 2017).

### **2.2. The Service Management Office (SMO) project at WF Company**

In 2011, WF Company went through a deep restructuring process, together with a productivity plan. This plan included actions related to aspects dealing with strengthening

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<sup>1</sup> Due to the company did not allow its name appears in this paper, WF Company (World food company) name is used instead.



the complementary businesses in the food, snack and beverage areas by taking advantage of new technologies and processes in all of WF Company's operations, *go-to-market* strategies and information systems, thus increasing the focus on sharing best practices worldwide, consolidating manufacturing, warehousing and sales offices, and the application of simplified structures in the organization with wider spaces for control and fewer management strata (WF, 2014).

The above is an evidence that the use of information systems is a part of strategic operations at WF Company and, therefore, service management is an important element in order to make sure that IT services do add value to business strategies and processes. Achieving efficiency in such services has implied for the organization an evolutionary process in the incorporation of IT to their productive and business processes, based on the following principles (Lucio-Nieto & Sanchez Trejo, 2010): Generate value for business units being serviced in Mexico through dependable, predictable service; innovate as a part of day-to-day living; generate productivity; being a source of talent for WF Company; and being a strategic business partner. Such evolution and embracing of principles has led WF Company's IT area, in a bit over a decade, to a series of transformations, as described below (Sanchez Trejo, 2017):

- **Shift from a local function to a *Shared Services* model, integrating services and leveraging resources under an economy of scale.**
  - **1999-2006:** establishment of a *Shared Services* model as a result of the consolidation of WF Company firms in Mexico, thus strengthening services under a Technology *outsourcing* model such as the Data Center and Telecommunication Services.
  - **2006-2007:** End user care services were integrated under a service *multisourcing* model, some of them include: ***Service Desk***, as the single point of contact to address the demand for IT services; ***Field Services***, which addresses the need for IT services in the field in a timely manner, thus establishing clear principles of Service Levels.
  - **2008** – Up to date. Consolidating business applications in ERP and applications to address the needs of the single model for business processes that deal with WF Company's value chain in Mexico.
- **Improving the IT Service model**
  - **2007-2009:** A vision of IT is created based on a focus on customer satisfaction along all WF Company business units in Mexico.
  - **2007-2009:** A standard service portfolio is defined.
  - **2008-2011:** An operating model and a service-driven, process-based organization to support such management (under the ITSM principles) are created.

- **IT Globalization (2011 up to date)**
  - A new identity for IT is created with a global vision for all geographies where WF Company has presence throughout the world.
  - Work is conducted under a model that seeks to maximize resource leveraging, thus generating productivity based on economies of scale with a focus on continual improvement and innovation processes.

### 2.2.1. ITIL implementation at WF Company

The relevant aspects of ITIL implementation in WF Company Latin America are described in this section. As mentioned above, in the 2000-2007 period, the IT organization was focused on seeing to it that everything that was done, would be of use a system for operation and marketing control, but by doing so the IT department lost the point of contact where they were close to the business and the end user, and the question arose: How to align IT with the business? As a part of the solution, a consulting firm was contracted and the first question had to do with the governance model, which was not consolidated. This revealed that the organization was not used to talk in such terms as: methodology, frameworks, governance, ITIL or COBIT (Ramírez, 2009). It was so to such an extent that in the initial stages of the implementation of ITIL, it was never seen as a stage where the individuals involved would say “we are implementing ITIL”. Even the name ITIL itself was of little importance for IT personnel, for the only intent was to get organized so as “to be able to respond better to customers and users”, because they were considered to be the ones who paid for service. Therefore, ITIL implementation came about because of the need to organize the operation of IT services. Here it must be stressed that this first stage of the implementation occurred after the company became organized in *business units*.

And so, the main objective of implementing ITIL practices was to improve and maintain an adequate level of quality, cost and time for technology services for the firm. The ITIL processes implemented were: incident management, problem management, change management and configuration management. In order to conduct this implementation, a cycle was implemented considering the following phases: initial assessment of the way the practices for such processes were, showing what could be done differently, joint design among areas and regions, internal training and certification in the implemented processes, coaching during operation start-up, execution by the company on its own, feedback and adjustment period (Lucio-Nieto & Sanchez Trejo, 2010).

Considering the timeline for ITIL implementation, it began in 2008, as a local initiative in Mexico and, in view of the results, the processes began to be implemented in all other regions in Latin America. This execution was divided into 3 stages in order to consolidate the adoption of processes and achieve business objectives (Lucio-Nieto & Sanchez Trejo, 2010). The rest of the implementations occurred by Region (which is the way they are



organized in BIS<sup>2</sup> in order to support the business) in this order: CARICAM September 2010 (Guatemala, Dominican Republic, Puerto Rico, Panama, Costa Rica, Honduras, El Salvador), the Andean Region February 2011 (Colombia, Ecuador, Peru and Venezuela), Brazil April 2011, South Cone Region June 2011 (Argentina, Uruguay, Chile); that is, 16 countries in all, where ITIL-based service delivery was implemented.

### *2.2.2. ITIL operation and the need for an SMO*

The first implementation of ITIL at WF Company started in December 2008 (in Mexico) and was completed in mid-2011 (South Cone Region). Within this context, it became evident that there were regions with a far more advanced maturity level with regards to the operation of the four implemented processes. By the time ITIL implementation was completed for the South Cone Region, it had already been in operation in Mexico for a couple of years.

Although the Latin American sector was operating under ITIL processes (incident, problem, change and configuration management), in the same line, attempts were being made to stabilize process operation in each Region. A post-implementation review was conducted, which was intended to identify the level of maturity and compliance of the processes in all of the Regions. Such assessment revealed the existence of different maturity levels for the processes in the various Regions, and a series of needs were detected for both business and BIS that would eventually result in the implementation of an SMO. Among the needs that were identified as related to management it was found that there should not be large deviations in processes, so as to ensure that operation would be similar in the various Regions, that is, to align them so that they would be managed as processes.

### *2.2.3. The creation of an SMO at WF Company*

As a result of BIS's concern to provide technology services to the highest quality standards in order to deliver business-oriented results such as: accelerating service solution times, having a positive impact on services related to critical sales / production / logistics / shipping processes, improving availability levels (Ramírez, 2011), and the results of the assessment described in the above section, the need to establish an SMO was identified, and its scope was stated as follows: (1) establish all *Service Manager* communication, who was responsible for Latin America's SMO, (2) establishing the mechanism or operating model to request changes or modifications to processes, tools or roles for the four processes that had been implemented, (3) do so through an audit scheme where a formal entity is located that oversees the way processes operate in all of the regions, so as to match this operation.

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<sup>2</sup> *Business Information and Solutions* (BIS): name of the department in charge of managing WF Company Latin America's IT services. It was oriented towards installing four main ITIL processes: incident management, problem management, change management and configuration management.

With regards to the participation of the SMO in the IT service design strategy, in 2012 the fundamental processes dealing with incidents, changes, configurations and problems were in place, which resulted in a one-year-long implementation of a governance model in terms of communication, where all indicators were revised – not process indicators, but business ones – so that they were aligned to BIS strategy in order to facilitate the availability of the services now existing for the business’ value chain. The overall SMO model proposed is shown in Fig. 1.

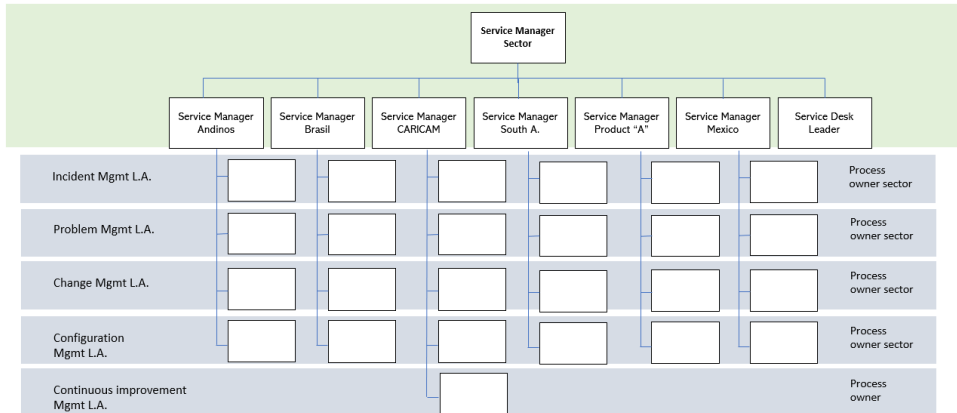


Fig. 1 SMO Model operating at WF Company Latin America

### 2.3. Lessons learned

While ITIL is one of the most widely used and recognized frameworks in IT service management (England, 2011; Gervalla, Preniqi, & Kopacek, 2018; Hirt & Melander, 2010), it is not exempt from having weaknesses such as the fact that it only describes what has to be done for ITIL implementation; it even only suggests the creation of a Service Management Office (Cannon, 2011), but it fails to describe a methodology or guidelines on how to do so and, even more importantly, what to do after its implementation, and it also fails to provide a clear indication that it is an evolutionary process (Lucio-Nieto & Sanchez Trejo, 2010). It should be emphasized that there is evidence that holding an ITIL certification is not a warranty of its adequate adoption or execution (England, 2011; Lucio Nieto & González-Bañales, 2016; Pollard & Cater-Steel, 2009) as evidenced in WF Company in the early stages of its implementation of ITIL. As a consequence, ITIL as a framework, requires taking care of a series of factors to achieve successful operation and functioning (Neničková, 2011), and one such factor is the operation of an SMO (Fry, 2008;

Montgomery, 2011). In the case of WF Company, an SMO has been identified as a means for aligning the Service Management (SM) strategy, resources, processes and tools to business objectives.

Considering the above, the main lessons learned in the WF Company case in the implementation of an SMO for Latin America are described below. The lessons are classified in three categories: people, processes and technology, considered as ITIL post-implementation success factors (Iden & Langeland, 2010; Neničková, 2011) and key elements to be considered in designing and operating an SMO (Roller, 2009).

### *2.3.1. People*

The main challenges to be overcome - and the ones WF Company faced after implementing ITIL – were: Many priorities, which made it difficult to be 100% focused on compliance with ITIL processes or implementing more processes; personnel operated with individual objectives that were not aligned to the organizational goal, but the goal was not always related to BIS process execution, continual improvement or roles; what would happen with roles? People were saturated and there would not be more hiring; inadequate perception of ITIL, being perceived at times as the end in itself and not as the means for providing good service; inadequate skills for change management.

### *2.3.2. Processes*

The processes defined to be run by the SMO are: communication management, execution of Committees at the three levels (Executive, Tactical and Operational), change management for SMO processes and tools. Additionally, the ITIL processes that are under its custody are: incident, problems, changes and configuration. The SMO provides support for governance and management of the processes together with control management and responsibility for field services (Peres, 2017).

Considering that the processes are a part of the success factors in IT service management, it should be taken into account that (1) adequate techniques and tools must be applied, (2) IT and the related business processes must be aligned, (3) there must be follow-up and measurement (Neničková, 2011; Pollard & Cater-Steel, 2009), and (4) there must be a clear vision of the benefits of adequate process management both individually and as a set (Tan, Cater-Steel, & Toleman, 2009).

In order to establish the criteria to be used to prioritize the processes to be implemented within the SMO, aspects related to technology, service and process governance for SM, application support and solution delivery were considered. Then, the following questions emerged: How does one go about innovating, being productive, making progress in terms of image and in terms of service quality? How to help transforming the business? What are the basic things one has to do in order to have a positive impact on the value chain for the

main business processes in Latin America? The answer was: “going back to the basics”, that is, making sure that what today is in a production environment is being offered in a standard way and making it more effective. The above defined the priority for what WF Company might call the “*foundation*” of SM.

### 2.3.3. *Technology*

Technology is considered to be one of the success factors in the implementation and post-implementation stages of ITSM frameworks (Aubry, Hobbs, Muller, & Blomquist, 2010; Pollard & Cater-Steel, 2009), and this applies to the SMO too – which is a part of it (Lucio-Nieto et al., 2016). Considering that organizations nowadays depend upon the use of IT to execute their processes, maturity in systems and information architecture in general is necessary, because with robust and mature technologies it is possible to have processes and services that are available, timely and properly to the end users who require them. Its presence is specially vital when processes used within a shared service model are related with each other in some way (Roller, 2009).

### 2.3.4. *Main results of the implementation of the SMO at WF Company*

The process for implementation of the SMO at WF Company lasted two months and two post-implementation verifications were conducted to validate compliance of the objectives established for the SMO. It must be mentioned that SMO processes and practices were tailored to the specific needs of the company. Following is a description of the main results perceived from the implementation of the SMO in 2012 (Peres , 2017):

- The main improvement perceived has to do with the identification of opportunities and improvements regarding operation, that is, the identification and correction of all recurrent incidents thus improving availability times for business critical services. Additionally, indicators have been created that allow measuring business process availability and improve the visibility of the value delivered by IT as a business partner, together with the launching of a communication campaign based on a monthly bulletin featuring the main indicators, projects and main points to be followed during the month (Peres , 2011).
- The framework for definition of the SMO has been of use as a formal guide for process implementation vs. the best practices consulted, but more so from an execution than from an implementation standpoint, and with a focus on service for the organization.
- It has been identified that the SMO must be sustainable, thus ensuring in turn, that processes last, with an orientation towards continual improvement.
- The SMO has helped align IT efforts to deliver business value and generate results, thus optimizing costs in terms of service and integrating three aspects: new

capacities (being able to have best practices), productivity (being able to have aspects such as resource leveraging for various business needs), and service quality (measuring user satisfaction), it all based on a tool allowing making decisions in a timely manner, which has been instrumental for BIS in terms of direction and operation.

- The main positive impacts of the SMO that have been identified: Elimination of “gray areas” regarding service management governance; elimination of meetings regarded as “*on the fly*”, to find out how process management is doing; and results can be known in terms of benefits with measurable, quantifiable and sustainable indicators through time.
- Remarks from the personnel involved in the SMO have been: Service quality is being measured in terms of customer satisfaction and service performance; now there is awareness that indicators and commitments with the business are one thing, and the perception of people from the various areas receiving service (*customer experience*) is quite another, which allows for measurement through some mechanisms; and an SMO is a means, a complement, rather than the fundamental part, it goes beyond having an IT governance initiative; it reflects and displays the benefits of the way of working of BIS in business day-to-day operation.
- Prior to the implementation of the SMO there was an area known as *Service Management*, which focused on monitoring operation and performance. Since the SMO was designed, its focus has shifted, to a greater extent, towards service and process governance.

An assessment of new services, processes and tools is provided, and it raises awareness that it is important to get organized first in order to be able to be focused as an SMO. Just as the positive impacts have been identified; the negative ones have also been pin-pointed; they include: A perception of work overload by the personnel involved; natural resistance to change; knowing how to manage change in people, for rework has been generated in the process.

### **3. Conclusions**

For WF Company Latin America’s BIS area it is clear that IT must deliver capacities for the organization and for processes to provide an environment with integrated services, fully aligned to company objectives, and improvement in IT quality and cost (Lucio-Nieto &

Sanchez Trejo, 2010). This is a fact that has led this area to implement initiatives that have allowed managing IT services more efficiently, seeking to support the company's mission: "... being the first convenience food and drink company... offering value to investors while providing opportunities for growth and enrichment to our employees, our commercial partners and to the communities where we operate..."

The lessons learned in the evolutionary process of IT service management, from the ITIL implementation, up to the SMO, lead to conclude that the more people there is, the more communication is needed; that support is required not just from top management, but also from intermediate level managers and supervisors; that IT personnel need to be trained in the areas related to best practices in IT services; and, perhaps more relevantly, to realize that an evolutionary process is required where a part of the key to success in achieving better results is people and a focus on generating business value, that is, meeting customer actual needs such as Sales, Production, Logistics and other business areas (Lucio-Nieto & Sanchez Trejo, 2010).

The greatest changes derived from the improvements in IT service management were being able to migrate from a function model to a service model: to go from management of cost by function to management by service; from an *order taker* to a focus on business transformation initiatives; from a *portfolio management* based on applications to a process based on flexible governance; from IT-based roles, to collaborative and cross-functional ones (Peres , 2017).

The case analyzed reveals, as the main challenge in the implementation of an SMO, change management in organizational culture and awareness raising regarding the importance of the inter-relation among IT service management processes as a part of a continual improvement process, for it implied making adjustments to the organizational structure in order to be able to define the SMO as the integrating point for processes, technology and people, to provide IT services to the whole organization in an efficient manner. In order to prioritize the process to be implemented within the SMO, technology, service and process governance must be taken into account for a more efficient management of SM services. An SMO must be sustainable, that is its benefit, because there must be roles allowing for constant evolution.

The authors consider that the results presented in this case may be applicable not just to companies sharing WF Company's characteristics: multinational and multiproduct, but they





can also be extrapolated to other types of sectors. The SMO model analyzed (Lucio-Nieto, 2011; Lucio-Nieto & Colomo-Palacios, 2012) was designed so that it could be adapted according to the IT service management needs of the company requiring it. Its bases are derived, mostly, from frameworks and best practices such as ITIL and COBIT, as commented by Rozemeijer (2007): “The available frameworks do not commonly fit as the pieces of a puzzle. In must be taken into account that they were created by different people, at different times, in different places, in different ways, for different reasons, focusing on different phases of the lifecycle, functions, processes, results and aspects, with varying degrees of granularity, precision, quality and consistency. Together they are an integrated image that can act as an umbrella to assist an organization in implementing multiple frameworks successfully.” Considering the above, this work suggests the searching and documentation of the lessons learned by companies from various sectors in their processes for implementation of an SMO and an appraisal of their usefulness for IT service management.

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## A Momentum-First Approach to Teaching Force in High School

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### **Abstract**

*A common conception that students have in mechanics courses is that a force is needed to maintain motion. Our work approaches this problem from a p-prim perspective with a comparison to the historical understanding of force. From a p-prims perspective, momentum is proposed to substitute force as a maintaining agency to motion. By a comparison with history, it is shown that a similar problem occurred in the development of the concept of force, which led to a similar solution to the one proposed in our work. As a result, a teaching plan and activities are prepared to introduce the concept of force through the concept of momentum. In this work, the main activities of the plan are discussed, as well as the results of a preliminary research based on its realization in a classroom.*

**Keywords:** momentum, force, teaching plan, history, p-prims.

### **1. Introduction**

Since the first introduction of physics in history by Aristotle, understanding force and motion was the most problematic. However, that understanding was important for science, as the concept of force is one of the corner stones of physics. But just as this concept became a stumbling block for physicists in the past, it seems it became a problem for students today as well. McDermott (1997), for example, mentions many different studies that have dealt with students' understanding of force and motion. It seems that the most problematic and reoccurring preconception is that an impetus, an internal motive force, is needed to maintain motion.

In our paper, we focus on this preconception as we discuss it from two different viewpoints, the viewpoint of phenomenological primitives (p-prims) and the viewpoint of history. We



believe those two viewpoints offer a significant advantage for the discussion about students' understanding of force and its effects on motion. Using the analysis of history and p-prims we offer a few recommendations for teachers to use in physics courses. The recommendations have been included in a teaching plan used over the course of the past few years in Slovak schools. A brief discussion of the effectiveness of the plan is also included in our paper.

## 2. The Viewpoint of P-prims

While preconceptions are understood to be “strongly held, stable cognitive structures; differ from expert conceptions; affect in a fundamental sense how students understand natural phenomena and scientific explanations; and must be overcome, avoided, or eliminated for students to achieve expert understanding” (Hammer, 1996), phenomenological primitives or p-prims can be understood as “intuitive knowledge that constitute people’s ‘sense of mechanism,’ their sense of which happenings are obvious, which are plausible, which are implausible, and how one can explain or refute real or imagined possibilities” (diSessa, 2016). P-prims are not considered to be incorrect on their own. Their activation in certain contexts however is not desired.

In other words, while preconceptions are usually connected to a certain theory or a concept, p-prims are more basic and can be activated with different theories. For a clearer understanding of how p-prims work, we will show how they appear in the context of force and momentum. For these concepts, the main p-prims which we need to consider are:

- **Maintaining agency:** for a mechanism to function there must exist an agency that maintains that functionality, e.g. an engine maintains the motion of a car, or motion implies a force.
- **Actuating agency:** this p-prim simulates the law of causality. There must exist something that causes a certain effect, e.g. a hammer causes a bell to ring.
- **Dynamic balance:** a pair of effects that are equal in magnitude but in opposite directions balance and cancel each other.
- **Overcoming:** when one effect or influence overpowers another.

A more detailed list of p-prims can be found in Kortland's *Handboek natuurkundedediciek* (Kortland & Poorthuis, 2017).

In the context of force, students often encounter situations where maintaining motion requires a force. Such situations activate the maintaining agency p-prim and builds the preconception that force is proportional to velocity. However, unknown to the student is the

fact that what he is experiencing is not a force working as a maintaining agency but as a dynamic balance to resistance. The true function of a force, if it is the only one affecting an object, is changing the momentum of that object.

That is why, we believe that in order to build a correct understanding of the role of force, it is important to introduce the true maintaining agency for motion before getting acquainted with the concept of force. We propose that the physical quantity which can be considered as a maintaining agency to motion is the momentum of the object. The main reason for this proposal is that conservation of momentum, although itself stemming from the role of force, is the law that keeps an object moving in case there are no external forces affecting it.

Only after the correct identification of the agency maintaining motion, the role of force can be truly identified as the actuating agency for motion, i.e. changing the momentum of the object. When the role of force is identified, a correct interpretation of previous experiences can be achieved through activating the dynamic balance and overcoming p-prims.

While a p-prims perspective offers much insight into the problem of understanding force, it is interesting that this perspective is paralleled in the way the concept of force developed in history, which in itself presents another positive argument why momentum should be introduced as the maintaining agency for motion.

### 3. A Parallel in History

To look at the historical development of the concept of force means to start with Aristotle and his book *Physics*. In it he mentioned a few ideas about force, of which the most important is that force is proportional to velocity or in his own words:

“Let the motive agency be  $\alpha$ , the moving body be  $\beta$ , the distance travelled  $\gamma$  and the time taken by the displacement  $\delta$ . Then an equal power, namely power  $\alpha$ , will move half of  $\beta$  along a path twice  $\gamma$  in the same time, or it will move it through the distance  $\gamma$  in half the time  $\delta$ . For in this way the proportions will be maintained” (Dugas, 1955).

This force was believed to be external as well as the cause of what Aristotle called, violent motion. As force according to Aristotle is always caused by an object in direct contact with the moving body (Baez, 2008), a definition of another type of motion, not caused by force thus defined, was needed. Aristotle therefore defined natural motion, as opposed to violent motion, as an object’s tendency to move upwards to the heavens, which he called ‘levity’, or downwards to the center of the earth, which he called ‘gravity’ (Miao, 2016). Aristotle also indicated, when speaking of gravity, that the velocity of a falling object is directly



proportional to its weight and indirectly proportional to the resistance of the medium (Baez, 2008).

One of the first people who criticized Aristotle's notions was John Philoponus of Alexandria in the 5th century. Philoponus laid the foundation for the theory of impetus, even though he never used the term in his work. His criticism was based on the fact, that Aristotle's mechanics gave a feeble explanation to the motion of a thrown projectile. Philoponus was one of the first who considered that the motion of a projectile after being released is due to a property of the object, while Aristotle claimed that the motive force is transferred to the air surrounding the projectile. Understanding that the medium does not maintain the motion of a projectile also lead Philoponus to grasp its true role in motion, which is resistance (Wildberg, 2016).

Philoponus' ideas were widely rejected until the 14th century, even though his work was known to many such as Albert Magnus and Thomas Aquinas. However, in the 14th century, his work became the basis of Jean Buridan's theory of Impetus (Hecht, 2015), which was formulated as following:

1. impetus is a kind of power, existing in the physical world, which is able to move objects in the same direction as the impetus itself,
2. impetus can be imparted to an object from another object,
3. depending on the amount of impetus imparted to an object, the object moves correspondingly to that amount,
4. impetus can be dissipated or weakened by the resistance in the medium,
5. because impetus can be either rectilinear or curvilinear, the motions produced by the impetus can also be straight or curved.

Even at first glance, we can notice parallels between the theory of impetus and momentum. The only exception is the 5th point, which uses impetus to explain motion on a curve. Buridan even proposed that impetus is the product of the amount of matter and speed (Graney, 2013) which can lead us to the following formula to calculate impetus:

$$I = mv$$

The theory of impetus became the stepping stone for defining momentum and its role in motion. Some, as was Albert of Saxony, used impetus to explain why a falling object does not infinitely increase its velocity but reaches a certain limit (Dugas, 1955). While others, like Galileo and Huygens, built upon the theory to reach the first correct understanding of inertia. In Galileo's *Discorsi*, for example, we can read the following: "I imagine a moving body thrown on a horizontal plane without any obstacle. It is said that its motion on the plane will remain uniform indefinitely if the plane extends to infinity" (Dugas, 1955).

Reaching a correct understanding of momentum, through the previous theory of impetus, finally led to understanding the role of force as the cause of change in an object's momentum. This understanding culminated with the definition of Newton's three laws of motion, of which the first two explain the role of force and how the lack thereof causes an object to continue in its motion, not stop as was previously believed.

The historical development of the concept of force offers three important lessons, which are in agreement with the p-prim viewpoint:

- it is natural for intuition to assign force the role of maintaining agency,
- once force is assigned the role of maintaining agency, it becomes hard to discern the true role of force,
- it is important to understand the concept of momentum before the role of force can be correctly understood.

#### 4. Recommendations for Teaching

As both history and p-prims seem to support the fact that understanding the role of momentum as a maintaining agency is an important step for understanding the concept of force, we offer a few recommendations for teachers that they can implement in their classes:

1. As understanding the role of momentum requires understanding the concept of momentum, we believe that momentum should be introduced before force early in a physics course.
2. To strengthen the connection between momentum, force and their roles in motion, we recommend not using the traditional division of concepts into kinematics and dynamics. Instead we believe momentum can be connected to uniform linear motion, while force can be connected to motion with constant acceleration. In our own mechanics course, we have settled for the following order of teaching the above-mentioned concepts: uniform linear motion, momentum and the conservation of momentum, force and its effects, motion with constant acceleration, combining forces and Newton's laws of motion.
3. After thoroughly analyzing momentum the concept of force should be introduced as the mutual interaction of two objects. Subsequently its role as an actuating agency for motion can be discovered with an activity, where students observe the effects force has on motion. Students release a ball on an inclined plane from a



fixed height. At the end of the inclined plane students lay different materials on which the ball should move. Then they observe how fast the ball stops moving on different materials, which leads them to observe the effects different friction forces have on motion. After observing that a larger value of friction force leads to the ball stopping faster, they are led to think about and discuss what is needed for the ball to never stop moving. Through this activity students can observe that force changes the momentum of the object, while also can reach the understanding that it is momentum which maintains motion not force.

4. When students have been introduced to combining force and Newton's laws of motion, an important activity for students is finding forces affecting objects in different states of motion. One example of such motion is a car moving with a constant velocity on a flat plane. A typical student response for this example is to draw a net force affecting the car in the direction of motion. The teacher does not dismiss the idea right away but acknowledges the existence of a physical quantity in that direction, and then he shows it to be the momentum of the car not a net force. This way, the teacher reinforces the idea that constant velocity is connected to momentum, or that the maintaining agency of motion is momentum, while force is its actuating agency.

The above-mentioned recommendations have been implemented in three different classes. The first of them presented a preliminary research of the effectiveness of the plan. The class was composed of a group of 20 students 15-17 years old. Using the Force Concept Inventory (FCI) test developed by Halloun and Hestenes (1992) the classroom achieved an average score of 20% in the pre-test and 69% in the post-test. We consider this to be a significant gain considering that we focused only on the concept of force in linear motion, which is not the only topic covered by the FCI test.

The two newer classes represented the first stage of a larger research to understand the effects of the plan prepared based on our previous recommendations. An interesting result immersed in students' responses through different activities in those classes. For example, when introducing the concept of centrifugal force, students analyzed forces affecting a rotating object. Most of the students chose to draw momentum in the direction of motion right at the beginning to avoid confusing it with net force. This shows that assigning the role of maintaining agency to momentum can have a significant effect on students understanding of forces. Another interesting effect was when considering motion after centripetal force ceases to act on an object. Students not only correctly observed that the object will continue to move on a straight line, but the explained their hypotheses using the understanding of momentum as a maintaining agency, for example a student's reaction was: "the centripetal force stops acting on the ball after leaving canal, therefore it only has its

momentum now. The constant momentum will cause the object to continue in its path without changing it”.

The FCI test was applied on those two classes as well. The classes consisted of 28 students 15-17 years old. The pre-test achieved a result of 21% while the post test achieved a result of 73%. We do not consider those results telling as per the small number of students in classes and therefore we point to the qualitative effects of the plan as a better basis for evaluating those effects. However, both the quantitative and qualitative results of the plan will be thoroughly examined throughout the next few years.

## 5. Conclusion

Most physics teachers have met with the student preconception that a force is needed to maintain motion. In our paper we analyzed this preconception through a p-prim point of view, where we saw that the main problem is that students assign the role of maintaining agency to force. To avoid such assignment, we proposed that the role of maintaining agency should be occupied before students are introduced to the concept of force, and that the role of the maintaining agency should be given to momentum. By taking a brief look at the historical development of the concept of force, we saw that a similar problem has occurred in history and needed a similar solution to what we proposed.

Based on the p-prims viewpoint and on the historical parallel, we offered a few recommendations for introducing the concepts of momentum and force. Two of the recommendations were focused on the order of introducing the taught concepts, while two were focused on activities that help emphasize the roles of momentum and force in motion. While the results of preliminary research and the first phase of a broader research were encouraging, the broader research project is still underway to verify the effectiveness of a plan based on our offered recommendations.

## Acknowledgments

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## Measuring the Speed of Light in Water Using a CD

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### Abstract

*The paper describes a simple method of measuring the speed of light in water using the wave properties of light. The tools used are a compact disk (CD), an aquarium, a laser pointer and a ruler. The key tool is a CD of which the reflective layer has been scratched off. Using the comparison method, we compare the speed of light in water with the already known speed of light in air. The measurement itself will be realized using a ruler and a graph paper. Other than measuring the speed of light in water, the activities offers an experimental proof that during light refraction the wavelength of the light changes while the frequency remains constant, which is an important but not trivial fact about refraction.*

**Keywords:** *Speed of light, simple experiment, wave properties, frequency, wavelength.*

### 1. Introduction

Throughout this paper, we will describe a series of activities with light refraction which have two main goals: measuring the speed of light in water and showing that the wavelength of light, not its frequency, changes during refraction. The secondary goal is a statement which is often mentioned in textbooks but is not explained. Take for example Giancoli's *Physics: Principles with Applications*, which states that "when a light wave travels from one medium to another, its frequency does not change, but its wavelength does" (Giancoli, 2014). This statement is not accompanied by any experimental reason for it. That is why we believe that experimentally observing the wavelength changes in refraction is very useful and important for physics teachers. While Snell's law is based on the idea that the wavelength of light changes when the medium changes, it is not an obvious



conclusion. Newton, for example, believed that the cause of refraction in water is that light goes faster in water than in air. Our experiment directly shows what quantity is changing during refraction.

The whole series of experiments discussed in this paper will require that students be already introduced to light diffraction and its interference on a diffraction grating. The activities are planned for two 45 minutes lessons, of which the first one is focused on preparatory experiments, which can be realized in an interactive demonstration form, if the teacher does not have enough tools for the students to use. This lesson ends with clarifying the theoretical background of the final experiment, i.e. measuring the speed of light in water using a diffraction grating. The second lesson is therefore focused on the realization of the experiment itself. The activities are proposed for slovak high students, however it can be realized at higher levels of education as well. The activities are not recommended for lower secondary education as it requires a great deal of abstraction.

Our paper is divided into two main sections: the preparation needed to successfully implement the activities and the implementations of the activities along with the steps of the implementation.

## **2. Experiment Preparation**

The preparation of the experiment can be divided into two parts: Safety precautions and tools preparation for the experiments.

As for the safety precautions, it is important to note that in our experiments, we will be working with laser pointers. This means that students must be notified about the importance of being cautious when using lasers, especially to not hit the eyes, which can cause eyesight damage. Throughout all our experiments we must use lasers with a power **only up to 1 mW**. There can be no chance of the laser hitting the eye, which means the teacher must closely watch student activity. That is also the reason why the used CD is without a reflective layer. Throughout the whole experiment, all of the equipment, including the laser, should be stationed at a safe distance from their eyes. For example, the students should stand during the experiment if the equipment is stationed on a table. Another recommendation for the experiment is to be used in a class no larger than 18 students, so the teacher can keep an eye on students' work.

The main tool of our experiment is a CD of which the reflective layer has been scratched off. Although the CD can be used without removing the layer for other experiments with



diffraction, as has been stated in the works of Baník (2006), Nöldeke (1990) and Velentzas (2014), we decided for removing the layer for increased safety.

To remove the reflective layer from the surface of a CD we use the following steps:

- scratch off an area about 2 mm<sup>2</sup> from the surface of the CD using a knife or scissors,
- put a piece of duct tape on the scratched surface,
- quickly remove the duct tape from the scratched surface.

These steps should leave us with a part of the CD clear of any reflective material. The steps can be repeated until the whole CD is clear of the reflective material as is done by Balachandran (2019) for example. The clear CD becomes a good diffraction grating. If we point a laser at the CD, we will be able to see the interference of the waves on an obstacle behind the CD. Using a CD prepared in such a way we can measure the grating constant of a diffraction grating using a light source of a known wavelength (Ung & Eve, 2016), while we can also determine the wavelength of a light source when we know the the distance between the grating lines on a CD (1.5 μm). While our activities are focused on measuring light speed in water, we believe it is important to carry out one of the aforementioned experiments before continuing with our following activities.

### 3. Experiment Implementation

As we have mentioned in our introduction, the goal of our first lesson activities is to review and strengthen the information they know about the wave properties of light, specifically interference behind a diffraction grating. Therefore, we assume that students have already met with light diffraction on a grating or that they have at least realized an activity using a diffraction grating such as the ones mentioned at the end of our previous section. Using their knowledge from those previous activities, students try to plan an experiment to measure the speed of light in water using the comparison method.

When implementing the activities we try to use interactive engagement methods (Hake, 1998), which means students do not only carry out the experiments, but they also solve problems where they have to make predictions. When implementing a specific experiment students work in groups, but they draw up their own predictions and write them down in their worksheets. The teacher can alternatively realize the experiment as an interactive lecture demonstration (Sokoloff & Thornton, 2004).



The activities to be realized in the first lesson are as follows:

**First Experiment:** Comparing the interference maxima of light diffraction on a grating for different colors of light.

- **Goal:** The main goal of the first experiment is to strengthen students' understanding of how interference patterns are created on an obstacle when the light of a laser pointer crosses a diffraction grating. The key point of this activity is a discussion about the following question: "How will the interference pattern on the obstacle change if we use a green laser instead of red one to go through the CD?"
- **Discussion and inquiry:** Students offer their predictions of the result of the experiments. During the experiment itself, a discussion should occur between students about their predictions. It is important that students try to formulate and explain their predictions. Students should formulate their predictions before they see the result of the activity.
- **Conclusion:** The conclusion of this activity should be the strengthening of the idea that the interference pattern is explained through the difference between distances crossed by the light. If that distance is a multiple of the wavelength then we get an interference maxima on the obstacle. In other words, changing the wavelength of light has a direct effect on the change of interference maxima.

**Second Experiment:** Comparing the interference maxima of light diffraction for different optical media.

- **Goals:** Throughout this experiment, students should use the results of the previous experiment to predict and explain the results of the current one. They should consider how the interference pattern will change when the light will go through water instead of air. The questions that students should get is: "How will the interference pattern change on the obstacle, if the light of the laser moves through water instead of air?" Just as with the previous experiment, it is important that students discuss and predict the results before realizing the activity with water to get the final results.

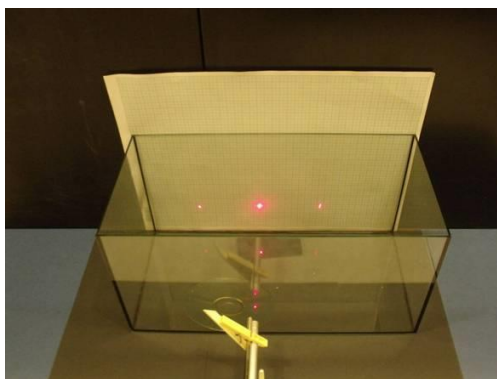


Fig. 1 The CD is on the front side of the aquarium, we can see the interference maxima on the graph paper

- **Discussion and Inquiry:** The experiment is realized using an aquarium. Students first turn on the light through the CD in an empty aquarium. Then after they discuss and predict the results for light moving in water, they fill the aquarium with water (figure 1) to get the final result.
- **Conclusion:** Through this experiment we can see that the interference maxima are closer to each other in water than they were in air. This can lead us to the conclusion that the wavelength of light becomes shorter when passing through water than when it was passing through air. This means it is the wavelength that changes during refraction not the frequency of light.

**Preparing the final experiment:** Measuring the refractive index of water using a CD.

- **Goal:** Using the result of the second activity we can propose a way to measure the speed of light in water. Throughout this phase, we can give students the space to figure out and prepare the measurement. We do not expect that all students will be able to succeed, so we do not use a summative evaluation on their work.
- **Conclusion:** The final result from this activity should be the equation to be used for measuring the refractive index of water and therefore the speed of light in water as well.

**Theoretical background for measuring the refractive index of water:** Using the comparison method, we compare the speed of light in water with the known speed of light in air. The measurement itself will be done only using a ruler and a graph paper.

We prepare an empty aquarium. On one of its internal sides we tape or glue our previously prepared CD. On the other side of the aquarium, from the outside, we tape a graph paper. The laser pointer is pointed perpendicularly to the CD at such a height that all the interference maxima are on the same horizontal plain. Also the outer maxima should be at equal distances from the middle maxima (figure 1).



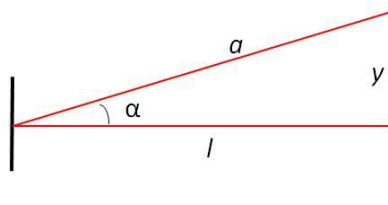


Fig. 2 A sketch for measuring the distances in the empty aquarium

Using this configuration, we can measure  $l$  the width of the aquarium and  $y$  the distance between the middle and the outer maxima (figure 2). We subsequently fill the aquarium with water. The interference maxima move closer together. We measure the distances of the new maxima (figure 3).

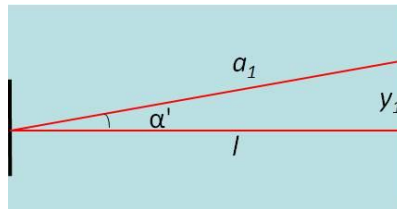


Fig. 3 A sketch for measuring the distances in the aquarium when filled with water

When we consider that the outer maxima had formed because of the difference in distances crossed by the light emanating from different slits (figure 4), we can derive the refractive index of water using quantities which can be easily measured in our experiment. It is therefore not important to calculate the distance between the grating lines in the CD, neither do we need to measure the wavelength of our used light in water. Such calculations would only increase the mistakes in our final result.

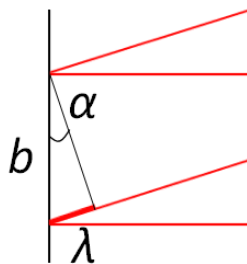


Fig. 4 The difference in distances for outer maxima

Using the wave properties and diffraction of light from figures 2, 3 and 4 we can mathematically derive the equation for measuring the refractive index of water. In the following derivation,  $\lambda$  is the wavelength of our light in air,  $\lambda_1$  is the wavelength in water,  $c$  is the speed of light in air,  $c_1$  is the speed of light in water,  $f$  is the frequency of the light which, as we have seen in one of our previous experiments, is the same in air and water,  $b$  is the distance between the grating lines of the CD,  $y$  is the distance between the outer maxima and the middle maxima in air,  $y_1$  is the distance of the maxima in water,  $a$  is the distance crossed by the light from the laser pointer to the outer maxima in air,  $a_1$  is the distance between the laser pointer and the outer maxima in water and finally  $l$  is the width of the aquarium.

$$\lambda = \frac{c}{f} \quad (1)$$

$$\lambda_1 = \frac{c_1}{f} \quad (2)$$

$$\frac{\lambda}{b} = \frac{y}{a} \quad (3)$$

$$\frac{\lambda_1}{b} = \frac{y_1}{a_1} \quad (4)$$

$$a = \sqrt{y^2 + l^2} \quad (5)$$

$$a_1 = \sqrt{y_1^2 + l^2} \quad (6)$$

Using equations (1) – (6) we can derive the final equations for the refractive index of water and the speed of light in water as following:

$$n = \frac{c}{c_1} = \frac{\lambda}{\lambda_1} = \frac{y\sqrt{y_1^2+l^2}}{y_1\sqrt{y^2+l^2}} \quad (7)$$

$$c_1 = \frac{c}{n} = \frac{y_1\sqrt{y^2+l^2}}{y\sqrt{y_1^2+l^2}} c \quad (8)$$

Both the refractive index of water and the speed of light in water are a function of the distance of the maxima and the width of the aquarium. These lengths can be easily measured using a ruler and a graph paper. Of course, students have a problem with editing formulas mathematically, which means the teacher should work with them slowly and carefully. Students should individually formulate or at least repeat the meaning of every new equation as often as possible.

At the end of the first lesson, students should prepare a detailed point by point plan for measuring the speed of light in water based on the theoretical background. If the lesson time does not suffice for such an activity, it can be offered as a homework for students.

During the second lesson, students carry out the measurement of the speed of light in water using the comparison method. Students work in groups and should achieve a result calculated using the measured values. The resultant refractive index is compared to the textbook value. Students require only a small amount of precision to achieve a very precise measurement of the refractive index and therefore the speed of light in water.

#### **4. Conclusion**

Using the proposed series of experiments student can observe that light in water has a different wavelength than in air. This means that the wavelength changes on the air-water interface causing refraction. Students can also observe through these activities that knowledge in science is achieved through the interpretation of observations, measurements and the results of experiments which is important to better understand the nature of science. While the experiments can probably be used to measure other properties of light, or the medium, we have not yet considered this in closer detail. One option that presents itself is using different liquids instead of water supported by a discussion with students.

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## Accessible co-creation tools for people with intellectual disabilities: working for and with end-users

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### Abstract

*In a world defined by rapid change, the search for solutions to societal challenges has become more complex calling for new paradigms of innovation focused on collaborations with the community and users. Co-creation approaches in the design and production of a service or product can bring low-cost innovation and unique and personalized customer experiences leading to user acceptance of a product or service.*

*Under a co-creation perspective, the participatory approach developed in the MINDInclusion project aims to improve the inclusion of people with intellectual disabilities into public places and society by using a co-created online tool based on personal experiences of people with disabilities. Paying special attention to the Design thinking method, the main goal of this experience was to co-create cognitive accessible design tools that guide the collection of users and other stakeholders experiences in the process of defining problems and solutions.*

*To this end, 14 researchers and educators worked defining together a set of guiding exercises and design thinking methods for the 4 co-design cycles.*



*As a result two tools were developed to gather information to recreate as a final output “personas scenarios”, an “empathy map” and expected “use scenarios”. The former was an adapted game board about public places based on the traditional monopoly game and the latter a diary with a set of activities that will facilitate the collection of contextual information.*

*Previous experiences have shown that co-design process can promote greater social cohesion, acceptance and empowerment. Working with people with intellectual disability presents several challenges since the co-creation process needs to be cognitive accessible. However, the tools created under this experience can be extrapolated to other contexts.*

**Keywords:** *Co-creation, intellectual disability, social inclusion, cognitive accessibility*

## 1. Introduction

In a world defined by rapid change, the search for solutions to societal challenges has become more complex calling for new paradigms of innovation focused on collaborations with the community and users. Co-creation approaches in the design and production of a service or product can bring low-cost innovation and unique and personalized customer experiences leading to user acceptance of a product or service. However, working with end-users can be a challenge, especially when working with groups that are more vulnerable.

Under the capability approach (Nussbaum 1997; Sen 1993), the Mind Inclusion 2.0 project aims to widen the opportunities of people with intellectual disabilities to be involved in the society. To this end, an innovative web platform will be developed, contributing to the sustainable and inclusive involvement of disabled people in the society. The innovation relies on the participation of people with disabilities during the design and production of the web platform, meaning that all the co-creation process must be cognitive accessible for people with intellectual disabilities and mindful with participants requirements for participation.

This paper shows an experience in the design of some cognitive accessible tools that can guide the collection of users and other stakeholders’ experiences, and help to know their motivations, preferences, problems and potential solutions that people experience in public places.



## 2. Co-creation methodologies

Paradigms focused on establishing close and active collaborations with the community and users are increasing. This change in the relationship between citizens/users and researchers, developers and companies have been preceded by a large number of concepts, guiding methodologies, approaches and frameworks such as user-centred and user-drive design. Nowadays, Co-Creation, integrating Co-Design and Co-Production, has been regarded as an unquestionable strategy for socio-health innovation, which is able to deliver innovations designed “with” and “by” the people, enabling the participation of those affected by the design.

To implement a strong participatory approach and co-creation methodologies the project focused on the learned experience with the Mindful design framework incorporates principles of Mindfulness in a Design Thinking that aims a Experience-led design process (Peters, Hansen, McMullan, Ardler, Mooney and Calvo, 2018; Wodehouse and Tzvetanova, 2015). Mind Inclusion aims to ensure user involvement in the design activities, in the form of both direct and indirect participation in the Agile development of the web-platform (Kautz, 2010).

Under the Mindful design framework, mindfulness in a design context refers “to the attentiveness of the user towards the consequences of their actions performed with an object, encouraging behavioural changes and adaptation by reconsidering actions and their causes” (Niedderer 2007: 4). This integrated co-design methodology covers three stages of data collection, design development, and implementation evaluation in a project. Recent experiences have applied this framework to support the participation of people with dementia in co-creation process in a successful way (Niedderer et al., 2017). On the other hand, Design Thinking (DT) is a method intending to create solutions that go beyond the ones developed by conventional analytical methods, based on creativity and systemic thinking (Koria, Graff, & Karjalainen, 2011). The term is also defined as the way designers think (McKilligan, Dhadphale, Ringholz, 2017). The main goal of this approach is to challenge the way innovation happens considering the needs and the perspective of end-users during the design and development process. In particular, this method consists of 5 steps: a) “Empathize”aiming to learn about the audience for whom we are designing; b) “Define”: focusing in redefining the initial user needs/ cases and design process goals; c) “Ideate”:intending to brainstorm and come up with creative solutions to the defined needs; d) “Prototype”:building a representation of one or more ideas; e) Finally the “Test” were researchers return to the original user group and test the prototype ideas for feedback.



In turn, Agile Method is generally adopted to increase development performance in terms of continuous, efficient and effective adaptation in user requirements changes by measuring and evaluating the status of a project (Lee & Xia, 2010). It focuses on the fundamental assumption that adaptive software can be developed by small teams using the principles of continuous design improvement and testing based on rapid feedback and change.

Apart from these theoretical perspectives and methods, nowadays the use of hybrid methodologies such the one presented is gaining importance. Specifically, Mind Inclusion 2.0 project will pay special attention to the combination of the Design Thinking method and Agile approach. Thus, while Design Thinking will allow to identify unmet needs of end-users, Agile approach will enable delivering a partially functional prototype to collect feedback, validate our assumptions and readjust.

### **2.1. Challenges when applying co-creation methodologies: cognitive accessibility**

Beyond the advantages attributed to co-creation methodologies, its application might suppose a challenge, especially when working with people with intellectual disabilities since they can be a heterogeneous group with different health, activeness, social involvement as well different problems related to a wide range of life aspects. In result, the main challenge when working with people with disabilities is to make the co-creation process accessible to their existent cognitive and communicative barriers.

Cognitive accessibility applied to environments and locations means that people can understand what characterizes each environment, its category, functionality, values and norms, and people' use it and roles (Belinchón et al., 2014; Plena Inclusión, 2008). All the above mentioned considerations regarding accessibility are an important, since the elimination of obstacles and barriers to accessibility are rights established in the Convention on rights of persons with disabilities (2006) in Art. 9, 19 and 20. Moreover, cognitive accessibility in spaces, services, and products can benefit the society as a whole.

Taking this into account, the participatory approach developed in the Mind inclusion project 2.0, that brings together principles of the Mindful Design Framework and Agile elicitation and development, aims to improve the inclusion of people with intellectual disabilities into public places enabling social participation through the use of a co-created online tool. This web-tool is being designed based on three pillars of information: i. base research on cognitive accessibility; ii. people with disabilities' personal experiences translated into requirements and preferences for interaction and functionality; iii. complementing with professionals accumulated experience and contexts analysis. For this process was essential to co-create cognitive accessible design thinking tools that guide the consultation and co-creation approach with collection of relevant insights from users and

other stakeholders in the process of defining problems and ideate solutions (corresponding to the first 3 steps of Design Thinking method: empathize, define, ideate) for requirements elicitation.

### **3. Methodology**

The Mind Inclusion 2.0 project co-creation process was structured in 2 co-design and 2 co-production sessions with users. In the planning phase two cognitive accessible design thinking tools were co-created to support information gathering in the co-design sessions. The aim was to recreate as a final output “personas scenarios”, an “empathy map” and concrete “use scenarios” that will guide the development of Mind inclusion web platform.

The objective of developing “personas scenarios” is to help to define problems that users face when accessing public places, gathering information related to individual interests and barriers find in the near context. Thus, tools that should be developed need to collect information about aspects of a real or imagined case of intellectual disabled person including the following: i. Life-context and motivations: about social engagement and interaction; ii. Needs or aids; iii. Likes: centred on self-realization, preferences about places and social activities; iv. Worries: reflecting experiences and/or emotions; v. Wishes: reflecting how support the persona may like to receive; desirable improvements for making places and activities more friendly.

In the case of the empathy map that serves to complement “personas”, this tool helps to create a common vision about users’ common thinking and feeling in a pre-elaborated situation, as well as motivations, attitudes, aspects of interaction, and beliefs. Therefore, the following dimensions of information are needed: i. Tasks that users are trying to complete and questions they need to answer; ii. Influences: people, things or places that might influence in the user’s acts and how they influence; iii. Feelings about an experience; iv. Pain points to overcome; v. Overall goal to achieve.

To this end, 14 researchers and educators worked defining together a set of guiding exercises and design thinking methods for the 2 co-design cycles that will involve people with disabilities, caregivers, social and health professionals and managers of public spaces. In order to participate, people with disability need to adults and be able to communicate and express preferences with or without help of a facilitator, able to give their consent or agree with participation and have low-to-mild degree of disability.

## 4. Results

During the sessions two tools were co-created to gather information to simulate “personas scenarios” and an “empathy map”. The former was an adapted game board about public places based on the traditional monopoly game and the latter a diary with a set of activities that facilitate the collection of contextual aspects that influence motivation for visiting places, access and general experience of the users.

### 4.1. Mind Inclusion game board

The final objective of the Mind Inclusion game is to gather information about the aforementioned dimensions: a) Life-context and motivations; b) Needs or aids used; c) Likes; d) Worries; e) Wishes. To this end, a board with different squares related to the participation in public places was developed.

#### 4.1.1. Description

The Mind Inclusion game is a board game similar to the traditional monopoly but adapted for people with intellectual disabilities. The game is composed of a board, two dices (one ordinary dice and a specific dice with pictures), two stacks of cards and a participant marker for each player.

In the board game there are several types of game boxes: 1. Places; 2. Blank boxes; 3. Collective Challenges; 4. Individual Challenges.

The participants will have to choose four different places from the list or images made available. This places will be added on the “places boxes”. Each selected place will appear 4 times in the game to let the participant have opportunity to remind experiences in such place.

All players start the game with the markers in the first starting game box. Depending on the game box in which the participant marker falls the activity or the information required will vary according to:

- Places boxes. The participant need to throw a special dice for the game. Depending on the picture on the dice’s face, the user will need to answer some of these questions: a) What would you like to find in ... (the place represented)... to be happy?; b) What makes you feel GREAT in ...?; c) What is your 1st thought visiting... ?; d) What do you need to enjoy ... ?; e) Share a funny experience in ...f) What makes you feel BAD in ...?

- Individual Challenge: in which each participant will take a card from the stack of cards answering a question or doing a creative exercise.
- Collective Challenge: at the beginning of the session the group decide the collective challenges.

## 4.2. Mind Inclusion diary

The Mind Inclusion Diary consists of a set of activities to be performed at home/activity center in order to reflect over leisure time and places to visit.

### 4.2.1. Description

The diary consists of 6 assignments:

- Activity 1-What do you like/don't like when you go out?: User should paste some pictures (from photographs, magazines, images...) on the diary.
- Activity 2- My feelings: users will reflect over feelings that they can have when they go out. This reflection will be made by using the stickers/stamps on each place of the diary.
- Activity 3- Rating places: this activity is made up of three sections: a)To select the places; b) people they go with; c) To rate the places from 1 to 5.
- Activity 4-Visiting a new place: users will need to find out places presents in their town.
- Activity 5- Explore a new place: we ask to the users to go to at least one place, which is new for them.
- Activity 6-What are the things or people that make you feel ok in new places?: There are several places and stickers and they need to paste "V" above the places that users found.

## 5. Conclusions

The group considered in the co-creation process different cognitive accessibility recommendations and guidelines such as "Mindful Design Principles" and facilitators for verbal and non-verbal communication. Previous experiences have shown that co-design process with users are able to promote greater social cohesion and acceptance, apart that the own process can be empowering. However, working with people with intellectual disability presents several challenges since the co-creation process needs to be cognitive accessible

and mindful in all the stages, from planning to evaluation of participation. This experience resulted in the creation of two cognitive accessible tools for supporting co-design processes with people with cognitive disabilities or with low to moderate cognitive impairment, and with potential to be extrapolated to other users groups participating in research and co-creation environments.

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## Cooperative learning and brainstorming as didactic strategies in conservation and restoration of cultural assets

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### Abstract

*This article exposes the tools of cooperative learning and brainstorming as a didactic strategy, in which teamwork, diversity, interaction between the students and feedback between them are promoted as the main source of learning. In professions related to the conservation and restoration of cultural assets, we work as a team, thus is fundamental that the students' training prepares them for this work reality and enables them to be part of and lead these teams, fostering cross-cutting skills such as communication effective, critical thinking, application and practical thinking among others. We will present the case of a teaching experience, in which cooperative learning is a fundamental tool to solve one of the practices of the subject "Introduction to the Conservation and Restoration of golds and polychromies" of the Degree in Conservation and Restoration of Cultural Assets in Universitat Politècnica de València. The practice consists in the identification of manufacturing techniques, and focuses on the subsequent professionalization and comprehensive training of students. The results obtained from it show how peer learning is an effective, dynamic strategy with infinite possibilities.*

**Keywords:** cooperative learning, brainstorming, training, peer learning





## 1. Introduction

The following article is presented in the framework of the “*Equipo de Innovación y Calidad Educativa EICE “AFA-Realidad El proceso de Enseñanza y Aprendizaje Fuera de las Aulas - Baños de Realidad”*”, from the Educational Science Institute of the Universitat Politècnica de València.

In this case this work is focused on the analysis of the results obtained from this educational innovation from the subject Introduction to the Conservation and Restoration of goods and polychromies” (cód.14068) of the Degree in Conservation and Restoration of Cultural Assets in Universitat Politècnica de València.

A teaching experience case will be presented, in which cooperative learning is a fundamental tool to solve one of the practices of the subject itself, which consists in the identification of manufacturing techniques, and focuses on the subsequent professionalization and integral formation of the students. *“We can say, that collaborative learning in university education is presented as a methodological alternative to individualistic models that are little creative and reflective, typical of traditional methodologies.”* (Guerra et al., 2018).

The main aim of this article is to analyse the results obtained from encouraging the use of alternative teaching strategies based on active methodologies, through a technological and cultural social immersion that enhances continuous learning. For this type of teaching innovation, special emphasis has been placed on group work and contact with real cases in which students will find themselves in their future career.

We draw from the premise that motivation is the learner’s engine (Ospina Rodríguez, 2006). Following this practice it is proposed to test the scope of the same, taking into account the motivation that it can generate within the students, by considering their specific concerns and interests, which in the vast majority of cases they are focused on their later career, making them strengthen critical thinking focusing on the real needs which they will encounter when they finish their studies.

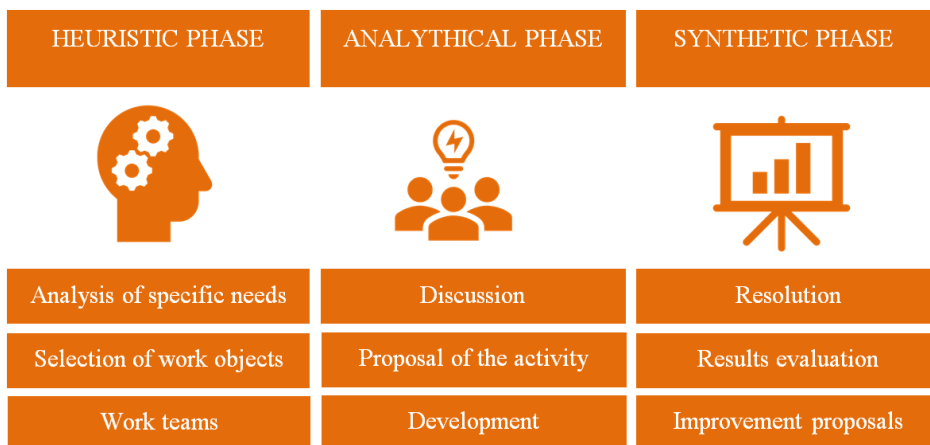
The implementation of the proposed activities in the involved subjects in the project encourages the acquisition of the following transversal competences: Understanding and integration, Innovation, creativity and entrepreneurship, Design and project, Effective communication and knowledge and awareness of contemporary problems.



## 2. Main Goals

- Expose the results obtained from the use of the tool of cooperative learning as a didactic strategy.
- Involve students in proposals they will face in their future work career, relating them to the theory and practice developed in the classroom, working on their skills related to autonomy and professionalization.
- Reflect on the need of implementing inclusive activities, taking into account the students' opinion, and their advantages by feeling themselves as leaders in their own learning, as a strategy for content integration.
- To provide students with an analytical view of the contents worked, so that they can develop their practical and critical thinking in real areas, promoting efficient communication.
- Promote interaction among students, teamwork, development of cooperative methodologies, leadership and problem solving.
- Promote equal conditions, diversity and parity in the different resolutions related to the activity.
- Promote feedback, after the use of brainstorming, as the main source of learning, as a result of a first working session.
- Transfer the results of such a teaching strategy to the university community.

## 3. Methodology



*Fig. 1 Methodology*

*Font: Own font*

### **3.1. Heuristic Phase**

1. Firstly, an analysis of the specific needs in the subject, Introduction to the Conservation and Restoration of golds and polychromies, which were related to the second part of the curriculum, linked to conservation and restoration. The purpose of the practice was to work on the contents that were intended to be strengthened in a real way. With this, the experience was practical and contained without directly making interventions on the subject, but proposals, doubts and real situations were generated, with which a conservative-cultural property restorer can be found in your future work.

2. Selection and numbering of work objects. In our case we work with golden frames, of royal collections, which are currently in our department to be restored, together with the pieces of work that they frame. Firstly, a classification of all the available frames was made, and then we selected those that we consider most appropriate to discriminate between the gilding techniques with which they were made. Gold frames with various metal sheets were also selected to make its identification more difficult. They were numbered to have a code to reference each of them during practice.

3. Division of students by heterogeneous groups in arbitrary order, ensuring that the groups did not coincide with those who had worked together in previous sessions. Working with heterogeneous groups is essential, since within Cooperative learning "the formation of collaborative groups is based on the heterogeneity of knowledge, skills, values, previous ways of acting and thinking, as well as social and behavioral skills, gender, age, etc." (Rodríguez et al., 2005).

There are a total of 45 students enrolled in the subject. The number of members in a group, when going to work with brainstorming is decisive for obtaining results. As determined by the study conducted by Paulus et al. "*One of the most influential factors in brainstorming is the size of the group (...) larger groups do provide more potential for exchange of a large number of ideas from a diverse group of individuals. However, the problem of Production blocking increases with group size, especially in groups that share ideas verbally. Thus the larger the group, the lower will be the number of ideas per person. The optimal group size is two.*" (Paulus et al., 2019). Faced with the impossibility of making groups of two with 45 people, 15 groups of 3 people were made.

### **3.2. Analytical Phase**

1. Team discussion about the results they expect from the practice. According to Esteban García and Ortega Gutiérrez, "Using the debate can be a very useful strategy for the intellectual development of the student and for connecting university issues with social

problems" (Esteban et al, 2017). In this first step, the teachers through observation, carried out a sweep of the opinions of the different teams, also taking into account the assessment between groups.

2. Proposal for the activity to be carried out. The proposal of activity drawn up consisted of three phases; work and individual reflection, the pooling as main strategy and brainstorming. All of them converged in Cooperative learning, since learning was between equals.

3. Development of the activity.

### 3.2.1. Individual work and reflection

Bearing in mind that "collaborative learning is from individual reflection to group reflection and from this to the enriched individual reflection" (Rodríguez et al., op cit., 2005), an opportune time was given for the students' individual reflection.

### 3.2.2. Putting teams together and brainstorming.

When the students were clear about their hypotheses, regarding the practice, they put everything in common, through the technique of brainstorming, trying to understand the technique of gilding of the frames and the materials used for it. The data that each of them was appointing, in practice, was being recorded in a portfolio that the faculty had prepared, with the questions they had to discuss and the aspects to which they had to pay attention to.



*Fig. 2 Cooperative Learning*  
*Font: Own font*

### **3.3. Synthetic Phase**

#### **1. Resolution of each specific case by the teacher.**

When the students completed the activity, a pooling of the 15 groups, referring to the whole practice, was carried out, drawing a series of conclusions, which were being led by the teachers, coming to the resolution of each of the analyzed cases.



*Fig. 3 Resolution of the practice*

*Font: Own font*

2. Evaluation of results. The opinion of teachers and pupils was valued. The teacher qualified the practice, taking into account the transversal competences and competences that had been worked by each of the working groups. The transversal competences that have been worked in practice are: Understanding and integration, Innovation, and creativity.

3. Proposals for improvement. Based on the experience gained with the development of the practice and with the evaluation and analysis of results.

#### **4. Results**

The present practice of identification of real techniques within the subject of Conservation and Restoration of golds and polychromies, in the previous years had been carried out in an individual way. The practice, when was carried out individually, was perceived by the students as very complex and of difficult resolution, to simple sight, without the capture of samples and analytical chemistries. The result of other years had not been so satisfactory for the teachers nor the students, given this complexity. With cooperative learning, the pupil feels leader of his own learning, his motivation has seen increased, meeting reflected in the resolution of the practice. It is important to stress that the complexity of approaches that the pupils were analyzing was great more advanced with the employment of cooperative learning. Likewise the worn out and acquired contents have been major to waited in beginning. With it, the interaction has been promoted among the pupils, the teamwork, the development of cooperative methodologies, leadership and the resolution of problems. In our case we can affirm that Johnsons's appointment was fulfilled, because what in previous years was one more practice of the subject, this year turned into an experience that the pupils to value in a positive way " The veers round of instructor is evolving from the presenter of information to the designer of learning experiences that maximize student activates engagement. The influences behind this change include the growing awareness that learning experiences should be activates in ways that maximize student engagement and the evidence that careful design of instructional experiences makes students ' acquisition of knowledge and competencies dwell efficient, effective, and appealing. One of the most useful methods of ensuring that students ploughs actively engaged in learning experiences is cooperative learning " (Johnson et to., 2018).

Other one of the results obtained of implementing this inclusive activity, is that the student body perceives that his opinion is born in mind, as strategy for the integration of contents, developing his practical and critical thought in real areas, promoting the efficient communication.

With this activity there has been promoted the equality of conditions, the diversity and the parity in the different resolutions related to the activity, the only routes for the collaborative work in the university classrooms.

#### **5. Conclusions**

The results obtained from the proposed activity show how peer learning is an effective, dynamic strategy with infinite possibilities.



The fundamental improvement of Cooperative learning in disciplines in which teamwork and interdisciplinarity are the only routes in the real tasks of conservative professionals - restorative, is that the students feel part of their own learning, developing specific valuable competences, in the achievement of proposals aimed at their future career.

Students' perception of brainstorming is always positive and motivating, but if a final response to the activity is not provided, it remains unfinished. By bringing the brainstorming together with the Cooperative learning, they understand that the processes developed in the classroom are aimed at solving real problems, with which they will meet when they leave the labour market.

The teaching methodology presented, however, is transferable to any university discipline, so special emphasis has been placed on the dissemination of the results of the experience in specialized media, for teachers interested in implementing the experience later.

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## Development of an interactive tool based on Education ERPs Software to support the learning of Transversal Competences

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### Abstract

*According to the current tendencies in University education strategies, students should develop not just the specific competences related to the particular degree they pursue, but also a series of transversal competences (TCs, also called key competences). Such TCs may be transferable between different contexts (personal, social, academic, etc.) while help students to solve problems from different perspectives and so, they would provide students with a holistic education and training. In this framework, the authors present in this paper a tool they have designed for the systematic analysis and evaluation of TCs so as to support students in the achievement of such competences. Moreover, the tool is able to help students to choose the courses that may help them to work out and complement the competences they may not be developed yet, as well as it suggests the most appropriate post-graduate courses for the students according to their background, particular interests and degree of development for the different TCs.*

*The tool has been designed under the scope of vertical ERP systems, which have demonstrated their ability to create collaborative and learning environments with multiple communication functionalities between professors and students. Thus, the tool has been thought as an interactive framework that includes different indexes to monitor the level of development of the diverse TCs, so that it may be accessible to both professors and students during their entire academic life. The tools have been tested within the program of Transversal Competences of the Polytechnic University of Valencia, specifically to the Degree of Energy Engineering.*

**Keywords:** Vertical ERP, transversal competences, active learning, methodology, training, evaluation.





## **1. Introduction**

In the framework of the current education strategies at the University level, students should develop a sort of transversal competences (TCs), which in addition to the specific competences related to the particular degree they study, provide students with a holistic education and training (Villa & Poblete, 2007). In the case of the Polytechnic University of Valencia, 13 TCs have been identified and, consequently, they are taught and worked out with students in the different undergraduate and graduate courses (Bonet Espinosa, Cabredo Fagrés, Calvet Sanz, de Andrés Martínez, & Soto Pacheco, 2015). Previous research developed by the authors has evidenced the need for support tools to help students to take decisions related to the courses they should choose to better complement their training and development of TCs (Montuori, Alcázar-Ortega, Vargas-Salgado, & Bastida-Molina, 2019). Therefore, such tools may guide students when choosing the most appropriate postgraduate courses so as to complement their career according to their academic and professional interests.

The tool here presented has been designed according to the Education ERPs (Enterprise Resource Planning) principles. ERP systems allow organizations to integrate the different operations and departments for a more efficient management of information and resources (Antonegi Martínez, Casadesús Fa, & Zamanillo Elguezábal, 2005). In particular, an ERP system specifically designed for University education means an essential support for the management of the different areas involved in such activities as research, academics or economics (Cloud Factory, S.L., 2019) due to the different managerial functionalities that it includes (Educacion 3.0, 2018). One of the objectives of the tool here presented is to enhance the active and auto-regulated learning done by the students, which has been also experimented by some researchers at the High School level (Demkanin & Kovác, 2018). In fact, the student is the actual responsible for its own learning process, that should not be limited to listen to the professor (Oltra Mestre, García Palao, Flor Peris, & Boronat Navarro, 2012). This tool has been thought as a module that may be included in the platform Poliformat, which is already linked to the database where all the information related to the TCs evaluation for the graduate and undergraduate students is stored. On the other hand, Poliformat is a well-known environment which professors and students are used to. This fact would facilitate the implementation of the aforementioned tool as a complement of such platform.

This paper is organized as follows: Chapter 2 is devoted to present the methodology based on which the tool here presented has been developed. Following, a case of application is presented in Chapter 3, where the tool has been applied to the evaluation of undergraduate



students enrolled in the Degree of Energy Engineering that is taught at the High School for Industrial Engineering at UPV. Finally, according to the obtained results, conclusions of this research are discussed and presented in Chapter 4.

## 2. Methodology

The proposed tool has been designed according to the methodology proposed by the authors in (Montuori, Alcázar-Ortega, Vargas-Salgado, & Bastida-Molina, 2019) which, including some updates and improvements, may be summarized in the following steps:

- 1) Analysis of transversal competences and weighting. The first step will be the identification of transversal competences that are worked out in each of the studied courses during the considered undergraduate or graduate degree. Once identified, each competence will be weighted according to the number of credits devoted to its development during the degree, according to the following expression:

$$W_{CT}^i = \frac{\sum_{n=1}^N ECTS_n}{\sum_{m=1}^M ECTS_m} \cdot 100 \quad (\%) \quad (1)$$

Where  $W_{CT}^i$  is the weight of transversal competence  $i$  related to the total number of credits that are assigned to the degree;  $ECTS_n$  is the number of credits for each course  $n$  in which the transversal competence  $i$  is worked out; and  $ECTS_m$  is the number of credits for each  $m$  course within the degree.

- 2) Analysis of optative courses. As one of the objectives of the tool is the support to students about the optative courses they may enroll in, the TCs that are worked out in each optative course related to the considered degree will be identified.
- 3) Definition of development thresholds and corrective actions. TCs are evaluated at UPV according to rubrics, which adopt a qualitative scale (A, B, C or D). In order to quantify the degree of development for each TC, the numerical scale included in Table 1 will be applied.

**Table 1. Quantification scale to measure the level of development of TCs**

Development degree (Scale UPV)	Numeric grade (GR)	Threshold to reach the next grade
A-Excellent	10	-
B-Acceptable	8	9
C-Developing	6	7
D-Not achieved	4	5



In the proposed methodology, it has been considered that levels C or D mean a non-appropriate development of the considered TC, so that corrective actions need to be applied. An example of such actions, based on the official rubrics developed by UPV for the TCs evaluation (Bonet Espinosa, Cabredo Fagrés, Calvet Sanz, de Andrés Martínez, & Soto Pacheco, 2015) and which should be automatically proposed by the tool, is included in Table 2.

**Table 2. Example of corrective actions to improve the performance of TC3**

<i>TC3</i>	<i>Analysis and problems resolution</i>	
<b>Topic</b>	<b>Grade</b>	<b>Suggestion</b>
Problem definition	D	• You should further work out the identification of the problems you are requested to solve
	C	• You should try to identify the most relevant information by yourself
	B	• You have reached a good competence on this topic, but you should define problems more accurately
	A	• You have reached an excellent competence on this topic
Sources of information	D	• You should identify and gather relevant information that is necessary to solve problems
	C	• You should gather more relevant and consistent information to solve problems
	B	• You have reached a good competence on this topic, but you should further justify the usefulness of gathered information
	A	• You have reached an excellent competence on this topic
Resolution method	D	• You should use the methods you have learned in the course to solve the problems
	C	• You should justify the calculations you do on each step (data, equations, etc.)
	B	• You have reached a good competence on this topic, but you should assess the adequacy of the used method (hypothesis, limitations, etc.)
	A	• You have reached an excellent competence on this topic
Solution consistency	D	• You should realize whether the obtained results are consistent
	C	• You should further justify the coherency of the obtained results
	B	• You have reached a good competence on this topic, but should be more critical with the implications of the obtained solution
	A	• You have reached an excellent competence on this topic

- 4) Definition of development timing. UPV considers three moments where TCs are evaluated. However, the tool may help students to monitor their level of development of the different TCs during their academic life, before the completion of the official level. In consequence, students may apply corrective actions or they could

complement their training on TCs according to the level of development of each one of them.

- 5) Definition of performance factors. In order to quantify and standardize the monitoring of the level of development of transversal competences, different factors are calculated and evaluated. Those factors do not just allow students to evaluate if they have reached or not some competences, but also to automatically get a series of corrective actions to help them improving such competences development.

Three performance factors have been developed, which are calculated as follows:

- a. Transversal Competences Performance Factor ( $C_{tr}^i$ ). It measures the level of development achieved by the student on each TC. It is defined as follows:

$$C_{tr}^i = \frac{\sum_{n=1}^N GR_n \cdot ECTS_n}{\sum_{n=1}^N ECTS_n} \quad (2)$$

$GR_n$  is the degree of development achieved in the course  $n$  for the TC  $i$ , according to the values indicated in Table 1; and  $ECTS_n$  is the number of credits of each  $n$  course in which the TC  $i$  is worked out.

- b. Technical Interest Factor ( $I_{tec}^k$ ). It measures the how interesting each  $k$  optative course to be chosen by the student is. This factor is self-assigned by the student according to the Likert scale proposed in Table 3:

**Table 3. Likert scale for the assessment of the Technical Interest Factor**

<b>Likert scale</b>	<i>Totally interested</i>	<i>Very interested</i>	<i>Moderately interested</i>	<i>Little interested</i>	<i>Not interested</i>
<b>Numerical scale</b>	10	8	6	4	2

- c. Technological Affinity factor ( $I_{tec}^k$ ). It indicates the affinity of students on the more appropriate optative courses they may enroll in according to their profile, background and personal interest, as well as by the level of development of the related TCs that the student has achieved. This index is calculated as follows:

$$A_{opt}^k = I_{tec}^k \cdot \frac{\sum_{i=1}^{13} \left(1 - \frac{C_{tr}^i}{10}\right)}{N_{TC}^k} \quad (3)$$

where the variables are those defined above and  $N_{TC}^k$  is the number of TCs worked out in the optative course  $k$ .

- 6) Analysis of results and feedback to students. Once the aforementioned factors have been calculated, the last step will be the interpretation of the obtained values and the feedback of recommendations to students, in line with the obtained results. An example application for such kind of analysis is presented in next section.

### 3. Application and results

The proposed method will be now applied to a fictitious “typical student” that is enrolled in the fourth course of the Degree in Energy Engineering at UPV. Fig. 1 shows the evaluation of TCs that will be used as basic case, whose assignation has been randomly done for a student that should decide the optative courses to be chosen for the 2<sup>nd</sup> semester of the fourth academic year. Each course has been identified by a code, according to the standard classification of UPV<sup>1</sup>. Grades A, B, C and D for each TC have been painted in blue, green, orange and red, respectively.

Q	Code	ECTS	1	2	3	4	5	6	7	8	9	10	11	12	13
9.0	10169 1A	9.0	Blue												
9.0	12929 1A	9.0	Blue												
6.0	12932 1A	6.0	Orange												
6.0	12934 1A	6.0	Orange												
6.0	12927 1B	6.0	Green												
6.0	12928 1B	6.0	Green												
6.0	12930 1B	6.0	Orange												
6.0	12931 1B	6.0	Orange												
6.0	12933 1B	6.0	Blue												
4.5	12939 2A	4.5	Blue												
4.5	12942 2A	4.5	Orange												
4.5	12947 2A	4.5	Green												
6.0	12948 2A	6.0	Orange												
6.0	12949 2A	6.0	Blue												
4.5	12935 2B	4.5	Orange												
4.5	12938 2B	4.5	Orange												
4.5	12940 2B	4.5	Green												
4.5	12943 2B	4.5	Blue												
4.5	12944 2B	4.5	Green												
6.0	12958 2B	6.0	Orange												
4.5	12936 3A	4.5	Blue												
4.5	12937 3A	4.5	Blue												
4.5	12941 3A	4.5	Blue												
4.5	12946 3A	4.5	Green												
4.5	12950 3A	4.5	Blue												
4.5	12951 3A	4.5	Blue												
4.5	12956 3A	4.5	Blue												
6.0	12945 3B	6.0	Orange												
4.5	12952 3B	4.5	Orange												
4.5	12953 3B	4.5	Green												
4.5	12955 3B	4.5	Green												
4.5	12962 3B	4.5	Green												
4.5	12964 3B	4.5	Green												
4.5	12961 4A	4.5	Blue												
4.5	12957 4A	4.5	Green												
4.5	12959 4A	4.5	Green												
4.5	12960 4A	4.5	Green												
6.0	12961 4A	6.0	Orange												
6.0	12963 4A	6.0	Orange												

Fig. 1. Example de TCs' evaluation for an Energy Engineering student at UPV

Based on the grade obtained for each TC, the proposed tool would calculate the Competences Performance Factor according to (2), which would provide the student with the level of development of each TC up to the present time. The obtained results are shown in Table 4.

<sup>1</sup> [http://www.upv.es/titulaciones/GIEN/menu\\_1015215c.html](http://www.upv.es/titulaciones/GIEN/menu_1015215c.html)

**Table 4. Competences Performance Factor for the considered student, per TC**

	Transversal Competence												
	1	2	3	4	5	6	7	8	9	10	11	12	13
ECTS	64,5	66,0	78,0	19,5	49,5	34,5	22,5	49,5	30,0	16,5	37,5	40,5	43,5
$C_{tr}^i$	8,88	6,09	7,04	7,54	8,55	9,39	9,07	9,15	6,50	8,73	7,84	8,52	8,97

According to Table 1, competences that have not been developed enough by the student are those with a grade lower than 7: TC2 and TC9.

Now, the student should indicate in the tool which of the optative courses are more interesting for him, which, according to the Likert scale shown in Table 3, will be translated into the Technical Interest Factor described in section 2. For this example, the assignation done in Table 5 has been considered. The ECTS for each optative course and the worked out TCs are also shown. Once students have indicated their preferences related to the optative courses, and according to the TCs worked out on each one, the tool calculates the Technological Affinity Factor according to (3).

**Table 5. Competences Performance Factor for the considered student, per TC**

Code	ECTS	$I_{tec}^k$	Transversal Competence													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
12973	4,5	10	█													█
13757	4,5	8		█											█	
12983	4,5	8									█	█	█			
12979	4,5	10														
12971	4,5	2	█												█	█
12970	4,5	4			█	█	█	█								
12969	4,5	4										█			█	
12974	4,5	6	█						█				█			█
12977	4,5	2	█													█
12982	4,5	8														█
13756	4,5	6									█					
12981	4,5	10														█
12978	4,5	8														█
12980	4,5	2	█													█

Optative courses have been ranked according to the obtained value on the Technological Affinity Factor, as shown in Table 6. Considering the preference of the student and the TCs that should be further developed, courses 13757 and 12983 have been suggested the first.

Table 6. Ranking of optative courses for recommendation to the student

Ranking position	Code	$A_{opt}^k$	Worked out Transversal Competences														
			1	2	3	4	5	6	7	8	9	10	11	12	13		
1	13757	2,428															
2	12983	2,315															
3	13756	1,385															
4	12973	1,075															
5	12981	1,075															
6	12982	0,860															
7	12978	0,860															
8	12970	0,722															
9	12974	0,605															
10	12969	0,505															
11	12971	0,287															
12	12977	0,215															
13	12980	0,215															
14	12979	-															

The suitability of the proposed factor arises here when the student gets the most appropriate courses to improve the TCs that have been less developed, while the proposed courses also satisfy the condition of technical interest. It is interesting to point out as courses 12981 and 12979 appear in positions 5 and 14 of the ranking even if the student said he was totally interested on them. However, the most interesting TCs for the student are not worked out on such courses, so that other optative courses are marked as a better option for the student.

#### 4. Conclusions

A novel ERP based tool to support students to better develop their transversal competences is presented in this paper. This tool would assist students in the election of optative courses to further develop the transversal competences they acquire when pursuing their degree, as well as to monitor the level of development of such competences during their whole career. This tool may also help students to choose the most appropriate postgraduate degree according to their academic and professional interests. The tool may allow students to introduce their preferences on which competences they would like to further develop in order to complement their CV. Thus, related to that, they would receive automatic suggestions on how to get this goal. In the case of UPV, this tool could be integrated in the platform Poliformat since it is an environment at which professors and students are used to.

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## A considerable improvement of the traditional FPGA-based digital design methodology by using an Arduino sensor board

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### Abstract

*The traditional way to learn and teach Digital Systems has been changing over the last decades by the use of Hardware Description Languages (HDL) and Field Programmable Gate Array (FPGA) evaluation boards. The use of an Arduino development kit with different sensors connected to the FPGA upsizes the students experience in the area of Digital Systems. A temperature and humidity ambience sensor combined with an ultrasound sensor to measure distance can effectively be used by students to implement its first serial data converter that takes the sensor data and shows the obtained values from the Arduino in the seven segment display of the FPGA kit.*

*After three years of experience in the new grade courses at the UPV Telecommunication School the number of students enjoying this new way to learn the subject Fundamentals of Digital Electronics (FSD) has dramatically risen up with an increase of a 20% in the number of students that pass the subject and that select the electronic branch of telecommunication studies in the future semesters.*

**Keywords:** FPGA, Arduino, Verilog HDL, Digital Systems.

## 1. Introduction

Last decades HDL and FPGAs have been introduced as a method to teach and learn digital systems. FPGA evaluation boards [1] usually have a wide resource of peripherals that are attached to the FPGA chip. However, first courses on Digital Systems cannot take advantage of those sometimes complex peripherals like Ethernet, video and audio codecs. Only a few switches, key buttons, LEDs diodes and the classical seven segment displays are the main physical interfaces the students can interact with. The use of an Arduino board



[2] with different sensors connected to the FPGA upsizes the students experience in the area of Digital Systems. A temperature and humidity ambience sensor combined with an ultrasound sensor to measure distance can effectively be used by students to implement its first serial data converter that takes the sensor data and shows the obtained values from the Arduino board in the seven segment display of the FPGA kit.

Specifically, the temperature and ambient humidity data will be received from a DHT11 sensor. The data reception speed is intentionally very slow so that the student can get to see the bit-by-bit reception of the data frame in a LED diode and thus understand the basic concepts of serial communications.

The student must focus his effort on the sequential design part, mainly synchronous sequential machines (FSM) and registers since the visualization of values in BCD (Binary Code Decimal) over the 7 segments of the DE2 card and the assignment and programming of pins are already done.

The paper is distributed as follows:

- Next section describes the teacher's motivation for the introduction of the Arduino Board in a classical basic digital system course.
- The third section will introduce the FPGA and Arduino boards to describe a basic serial communication protocol.
- To end, some conclusions are described and analyzed in the fourth and last section.

## **2. Motivation: a new syllabus for born-digital students.**

Some years after the adaptation to the rules of European Higher Education Area (EHEA) [3] also known as Bologna Process of all the graduate courses at the UPV, next major challenge arrived when student motivation for the IT technologies started to go down. This reduction in the motivation surprisingly happened when the born-digital students started to enter in high-education studies. What were the external changes that diminished the student's motivation?

Even though the studies had become more practical and had reduced the number of hours devoted to theory in every single subject, reducing from 5 to 4 the number of years to become a Graduate in Telecommunication Engineering, the perception of a lack of enthusiasm in digital electronics was a fact that drove teachers in the search of answers to this new and unexpected challenge.

Thinking about how the relationship between the students and internet had changed over the last decade, with the increase of information in all the areas of knowledge included the

IT technology, one could think that a student will not pay more attention to the theory or older datasheets. In these times when drones are flying outside and the DIY (Do It Yourself) concept arrived at YouTube platforms, anyone can think he can design and build electronic devices without the necessity of a graduate course. These new issues drag the interest of students in traditional teaching methodology.

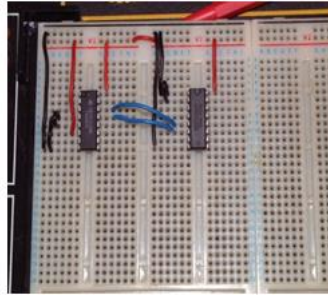
The solution to the problem is as easy as to adapt the syllabus of Fundamentals of Digital Design (FSD) to the new way to acquire information that our students had developed by themselves.

FSD is a core subject in the second year of the Telecommunication grade at UPV with more than 190 students every year. The subject has groups in the Grade, in the double grade of Telecommunication and Business Administration and also in the ARA group of the grade, where EMI (English as a Medium of Instruction) is conducted [4].

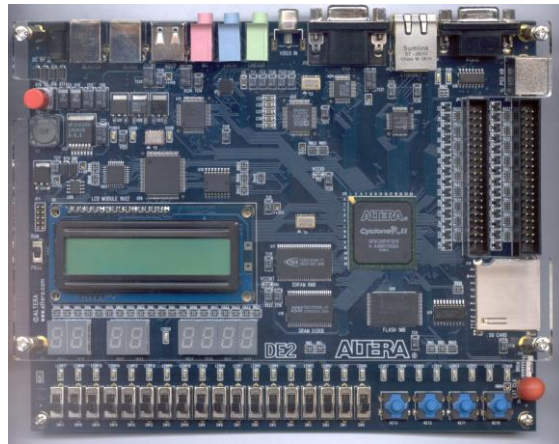
The way to engage the students from the very first day was announcing that they are ready to design its first integrated circuit (IC) in the first lab session. For a 4,5 credits course the main changes adopted were:

- Introduction of Verilog HDL [5] instead of the previous VHDL [6]. Verilog allows the programmer to design with the flexibility of a high-level language like C or C++. Only with several code lines, anybody can create complex digital circuits. Whereas VHDL was more structured and needed more sentences to describe the circuits.
- Substitution of ancient datasheets for Verilog descriptions of basic digital structures as coders, decoders, comparators, multiplexers, counters, registers and finite-state machines.
- Evolution from the classic breadboard circuitry to the FPGA board from the real beginning, allowing the creation of an IC in the first practice session.
- Introduction of the Arduino board with sensors attached to it so the real-world can be connected with the designs that students are creating.

Next pictures (Figure 1 and Figure 2) show how the breadboard has been substituted by a FPGA design in the first laboratory session. In the second picture, it can be observed the Intel/ALTERA FPGA (Cyclone II) chip and the GPIO (General Purpose Input/Output) connectors at the right-side [7], to expand the capabilities of the board.



*Figure 1. Basic boolean function designed with classical Dual-In-Line IC*



*Figure 2. The FPGA board where students create its digital designs.*

### **3. Introducing FSM design by using an Arduino microcontroller and an FPGA board.**

The course is divided into two main parts: combinational and sequential designs. The first uses circuits without memory and the second adds the concept of memory. In this second part, once the finite state machines (FSM) theoretical concepts have been introduced in the classroom, students start their final project based on an FSM design over an FPGA that connects with the Arduino to show the T and H data transmitted by using a serial protocol between both boards.

### **Arduino sensor board.**

Arduino is an open-source electronics platform based on an easy-to-use and free-of-charge software and hardware (ranging from five to some tens of euros for the most expensive board). The smoothing way to introduce the tough process to understand a microcontroller architecture and its software was the success of the Arduino platform. There is a huge amount of information gathered by a worldwide community of makers that pave the way for a DIY and open a new way to study basic digital systems. The easy software code that controls the sensors is not part of the subject but it is recommended to read and understand it, promoting the DIY methodology.

### **Sensors and 3D printed structure.**

Several sensors have been connected to the Arduino board: the DHT11 that integrates a room temperature and humidity sensor and the ultrasound sensor. Teachers have developed a 3D printed model to secure and protect the sensors. Figure 4 shows the final result where a blue plastic cage is used to fix the sensors on the Arduino MEGA board [2].

### **Structure of the sensor data acquisition system.**

The following figures (Figure 3 and Figure 4)) show the connection between the ARDUINO microcontroller board and the DE2 FPGA board. The Arduino total cost was less than €30.

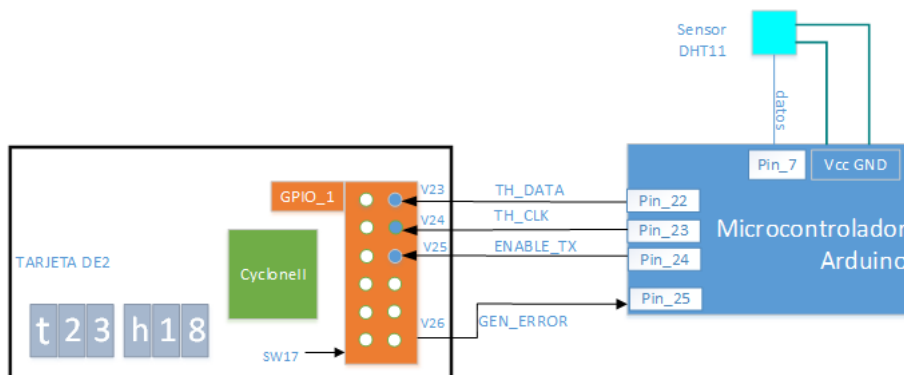
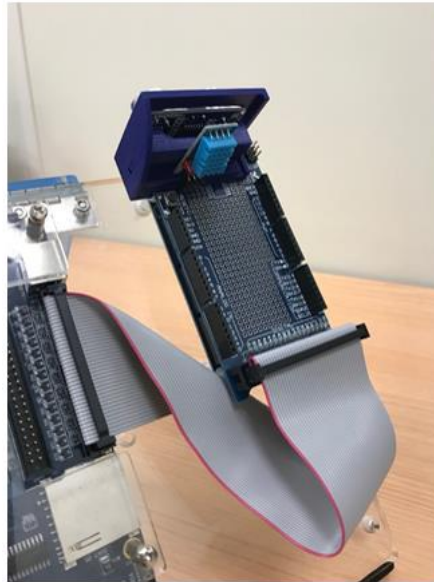


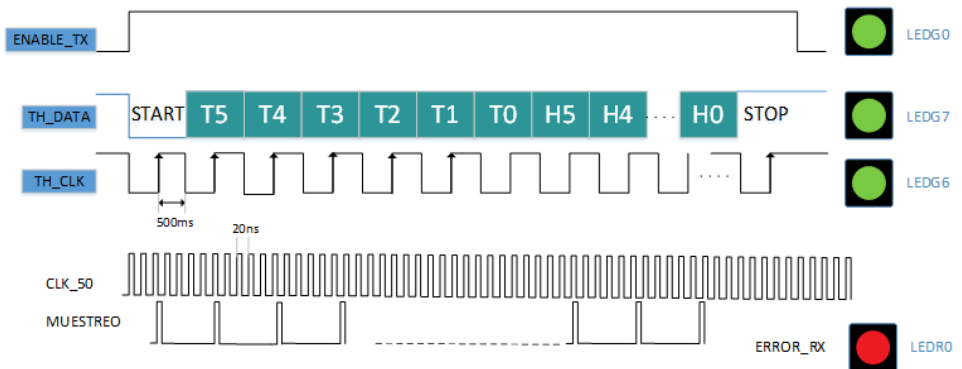
Figure 3. Connection structure between the Arduino board, the DHT11 sensor and the DE2 board



*Figure 4. The Arduino Board and its sensors connected to the FPGA by a flat cable like a data bus.*

### ***Serial communication protocol.***

Figure 5 specifies the serial protocol between Arduino and the FPGA. Some red and green LED diodes must be connected to easily visualize the data, the clock signal and the error signal of the received data frames.



*Figure 5. Serial Protocol of data sent by the Arduino board to DE2 FPGA board.*

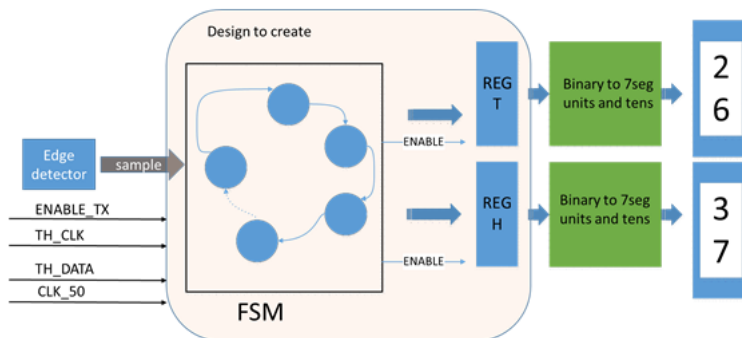


Figure 6. Structure of the design created by the students

The students have to program an FSM in Verilog HDL to complete the design (Figure 6). Only the block described as ‘design to create’ in Figure 5 has to be accomplished. The rest of the design, with combinational structures already studied in previous works, is designed in advance by teachers and can be downloaded from PoliformaT as an archived design project.

## Evaluation

The distribution of the marks in the subject are: test exam 3 marks, practical projects 2.5 marks, laboratory test 0.5 marks and written exam 4 marks

The students not only design the FSM but also they have to test it by using the waveform editor. Once the waves have been verified the design can be programmed into the FPGA. One video must be recorded and uploaded to PoliformaT platform with the result of the design.

The students try to change values of temperature and humidity by covering the sensors with their hands (Figure 7). After covering the sensor its sensed values were modified. Also, the red led in the right frame of the picture shows an error in the data received that was detected by the students' design. Eventually, students edit the recorded video adding music, text on the screen and different effect as a voluntary exercise (Figure 8). The teachers never ask for these extra work, it is just motivation and this happens in the last week of the course when students are stressed out with exams but enjoying their firsts digital designs.



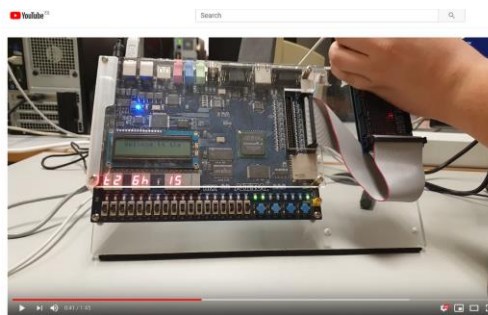


Figure 7. Student's interaction.



Figure 8. YouTube video uploaded by students.

## 4. Conclusions

The table shows the evolution of marks obtained in the subject in the last 5 courses.

**Table 1.1. Distribution of subject marks**

YEAR	2014/15	2015/16	2016/17	2017/18	2018/19
<i>Matric. Honor</i>	0,67%	0,60%	1,86%	0,00%	1,89%
<i>Sobresaliente</i>	1,34%	0,60%	0,00%	0,00%	0,00%
<i>Notable</i>	14,09%	7,23%	13,04%	10,77%	19,50%
<i>Aprobado</i>	66,44%	45,18%	52,17%	76,15%	69,18%
<i>Suspense</i>	17,45%	31,93%	31,68%	12,31%	8,81%

The worrying data was the number of students that failed in 2015/16 and 2016/17 courses, reaching more than 30%. Although it was not a really bad percentage, the telecommunication school was increasing the number of students that abandon the grade in the two first years, reaching a worrying number of 80 every year. The fail in motivation was a major issue to change. Next course, in 2017/18, the related changes in the subject took place and a sudden rise up in students who pass the subject was obtained. Dotted lines in Figure 9 show trends in % of students who pass and fail the subject. The evolution from that 30% of fails changed to a final big number of only 8,8%, depicting a reduction in more than 20%.

All in all, the director board of the school decided to change the study plan, adding a new subject based on digital electronics as a common brach study subject in the fourth course.

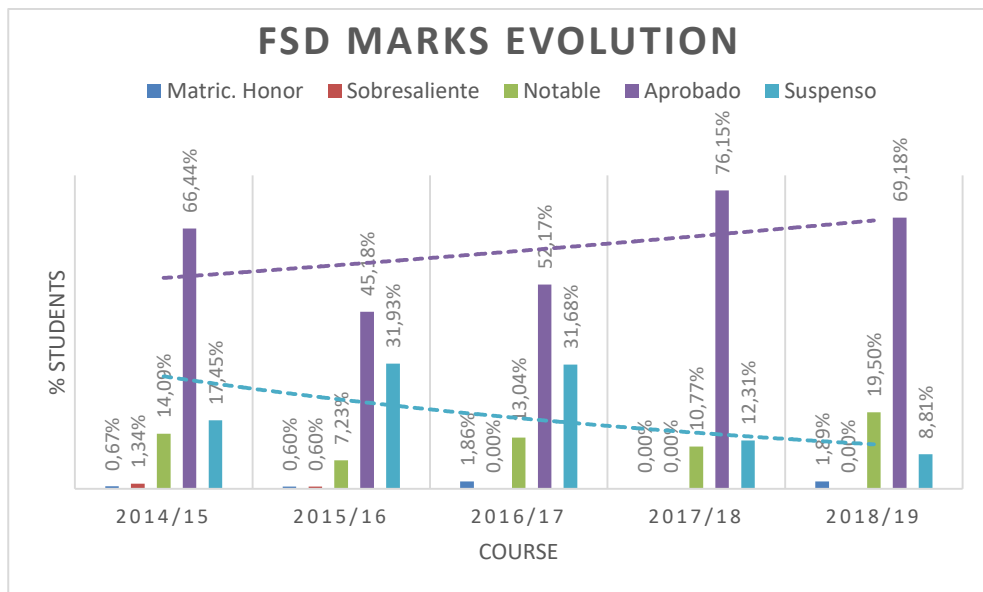


Figure 9. Number's evolution in the subject. Last two courses show a new tendency in the number of students that pass the subject. Dotted lines describe tendencies in pass /fail students over the years.

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## Introducing a gender perspective in engineering degrees, a case of study in an Energy Markets course

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### Abstract

*Although being mandatory since 2007, Spanish universities have not fully introduced a gender perspective in their degrees. This becomes even more critical in Science, Technology, Engineering and Maths (STEM) fields, where non biased information and objective knowledge is presupposed. Nevertheless, different studies reveal that the absence of role female models may be one of the reasons to lower engagement of women in STM degrees. In this paper, different techniques to approach a gender perspective in the engineering field are described. The introduction of a gender perspective activity in the course Energy Markets from the degree in Energy Engineering at the Polytechnic University of Valencia is presented and analysed. This activity is evaluated alongside the students through a series of semi structured questionnaires. Moreover, the situation and student expectations of the inclusion gender perspective in the whole degree is critically discussed with the valuable inputs of students.*

**Keywords:** Gender perspective, STM, Energy Markets

## 1. Introduction

Gender inequality is currently seen as one of the main social issues globally. Women rights have been increasing in most parts of the world, especially in the developed countries. However, large gaps among gender equality can still be seen in several places and sectors. For instance, in Europe Women with higher studies suffer from higher unemployment rates and pay gap, which tend to increase with the age (EC, 2019). One of the sectors that has



been widely considered is the STEM. The gender perspective in STEM has been a topic of interest and discussion for many years now, where studies on reasons and percentages of women abandoning or not starting these careers and professions have been a topic of study (Flores Solano, 2016; Fouad, Singh, Cappaert, Chang, & Wan, 2016; Smith, Gayles, Smith, & Gayles, 2018).

Even though that numbers have been increasing in recent years, women represent just 20% of the engineering graduates and only 12% of the workforce (National Science Foundation, 2017). The reasons for the underrepresentation of women in these areas have been argued to be the lack of interest in technical areas, lack of confidence due to sexist environments and lack of role models (Fouad *et al.*, 2016; Smith *et al.*, 2018). These characteristics generate negative environments that can be appreciated as adverse for women.

In order to overcome this barriers different initiatives have been taken into account. For instance, European legislation included the gender perspective in the European funded research projects. And, several recommendations have been done to national states to include gender equality mechanisms in specific domains, including university degrees. The inclusion of a gender perspective in superior education has been a topic of interest in Spain since the incorporation of it in 2007. Nevertheless, studies of different universities conclude that no real integration of this perspective has occurred in the engineering degrees (Belén & Baena, 2018). Moreover, there is a lack of the impact assessment and the reception that this type activities have among students.

The innovation project hereby presented dwells with the inclusion of a gender perspective in an energy engineering degree. This project aims to explain how an activity was included and to understand the impact that these type of activities can produce among students. Moreover, the interest and acceptability of these type of activities among students is also presented.

This paper is structured as follows: Section 2 sets out a brief state of the art on energy studies with gender perspective; Section 3 presents the methodology used; Section 4 deals discusses the results; and finally Section 5 concludes.

## **2. State of the art**

Gender inequalities are apparent in many major business sectors, but different analysis suggests that they are particularly acute within the energy sector, where larger gender inequalities exist (Ernst & Young, 2016). This result is particularly relevant when it comes to decision-making positions and boards. Moreover, studies suggest that women tend to be



more likely than men to express environmental concerns and boost investment on carbon emissions reduction.

A traditional approach defends that engineering and energy studies are gender-neutral. However, once a closer look is taken, it becomes clear that gender aspects are relevant and have been traditionally underestimated. Currently, the demand of energy is still highly dependent on gender and socioeconomic position (Sovacool, 2012).

Research on gender and energy issues has focused on the different uses of energy. Particularly, household-energy use in developing countries, energy poverty and women's positions and decision making within the energy industry have been studied topics (Pearl-Martinez & Stephens, 2016). Studies on gender and decision making in companies with larger women presence on their decisions board show that these companies tend to proactively invest in renewable energy and to reduce carbon footprint (Mcelhaney & Mobasseri, 2012). Moreover, the lack of women in decision making position in the industry has a large correlation with the lack of role models to choice STEM degrees.

### 3. Method and materials

A gender perspective activity was introduced in the course Energy Markets of the third and fourth courses of Energy Engineering at the *Universitat Politècnica de València*. These courses had a female presence of approximately one third, being this percentage larger than other engineering courses.

The activity was introduced during a three hour practical lesson that had as its main objective to understand how the marginal price of electricity was calculated in the Iberian Electricity Market (MIBEL). Prior to the mathematical formulation and data analysis, electricity regulation and how the market has evolved to its actual situation is explained. Therefore, it was decided that the gender and energy topic that had larger relationship with the course was the presence of women in decision-making position, both in the private and the public sector.

During the theoretical explanation of the legal evolution of electricity markets, a public discussion over the underrepresentation of women was introduced by the teacher, inviting the students to show their opinions. An open discussion on how they saw the situation of gender balance on the energy industry. After a first round of opinions specific data with female presence on decision-making positions was presented and explained to the class. The data was obtained from the Women in Power and Utilities Index report (Ernst & Young, 2016) and a summary of it can be seen in Figure 1.



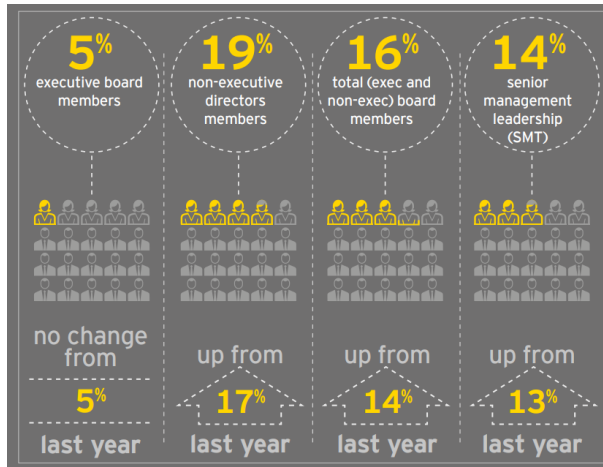


Figure 1. Percentage of women in decision-making positions (Ernst & Young, 2016)

Regarding the presence of women in the public service, it was presented how from the 9 ministers that have been responsible of the energy department in Spain since the Democratic Transition occurred, only the last one has been a woman. The current Spanish minister of ecological transition, from which depends the energy department, is Teresa Ribera. She is an well-known international professional on the sector that used to be the director of the Institute for Sustainable Development and International Relationships of Paris and worked as an advisor for the United Nations Framework Convention on Climate Change (UNFCCC). However, most of the students did not know who she was when they were asked. After the presentation of results a new round of opinions was opened were the students that could answer again about the information treated.

### a. Interview structure

In order to assess the interest, acceptance and perspective on the topic, a semi structured questionnaire is used. This has been built with Google Forms and can be consulted in Spanish<sup>1</sup>. The following questions have been answered anonymously by eleven students out of sixty, both male and female when the course was finished, a couple of months after the session. Due to the small sample of voluntary answers, the results presented here are exploratory and just provide a first approach to the perception among students of gender perspective in engineering. The small and voluntary sample could show biased results of more interested students on the topic. Additionally, women answers are 63%, being

<sup>1</sup> [https://docs.google.com/forms/d/1aXyESi8c\\_kg4xs9tzqRjLmtFJoOXmjQqfnwJT9ejb0](https://docs.google.com/forms/d/1aXyESi8c_kg4xs9tzqRjLmtFJoOXmjQqfnwJT9ejb0)

overrepresented in the study compared with the class structure. The questions asked are the following:

*Table I. Questionnaire to evaluate the activity*

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What is your gender?

<input type="checkbox"/> Female	<input type="checkbox"/> Male	<input type="checkbox"/> Rather not answer	<input type="checkbox"/> Other:
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Do you think that gender perspective is important?

<input type="checkbox"/> Yes	<input type="checkbox"/> No
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Do you think that an energy engineering degree should have a gender perspective?

<input type="checkbox"/> Yes	<input type="checkbox"/> No
------------------------------	-----------------------------

Would you like it?

<input type="checkbox"/> Yes	<input type="checkbox"/> No
------------------------------	-----------------------------

Did you learn anything new about gender perspective in energy with the activity carried out?

<input type="checkbox"/> Yes	<input type="checkbox"/> No
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How did the activity affect over your interest on the topic?

<input type="checkbox"/> Increased my interest	<input type="checkbox"/> Did not affect my interest	<input type="checkbox"/> Decreased my interest
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What is your perception about gender inequality in the energy sector after the activity?

*Open answer.*

In your opinion, what could be done to increase the gender perspective in the degree Energy Engineering?

*Open answer.*

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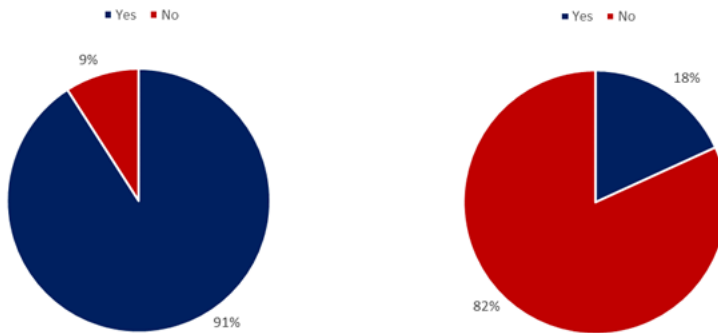
#### 4. Discussion

The discussion with students took place during 3 sessions of around fifteen to twenty-five students each one. The students did not participate much during the first round of questions. However, their participation increased after showing the statistics presented. The activity



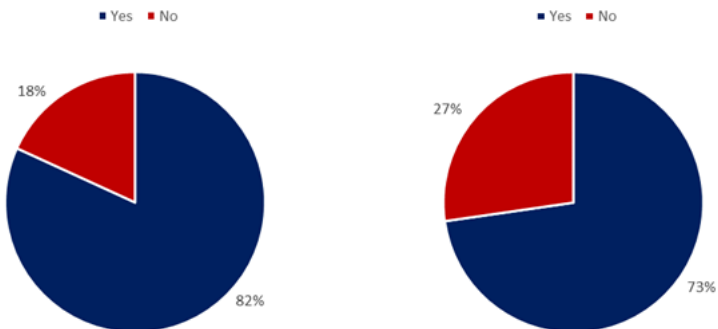
went well and generated no conflicts or disagreements. Moreover, positive feedback was provided personally about it.

Regarding the opinions of the students, Figure 1 presents the interest that students have expressed on gender perspective, which did not substantially varied depending on their gender. Even though that having a small sample, more than 90% of the students believe that gender perspective is important and should be taken into account. These numbers contrast with the perception that students have over the inclusion of gender perspective in the degree, where more than 80% of them state that does not have.



*Figure 2. Percentage of students that believe that gender perspective is important (left). Percentage of students that think that gender perspective is included in the degree (right).*

On the other hand, again, more than 80% of the students express that they would like that the engineering degree included gender perspective. This opinions result interesting due to the fact that no gender perspective is normally included in engineering degrees even though that the results indicate that students would like to receive this kind of training.



*Figure 3. Percentage of students that would like to include gender perspective in the degree (left). Percentage of students that state that they learnt something new with the activity (right).*

Regarding the proposed activity, the acceptance among students remained quite positive. More than 70% of the students stated that they learnt something with it and also more than 70% of them expressed that after it have more interest than previously. Another interesting conclusion is that the people that no one expressed that after the activity their interest on the topic decreased.

Regarding the open answer to the situation of women on the energy field, the students expressed their concerns about the lack of information and the current situation of the sector and other sectors such as science and research. Concerns about how these sectors are seen as male professions in society was also mentioned.

■ Increased my interest   ■ Did not affect my interest   ■ Decreased my interest

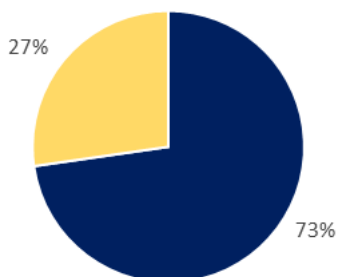


Figure 4. Percentage of students that reflect how it changed their interest on the topic

On the other hand, some answers expressed that inequalities do not exist in this field and it is just about the academic and professional background of the people. Although not being a majority, some voices expressed also that no gender perspective should be included in engineering fields.

Finally, most students mentioned that these types of activities should be done and promoted. Moreover, petitions to include female role models were mentioned a couple of times, showing how the requirements among students align with the recommendations analysed in the literature. Some of the ideas proposed by the students are:

“It would be interesting to talk about women who are models in the engineering field, more specifically on the energy field.”

“It would be interesting to visualise this share of women who hold these decision-making positions, showing the inequalities to get people aware of it and to have role models.”

## 5. Conclusions

This communication presents an activity with gender perspective performed in the course Energy Markets. After its explanation and the decision on how was selected the activity, the results of a survey among the students are presented. Due to the low sample, the presented results are tentative and have to be considered with caution. Nevertheless, they seem to provide two main conclusions. First, no gender perspective is appreciated, by students, to be included in the engineering degrees as the literature says. Second, most of the students believe that this topic is important and would like to see it more in the courses with activities such as the presented. Students also highlight that exists a lack of information and these activities help them to know more on the topic. Finally, it results crucial to deep the studies on the topic. More studies are recommended since it exists a knowledge gap on how students perceive and evaluate activities with gender perspective in engineering courses. A perspective that different studies suggest that is essential to improve the quality of the superior education and help younger generations to have role models in the engineering fields.

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## Leadership and supervision in pre-service Economics and Accounting teacher education in Portugal

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### **Abstract**

*The process of leadership and pedagogical supervision in preservice teacher education is a determining factor in the relationship that needs to be established between the higher education institution (HEI) and the cooperating school (CS) where the future teacher carries out his supervised pedagogical practice.*

*This study intends to analyze this process of leadership and supervision, understanding this relationship in a perspective of effective collaboration, reflection and sharing of practices, assuming the teacher of the CS as a fundamental element of the process.*

*Based on this assumption, it will be important to provide teaching and learning situations with individual and joint reflections, in order to promote autonomy and shared interaction, contributing to professional development and to the co-construction of knowledge.*

*Methodologically, this is a case study with participant observation, within the scope of the Master's Degree in Teaching Economics and Accounting of the Institute of Education of the University of Lisbon, the only master's degree in Portugal that gives professional qualification for teaching in secondary education in Economics and Accounting.*

*With this study hope to obtain a characterization of the leadership and supervision process developed and to delineate the main functions of the mentor teacher as a fundamental part of the process of collaborative supervision, in the context of the current model of teacher training.*

**Keywords:** *Leadership, supervision, preservice teacher education, economics and accounting education.*



## Liderança e supervisão na formação inicial de professores de Economia e Contabilidade em Portugal

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### **Resumo**

*O processo de liderança e supervisão pedagógica na formação inicial de professores é um aspecto determinante na relação que é necessário estabelecer entre a instituição de ensino superior (IES) e a escola cooperante (EC) onde o futuro professor efetua a sua prática pedagógica supervisionada.*

*Neste estudo pretende-se analisar este processo de liderança e supervisão, compreendendo esta relação numa perspetiva de efetiva colaboração, reflexão e partilha de práticas, assumindo-se o professor da EC como elemento fundamental do processo.*

*Partindo deste pressuposto, será importante proporcionar situações de ensino e aprendizagem com reflexões individuais e conjuntas, no sentido de promoverem a autonomia e a interação partilhada, contribuindo para o desenvolvimento profissional e para a co-construção de conhecimento.*

*Em termos metodológicos trata-se de um estudo de caso com observação participante, no âmbito do Mestrado em Ensino da Economia e Contabilidade do Instituto de Educação da Universidade de Lisboa, único mestrado em Portugal que confere a habilitação profissional para a docência no ensino secundário na área da Economia e Contabilidade.*

*Com este estudo espera-se obter uma caracterização do processo de liderança e supervisão desenvolvido e delinear as principais funções do professor cooperante como parte fundamental do processo de supervisão colaborativa, no contexto do atual modelo de formação de professores.*

**Palavras-chave:** *Liderança, supervisão, formação inicial de professores, ensino da Economia e Contabilidade.*



## 1. Introduction

The pedagogical supervision process, in the current preservice teacher education model in Portugal, is prefigured as an usual and fundamental procedure, a process that contributes strongly to the construction of the professional identity of a future teacher, according to Izadinia (2015).

In this sense, this study intends to analyze the leadership and supervision process, understanding this relationship in a perspective of effective collaboration, reflection and sharing of practices among the various stakeholders, considering the university teacher, but especially focusing on the relationship between the preservice teacher and the mentor teacher of the cooperating school (CS).

Associated with this process, evaluation is a complementary and indispensable component. In this case, a predominance of formative evaluation is sought, based on the assumption that collaboration can foster reflection and provide situations of mutual learning.

In this way, it is intended to characterize the leadership and supervision process developed within a Masters in Teaching at the University of Lisbon, and to outline the main functions of the mentor teacher as a fundamental part of collaborative supervision process in the preservice teacher education.

## 2. The leadership and pedagogical supervision process in pre-service teacher education

When we approach the topic of leadership and pedagogical supervision we find the term "clinical practice". In addition to the parallel that can be established with the medical field, this concept was mainly intended to highlight particular characteristics attributed to professional training (Burn, & Mutton, 2015). In this sense, these authors consider that preservice teacher education programs should not be interpreted merely as spaces to learn through experience or by imitation of the more experienced teachers, with pre-specified classroom routines. "Clinical practice" presupposes that preservice teachers engage in a research process, based on various sources of knowledge, including research and data collection, in order to acquire interpreting skills, in particular the intervention and implementation of pedagogical actions and evaluation of results.

Nonetheless, Mena, Hennissen, and Loughran (2017) point to the importance of self-learning through experience in knowledge acquisition, in relation to learning through the





guidance of more experienced teachers, however they consider that the support of these mentor teachers is crucial in the knowledge of the practice and professional development of the teachers in formation.

The study carried out by these authors found that the level of participation of the mentor teachers in the creation of knowledge was generally high, which may indicate the relevance of the first experiences of the preservice teachers and how their learning can be promoted through the advice of the experienced teachers. It is also suggested that less directivity of these, offers greater opportunity for preservice teachers to acquire higher level knowledge.

Bond (2011) argues that the concept of teacher leadership should be introduced in initial training, and teacher training programs, under the guidance of mentor teachers, are the ideal place to begin to develop the knowledge and skills of teachers in training by providing them with a leadership framework. By starting this process early in their careers, they will be better prepared to take increasingly consistent roles at the leadership level.

On the other hand, Izadinia (2015) found that, although mentor teachers did not create very significant changes in the professional identity of the preservice teachers, they can influence them positively or negatively. In this way, when the orientation relationship is positive and the expectations of the preservice teachers are reached, they tend to obtain a higher level of confidence in their capacities as a teacher, which can have a significant impact on the construction of their professional identity.

Vieira & Moreira (2001), refers to some supervisory strategies that can be mobilized, namely, self-questioning or self-assessment, reflexive dialogue, documentary analysis, inquiry, observation of classes, professional narratives, teaching portfolio and action research; which correspond to the following instruments: questionnaires, field notes, reflexive records, audio and video recordings, grids and scripts.

One of the strategies most used in preservice teacher education programs around the world is peer coaching, aiming to improve teachers' professional practices and development, according to Lu (2010). In this case, from a perspective of expert coaching, where more experienced teachers support teachers in training (Ackland, 1991 quoted in Lu, 2010). In this strategy, class observation is very important, which normally includes three main phases: pre-observation, observation and post-observation, where in order to make the observation cycle operational, time is required for teachers to gather before and after class.

According to the same author, for the development of this strategy, it is important to guarantee three conditions: a) a programmatic vision that believes in the strategy potential for the development of future teachers, b) an organized, balanced and significant program, and c) an implementation phase followed by constant evaluation (Lu, 2010).

Regarding the evaluative issue associated with the pedagogical supervision process, some relevant ethical guidelines are also highlighted, which allow us to support procedures for a fair assessment. These should obey the following principles: rigor about the normative framework, principles and objectives; clarification on the role of each player involved in the assessment relationship; diversification of observation and information collection strategies; and transparency in the presentation and use of the collected information, based on intelligibility schemes of practical knowledge (Batista, 2011).

### **3. The role and functions of the mentor teacher**

The mentor teacher is one of the key elements of the leadership and supervision process, in which it is intended to promote reflective and collaborative capacity, so that it contributes to the autonomy of the preservice teachers, the construction of professional knowledge and the improvement of quality of education, according to Azevedo (2012).

Vieira (1993) describes five general functions of the mentor teacher: i) to inform: its primary function is to provide relevant and updated information, in the scope of supervision, observation and didactics, according to the teacher training objectives and needs; ii) to question: must be able to problematize, questioning the reality that observes, equating the problems of practice and looking for alternative options; iii) to suggest: should propose ideas, practices, solutions, motivate and encourage the realization of projects and classes for which both are responsible together; iv) to encourage: in the context of interpersonal relationship, as the affective load can influence the teacher's emotional balance, as well as his overall attitude towards the professional training process; v) to evaluate: mainly in its formative sense and not only of classification, being essential the specification of the evaluation procedures.

Also Alarcão and Tavares (1987), define some functions of the mentor teacher, emphasizing: establishing and maintaining a good affective-relational climate; developing a spirit of reflection, self-knowledge and innovation; to plan the teaching-learning process of students and the teacher; to determine the aspects to be observed and establish observation strategies; to analyze and to interpret the observed data; to evaluate the teaching-learning processes and to define the action plans to be followed.

When we refer to the functions of the mentor teacher we are also associating them with those of the university teacher, as an element of the supervision process, despite their more specific presence in the cooperating schools. Levine (2011) also suggests two additional

features that may be needed to promote best practice among supervisory teachers: meet expectations and share information about their role and time frame for collaboration.

According to Mena, Hennissen and Loughran (2017), it is also very relevant to take into account the skills that mentor teachers use in their practices, and to what extent their support can facilitate the acquisition of knowledge and professional development. They also conclude that supervisory skills can lead to effective reflective practice, as long as the process is well defined and deliberately implemented through teacher training programs.

#### **4. Method**

Methodologically, this is a case study with participant observation, within the scope of the Master's Degree in Teaching Economics and Accounting of the Institute of Education of the University of Lisbon, the only master's degree in Portugal that gives the professional qualification for teaching in secondary education in Economics and Accounting.

In the context of the Bologna Process, the level of professional qualification for teaching became the masters degree, particularly in Portugal. This increase in the qualification of the teaching staff aimed at strengthening the quality of their preparation and enhancing their socio-professional status. The new system of professional qualification for teaching gives special value to the area of professional practice, as the privileged and irreplaceable moment of application of knowledge, skills, competences and attitudes to the real context.

The aim of this study was to analyze the main aspects for a relationship of effective collaboration, reflection and sharing of practices in the process of pedagogical supervision in the initial teacher education.

Based on a qualitative methodological approach, this case study was based on two classes from the last two school years, totaling 24 preservice teachers, 17 mentor teachers and 4 HEI teachers.

The case study methodology is an approach that is well suited to research in education, where the researcher is confronted with complex situations in which it is difficult to select variables, but in which one tries to describe and analyze a phenomenon and its interactions (Yin, 1994).

In addition to the characterization of the classes and contexts, through documental analysis and interviews conducted by the preservice teachers in the schools where they developed the supervised teaching process, the data were collected through participant observation by the HEI teachers. Field notes were made of these observations and also of the informal

meetings and interviews with the mentor teachers before and after the observation of the classes in the cooperating schools, with descriptive and reflective records, which allowed to record the most subjective part of the observation and to constitute a report of research (Bogdan & Biklen, 1994). Class observation was supported by purpose-built observation grids.

Data analysis was performed through content analysis, and was subjected to triangulation by diversification of instruments and researchers, since the observation of classes has been carried out on several occasions as a pedagogical pair by HEI teachers, to give greater accuracy in the collection and analysis of the data (Denzin, 1984).

## **5. The supervised teaching practice in the Master's Degree in Economics and Accounting Education**

The supervised teaching practice begins with visits to the school, interviews and observation of the work developed by the mentor teacher, which complement the seminars at HEI. The second year is developed with the assistance and teaching of classes, assuming the students progressively the most complete exercise of the teacher's functions.

The work developed by the master's degree seeks to appropriate knowledge and the development of their professional capacities, through planning, teaching, reflection and evaluation activities, which will be supported by the research that the student will describe in a final supervised practice report in a field diary, which includes a description component of observations and a reflective one.

In the leadership and supervision process, the observation of classes, usually by the mentor teacher and sometimes by one or two HEI teachers, is one of the most important strategies used, since it allows the observation in real context of the development of competences, namely autonomy, relation with the students, reflective and collaborative capacity.

In this process, we followed the guidance of Reis (2011), having developed the necessary procedures so that before the observation of the teachers' training classes, the mentor teacher clarified the objectives of the observation and discussed: the rules for the observation, the integration of this curriculum and planning, the objectives of the class, the strategy and potential evidence for its realization, the possibility of differentiation from some students, the dimensions of observation, and also explain what they would do during observation with date setting and time for the feedback meeting.

During the observation, the supervising teachers sought to minimize their presence in the room, record their observations according to established standards, record impressions and questions for the feedback meeting. In this meeting, following the defined procedures, they also sought to reconstruct, together with the preservice teacher, the events of the class, to ask him to reflect on what he considers to have gone well in class, what he would like to improve and how, and to mention possible atypical situations. We also took care to describe the observed behaviors rather than evaluate them, as they should be concrete and specific, focus on behavior that the teacher in formation has the capacity to modify, and finally, constructive suggestions were presented.

Throughout the developed supervision process, it is considered important to provide collaborative situations of teaching, assessment and learning, with individual and joint reflections, in order to promote autonomy and shared interaction, contributing to professional development and co- knowledge of the various stakeholders.

## **6. Conclusions**

Supervised practice can have a profound impact on teachers in their initial training, depending on whether or not the leadership and oversight process they have involved has influenced them. It must sustain the necessary link between theory and practice and allow the construction of its professional identity.

Despite the evidence found in different contexts about the value of "clinical practice", its impact is mainly determined by the interaction between the various actors (Levine, 2011). Therefore, in the same vein, this study also highlighted the importance of seeking long-term lasting partnerships with experienced mentor teachers from cooperative schools for the training of future teachers and, secondly, to be concerned with the development professional and training of mentor teachers, or even by creating supervising teacher communities.

In this way, clinical practice may also be relevant in terms of its impact on experienced practitioners involved, in particular the benefits they perceive, as they are encouraged to engage critically in sustained research perspectives when in-service teachers and evaluate their own practice (Burn, & Mutton, 2015).

In summary, this study found the importance of the clarification of the objectives and the process, the joint analysis and reflection of the observed events and the suggestions for constructive improvement offered to the future teachers, as well as the concomitant possibility of professional development of all actors in the process.



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## ICT management in Latin America educational institutions. Between policies and innovation.

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### **Abstract**

*The use of Information and Communication Technologies (ICT) in educational contexts has focused its greatest efforts on the acquisition and use of technology. This makes necessary a conceptual and methodological redesign of its use, one that integrates all the members of the organization and generate permanent changes in the culture of the organization (Salinas, 2005). The management of educational institutions is crucial to normalize experiences and provide references that can be integrated into environmental conditions. Despite this, educational management has been relegated to the studies of innovation in education supported by technology, with little systematized information in this regard (Sunkel, Trucco, & Espejo, 2013). The present work uses bibliographic techniques to analyze the trends that have been followed in Latin America in terms of educational management for the adoption of ICT. The influence of public policy on the promotion of these programs is observed, as well as the need for a theoretical methodological support for the development of an integral management model, in which the technology component does not constitute a parallel item..*

**Keywords:** Educational management, ICT policies, innovation.

### **1. Introduction**

The notion of Information and Communication Technologies (ICT) as a relevant element within the innovation processes of organizations, including educational ones, is increasingly accepted (Cifuentes, 2016; 2016; Kozma, 2010). Likewise, the notion of ICT as an innovative element is reinforced by recent empirical studies of the OECD (2012), pointing to a positive relationship between adoption and use of ICT and the economic performance of its member countries at micro and macro levels.





In its report on innovation in the knowledge economy, the OECD (2004) points to ICT as a driver of innovation along with three other major drivers: scientific knowledge, collaboration between user-makers and modular structures. Thus, the creation of user networks and the flow of shared knowledge are valued as articulators of innovations with the potential to break into the entire system and not to only be absorbed by their current practices.

In the education field, ICTs have been identified within public policies as elements of innovation with expectations of knowledge potentialization and democratization of education, producers of development with equity (Lugo & Brito, 2015; Represas, 2015). These expectations have risen ICT initiatives in almost all countries, with emphasis on the provision of infrastructure and improvement in access indicators.

Nevertheless, results from ICT incorporation in education do not show the expected scope and effectiveness; suggesting that they have not revolutionized but reinforced existing teaching methods, curricula and educational goals (Watson, 2006; Torres, 2010). In other words, they have been assimilated by current systems without having generated the anticipated disruptive effect. Similarly, UNESCO (2011) points out that policies have the capacity to add value to the educational processes and system results; as long as they are considered a systemic change. In this systemic perspective policies are capable of promoting innovations based on technology. Yet, innovations could occur throughout the system and still not change it, if their objectives, practices and structures remain unchanged.

Cifuentes (2016) considers that future research on ICT should consider the area of implementation (execution) of education policy as a key part of the analysis of contemporary educational policies in the Latin American context. Is in the execution where we find the reinterpretation of policy that is carried out within the organizations to integrated it into the existing structure and processes. Thus, it is necessary a methodological redesign in relation to the adoption of technology, to integrate all the actors and generate permanent changes in the organization (Salinas, 2005).

An understanding of the integration of ICT in teaching-learning processes reveals that there is a close relationship with politics, under which the academic, administrative and organizational aspects are intertwined (Cifuentes, 2016). This internal management of educational institutions combines quality assurance systems and accountability practices of both academic and administrative personnel; including discourses of efficiency in the practice of public management. Strategic plans increase success in the integration of ICT in educational contexts (Cifuentes & Vanderlinde, 2015). Despite this, the influence of ICT management models in schools as part of the implementation of public education policies has not received enough attention and has been relegated from studies of innovation

supported by technology in education. As a result, there is little systematized information about it (Sunkel, 2013; Cifuentes, 2016).

Management can be defined from different perspectives. If observed from the organization actors interactions, it can be understood as "*the ability to articulate mental representations of the members of an organization*" (Casassus, 2000, p.4). In order to observe the implementation of public policies, we consider the ICT management in education from the paradigm of the mobilization of resources (material, human and social).

The objective of this work was to identify representative ICT integration programs in educational activities presented in recent decades in Latin America, as part of the interpretation and adaptation of public policies to the particular context. The aim is to emphasize the mechanisms established by the actors to assume the strategic planning of innovation from the day-to-day management of the school. To meet this objective, an exploratory study based on bibliographic techniques was proposed. The literature review methodology uses both public documents from official government sites and supranational organizations, as well as articles in scientific databases that account for regional experiences in the field and meet the criteria of thematic and temporal relevance.

Results from the study provide a descriptive framework for the recent implementation of ICT educational public policy on several Latin American countries. It presents the relationship between strategies and management that have been developed in each particular case for the adoption of technological resources and their adaptation to the contextual characteristics. This review contributes both to the analytical reflection of the processes of adoption of innovations, and to establishing comparisons of the management models used in the educational field to interpret and execute public policy from a pre-existing organizational structure.

## 2. Methodology

In order to meet the established research objective, an exploratory study based on bibliographic techniques was developed. According to Chong (2007, p.187), a documentary research "*is the methodical and formal process that facilitates and supports the agile and systematized access to the product of scientific research, reported in documentary sources*". Its importance lies in that it "*leads to the collection of information, systematically, analytically, synthetically and critically*".

Documents with the following characteristics were included in the review:



- Bibliographic database; including peer reviewed articles and books published in Spanish or English from year 2000 to date .
- Databases of international organizations for education and economic development: UNICEF, OECD, CEPAL & SITEAL.
- Electronic pages of government agencies; Colombia, Mexico & Argentina.

In the end, more than 70 articles from scientific journals, 4 databases and 3 government websites were analyzed. For each coincidence, priority was given to the existence of an exposition of the policies that went beyond the discourse analysis to focus on the experiences and their results; preferably from the actors vision.

### **3. Results**

Countries in Latin America are part of a heterogeneous region, where great socioeconomic inequalities are yet present, despite most of them having a democratic process and a growing economy in decades (Lugo & Brito, 2015). According to the OECD, governments consider ICT to be an important platform for research and innovation in all sectors. Consequently, its main associated areas of interest are: penetration of bandwidth, research and development in ICT, financing for innovative entrepreneurship, and diffusion of technology in business. Particularly with regard to ICT, the priorities during 2012 of the member countries of the OECD were: ICT skills and employment, online government, as well as the security of information systems and networks (OECD, 2012).

Still, schools in less developed countries, such as those in South America, face more barriers to the use of ICT in addition to the primary represented by accessibility. Some range from access to computers, lack of software, technical and administrative support, teacher training, internet access and, in some cases, even lack of electricity in some areas (Kozma, 2010).

Hence, about 44% of developing countries have developed national plans for the growth of the ICT sector and another 20% are in the process of developing them. Although a large number of countries are reported with plans to accelerate infrastructure, more specifically the adoption of bandwidth, there is great diversity among them in terms of objectives and policies. Remarkable is also the fact that in many of the programs there is a lack of theoretical bases to carry out the evaluation of the effectiveness of such ICT policies (Prashant, 2015). Some of the ICT programs settled in Latin America as part of the strategic development initiatives are shown in Table 1.1. This list does not intend to be exhaustive,

but to account for the diversity of existing proposals in the region and, in some cases, even within the same country.

**Table 1.1. Strategic programs in Latin America for the incorporation of ICT in education.**

Argentina	Educ.ar Programa Núcleos de Acceso al Conocimiento
Bolivia	Una computadora por docente
Brasil	Programa Nacional de <a href="#">Acesso ao Ensino Técnico e Emprego (Pronatec)</a> Programa Nacional de <a href="#">Formação Continuada em Tecnologia Educacional (Integrated ProInfo)</a>
Colombia	Educa Digital Colombia® Programa de Formación de Educadores CREA-TIC: Inspirar, Crear y Diseñar Aprendizajes con TIC
Costa Rica	Plan Nacional de Tecnologías Móviles (PNTM), <a href="#">Tecno@prender</a> Programa Nacional de Informática Educativa (PRONIE MEP-FOD)
Cuba	Joven Club de Computación y Electrónica (JCCE)
Chile	Formación Docente para el Desarrollo de Competencias TIC Tecnología en el Curriculum
República Dominicana	Agenda Digital Programa <a href="#">Compumestro 2.0</a>
Ecuador	Agenda Educativa Digital Plan de Acceso Universal y Alistamiento Digital
El Salvador	Programa Creando Conocimiento Programa “Cerrando la brecha del conocimiento”
Guatemala	Estrategia para una Educación de Calidad para la Niñez y Juventud Guatemalteca
Honduras	Agenda Digital de Honduras 2014-2018
México	Estrategia Digital Nacional México conectado
Nicaragua	Proyecto de Telecomunicaciones rurales
Panamá	Aprende al Máximo Para, Piensa, Conéctate
Paraguay	Plan Director TIC Alfabetización digital ( <a href="#">Infocentros</a> comunitarios)
Perú	TIC para la educación pública Plan de Desarrollo de la Sociedad de la Información en el Perú La Agenda Digital 2.0
Uruguay	Uruguay Digital Plan Ceibal (Conectividad Educativa de Informática Básica para el Aprendizaje en Línea)
Venezuela	Plan Nacional de Alfabetización y Formación Tecnológica

Source: SITEAL (2019)

In the case of Peru (Balarín, 2013) there is a lack of systematized official information to allow the analysis of the impact of ICT policies in recent years. Likewise, the alternation between two trends is reported: centralizing the management of ICT policies and mainstreaming at all levels and spheres. In counterpart, Colombia is an example of the development of an ICT policy with a strategic vision; addressing elements such as infrastructure, human capital development, improvement of teaching practices with technology and management and production of digital educational resources. Thus, through its PlanEsTIC program, higher education institutions were encouraged to develop, implement and evaluate their own plan (Cifuentes, 2016; Galvis, 2014). In this flexible way, the characteristics of the context and the culture of the organization could be considered within its own strategy of technological appropriation and policy execution.

Argentina, for its part, has recognized both the financing difficulties involved in the obsolescence of ICT, as well as the importance of linking the public and private sectors in these initiatives. Its Connect Equality Program aims to go beyond the provision of infrastructure, to reorganize the actions of institutions in the same field; recognizing the importance of communication policies in educational management (Vacchieri, 2013). In the same case is Costa Rica, where ICT projects are developed in conjunction with a non-profit organization promoted in 1987 by the Costa Rican government, the Omar Dengo Foundation. In this country, a comprehensive management model is reported, covering the operational framework, infrastructure, monitoring and evaluation (Muñoz, et al., 2013).

In addition to Costa Rica, Uruguay is one of the few countries in the region that has an evaluation program for its social and technological inclusion plan (Plan Ceibal), which includes quantitative and qualitative approaches. However, this program has been repeatedly pointed out to the lack of articulation with the formal education system, being developed without the participation of educational authorities or teachers (Vaillant, 2013). This is a case in which political aspects have a strong influence on the development of programs. In Mexico, educational innovation programs are also strongly linked to changes in public administration and have a strong political component. Current models in Mexico include computer labs, educational portals and digital content, the provision of computer equipment to classrooms and the emergence of the 1 to 1 approach (Díaz Barriga Arceo, 2013).

In general, from the aforementioned strategic programs it can be observed that, even though ICT employment for education and innovation has appeared on the Latin American political agenda, it is not clear that they are accompanied by a theoretical support that strengthens its employment at classroom level and benefits its effective appropriation by the community members in which they seek to influence. The strategies used vary from connectivity improvement, equipment provision and teachers training; to external participation proposals with financing purposes. On the other hand, there is no evidence of the development of an integrated management system in schools, one which includes the systematic information collection that allows its evaluation, as well as a precise definition of evaluation criteria.

#### **4. Discussion**

Literature shows that, although Latin American countries are formalizing strategic plans on ICT, most of them do not incorporate evaluation systems on their implementation (Cifuentes & Vanderlinde, 2015) nor systematic data collection. This is a characteristic that differentiates the region as well as the remarkable social and economic differences found.



However, it can be seen how innovation through ICT has opened its way in the regional political agenda and the existence of a gradual progress in the areas of infrastructure and access.

For Casassus (2000) there is a problem of divergence of objectives in the management, from the scale perspective. Thus, politics is located at the macro level and deals with the economy from a pragmatic and neoliberal perspective; while the micro level is devoted to student learning, from pedagogy. The tensions originated are observable when the design of policies does not consider elements to articulate them. That is why considering the incorporation of ICT as regular part of educational management allows an association between technological innovation and the culture of the organization, an articulation that is yet lacking in the implementation of those policies. This work we has recovered multiple existing regional initiatives and some of the difficulties they face from the dimensions of context, policy and theoretical foundation. It also presents the need to approach the phenomenon from a systemic position that combines the communication of the discourse within the organization with its substantive processes.

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## **Creativity, Meaning, and Purpose: Mixing cultures in creative collaboration**

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### ***Abstract***

*Music composition is embedded into the Viterbo University music theory curriculum to promote active engagement of musical materials. The project accomplishes three basic complementary outcomes: 1) Students will be able to creatively apply and develop the foundations of music theory learned in their first year of university-level music study, 2) Students will develop proficiency using music writing software, and 3) Students will overcome their fear of composition and gain confidence as musicians. Students are taught foundational concepts during the first four semesters of music theory; these concepts are creatively applied and developed in the gestation and birth of a musical composition that is original and personal. Meaning and purpose, combined with guidance and encouragement, sustain these freshmen and sophomore students over a five-month process of framing a concept, composing music, editing their scores, and finally rehearsing and performing their works. The “concept” for the 2018-2019 freshmen and sophomore music theory students was a collaborative venture with Gateway Christian School, which is part of Project Gateway in Pietermaritzburg, South Africa. Poetry written specifically for this project by Grade 7 students was collected and given to Viterbo University students for setting. The student learning outcomes, as well as the global focus of the project are excellent examples of the value of high-impact teaching and learning.*

**Keywords:** *Music education, composition, project-based learning.*

### **1. Introduction**

High-impact teaching requires teachers who are dedicated to teaching beyond the information at hand. In order to make a vital connection with students, teachers must employ a variety of techniques to engage, encourage, and ultimately help students retain



and make relevant connections with subject matter. This paper will present essential qualities for high-impact teachers and describe a class music composition project that offered students deeper learning in music, as well as a broader view of culture. The paper will also propose that high-impact projects such as the Viterbo University music composition project reinforce learning and build student confidence.

## **2. Creativity, Meaning, and Purpose**

### **2.1. Introduction**

Imagine yourself a ninth grader living in southern California on the first day of school. You seat yourself in the back of English 9 because you still haven't learned to spell and would prefer to stay unnoticed and uninspired. The bell rings and a handsome young man with a cool haircut and red tennis shoes walks into the door. He is funny, smart, and works hard to make a connection. You decide to pay attention.

### **2.2. The Courage to Teach Creatively**

Matt Hauptert was recruited (2013) by TEACH FOR AMERICA, a self-described “diverse group of leaders with a record of achievement who work to expand educational opportunity, starting by teaching for two years in a low-income community.”<sup>1</sup> He was hired to teach English at the Community Charter Early College High School in Lakeview Terrace, California, and although he doesn't have an education degree, he uses his background in theater and English to teach composition, literature, and poetry. He uses live turtles, humor, and any other manner of ingenuity to get his students excited about the material they are studying. In his words, “Today I gave my students the option of either sitting in their chairs or standing on their desks during our discussion of *Lord of the Flies*. One student's response: ‘Well, gee, Mister...this class is sure abnormal!’”

### **2.3. Engagement vs. Entertainment**

Engaging students at that level would have been criticized as “entertainment” when the author was a student thirty years ago. Back then, teachers received high marks for having instant recall and delivering an organized lecture (which is still commendable) and generally, cultivated a more objective approach to education. Thirty years ago, fine

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<sup>1</sup> Teach for America: <https://www.teachforamerica.org/our-mission>. web

teachers with a natural inclination toward presenting material in a creative and engaging way were more rare, especially in university settings. A few stand out. Retired Minnesota teacher Reuben Patnaude (Grand Rapids MN, School District #318), was an art teacher who didn't believe in coloring books, so supplied his students (and children) with paper, paints, crayons, clay, and other materials for various class projects. Without controlling the outcome, he unfolded the principles of design, color, and texture in the same way that Matt approached a lesson on *Lord of the Flies*—out of the box.

At the collegiate level, master teacher Shelley Gruskin (College of St. Scholastica) made sure that each class period was a step into a world of possibility.<sup>2</sup> He went so far as to cobble together an Elizabethan-style masque, writing parts for each of his students in a staged public performance—unusual at a time when grasping the material didn't involve getting out from behind a desk.

Each of these teachers made an impact on the author of this paper, and their quest to make an indelible impact on each student's learning was achieved by the meaning and purpose they brought to the subject matter. In the same way that Reuben Patnaude aimed at refining the way that his students looked at the world (recognizing negative space and the nuances of artistic hues), the Viterbo University music composition (“Project Gateway” 2018-2019) was designed to help students experience music more as a creator than a consumer. Students involved in “Project Gateway” were given license to make an extraordinary amount of choices - affording them meaning and ultimate ownership of their creative work.

#### 2.4. The Soul of the Classroom

In his book, “The Courage to Teach,” Parker Palmer describes the ideal environment for teaching/learning as a community of truth that promotes living and learning in a purposeful manner. It is not enough to know things (which he describes as “objectivity”) but to recognize that education, at its very best, pursues excellence through meaningful and purposeful relationships. He writes, “Teaching, like any truly human activity, emerges from one's inwardness, for better or worse. As I teach, I project the condition of my soul onto my students, my subject, and our way of being together.”<sup>3</sup>

Viterbo student Alivia Schmidt-Sanders composed “Hide and Seek” as part of “Project Gateway.” Her composition was based on a poem by Gateway Christian School 7<sup>th</sup> grader, Munaste Chilembetembe. Alivia described the creative work that she did to capture the youthfulness of Chilembetembe's poem.

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<sup>2</sup> Zander, Benjamin and Rosamund Stone Zander. *The Art of Possibility*. Boston: Harvard Business School Press, 2000.

<sup>3</sup> Palmer, Parker. *The Courage to Teach*. San Francisco: John Wiley and Sons, 1998, 2007, 2.



Basing my composition off the poem “Hide and Seek” by Munaste Chilembetembe was not only a great opportunity to get in touch with my creative side, but it was a chance to create something truly authentic inspired by my favorite kind of person, a child. Throughout the poem, the reader gets the impression of children at play, and I tried to capture that youthful feeling in my song. The melody of this piece is akin to the voices of children while they interact with each other. The song should make the listener feel like they are ten years old again, playing hide and seek with their friends in the backyard. The simplicity of the original poem allows for this time-travel to a simpler time in all of our lives where our only worry was staying quiet long enough to win a game of hide and seek. In a world full of hard challenges and tough decisions, it is always important to remember to live a simpler life like that of a child.<sup>4</sup>

## 2.5. Fostering Intellect and Spirit

Palmer claims that the greatest teachers are those who foster and develop intellectual, emotional, and spiritual aspects of the learning process in their students. His particular focus is one’s “inner landscape” and writes about the type of outcomes that fully meet the demands of our global landscape. “To chart that landscape fully, three important paths must be taken—intellectual, emotional, and spiritual—and none can be ignored. Reduce teaching to intellect, and it becomes a cold abstraction; reduce it to emotions, and it becomes narcissistic; reduce it to the spiritual, and it loses its anchor to the world. Intellect, emotion, and spirit depend on one another for wholeness.”<sup>5</sup>

The “Project Gateway” music composition project incorporated the three important paths, described by Parker Palmer. The intellectual path involved compositional technique and software navigation, while the emotional and spiritual paths converged at times, but ultimately lay in the personal connections that each young composer made with his/her music compositions.

Student Zoe de Boer’s “Spring Is Back,” was based on a poem by Gateway Christian School 7<sup>th</sup> Grader Siphokazi Hleta. Zoe’s program notes convey the emotional and spiritual dimensions of music composition. The focus on Parker Palmer’s “inner landscape” is evident:

I fell in love with the poem, “Spring is Back.” The lyrics are so delicate and gorgeous. The language you [Siphokazi Hleta] used is mature and I think I was able to create a composition that showed the feelings that were caused inside my own heart when I read your [Siphokazi Hleta] poem. I have been deeply influenced by music performed at *Feinstein’s/54 Below*, which is a very elite performance venue in New York City. I

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<sup>4</sup> Program Notes, Viterbo University Music Department Forum; Friday, January 25, 2019.

<sup>5</sup> Palmer, 2.

created a song that reflects something that could one day be performed there. I wrote rhythmic lines that mimic human speech. I am so excited to share my piece, using your voice with the world.<sup>6</sup>

## 2.6. Best Practice in the Classroom

Matt Hauptert, Reuben Patnaude, and Shelley Gruskin are examples of teachers who espouse and engender creativity, meaning, and purpose in the classroom. They teach the subject-at-hand hoping that their students will use it for a greater purpose beyond the classroom. Like Parker Palmer, they convey passion for their subject matter in a way that becomes meaningful for their students. They provide us with “best practice” lessons that aren’t narrowly focused on material, but include experience and reflection, while increasing possibilities in the classroom. Daniel Pink, in his book *Drive*, describes a necessary “third drive” that supports Palmer’s intrinsic model: “The science shows that the secret to high performance isn’t our biological drive or our reward-and-punishment drive, but our third drive—our deep-seated desire to direct our own lives, to extend and expand our abilities, and to live a life of purpose.”<sup>7</sup>

## 2.7. Generating a Spark of Possibility

Conductor Ben Zander and his wife, Rosamund, incorporate creativity, meaning, and purpose into a practice they call enrollment.<sup>8</sup> Mr. Zander works with high-achieving musicians at the *New England Conservatory* and abolished grading in his class because it increased anxiety and fear in the pressure-filled world of music performance. When they enter his classroom each week, they practice enrollment, described as “generating a spark of possibility for others to share.”<sup>9</sup>

Zander writes,

“We have at our fingertips an infinite capacity to light a spark of possibility. Passion, rather than fear, is the igniting force. Abundance, rather than scarcity, is the context. So the practice of enrollment is about giving yourself as a possibility to others and being ready, in turn, to catch their spark. It is about playing together as partners in a field of light. And the steps to the practice are:

1. Imagine that people are an invitation for enrollment.
2. Stand ready to participate, willing to be moved and inspired.
3. Offer that which lights you up.
4. Have no doubt that others are eager to catch the spark.”<sup>10</sup>

<sup>6</sup> Program Notes, Viterbo University Music Department Forum.

<sup>7</sup> Pink, Daniel. *Drive: The Surprising Truth about What Motivates Us*. New York: Riverhead Books, 2009, 145.

<sup>8</sup> Zander, 125.

<sup>9</sup> Zander, 125.

<sup>10</sup> Zander, 126.

Most of the students in the Viterbo University music department are singers who perform together regularly in choral ensembles and productions. Their collaborative work continually invites them for “enrollment” and participation in both performance and classroom activities. The “Project Gateway” composition project was no exception. Nathan Janzen’s notes for his setting of Sthabile Ngoego’s poem, “I Like Pizza,” emulates the art of possibility that Zander describes in his work.

The poem I selected was “I Like Pizza” by Sthabile Ngeobo. The most attractive aspect of the piece to me was its short and sweet theme, which I decided to use ironically by putting it in a drawn-out operatic setting. I have really enjoyed working with this text and hope to see more works from this writer in the future. Sometimes the simple things in life are taken for granted—even the wonders of pizza and strawberries—but this experience with *Gateway Christian School* has not been one of those times. I would like to thank Shtabile and the staff of GCS and Viterbo for making this all possible.<sup>11</sup>

### **3. Conclusions: The Challenges and Rewards of “Project Gateway”**

#### **3.1. Overcoming Obstacles**

Fear can be a formidable obstacle to creativity. The typical college music major memorizes part-writing rules and properly ascribes Roman numerals to musical excerpts from Bach to Berlioz, without ever writing a phrase of their own music. Many would prefer to reserve that work for musical geniuses like Mozart and Bartok. These “musical geniuses” exchanged ideas with one another and improved their performance and composition skills by creating and re-creating music (as well as requiring the same from their students).<sup>12</sup>

Today, there remains a shrouded mystique that reserves music composition for musical icons like Wolfgang Amadeus Mozart, Ludwig van Beethoven, Clara Wieck Schumann, and Amy Cheney Beach. In fact, the general lack of creativity in music education today has become an obstacle to music composition. Contemporary performers are more concerned with interpretation (adding fingering and other interpretative markings in performance scores) than they are with the creative process. Performers are expected to perfect what’s in the score, but aren’t required or even encouraged to perform their own original works. When students begin to compose, their experience more closely resembles that of the “musical geniuses,” and ultimately changes the way they interpret music.

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<sup>11</sup> Program Notes, Viterbo University Music Department Forum.

<sup>12</sup> Mann, Alfred. *Theory and Practice: The Great Composers as Teachers and Students*. New York: Norton, 1987, p. 7.



### 3.2. A New Way of Thinking

The theory program at Viterbo University has been successful with various active-learning analysis projects, but there was significant improvement in the students' understanding of musical material when they began composing their own works. The idea was both personal and creative, yet required freshmen and sophomores to utilize what they learned in their respective theory classes. If they invested themselves in the project, there would be what Daniel Pink describes as the perfect “symphony.” In his book, *A Whole New Mind*, the perfect symphony is “the ability to put together the pieces. It is the capacity to synthesize rather than to analyze; to see relationships between seemingly unrelated fields; to detect broad patterns rather than to deliver specific answers; and to invent something new by combining elements nobody else thought to pair.”<sup>13</sup>

### 3.3. Values - An Ocean Apart

When Dr. Mary Ellen Hauptert joined Dr. Matthew Bersagel-Brale, and a VUSM 300 (Viterbo University Mission Seminar) class in May 2018 on a trip to South Africa, she had no idea that the trip would provide the “concept” for the 2018-2019 music composition project. Even after collecting poetry from the 7<sup>th</sup> grade English classes at *Gateway Christian School/Project Gateway*, and presenting the poems to Viterbo music theory students, there was still the risk that the project might fail.

Even so, it offered some powerful social and historical lessons to Viterbo students. Situated in a land that has been socially ravaged by apartheid, South Africa's *Gateway Christian School/Project Gateway* is committed to the education and training of children, young people and adults who would otherwise not have access to affordable, quality resources. *Gateway Christian School/Project Gateway* is also located in the “Old Prison” in Pietermaritzburg, South Africa, and contains a history museum with displays of political prisoners' Nelson Mandela and Mahatma Gandhi's incarceration.<sup>14</sup> The cultural lessons were invaluable, even without the music.

### 3.4. The Challenges of Distance Collaboration

“Mixing cultures,” from the start, was both difficult and exciting. Even though all the poems weren't set to music, there was a tremendous level of engagement from the music theory students. At the end of the fall semester, students submitted a working draft of their

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<sup>13</sup> Pink, 130.

<sup>14</sup> [The Old Prison](#), Project Gateway, web.





compositions, and at the beginning of the spring semester, students spent two weeks rewriting, editing, rehearsing and finally performing their works at the weekly music department forum. The performances were recorded and posted on YouTube so that our friends at *Gateway Christian School* could see the fruit of their work.<sup>15</sup>

Unfortunately, there wasn't an opportunity for a personal connection between each poet and composer. Though *Gateway Christian School* was happy to receive "Project Gateway" and share it with the teachers and students, we weren't able to facilitate conversations between each poet and composer, which might have brought deeper meaning to the process.

### **3.5. Accomplishing a Goal**

Even without the personal connection between poets and composers, "Project Gateway" achieved its student learning outcomes. Students developed music theory skills while making choices about key, meter, melody, harmony, and rhythm; through their synthesis of musical elements, they became better interpreters of music. They applied elements of music to produce a work of art, while gaining proficiency with music writing software. They also gained confidence as musicians, while learning about the struggles and challenges of another culture. When the "Project Gateway" music theory compositions were performed at a Viterbo University Department of Music forum on Friday, January 25, 2019, the world seemed a bit smaller.

### **Acknowledgments**

Thank you to Viterbo University Music Department, Matthew Bersagel-Braley (Viterbo University), Di Milford (Project Gateway – Gateway Christian School), and the Grade 7 teachers of Gateway Christian School.

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- Project Gateway: <https://www.projectgateway.co.za/old-prison>. web

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<sup>15</sup> It was bittersweet to receive word from Di Milford that our seventh grade poets matriculated to another school! Future collaborative projects with South Africa will need to partner poets and composers more intentionally.

Teach for America: <https://www.teachforamerica.org/our-mission>. web

Zander, Benjamin and Rosamund Stone Zander (2000). *The Art of Possibility*. Boston: Harvard Business School Press.





## Preparation of New Physics Teachers in the Light of Goals of Physics Education

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### **Abstract**

*In some of our previous articles, we have analysed and discussed the goals of physics education at secondary schools and some aspects of physics education at the secondary school level. In this contribution, we proceed with bringing our experience with the preparation of new physics teachers at Comenius University in Bratislava. We discuss the theoretical background we used as a base for preparing the curriculum for university students – future physics teachers, and we highlight some aspects of their preparation. Primarily, we focus on the development of abilities to scaffold the learning of their future secondary schools' students. In details, we describe the ways we try to improve the abilities of our students to scaffold their future secondary schools' students in concept formation, process skills development, in planning and processing inquiry, ability to scaffold practical work with literature. As a vast majority of our graduates will teach their secondary school students in the Slovak language, which is a language used by a small number of people (5 mils). So we discuss also some specifics related to physics textbooks for secondary schools in Slovak language, university textbooks available in Slovak language and ability of our university students-future physics teachers to work with sources written in English. At the conclusion, we propose some possible improvements, hopefully, inspiring also for preparation of physics teachers for other educational systems.*

**Keywords:** *physics teacher, pre-service teacher, teacher preparation, physics education.*



## **1. Introduction**

Preparation of physics teachers at Comenius University in Bratislava has a long history, which, of course, has some influence on the present state. In this contribution, we discuss the present state and some innovations we are applying these years.

Future physics teachers are prepared in combination with another subject, most of them with mathematics, and for higher and lower secondary education. Based on Shulman's domains of teacher knowledge (Shulman 1987), transformative model of teachers preparation is preferred, integrative is tried to avoid. The courses are focused mainly on pedagogical content knowledge (PCK), subject matter knowledge (bachelor physics course, adapted for future teachers) and educational psychology. Some time is also devoted to curricular knowledge (oriented on Slovak national curriculum and often compared with International Baccalaureate curriculum); knowledge of learners (as a part of educational psychology); knowledge of educational contexts and knowledge of philosophical and historical goals of education.

Even if our university preparation of physics teacher is based on upper-mentioned decisions, we can say that the present state of physics teachers preparation in Slovakia can be described as unsettled, quite changing. A similar situation can also be seen in many other educational systems. Even if the author of this contribution is also the main author of the national physics curriculum, which was formulated more than ten years ago, it can be said that it needs reform. Some schools in Slovakia try to adopt some aspects of physics education from other educational systems. It must be mentioned that most of such attempts do not bring internally consistent sights.

In the world, we can see some innovation paths. Some systems emphasis content of physics education and utilise instructional methods, cognitive constructivism methods. Some of the others put the accent on the child, pupil, on the learner. Exceptional are the ways colleagues from Finland and Norway decided to develop, where the emphasis is put on projects, complex problems inquiry, where pupils gain knowledge via complex real-life problem solutions well scaffolded by experts (including teachers). Interesting is also a relatively new approach, in which experts on practical education work in teams together with neuroscientists, psychologists and in-service teachers. Some of such groups develop the movement The Learning Science, (R.K. Sawyer, 2014) based on social constructivism.



## 2. Our focus

Within the holistic approach, we focus on innovations in the development of teacher's competencies for:

- a) Effective scaffolding of the work of pupils. Today, the concept of scaffolding is almost unknown in Slovakia, despite it is one of the basic concepts of constructivism, from the age of the introduction of constructivism. We hypothesise that this state is the result of the extreme emphasis on instructions and instructional approaches. In the traditional approach, it is tried to activate learners via instructions, but, paradoxically, the natural result is a passivity of the learner, who is not inspired to formulate her/his challenging goals, aims, is not taught to cooperate with somebody with more profound and broader knowledge and abilities. The only example of this approach in physics education in Slovakia can be mentioned, is the preparation of students for Young Physicists Tournament at some schools;
- b) Management of the stages of (relatively) independent inquiry of teams of pupils;
- c) Management and support of pupils in discussion ability development;
- d) Formative assessment is also a topic future physics teacher used to have only mentioned, and now, within the holistic approach, it is tried to train them for it. Peer-assessment is also the aspect which should be better incorporated into the programme of teachers preparation;
- e) Summative assessment, differences between formative and summative, aspects to assess within physics education;
- f) Work of pupils with sources of information – our available sources in the Slovak language are limited. The work with sources of information optimised for various age levels is one of the main gaps, which we have in physics education theory now;
- g) Work in the environment of computer-supported school science laboratory. We have already done much in the utilisation of sensors and data loggers. Still, we must search in the utilisation of video measurement, computer modelling (by pupils themselves), interactive animation (applets, innovated and developed by the pupils themselves);
- h) Mentoring of pupils in the use of gadgets brought to school by pupils (BYOD-bring your device approach).
- i) Search for a typology of physics teachers using research methodology by K. Charmaz, grounded theory and also the model of personality by R.C. Cloninger, and here we are just at the starting point.

### **3. Textbook for preparation of new physics teachers**

Last year we finalised a textbook for our students – university students of physics education in combination with hither school subjects (Demkanin, 2018). The textbook, *Physics education for Pre-Service and In-Service Physics Teachers*, is now available in Slovak only. Let us present some of its features.

In the preface we say: Physics teacher today at a secondary school is facing demanding task – to work with children, adolescents, with their parents, to fulfil goals of physics education, clearly present her/his requirements towards pupils and consistently demand to meet them by them, to activate pupils for awareness of their process of learning, to learn pupils to observe, measure, make experiments, inquire, and lead them to thinking, to utilisation of their own previous knowledge. Besides investigating nature, physics teacher also teaches how to use some technologies. In these two sentences are presented eight chapters of this book. Next chapters are devoted to informal and unformal physics education, concepts formation and concept transformation, to science projects at schools and assessment. In conclusion, some historical view and some vision of the future is offered. To present this textbook in more details, let us discuss the chapters and our goals related to these chapters.

In the introduction, it is stressed the central question of the book – What it is about the quality of physics education? Moreover, we discuss the main dimensions of a teacher – knowledge, abilities and relations. In one table, we present the assumptions related to the physics content, the list of topics the university student of magister level study, future physics teacher, should know to be able to use this textbook. In the second table, we present a list of some psychologists. We used the list of the most cited psychologists in 20. Century, where are such names as B.F.Skinner (behaviourism and programmed learning), J. Piaget (cognitive development), S. Freud (psychoanalysis), A. Bandura (social psychology), L. Festinger (social psychology, mental discomfort), C.R. Rogers (humanistic psychology), S. Schachter (theory of emotions), N. Miller (experimental behaviourist), E. Thorndike (educational psychologist), A. Maslow (hierarchy of needs), and some others. Our aim here is to focus attention on the needs to base the physics education on facts, on the results of systematic research (including the research of psychologists). Of course, we do not focus the attention of our students – future physics teachers, on the in-depth study of all parts of general psychology. Later in the book, we use mainly the results of The Learning Science movement presented by R.K. Sawyer. In this introduction, we also present a list of some terms with short descriptions, terms like knowledge, information, concept, phenomenon, the strategy of education, teaching style, experiment, variable in an experiment, observation.



In chapter one of the textbook, the attention of the students is focused on the topics of this textbook, and we try to demarcate, define the topics of this textbook. We are trying to present The transformative approach is presented; the teacher can have in one domain topics like ways to focus the attention of learners, personality model, working with pupils, which disobey, transform units of physical quantities, working with graphs of physical dependence. The students here solve problems like:

A flute emits the sound of frequency 440 Hz. Determine the wavelength of this sound and the length of the flute closed at one end, which emits this sound.

Propose an experiment to measure the speed of sound in a school laboratory.

Discuss how the teaching of physics and higher secondary school can help to raise the use of public transport in the horizon of 10 years.

The problems should be not only solved/answered, but the reason we use such problems within physics education should also be discussed.

One of the next tasks is to discuss the interrelation between secondary level school derivation of Bernoulli's equation (from the conservation of energy principle) and the character development. We use here the model of the personality of R.C Cloninger and discuss the development of three traits of character – Self-Directedness, Cooperativeness and Self-Transcendence. The students should in this chapter also discuss, what to do, if a secondary school student refuses to deal with the Bernoulli's equation, giving the reason, that she is planning to study Economics at University and that she will not need to understand the Bernoulli's equation derivation. We use here some parts of Adler's psychology.

Chapter 2 of the textbook and also the second lesson is focused on the goals of physics education. 3-level primary taxonomy of goals formulated previously (Demkanin, 2013) is used. Then we go to Big Ideas formulated by W. Harlen with her team (2010), (2015). With these Big Ideas, students also work on other parts of the textbook, especially in the chapter devoted to the concept formation. The easy to use the formulation of goals is adapted from the International Baccalaureate Diploma Programme, which is followed by some school physics examples, in which the students should discuss the goals, which are fulfilled by these examples. The most favourite is the last task of this chapter – to suggest a method (way, process) to fulfil a specific goal: To present, that physics is a very demanding science discipline, no one, except the physics teacher, can understand.

In chapter 3, we deal with the role/position of the pupil and the role/position of the teacher within formal physics education. Shortly we list some of the school of learning (J. Bruner, T. Luckmann, B.F Skinner, A. Bandura, R. Steiner, M. Montessori). After this short introduction we highlight, that "learning is making sense of new experience by learners in



collaboration with others” (Harlen, 2006) and this idea is applied in some contexts – filament bulb (hot and lighting), working with a textbook, watching a movie (Harry Potter), barking dog, cooling cup of tea, cooling cup of tea with exponential function used, radioactive decay. The discussion on the role of the teacher is based on the work of W. Harlen (2006), and one of the examples brings very poorly formulated instruction for pupils. The student should identify bad aspects of the instructions and try to re-work to be usable. In this chapter, our students also find quite a large part focused on scaffolding, mainly based on the work of Reiser and Tabak (2014). The last part of this chapter is focused on the conversation in the work of teacher and in detail is presented exploratory talk (Mercer, 2000).

#### **4. Conclusion, near-future development**

The book discussed in this contribution was met by the University students as well as by the in-service physics teachers very well. There was a gap in this field, the previous book on the similar topic has been published in the Slovak language in 1988, and there was made, and still is made profound changes in physics education. It can be seen, that the sight of the students on the physics education via this book is changing and it is met the goal - not to teach as I was taught, base my teaching on the results of relevant research.

In this contribution, some aspects of future physics teachers at Comenius University and also the first three chapters of the new textbook Physics Education is presented. The intention was to contribute to a discussion or to initiate a discussion on the topic of physics teachers’ education. All ideas are welcomed via email, future years of this conference or via ResearchGate.

#### **Acknowledgements**

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## Assessment of the transversal competences: analysis and resolution of problems and, planning and time management

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### Abstract

*European universities are in the process of experimenting with teaching by applying the new learning model according to the Bologna plan, based on specific and transversal competences. Due to the old teaching model, which is still rooted in the current learning system, professors have difficulties in assessing transversal competences. In this paper, the results of applying a methodology to assess the transversal competences: analysis and problem solving, and planning and time management is presented. Although the methodology is designed to evaluate transversal competences, it could also be used to evaluate traditional specific competences, in which the acquired technical knowledge is assessed. The methodology consists of explaining to the student how a practical problem is solved, applied to a case that an engineer can find in professional life. Subsequently, the student must solve another problem of the same type raised by the professor. The student will be given a limited time to solve the problem. The methodology is applied in two different sessions. The students have previously been informed about the performance of the test. Unlike the traditional method, the student must prepare the class before the lecture. Therefore, when the professor explains the theoretical part and how to solve the problem, it can also resolve doubts raised by the student during the preparation of the session. Additionally, the students who take less time to solve the test will have a higher score in the assessment of planning and time management. The results obtained are analysed and improvements are proposed to facilitate the acquisition of skills.*



**Keywords:** *Transversal competences, Assessment, Specific competences.*

## **1. Introduction**

Transversal or key competences are a set of competences related to attitudes, values, and procedures that are acquired in one context to master a special situation and can be transferred to another context. (EUROPEAN COMMISSION, 2018).

Due to their importance in the European Higher Education system, transversal competences assessment has been treated in several teaching publications (Cáceres, Martínez, Noguera, Pérez, & Sanabria-Codesal, 2016) (Fernández, Mallol, Chornet, Noguerae, & Gutiérrez, 2017) (García-García, 2009) (Mula, Sanchis, & Díaz-Madroñeroa, 2017) (Verdecho, Pedro-Gómez-Gasquet, Rodríguez-Rodríguez, & Alfaro-Saiz, 2016) (Verdechoa, Rodríguez-Rodrígueza, Alfaro-Saiza, & Gómez-Gasqueta, 2018). European universities are in the process of experimenting with teaching by applying the new learning model according to the Bologna plan, based both on specific and transversal competences.

According to (CompAssess, 2019), competence is not only an individual phenomenon but is a social-cultural phenomenon in a way in which, the categories ‘individual’ and ‘organization’ are inevitably entangled with another. Hence that it becomes impossible to draw the boundaries between the two. The question is what we can actually say about competences and transversal competences and how can we measure it.

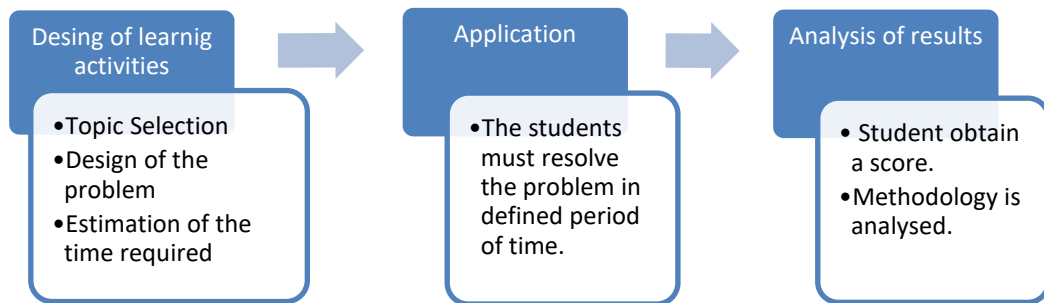
Due to the old teaching model, which is still rooted in the current learning system, and the lack of a relationship between university and professional life, professors have difficulties in assessing transversal competences. In this paper, a methodology for the assessment of the transversal competences analysis and resolution of problems (TC-03) and, planning and time management (TC-12) has been carried out and implemented in the course of Thermal Renewable Energy of the Bachelor's Degree in Energy Engineering. Both transversal competences are in the list of transversal competences at the Universitat Politècnica de València (Universitat Politècnica de València, 2017).

The goal of this paper is to apply a methodology for assessing the transversal competences: analysis and resolution of problems; and planning and time management. Afterwards, the results obtained with the application of such methodology are analysed.

## 2. Methodology

Before applying the methodology, it is explained to the student how a practical problem is solved, to apply it to a case that an engineer can find in professional life. Subsequently, the student must solve another problem of the same type raised by the professor. The students will have a limited time to solve the problem, and they have previously been informed about the test. The student must prepare the test before the lecture in which the test is carried out. Therefore, when the professor explains the theoretical part and how to solve the problem, he can also resolve doubts raised by the student during the preparation of the session. At the end of the session, the students must carry out the test.

The methodology applied is based on (Verdechoa, Rodríguez-Rodríguez, Alfaro-Saiza, & Gómez-Gasqueta, 2018) and (Universitat Politècnica de València, 2017). Since the competences to be evaluated are: analysis and resolution of problems (TC-03) and, planning and time management (TC-12), the student must solve a problem raised in a limited period of time. The methodology of the process is shown in Figure 1. The methodology was applied in two different sessions for two different topics. Unlike the traditional method, to carry out the test as similar as possible to a real problem, the student can consult notes, computer, tablets, etc.



*Fig. 1 Methodology applied for assessing transversal competences*

*Source: (Verdechoa, Rodríguez-Rodríguez, Alfaro-Saiza, & Gómez-Gasqueta, 2018)*

The methodology consists of three steps, as shown in Figure 1. In the first step, the learning activity is designed. The design includes the topic selection, the problem to be solved by the students and the estimation of the time required to solve the problem. The assessment instrument is a real problem that must be solved by the students. Figure 2 shows the two problems raised in two different sessions.

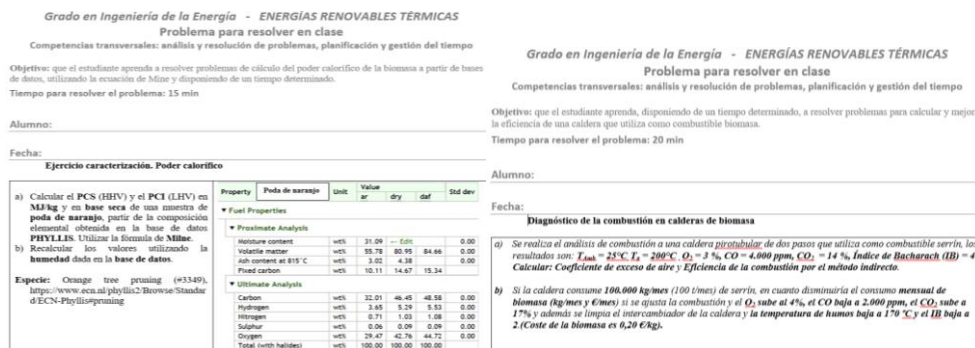


Fig. 2 The problems raised to assess the TC-03 and TC-12

According to (Universitat Politècnica de València, 2017), a scale with 4 values has been defined to assess the point of development of the transversal competences reached by the students A, B, C, D. Table 1 shows the meaning of every level (represented by the letters from A to D) and the relation used in this paper to scale the score from 0 to 10 obtained by the student. When more than one test is carried out, it is useful to assess using a numeric value, since it is possible to obtain an average final score that can be converted into one of the four levels for easily evaluating the transversal competences.

Table 1. Levels for evaluating the transversals competences

Level	Meaning	Score range (1 to 10)
A	Excellent	9 - 10
B	Adequate level	7 - 8,9
C	Developing	5 - 6,9
D	Development not reached	0 - 4,9

Source: (Universitat Politècnica de València, 2017)

The algorithm of the second part of the methodology applied is shown in Figure 3. Unlike the traditional method, the students have different range of times to solve the problem raised. Once the students receive the problem, they have three different limited range of time to finish the problem. If the students solve the problem without mistakes in the initial time raised, it is obtained the best score in both competences. If the students cannot resolve the problem in the defined time, they have 20% extra time to try to finish the problem. If the students solve the problem properly, it is obtained the maximum score in TC-03 and 8/10 (equivalent to B) in the final score for TC-12. If so far, the student has not been able to solve the problem; it has 40% extra time respect to the initial time. If after this time the problem is solved, it is obtained the maximum score in TC-03 and a 6/10 (equivalent to C)



in the final score for TC-12. Finally, if the student does not know how to solve the entire problem, the score for TC-03 will be equal to the proportional solved part in the scale from 1 to 10, and the score for TC-12 will be 3 (Equivalent to D). The student must solve other problems by mean of other tests during the course, then the final score of the competence will be the average grade according to Table 1.

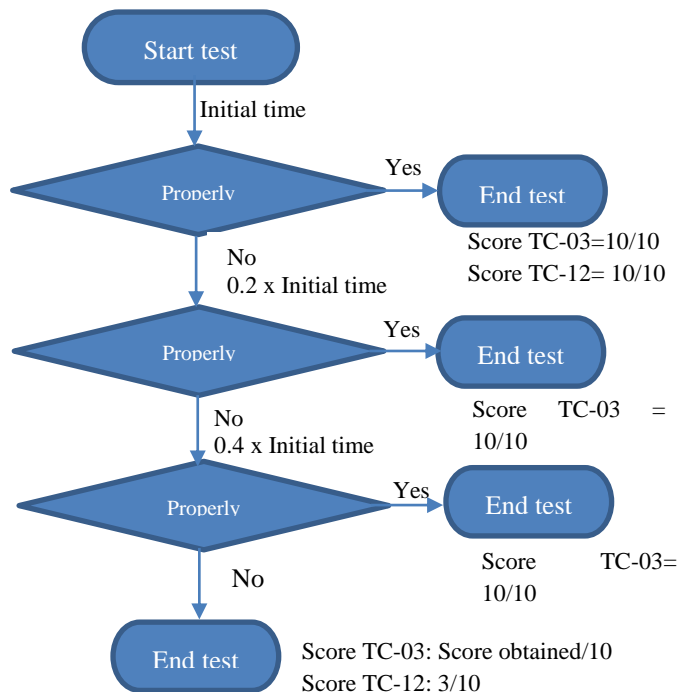


Fig. 3 The algorithm applied for assessing transversal competencies. The final score is the average of all the test performed.

### 3. Results

Results of the assessment analysis, obtained from Figure 4, show that 92% of the students have reached the minimum level of development required in CT-03. In the case of CT-12, 75% of the students have reached the minimum level of development required. Similarly, 39% of the students have reached the maximum level in CT-03, and 28% have reached the maximum level in CT-12. On the other hand, 8% of the student have no reached the minimum required level in CT-03, and 25% of the student have not reached the minimum level required in CT-12.



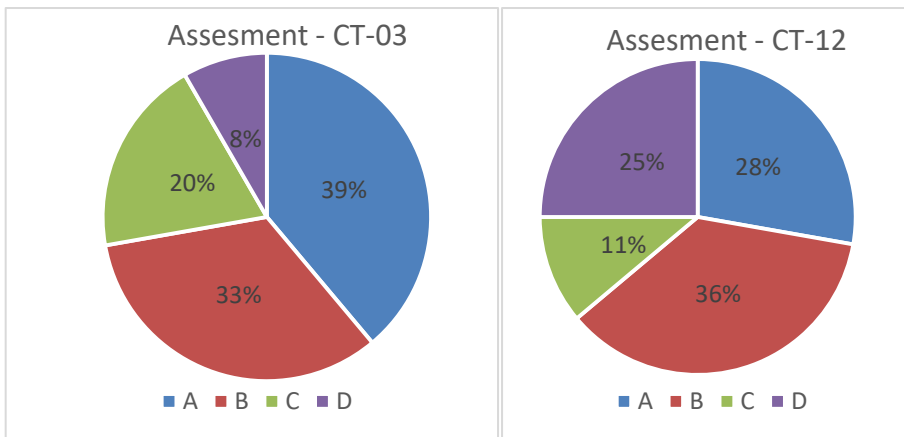


Fig. 4 Results of the methodology applied for assessing the TC-03 and TC-12.

Figure 5 shows the final score for each of the 36 students in the 0 to 10 scale for the CT-03, and in the A to D scale for CT-12. Only 1 student Scored 0 in the final grade scale from 1 to 10 points for CT-03.

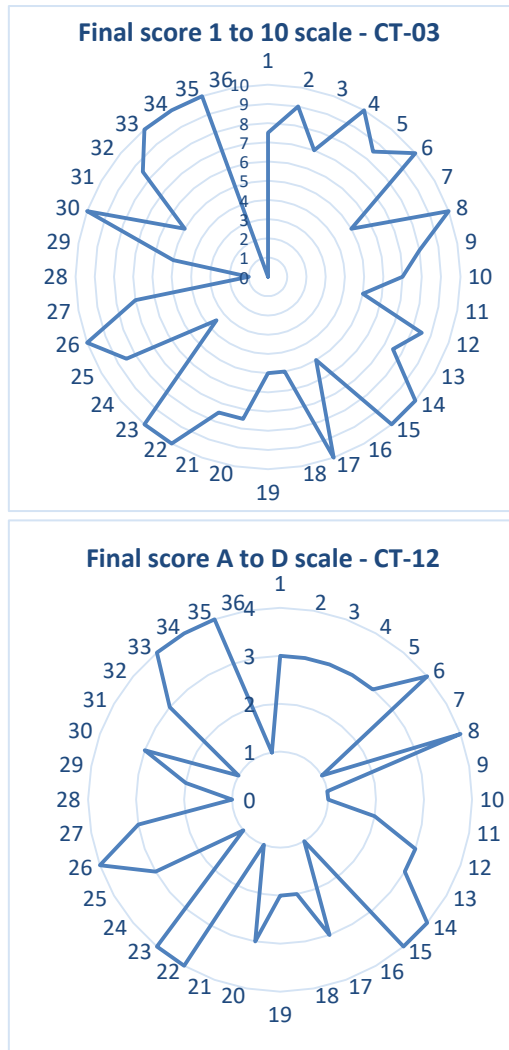
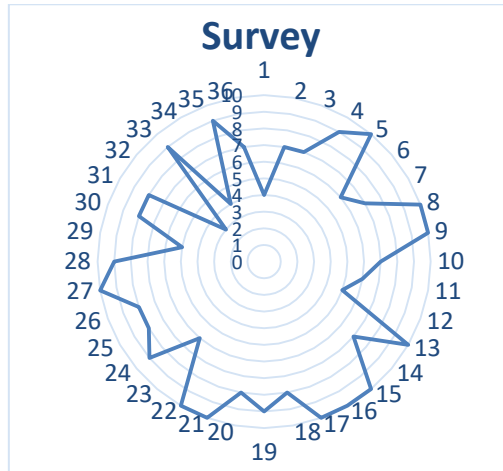


Fig. 5 Final score for CT-03(0 to 10 points scale) an for CT-12 (0 to 4 points scale, where 1=D; 2=C; 3=B; 4=A)

The methodology has been applied to a theoretical part of the subject Thermal Renewable Energies. Nevertheless, the methodology could be applied to a practical part of the subject. If the competence to be evaluated is related to a specific technical part, as is the case of transversal competence 13 (Specific instruments), surely, the results obtained would be more realistic.

Finally, a survey for assessing the methodology has been carried out. The results are shown in Figure 6. Where 44% of student have scored the methodology with a grade greater than 8 and only 8%, have scored the methodology with a grade less than 5.



*Fig. 6 Results of the survey carried out for assessing the methodology applied.*

#### **4. Conclusions**

In this paper, a methodology for assessing the transversal competencies CT-3 and CT-12 has been developed and applied. This methodology can be applied to other transversal competencies. Once the initial defined time to perform the test is finished, the student has the possibility of continuing working for an extra period. Then it is possible to assess the CT-12 according to the time expended by the student to solve the problem. The students have assessed the methodology in a very positive way, which has been positively rated by 92% of students.

The methodology has been applied to a theoretical part of a subject. Nevertheless, if the methodology is applied to a practical part of a subject, surely, results obtained would be more realistic when a technical transversal competence is evaluated.

To save time, the test can be designed for assessing both: transversal competences and the final grade of the subject. The methodology used in this paper was designed for covering both purposes.

Finally, the results obtained are consistent. According to the results, the student receives feedback to improve the deficiencies detected in both: analysis and resolution of problems; and planning and time management.

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## The development of pupils' Science process skills at secondary school

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### Abstract

*As an integral part of physics education, we consider the development of pupils' SPS. The aim of our survey is the development of selected pupils' SPS - predicting and formulating hypotheses on the age level 14- 16 years. As an endeavour to meet such a goal, we prepared and included specific activities, which requires to make predictions or formulate hypotheses, and also we included physics experiments planned by students themselves in physics education. The process of preparation of specific activities for the development of selected SPS is described below. Reason for the inclusion of physics experiment planned by students themselves in physics education is that formulating hypotheses or prediction is one of the planning stages of a physics experiment. In the second part of our contribution, we present our experiences with utilization of specially designed activities and with the implementation physics experiments planned by students themselves. In the last part, we present a Hypotheses quality scale, a tool for the comparison of students' hypotheses, to compare how they formulate hypotheses in the first, second and third activity in a series. We also made a comparison between hypotheses formulated in activities prepared by the teacher and hypotheses formulated for experiments planned by pupils themselves.*

**Keywords:** Science process skills, predicting, hypothesis, physics education.

### 1. Introduction

To teach pupils to think is one of the most important goals of schooling. All school subjects should be involved in achieving the goal. In physics lessons, we can achieve it by application of science process skills.



Harlen (1999) points out that the development of SPS should be the main goal of science education.

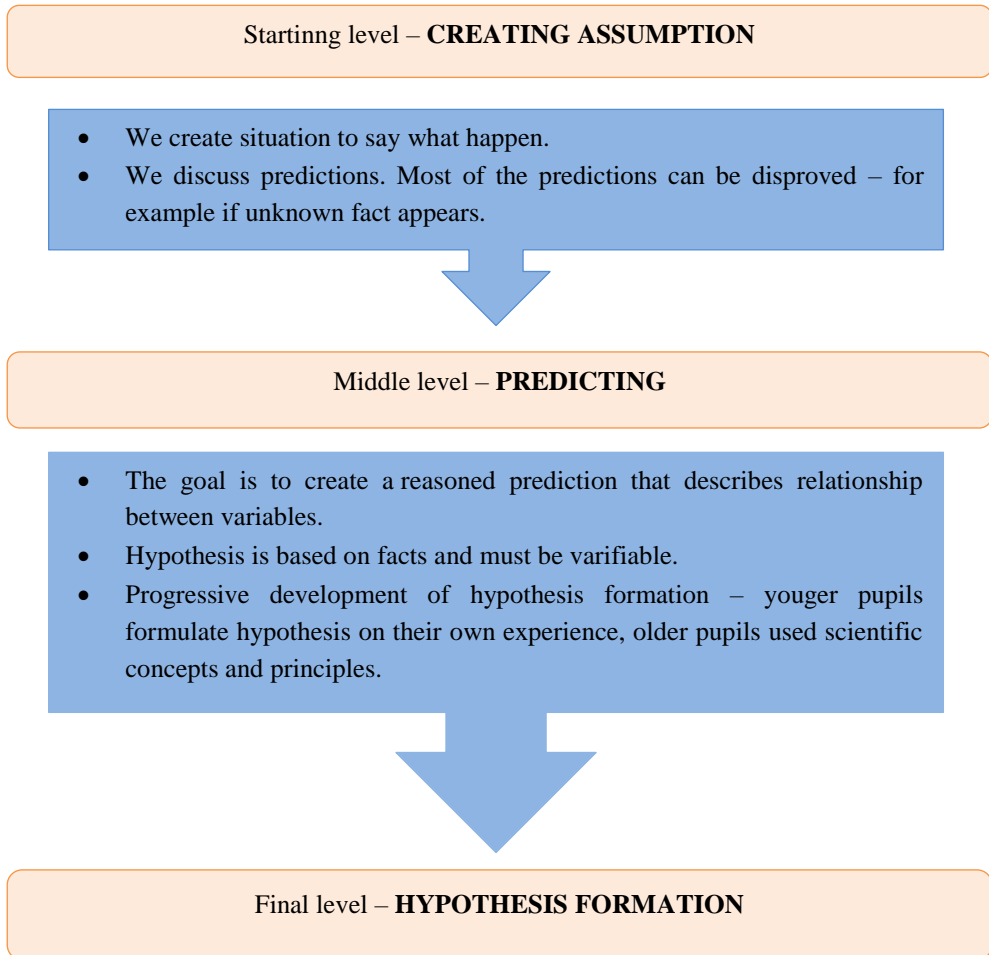
### **1.1. Predicting and formulating hypotheses**

**Predicting** is the ability to create a statement about a future event based on a pattern of evidence (Held, 2011). Predictions reflect our understanding of the issue, our experiences, thinking and the evaluation of facts and expected events. Learning predicting is not easy. Students learn to take into account their experience, and they start to think about alternatives. Once the experiment has been completed, it is right to return to the prediction and compare it with reality (Demkanin, 2006; Kireš, 2016).

Quinn and George (1975) define a hypothesis as a testable explanation of an empirical relationship among variables in a given problem situation. Demkanin and Velanová (2016) highlight that a hypothesis is a causal prediction, which must be based on arguments, on previous knowledge. **Formulating hypotheses** means to make a sentence which includes a verifiable relationship between variables. After verification, we decide if the hypothesis is accepted or not. If we accepted the hypothesis, the predicted relationship between variables is correct. We gained new knowledge. Negative results are as important as positive because they help us cross from ignorance to understanding, but we must continue with researching. Continuing research is based on circumscribed ignorance. If we find that variables are not dependent, our cognition has progressed (Kerlinger, 1972). For example, pupils predicted that a larger area of contact between two surfaces creates a larger frictional force. However, if pupils change the size of surface area, they will find that the frictional force is constant. Pupils gained knowledge about independence of surface area with friction force, their cognition progressed.

Learning hypotheses formation requires to move from the lowest level of creating assumption to the level of making a prediction and then progress to the highest level of formulating hypotheses. If we want to teach pupils to formulate hypotheses of good quality, we must do it gradually. Hypothesis includes predicted relationship between variables. Hypotheses formation requires pupils to be familiar with making correct predictions. Predicting requires to give up guessing and creating assumption. The assessment of the situation, estimate the acquisition of predicting. Correct prediction is not based on guesses, but on a pattern of evidence. Fig. 1 is based on Lapitkova's tables (2015). It schematically shows the progress of teaching hypotheses formation.

Figure 1 The progress of teaching hypotheses formation



Answer on the question: “How to develop selected SPS in the education process?” is still the focus of our research. Withing traditional, instructional education, the task of teachers is to induce situations, which require the application of the skills. We tried to apply this strategy. We focused on the development of predicting and formulating hypotheses on the age level 14-16 years. Our survey took two years. The first year we included in the education process special activities for the development of selected SPS. We prepared 3 activities for the development of formulating hypotheses and some other activities for the development of predicting. The activities for the development of formulating hypotheses were included at the beginning of the school year, in the middle of the school year and at the end of the school year. Activities for the development of predicting were included



whenever possible. After a few activities aimed at making predictions, students formulated a statement about future event automatically when it was appropriate. After every activity, there was a discussion aimed at making a prediction or hypothesis of good quality.

The process of preparing special activities usually starts by searching for appropriate experiments. We can search in books, magazines or on web sites. Sources of experiments also can be our own ideas or debates with our colleagues, friends and students. Previous methods can inspire us, but generally, this is not enough. The main part of the preparation of activities is to modify them into the form, which offers the opportunity to scaffold students in predicting or in formulating a hypothesis. If we want pupils to predict, we have to challenge them to create a statement about a future event. For example: *"Two same coins are put on the side of a ruler at some distance from each other. What happens when we push one coin, so it hits the other one?"* If we want pupils to formulate hypotheses, we have to challenge them to make a sentence which includes a verifiable relationship between variables based on arguments. *Jet* is an activity aimed at acquisition of pupils' hypotheses. The activity has been included in the education process in the first grade of upper secondary school in part *Uneven movement*. Pupils have to build a jet whose average velocity is as high as possible. For building and upgrading they could use balloons, straws, twine, paperclips, duct tape, scissors, meter and stopwatch. The most important part of the activity are answers to the question: *"How does the average velocity of jet depend on its parameters?"* Pupils answered the question before upgrading the jet.

The second year we included in the education process physics experiments planned by pupils themselves. Pupils prepared and performed three physics experiments. In the framework of physical experiments, the pupil has different tasks. One approach to leading pupils to structured work within physical experiments is the approach of the International Baccalaureate Organization. We focused on the planning stage of physics experiments, which contain formulating hypotheses. In the right column is the aspects that pupils and teachers should follow and in the left column is a requirement to fulfil the aspect.

Table 2 Planning stage of a physics experiment

<b>Defining the problem or research question</b>	Identifies a focused problem or research question.
<b>Formulating a hypothesis or prediction</b>	Relates the hypothesis or prediction directly to the research question and explains it, quantitatively where appropriate.
<b>Selecting variables</b>	Selects the relevant independent and controlled variable(s).
<b>Selecting appropriate apparatus or materials</b>	Selects appropriate apparatus or materials.
<b>Designing a method for the control of variables</b>	Describes a method that allows for the control of the variables.
<b>Designing a method for the collection of sufficient relevant data</b>	Describes a method that allows for the collection of sufficient relevant data.

*IBO (2001)*

## 2. Experiences from implementation specially designed experiments and experiments planned by pupils themselves

We led pupils to formulate hypothesis before the realization of the experiment. Pupils first formulated hypotheses separately, then discussed their hypotheses with a classmate and then they could change them. When pupils formulate hypotheses first, they were afraid that predicted relationship would not be correct and the hypotheses would not be accepted. We had to encourage them to formulate hypotheses and also we had to assure them that it would not be assessed. Each activity was followed by discussion about their hypothesis. The aim of the discussions was to draw attention to shortcomings of hypotheses to avoid them, and also formulated hypothesis of good quality.

When we first implemented in the education process physics experiments planned by pupils themselves, pupils were confused. Some of them enjoyed that they can explore what they want; others did not know what to do. The most problematic part was to teach students to formulate a problem. We tried to guide them to the clear and correct formulation with appropriate questions.

### 3. The success of pupils' hypothesis formation

Pupils' hypotheses were evaluated by Hypotheses quality scale, which was created based on Hypotheses quality scale of Quinn and George (1975). Points were assigned to each hypothesis according to the criteria listed in table 3.

**Table 3 Hypotheses quality scale**

Points awarded	Criterion
0	No explanation, non-scientific statement, such as, nonsense statement, a question, an observation.
1	Partial scientific explanation, such as, incomplete reference to variables, a negative explanation or an analogy.
2	The scientific explanation includes a predictive relationship between all variables.
3	The precise explanation includes a predictive relationship between all variables and a justifying relationship.

*Klinovská, L. (2018)*

#### 3.1. Hypotheses formulated by pupils

To compare the level of hypothesis formulation, we looked at the percentage of representations of pupils in each points category.

**Table 4 Percentage of pupils in individual points' categories**

points awarded	percentage representation		
	first hypothesis formulation	second hypothesis formulation	third hypothesis formulation
0	42%	0%	9%
1	25%	19%	18%
2	33%	62%	64%
3	0%	19%	9%

*Klinovská, L.*

If we look at percentage representation of pupils in individual points' categories in table 4 we see that in the first experiment pupils were afraid to formulate hypotheses– 42% of pupils did not formulate predicted relationship between variables. The percentage of hypotheses, which contained the relationship between complete variables, almost doubled. In the second and third experiment, some pupils formulated the justified relationship between all variables. They gradually tried to specify the hypotheses.

To compare hypotheses formulated for experiments prepared by us with hypotheses formulated for experiments planned by the students themselves, we looked at percentage representation in individual points' categories. In table 5 we see that almost the same percentage of pupils received 0 points. A significant reduction in the percentage of pupils, who received 1 point reflects the fact that most hypotheses formulated for experiments planned by pupils themselves contain all variables. In the last row of the table we see, that percentage of hypotheses, which include the justified relationship between all variables, doubled. When we looked at the theoretical background, which pupils used in the formulation of their hypotheses, we found out that their arguments were clear and obvious. Based on the results we think that it is easier to argue the relationship between all variables in experiments planned by pupils themselves. These results offer an opportunity to examine whatever the quality of hypotheses is related to the understanding of the problem situation.

**Table 5 Percentage representation in individual point's categories for experiments prepared by the teacher and for experiments planned by pupils themselves**

points awarded	percentage representation	
	experiments prepared by the teacher	experiments planned by pupils themselves
0	15%	16%
1	21%	3%
2	54%	59%
3	10%	22%

*Klinovská, L.*

#### 4. Discussion and Conclusion

In physics lessons, we included 3 specially designed activity aimed at acquisition pupils' hypotheses and 3 physics experiments planned by pupils themselves. Within the limitations of this survey, the observations and percentage representation of pupils in individual points' categories suggest that hypothesis formation can be taught and developed by specially

designed activities and physics experiments planned by pupils themselves. In the near future, we plan to look at the problem of development of the ability of students to formulate prediction and hypothesis in the light of the learning science (Demkanin, P., 2018). As we know, that formulation of hypothesis most methodologists connect to logical inference – abduction, abductive reasoning (Magnani, L., 2017), we plan to analyse each activity used in the process of development of abilities to formulate hypothesis from the view of abduction.

## **Acknowledgements**

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## “Innovation, creativity and entrepreneurship” transversal competence evaluation by technical-economic analysis of commercial electrical transformers

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### Abstract

*“Innovation, creativity, and entrepreneurship” transversal competence evaluation method (CT04-UPV) used in Electrical Machines course (2<sup>nd</sup> course, Electrical Engineering Degree) is described in this paper. Its evaluation activity consists of a technical and economic analysis of different commercial electrical transformers, carried out by the students. To this end, students get in touch with electrical suppliers, obtaining real transformers data. With this data, they can calculate transformers efficiency through its energy losses and the economic cost that these losses suppose in a period of 10 years. In this way, students are able to question reality, identifying the existing necessity of evaluating not only its initial cost but also economic cost generated by its energy losses when selecting a transformer. With this method, CT04-UPV learning outcome referred to the 1<sup>st</sup> domain level is achieved: to question the reality, identifying improvement necessities and generating added value ideas. This methodology has been applied for the last three years in the course. In each year, students marks have been graded by the professor using a rubric. Results indicate that “innovation, creativity, and entrepreneurship” transversal competence learning outcome is satisfactorily reached by students. Moreover, rating survey answered by students, using Google Forms, shows that their level of satisfaction is very high.*

**Keywords:** transversal competence, evaluation, innovation, creativity and entrepreneurship.





## **1. Introduction**

Traditional university education has been focused on transferring specific knowledge to students, always directly related to the courses. The technical training that Universitat Politècnica de València (UPV) offers to the students is one of the widest and completest, as graduated students job performance has been verifying for years (“La UPV en los rankings,” 2018). However, transversal training of UPV students has not been enough worked out. For this issue, researches like (Fernández, 2011; Scallon, 2007) indicate that it is essential to develop a broad range of transversal competences, that can be defined as all the abilities associated with the personal growth, that does not depend on a specific topic, but appear in all the professional and academic performance fields (González & Wagenaar, 2003). In order to achieve this goal, Studies, Quality and Certification Vice-Rectorry from UPV launched The Transversal Competences Project (“Proyecto competencias transversales UPV,” 2005) on 2015, currently supported by UPV2020 strategic plan. In this project, thirteen transversal competences were defined. In every degree, all these thirteen competencies should be evaluated in different control point courses. Learning outcomes of the transversal competences are different, depending on the level of domain of the course: basic (1<sup>st</sup>) for 1<sup>st</sup> and 2<sup>nd</sup> years of degree, middle (2<sup>nd</sup>) for 3<sup>rd</sup> and 4<sup>th</sup> years of degree and advance (3<sup>rd</sup>) for master.

Electrical Machines course of 2<sup>nd</sup> year of Electrical Engineering Degree (Hurtado, 2018) is a control point of the transversal competence “Innovation, creativity and entrepreneurship” (CT04-UPV) (“CT04-UPV,” 2015). As this course is given during the 2<sup>nd</sup> year of the degree, the learning outcome concerns the 1<sup>st</sup> domain level: to question the reality, identifying improvement necessities and generating added value ideas. Chosen activity for evaluating this learning outcome consists of an academic work, where students develop a complete technical and economic analysis of different electrical transformers.

At the beginning, it was quite difficult for the professors of the course to find the suitable assessment method and instrument, as it was something new and unknown for them (Ramón et al., 2017; Villa, A y Poblete, 2007). The rubric “Rubric UPV CT-04. Innovation, creativity and entrepreneurship” (“Rúbrica UPV CT-04,” 2015), made by some UPV staff, meant a reference point for them, as it hugely helped professors find out the right activity to evaluate CT04-UPV in the 1<sup>st</sup> domain level. With the results compiled during three years, the present paper shows the study made to really verify the suitability between the evaluation method and the CT04-UPV learning outcome for Electrical Machines Course and its acceptance-scale among students.



## 2. Educational Methodology

### 2.1. “Innovation, creativity, and entrepreneurship” transversal competence

The Transversal Competences Project (“Proyecto competencias transversales UPV,” 2005), launched on 2015 by Studies, Quality and Certification Vice-Rectorate from UPV, collects thirteen transversal competencies, that should all be assessed in every degree by means of different control point courses. In this paper, “Innovation, creativity and entrepreneurship” (CT04-UPV) (“CT04-UPV,” 2015) is going to be deeply analyzed since Electrical Machines course is one of its control point courses.

This competence looks for innovation as a mean of answering to the personal necessities and social claims, with the aim of adding new value with an entrepreneurship behavior (Cuenca et al., 2016). Focusing on the student, it is necessary to detect the improvement of this competence development. For this issue, three levels of domain are defined: 1<sup>st</sup> for 1<sup>st</sup> and 2<sup>nd</sup> years of degree, 2<sup>nd</sup> for 3<sup>rd</sup> and 4<sup>th</sup> years of degree and 3<sup>rd</sup> for master. In each level of domain, different indicators are defined. Depending on the scale that students achieve the different indicators of the corresponding learning outcome, they would get a different mark: A, if it is satisfactorily achieved; B if it is adequately achieved; C if it still being developed; D if it is not achieved (“Rúbrica UPV CT-04,” 2015).

### 2.2. Electrical Machines Course as a control point for “Innovation, creativity, and entrepreneurship” transversal competence

Electrical Machines course of the 2<sup>nd</sup> year of Electrical Engineering Degree (Hurtado, 2018) is a control point of the transversal competence “Innovation, creativity and entrepreneurship” (CT04-UPV) (“CT04-UPV,” 2015). This course is given during the 2<sup>nd</sup> year of the degree, so the learning outcome concerns the 1<sup>st</sup> domain level: to question the reality, identifying improvement necessities and generating added value ideas.

#### 2.2.1. Evaluation activity

As in every new situation, it was not easy for the professors of Electrical Machines to find out an activity to evaluate “Innovation, creativity, and entrepreneurship” transversal competence. Specifically, to evaluate the learning outcome referred to the 1<sup>st</sup> domain of the competence. Taking as a reference point the rubric “Rubric UPV CT-04. Innovation, creativity and entrepreneurship” (“Rúbrica UPV CT-04,” 2015) and consulting previous activities to evaluate this competence in different universities (Cuenca et al., 2016; Le Boterf, 2001; Tardif, 2006), it was possible to finally find out the suitable activity. This activity is next described:



- It is individually made. Every student should present at the end of the course an academic work.
- Firstly, students need to contact with different electrical suppliers in order to get real transformers data (initial cost, nominal voltage, short-circuit voltage, short-circuit power, no-load losses and no-load current). With three commercial electrical transformers data is enough.
- Then, with these data, they ought to make the complete technical analysis of the different electrical transformers: equivalent circuit, daily performance curve, daily electrical voltage variation curve, and daily energy losses.
- Next, students have to obtain the economic cost that these energy losses suppose for every electrical transformer in a period of 10 years.
- Finally, they have to think about the total cost of every studied transformer in a period of 10 years old (initial cost + energy losses cost). With this activity, students realized how important is to pay attention not only to the machine initial cost but also to its long period energy losses cost. Then, they have to write ideas to improve these energy losses.

In this way, learning outcome referred to the 1<sup>st</sup> domain level is achieved, since students question the reality, identifying improvement necessities and generating added value ideas.

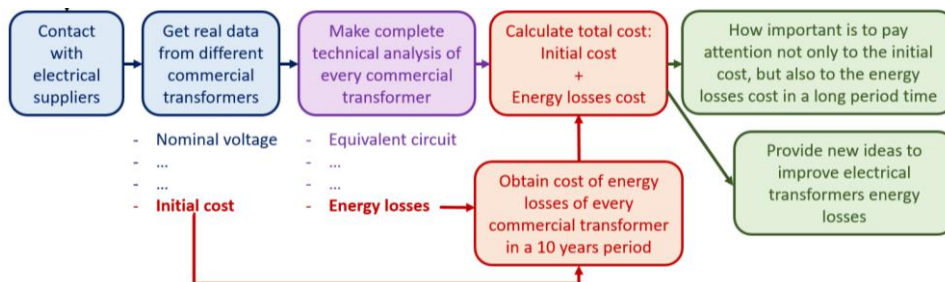


Figure 1. Flowchart of evaluation activity

### 2.2.2. Evaluation method

Finding out the right evaluation method to assess the learning outcome of the transversal competence “Innovation, creativity and entrepreneurship” in Electrical Machines course was the most difficult part of the process, even more than finding out the evaluation activity (Ramón et al., 2017; Villa, A y Poblete, 2007). Previous studies show that using a rubric as an evaluation instrument for “Innovation, creativity and entrepreneurship” would be really helpful for professors (Cuenca et al., 2016; Fernández, 2011; Masmitjà et al., 2013). Considering these researches and using “Rubric UPV CT-04. Innovation, creativity and

entrepreneurship” (“Rúbrica UPV CT-04,” 2015) as a point of reference, Electrical Machines professors have elaborated a specific rubric to evaluate the concerned learning outcome. It is shown in Figure 2.

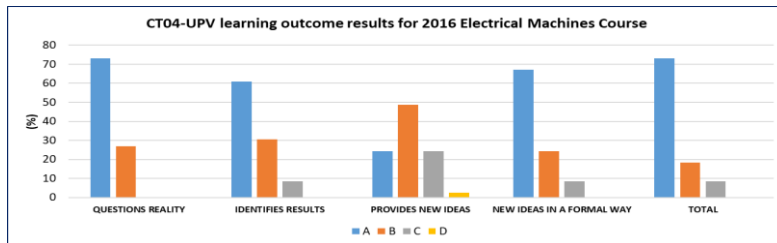
INDICATORS	DESCRIPTORS			
	A. Satisfactorily achieved	B. Adequately achieved	C. Still being developed	D. Not achieved
<b>The student questions reality</b> Does the student realize the necessity of analysing both economic factors: initial cost and long-period energy losses cost?				
<b>The student identifies results</b> Does the student identify the necessity of improving the electrical transformers energy losses?				
<b>The student provides new ideas</b> Does the student provide new ideas for improving the electrical transformers energy losses?				
<b>The student describes new ideas in a formal way</b> Are the new student’s ideas described in a formal way?				

Figure 2. Rubric for evaluating learning outcome of CT04-UPV in Electrical Machines Course.

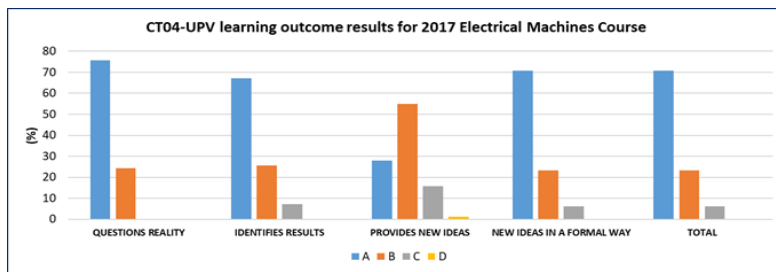
### 3. Results

#### 3.1. Transversal competence learning outcome results achieved by students

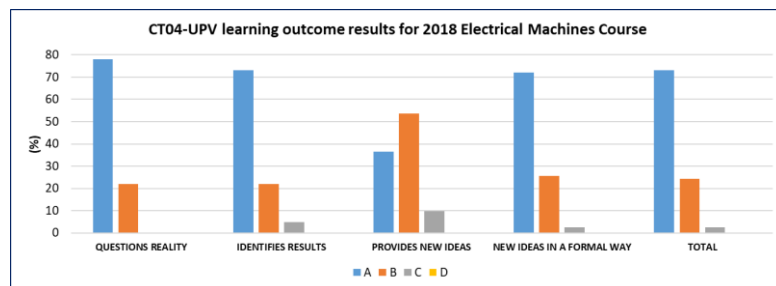
Previous rubric (Figure 2) and evaluation activity have been used in Electrical Machines Course for three years for assessing the concerning learning outcome (1<sup>st</sup> domain) of the transversal competence “Innovation, creativity and entrepreneurship” from UPV. These results are shown in Figure 3.



(a)



(b)



(c)

Figure 3. CT04-UPV learning outcome results

Paying attention to the individual indicators of the rubric, it is possible to observe that the highest indicator always corresponds to “The student's questions reality”. Globally, around a 75% of the students got an A and 25% a B. Referring to the evaluation activity, it is possible to deduce that most of the students realize the necessity of analyzing both economic factors of a transformer: initial cost and long-period energy losses cost.

Indicator “The student identifies results” is not as high as “The student questions reality”, but it is also adequately reached: globally, a 68% of the students got an A, 25% a B and 7% a C. The majority of the students identify the necessity of improving the electrical transformers energy losses, in a higher or lower scale (A or B). However, there is a small percentage of students that are not completely able to reach this indicator (C).

Indicator “The student provides new ideas” is, by far, the lowest one: generally, 26% of the students got an A, 52% a B, 15% a C and 1% a D. Professors of Electrical Machines understand that this is the hardest indicator to reach, as students should provide new ideas for improving the electrical transformers energy losses. Nevertheless, it is essential for them to develop this point.

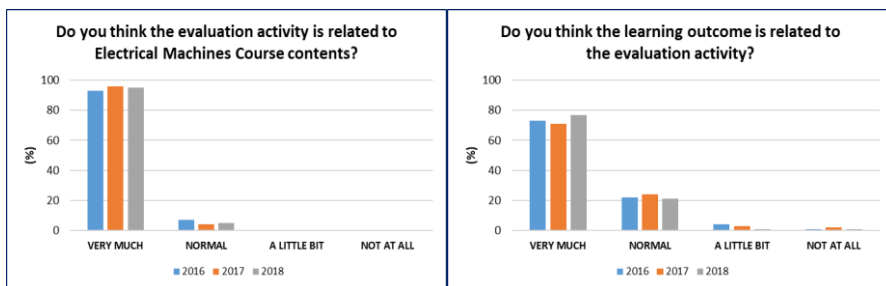
Final indicator, “The student describes new ideas in a formal way”, is adequately achieved by the student, as, in global, 70% of the students got an A, 24% a B and 6% a C.

Having the rubric allow professors evaluating the learning outcome taking into account four different indicators. In this way, they are able to observe the results of each indicator, identifying the strong and the weak points. As it is shown in Figure 3, year by year indicators have been improving, since professor has stressed on the weak points in order to improve them.

Finally, the global mark of the learning outcome is obtained as an average of the individual marks of the indicators. Figure 3 indicates that in 2016, 73% of the students got an A, 18% a B and 9% a C; in 2017, 71% of the students got an A, 23% a B and 6% a C and in 2018 73% of the students got an A, 24% a B and 2% a C. These results are very positive since they show that almost 92% students achieved the learning outcome in past years. It is also possible to observe that results are getting better year by year, as it has been explained in the previous paragraph.

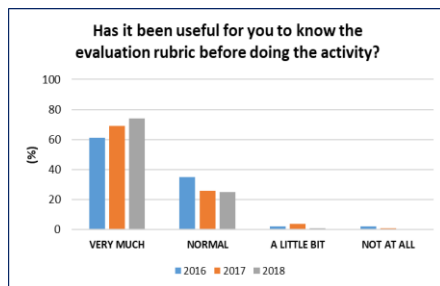
### 3.2. Students opinion

Previous results show that learning outcome in question has been satisfactorily reached during 2016, 2017 and 2018. Moreover, a growing achievement tendency is observed, as Figure 3 indicates. Even so, it is thought that knowing the student's opinion in every educational aspect is something vital, especially when new situations or changes take place (Harden, RM; Crosby, 2000). A survey made by Google Forms tool (Jhonnell & Álvarez-Andrade, 2012) has been used for knowing students' opinion about the activity and the evaluation method used to assess CT04-UPV learning outcome applied to Electrical Machines Course. The results are detailed in Figure 4.

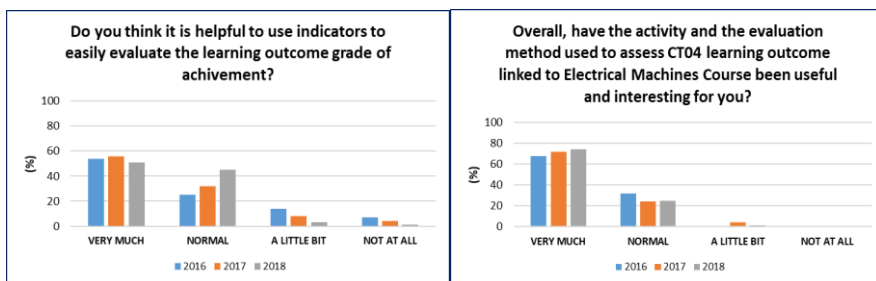


(a)

(b)



(c)



(d)

(e)

Figure 4. Students' opinion

As Figure shows, students' opinion is approximately the same in 2016, 2017 and 2018. The great majority of them (around 95%) considers that the concerned activity is hugely related to Electrical Machines contents. Additionally, approximately 95% of the students think the learning outcome is linked to the evaluation activity in different scales: 73% very linked and 22% normally linked. Knowing the evaluation rubric before doing the activity has also been useful for almost students: for around 69% very useful and for 26% just useful. They also consider that using indicators makes easy the learning outcome grade of achievement evaluation: for around 56% of students in a great way and for around 32% in a normal way. Finally, most of the students consider that the activity and the evaluation method have been very useful and interesting (72%) or useful and interesting (24%) for them.

These results prove that the activity and the evaluation method used to assess CT04-UPV learning outcome in Electrical Machines course has great acceptance among students. With their answers, it can also be observed how greatly fits the chosen methodology with the learning outcome and the course contents.

## **4. Conclusions**

The introduction of The Transversal Competences Project in 2015 by Studies, Quality and Certification Vice-Rectorate from UPV supposed a new way of understanding university studies. This project highlighted the importance of developing a broad range of transversal competences on UPV students since it would make easier their labor insertion. Thirteen transversal competences were defined. Every degree had to evaluate all of them by means of control point courses, considering the specific learning outcome too. With this project, professors had to face a new challenge: assessing transversal competences learning outcomes.

Electrical Machines course of the 2<sup>nd</sup> year of Electrical Engineering Degree is a control point of the transversal competence “Innovation, creativity and entrepreneurship” (CT04-UPV). As this course is given during the 2<sup>nd</sup> year of the degree, the learning outcome concerns the 1<sup>st</sup> domain level: to question the reality, identifying improvement necessities and generating added value ideas. Finding out the right activity to evaluate the corresponding learning outcome, that should also be linked to Electrical Machines contents, and the suitable evaluation method were not easy for the professors. With the help of previous studies and the “Rubric UPV CT-04. Innovation, creativity and entrepreneurship”, made by some UPV staff, professors finally found out the suitable activity and evaluation method. The concerned activity consists of realizing the importance of considering not only the initial cost of machines but also its total cost in a long period of time due to its energy losses. This activity is related to the learning outcome in question. Using a rubric with 4 indicators and 4 descriptors, professors are able to assess the learning outcome achievement grade of students.

Collected results show the importance of using a rubric. As it is divided in four indicators, professors can observe weak and strong points of the students during the process of reaching the learning outcome. In this way, they can focus on the weak points in order to improve them. These results show besides that, generally, most of the students reach the learning outcome (around 95%): satisfactorily (around 73%) or adequately (around 22%). Year by year these results are improving, as professors can highlight the weak points thanks to the rubric indicators marks.

Having feedback from every educational activity, especially from new activities or situations, is essential for professors. That is why every year since 2016 students answer a survey about the evaluation of CT04-UPV learning outcome. Collected results show in general terms that the activity and the evaluation method have great acceptance among students: 72% of students consider they are very useful and interesting and 24 % think they are useful and interesting.





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## Using Apps in Formal Education to Improve Executive Functions in Preschoolers

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### **Abstract**

*The term Executive Functions (EFs) refers to a set of higher order cognitive processes that are critical for goal directed behaviour. They include inhibition (i.e., the ability to suppress task-irrelevant cognitive processing and ignore salient yet irrelevant features of the situation), shifting (i.e. the ability to switch between different operations or levels of processing), and updating (i.e. the ability to encode, hold and monitor incoming information in working memory, replacing information that is no longer relevant with new information). The most notable developmental change in children's EFs occurs during the preschool period, and this is associable to and predictive of children's general learning ability. For this reason, efforts to develop EFs in preschoolers is of vital importance. In recent years, only few studies have investigated the effect of EFs intervention on preschoolers, despite the potential preventive effect of early intervention on later developmental problems. A number of related solutions have been proposed over the years, including both paper-and-pencil activities and digital applications (e.g., software and videogames). However, few attempt have been made to integrate the many advantages of traditional, low-cost playful activities with the (often) powerful affordances of digital technologies. Hence, we propose just such a hybrid solution, with a set of mobile applications (apps) designed to foster EF development among early learners in education settings. We opted for such a solution as mobile apps have proved to be familiar, highly usable and well accepted among young children. At a more general level, this contribution seeks to provide useful input on the affordances and indicators that can help guide the effective choice of apps useful for developing EFs, and how these tools can be optimally introduced and employed in traditional teaching and learning programs.*

**Keywords:** executive functions, app, preschoolers, educational context



## 1. Introduction

Executive Functions (EFs) refer to a family of adaptive, goal-directed, top-down mental processes needed to focus and pay attention and when an automatic response would be insufficient (e.g., Burgess & Simons, 2005). There is general agreement that three core EFs exist (Miyake, Friedman, Emerson, Witzki, Howerter, & Wager, 2000; Miyake & Friedman, 2012): (a) inhibition, namely the ability to suppress task-irrelevant cognitive processing and ignore salient yet irrelevant features of the situation; (b) shifting, namely the ability to switch between different operations or levels of processing; and (c) updating, namely the ability to encode, hold and monitor incoming information in working memory, replacing information that is with new information.

Furthermore, Miyake et al. (2000) suggest the possibility that all EFs rely to some extent on Working Memory (WM), i.e. the simultaneous maintenance and manipulation of information.

Although EFs develops over a long period spanning the first year of life until late adolescence, the most remarkable change in EFs skills occurs during the preschool period<sup>1</sup> (e.g., Garon Bryson, & Smith, 2008; Morra, Panesi, Traverso, & Usai, 2018). There are studies demonstrating that the development of EFs and WM in this period is associable to and predictive of children's general learning ability, such as mathematical achievement (e.g., Blair, & Razza, 2007; Clark, Pritchard, & Woodward, 2010) and literacy ability (e.g., Blair, & Razza, 2007). For this reason, efforts to improve WM and EFs in preschoolers are of vital importance as a prevention strategy, in particular for children with a potential delay or impairment in the development of EFs, such as children at risk of acquiring ADHD symptoms (e.g., Re, Capodici, Cornoldi, 2015), children with specific language impairment (e.g., Vissers, Koolen, Hermans, Scheper, Knoors), or children whose development is impeded by their low socio-economic backgrounds (e.g., Miech, Essex, & Goldsmith, 2001). In this regard, there are studies demonstrating that EFs can be improved in preschoolers in regular classrooms and the benefits are transferrable to other activities (e.g., Diamond, Barnett, Thomas, Munro, 2007). Therefore, school teachers could play a crucial role in supporting children's development of WM and EFs (e.g. Bodrova & Leong, 1996) by providing challenging activities performed in suitably designed environments

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<sup>1</sup> The structure of EFs and WM in this period is controversial: some studies (e.g., Wiebe, Scheffield, Nelson, Clark, Chevalier, Espy, 2011) propose a single factor for all executive functioning while others (e.g., Miller, Giesbrecht, Muller, McInerney, Kerns, 2012). propose two factors. This doubt makes it difficult to distinguish the main EFs (inhibition, shifting and updating) and WM in preschoolers.

(e.g., Traverso, Viterbori, & Usai, 2015; Passolunghi & Costa, 2016) that blend paper-and-pencil environments with the new technologies young digital natives find so attractive (e.g., Dini & Ferlino, 2016).

Based on a review of the literature, the main aims of this paper are to:

- (1) provide a theoretical deepening about the importance of integrating technological tools in traditional educational programs to improve EFs and WM in preschoolers, focusing in particular on the powerful affordances of educational apps;
- (2) provide suggestions for selecting and evaluating apps useful for promoting EFs and WM in the educational context;
- (3) provide practical information about how teachers can use apps to improve WM and EFs, integrating their use with traditional educational activities.

## **2. Integrating Technological tools to improve EFs and WM in the educational context**

WM and EFs interventions using digital applications (e.g., software or video games) have the dual advantage of automatically modifying task difficulty according to performance and focusing on specific EF components. However, these programs are rarely generalizable to daily life activities and are resource consuming, requiring individual exercises and extensive teacher training (e.g. Rueda, Checa, & Combata, 2012; Thorell, Lindqvist, Bergman Nutley, Bohlin, & Klingberg, 2009). To avoid these problems, Di Lieto and colleagues (2017) propose alternative activities based on Educational Robotics that stimulate children to maintain and update information, inhibit automatic response and solve problems. These researchers argue that Educational Robotics allow children to integrate several EF training strengths, such as: a) incremental challenging tasks based on an adaptive paradigm, b) real engaging objects to work on, and c) group settings.

Though partially effective, EF training programs using technologies for preschool children can be challenging and expensive when applied in standard educational contexts. On the other hand, EF training programs based on low-cost paper-and-pencil activities can be cost-effective but clash with the drive for digitally-based school innovation. Furthermore, while digital-based EF training programs tend to favour individual activities, those adopting paper-and-pencil activities tend to favour small group activities.

Clearly, the space exists for a mixed method that integrates digital approaches with more traditional, low-tech activities. A key advantage of this method would be useful for



combining the development of EFs on an individual basis with digital activities with EF improvement through more traditional group activities.

To this end, we need to identify a digital solution appropriate for employing in a mixed method. We maintain that mobile applications (apps), in particular educational apps, can represent a valid tool to foster EF development among early learners in education settings.

### 3. Powerful affordances of Educational Apps

The term educational app refers to a software application designed to support learning (e.g., Bouck, Satsangi, & Flanagan, 2016) that works on a mobile device (Purcell, Entner, & Henderson, 2010) such as tablet or smartphone. These devices are available to practically everyone, including young children (Holloway, Green, & Livingstone, 2013). In particular, Hirsh-Pasek and colleagues (Hirsh-Pasek, Zosh, Golinkoff, Gray, Robb, & Kaufman, 2015) argue that educational apps are those designed to promote active, engaged, meaningful, and socially interactive learning within the context of a supported learning goal.

Despite the potential and increasing uptake of apps, there is limited understanding of their impact on young children's learning and development. In particular, there is limited understanding of how apps can improve the cognitive development of young children. In this regard, Huber and colleagues (2018) found that apps can play an important role. Specifically, these authors studied 2- and 3-year-old children's experience of three different screen-based interventions: watching an educational television show; playing an educational app<sup>2</sup>; and watching a cartoon. It emerged that children's WM improved after playing the educational app.

The tactile-based interface of touchscreens enables the introduction of digital interaction at an early age (Plowman, Stevenson, Stephen, & McPake, 2012; Dini, Ferlino, 2016). Young children instinctively touch the screen and experience objects that appear as if they were real. Preschoolers think it is normal to receive feedback when they touch the screen, assuming that everything around them is interactive and responsive to the same gestures they use to interact with tablets (Dini, & Ferlino, 2016). This near-direct relationship with what appears on the screen and the mind-set that virtual objects react according to the type

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<sup>2</sup> In this study, the authors use the app *Shiny Party* by the developer Shiny Things. It was chosen for the opportunities it offers to learn shapes and complete puzzles, activities set within the narrative of preparing for a character's birthday. The app can be considered educational in that it incorporates a learning goal [Hirsh-Pasek et al., 2015]) and features a physically interactive dimension accessible to the age of users (Huber et al., 2018, p.76).

of touch are factors underlying the attractiveness and increasing success of apps for mobile devices (Kopecký & Szotkowski, 2015).

These features make apps used via mobile devices more approachable for young children than software used on the computer. Other comparative advantages include lightweight design, portability, relatively intuitive interfaces, communication features, and affordability (e.g., Vavoula & Karagiannidis, 2005). Finally, young children are often gain familiarity with apps proposed to them by their parents for leisure purposes (Dini, & Ferlino, 2016).

#### 4. Suggestions for selecting and evaluating apps

Teachers who decide to propose apps to preschoolers with the aim of promoting EFs and WM need to be aware that no single app exists that has been designed to develop one cognitive ability in isolation. Some, however, promote multiple cognitive abilities simultaneously, as is the case with traditional playful paper-and-pencil activities created for training preschoolers (e.g., Traverso et al., 2015).

A typical example is a memory game app that invites players to (a) *pay attention* to the moves of the virtual player (the opponent), (b) *memorise* the visual information, (c) *recall* necessary information at the right time, and (d) *inhibit* unnecessary information.

This multiplicity of WM and EFs addressed is but one of the key characteristics teachers need to consider when selecting apps for educational use by preschoolers. First, according to traditional WM and EF training approaches (e.g., Traverso et al., 2015; Caponi, Clama, Re, Cornoldi, e gruppo docenti "Rete Ricerca infanzia" di Treviso, 2009) apps must propose activities graduated in difficulty "from the simplest to the most complex". They can also offer added value by proposing activities that are calibrated in response to the performance of the young user; that is, children can start from an easy level and progress to increasingly complex levels based on their individual performance. This helps to optimise the level of challenge, which is key to both motivation and successful performance. Another key to motivation in young children is the level of fun the app induces. Furthermore, apps need to provide feedback so that the young user gains a sense of their performance and progress.

Selecting effective apps for preschoolers also involves some key technical elements (a) clear, well defined contents; (b) attractive graphics and design; (c) audio-visual rather than text-based communication; (d) effective exploitation of touchscreen interaction; (e) limited screen size; (f) active/touch-sensitive screen areas of sufficient size (Dini, & Ferlino, 2016). A good example of the role these elements play in an app for improving preschoolers' EFs



and WM is "A Memory Game for Kids"<sup>3</sup> by Rony Arbiv. This app proposes four fun and original games to improve different memory skills and responds well to the six technical criteria mentioned above. Figure 1 shows the "auditory memory game". This activity proposes a "span task" in which children must memorise and process an increasing quantity of auditory information and provide a simple motor response (touch the screen). Specifically, the child listens to the individual sounds from a series of onscreen monsters; then, an off-screen speaker reproduces one of those sounds. The child must identify the monster that produced that sound by touching it. If the child responds correctly, the number of sounds produced by monsters increases but if the child makes a mistake, the number of sounds decreases.

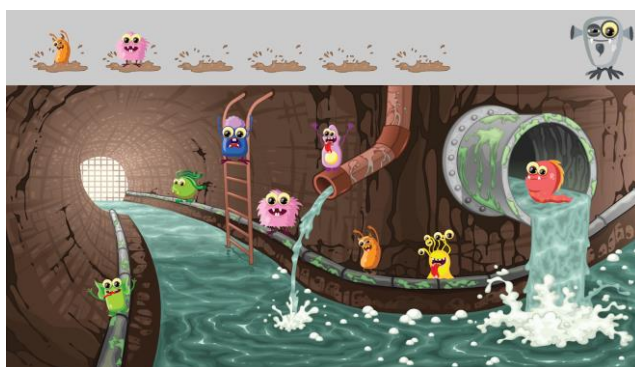


Fig 1. Screenshot of the app "A memory app for kids", activity "auditory memory game"  
Source: <https://itunes.apple.com/it/app/a-memory-game-for-kids/id1070495677?mt=8> or  
<https://play.google.com/store/apps/details?id=air.com.shubi.memoryEnglish&hl=it>

## 5. How teachers can use apps to improve WM and EFs

Using only apps to improve preschoolers' EFs and WM would be limiting; it is fundamental to integrate app use with traditional educational activities, ideally fun activities carried out in small groups. Clearly, the cognitive abilities targeted by the app and the group activity should match. When the individual and group activities are concluded, the teacher can help the children reflect about the strategies they used to tackle the tasks, the

<sup>3</sup>

Link (iOS): <https://itunes.apple.com/it/app/a-memory-game-for-kids/id1070495677?mt=8>  
Link (Android): <https://play.google.com/store/apps/details?id=air.com.shubi.memoryEnglish&hl=it>

difficulties they faced, and how they overcame them. Such collective teacher-mediated reflection can foster metacognitive abilities, even in quite young children.

To obtain an effective outcome, it is fundamental to plan a learning path that (a) comprises a series of sessions in which activities of increasing difficulty are proposed, and (b) alternates individual app games with more traditional non-digital group games. Additionally, the learning path must be flexible enough to allow modification according to the (emergent) needs of the children.

## 6. Conclusions

Improving EFs and WM in pre-schoolers is of vital importance because they are associable to and predictive of children's general learning ability. School teachers could play a crucial role in supporting the development of WM and EFs in the educational context, proposing integrated educational programs that include both paper-and-pencil and technological activities. In the latter case, educational apps, if appropriately selected and evaluated, seem to offer a series of features that are useful for promoting pre-schoolers' WM and EFs. Therefore, suggestions for selecting and evaluating apps provide fundamental support to teachers who are seeking to promote WM and EFs in young children.

## Acknowledgments

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## Leaders' ambidexterity traits

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### **Abstract**

*The ability of companies to develop simultaneously innovations that exploit their current knowledge, while exploring new opportunities that go beyond their present knowledge is recognized as organizational ambidexterity and essential in the achievement of sustained performance above the average of the industry. The concept of ambidexterity, includes exploration and exploitation. Exploration requires search, discovery, experimentation, risk-taking and innovation, while exploitation consists of behavioral patterns characterized by refinement, implementation, efficiency, production and selection.*

*Top managers are crucial to balance trade-offs among the competing objectives regarding exploration and exploitation and to reduce the organization's tendency to focus only in one of them. Top managers act as a leaders in the process of exploiting existing competencies while also exploring new opportunities.*

*In this study we are going to review the literature to extract the characteristics of ambidextrous leaders capable to cope with these tensions, in order to achieve organizational innovations.*

**Keywords:** Leader, ambidexterity.

## 1. Introduction

Innovation in firms and organizations requires the development of different capabilities. In a dynamic environment firms could only be successful and innovative if they are enough aligned with their current knowledge and capabilities while also explore new opportunities (Gibson and Birkinshaw, 2004; Jansen et al., 2006). Organizational ambidexterity has been analyzed as a capability that allows balancing and developing activities oriented to the exploitation of existing businesses and the exploration of new opportunities (Raisch and



Birkinshaw, 2008). Ambidexterity is difficult to achieve because it requires the management of contradictory processes associated with exploration and exploitation (March, 1991). It requires leaders that promote and encourage organizational members to achieve ambidexterity. Managers are therefore proposed as one of the principal actors in catalyzing these tradeoffs in order to be enough successful in exploring new opportunities and knowledge at the same time that they exploit current knowledge and capabilities (Mom et al., 2006; O'Reilly and Tushman, 2011). In this sense, education in management should promote this ambidexterity orientation in future organizational leaders. Encouraging ambidextrous thinking in higher education institutions could be an opportunity also to adapt the educational process in these times of great changes (Rezende et al., 2016). The design of the educational process has significant consequences for people involved in innovative activities. Education provides technical competence and mastery of currently available analytic tools to future entrepreneurs and others who will participate in activities related to innovation and growth. Education can stimulate creativity and imagination and facilitate its use (Baumol, 2005). Many business skills can be taught. In fact, it has been shown that the effect of general education as measured in years of schooling on entrepreneur performance is positive (Van der Sluis and Versloot, 2007) and business training is effective for the performance of people who applied for microfinance to start their own business (Valdivia and Karlan, 2006). Therefore, management schools should know the ambidexterity concept and promote the necessary management skills to achieve it in organizations. Ambidexterity “would be an extremely useful capability, which should be studied in depth and learned as subject to exercise management” (Rezende et al., 2016: 1016).

Given the importance of learning managers' skills for business students as a future leaders in the organization, **in this paper, it is intended to deepen into the antecedents that allow managers dealing with complex trade-offs.** Knowing these features is a starting point to know how to design management courses that promote different skills to allow the development of future leaders.

## **2. Theoretical background**

### **2.1. Organizational Ambidexterity**

Whereas Duncan (1976) was the first to use the term organizational ambidexterity, it is March's seminal paper (March, 1991) which acted as the catalyst for the current interest in exploration and exploitation in the management literature. Building upon earlier work by Duncan (1976), Tushman and O'Reilly (1996) were first to present a deepen analysis of organizational ambidexterity.



March (1991) started from a definition of exploitation and exploration in the framework of organizational learning as two different activities. Exploitation was understood as "refinement, choice, production, efficiency, selection, implementation and execution" in contrast to exploration, understood as "search, variation, risk taking, experimentation, game, flexibility, discovery and innovation" (p. 71).

From a strategic perspective, companies need competencies and capabilities to be able to guarantee their survival and long-term success. These capabilities are also required to compete in today's markets and allow companies to recombine and reconfigure assets and organizational structure for adapting to technology and emerging markets (O'Reilly and Tushman, 2008). In this sense, Teece (2007) characterized dynamic capabilities such as skills, procedures, organizational structures, decision processes and disciplines that are distinctive and enable senior managers to identify threats and opportunities and reconfigure assets to address them. O'Reilly and Tushman (2004) argue that the understanding and management of the tensions between paradoxical objectives (exploitation vs. exploration), as well as the success in the simultaneous achievement of high levels in the variables that cause such tensions, are essential for the competitiveness of companies and their survival.

Organizational Ambidexterity is a dynamic capability referred to the routines and processes by which an organization mobilizes, coordinates and integrates dispersed and contradictory forces, besides assigning, reallocating, combining and recombining resources and assets between differentiated organizational units (O'Reilly and Tushman, 2008).

The underlying idea of achieving the simultaneity of objectives is justified under the premise that actions aimed at radical change could generate chaos in the organization if companies do not think about the current moment. Likewise, an approach that is too focused on the present would provoke an organizational inertia (Huy, 2002). This is why ambidexterity is considered as a dynamic capability, which allows ambidextrous companies to adjust to the changes that take place in the environment (O'Reilly and Tushman, 2008, 2011).

This capability enables to pursue two sets of completely different objectives simultaneously: exploitation vs. exploration, stability vs. adaptability, short-term benefit vs. growth over the long term (Benner and Tushman, 2003). While these sets of objectives are different and paradoxical, they are not alternative. Ambidexterity is the capability that allows these objectives to be reached, not only simultaneously but also to a high degree and in a balanced way (Simsek et al, 2009). These tensions may not be completely eliminated, but the most successful organizations manage to reconcile them to a great extent, which allows them to be competitive in the long term (Gibson and Birkinshaw, 2004).

## **2.2. Leader's Ambidexterity**

Is essential for senior executives to manage completely varied and inconsistent organizational alignments. Efficiency, discipline, incremental improvement and continuous innovation, in the exploitation demand with a short-term perspective, are the crucial success factors needed to succeed in exploitation. Exploration focus in a longer time perspective, more autonomy, flexibility, risk taking and experimentation (March, 1991).

As key leaders in organizations, senior executives are considered to play an important role in promoting ambidexterity. Tushman and O'Reilly (1997) state that ambidexterity is facilitated by the top management team's internal processes. Some studies describe leadership processes as a supporting factor in the implementation of structural or contextual ambidexterity, for example Smith and Tushman (2005) explored the integrative mechanisms by which leadership teams can successfully handle the contradictions that arise from structural separation in ambidextrous organizations. In this way, Gibson and Birkinshaw (2004), noted the "important role played by senior executives in making an organization context effective and developing ambidexterity" (p. 223). In this sense, managers must act as a leaders in the achievement of ambidexterity.

## **3. Leader's ambidexterity traits**

Organizations not only need ambidexterity at the business unit and company level, but also at the individual level (Mom et al., 2009). The ambidexterity at the manager's level is defined as "a manager's behavioral orientation toward combining exploration and exploitation related activities within a certain period of time" (Mom et al., 2009). The following characteristics have been proposed in literature as necessary for managers' achievement of ambidexterity.

*Hosting contradictions* (Mom et al., 2009; O'Reilly and Tushman, 2011)

Ambidextrous managers have the motivation and also the ability to be sensitive, to understand, and to know how to manage the apparently conflicting range of opportunities, needs and objectives. Previous research points out the need for ambidextrous managers to deal with conflict (Duncan 1976; Floyd and Lane 2000) and to engage in paradoxical thinking allowing managers to work simultaneously and longitudinally through the tensions of exploration and exploitation (Gibson and Birkinshaw 2004; Smith and Tushman 2005).

The organizational ambidextrous context encourages managers to make their own decisions about how to divide their time between alignment- and adaptability-oriented activities (Gibson and Birkinshaw, 2004). This characteristic indicates that ambidextrous managers

look for market and technological needs and opportunities at the same time that they have to be able to reinforce existing positions in the product market (Burgelman 2002; Tushman and O'Reilly 1996). Another contradiction that managers have to take into account, following Floyd and Lane (2000), is that each level of management has different roles in a strategy process, so ambidextrous managers should fulfill multiple roles.

Ambidextrous managers elaborate and reassess existing decisions, goals, and beliefs, and moreover are short-term and long-term orientation for identifying and pursuing opportunities (Ghemawat and Costa, 1993; O'Reilly and Tushman, 2004). It asks managers to deliberately and consciously engage in experimentation and small-scale efforts with a long-term possible payout rather than the short-term maximization of profit (O'Reilly and Tushman 2007). Leaders must to resolve conflicts arising in the organization and take resource allocation decisions for reaching this ambidexterity (O'Reilly and Tushman, 2011).

*Performing multiple task* (Floyd and Lane 2000; Birkinshaw and Gibson 2004)

Ambidextrous managers accomplish different roles and manage multiple diverse tasks within a limited period of time (Floyd and Lane 2000; Birkinshaw and Gibson 2004) for the competence deployment and the competence definition activities (Floyd and Lane 2000, Sanchez et al. 1996), carry out both creative and collective actions (Sheremata 2000), and perform routine and non-routine activities (Adler et al., 1999). Some authors also indicate that ambidextrous managers are more generalists rather than more specialists (Birkinshaw and Gibson 2004,) and usually act outside the limits of their own job (Adler et al., 1999).

*Refining and renewing their knowledge, skills, and expertise* (Floyd and Lane 2000; Sheremata, 2000; Mom et al., 2009)

The ability of being continuously searching for distant knowledge while also achieve more reliability and efficiency in the current and local knowledge in another characteristic of ambidextrous managers (Mom et al., 2009). Gibson and Birkinshaw (2004) stated how managers with more authority and flexibility in decision-making could have higher motivation in achieving efficiency and flexibility, by recognizing new opportunities. Pursing different goals requires higher authority and self-control in the tasks development (Tushman and O'Reilly, 1996).

*Benefiting from top-down and bottom-up knowledge* (Floyd and Lane, 2000; Mom et al., 2007)

Top-down knowledge inflows are associated with knowledge coming from persons and units at higher hierarchical levels to the lower levels while bottom-up knowledge inflows are associated with knowledge coming from persons and units at lower hierarchical levels to the higher levels (Mom et al., 2007). These inflows positively relate to the extent to which this manager conducts exploitation activities, (Daft and Lengel, 1986). Moreover,



bottom-up and horizontal knowledge inflows is positively related to the extent to which managers conduct exploration activities (Floyd and Lane, 2000). The more a manager acquires both top-down and bottom-up knowledge flows, or both top-down and horizontal knowledge flows, there will be higher levels of both exploration and exploitation activities (Mom et al., 2007).

*Promoting common vision* (Ravasi and Schultz, 2006; O'Reilly and Tushman, 2007, 2011)

O'Reilly and Tushman (2011) affirm that the articulation of a common vision and values that provide for a common identity increase the likelihood of ambidexterity. This global vision and values allows employees from the legacy and new business to create a common identity. A vision helps employees to adopt the mentality in the long term being important for the exploration (Ravasi and Schultz, 2006). The shared vision provides organizational members, including managers, with a meaningful purpose and direction, helping to keep a connected system and promote the integration of an entire organization (Orton and Weick, 1990). Without a shared vision, the reality of a firm would be characterized by very enthusiastic and committed individuals who pull the organization towards different directions.

It can override the adverse effects of divergent goals and conflicting perspectives among senior team members in charge of exploratory and exploitative units (Brewer and Miller, 1984; Mackie and Goethals, 1987), and prevent senior teams from devolving into fragmented structures. By contrast, a lack of shared vision and values can lead to distrust within senior team members and throughout the organization, making it hard to draw common characteristics and to identify, extract and combine diverse skills, abilities, and perspectives within exploratory and exploitative units (O'Reilly and Tushman, 2011).

#### **4. Conclusions**

Leaders need a serial of competences and capabilities to be able to handle in an ambidextrous way the different exploration and exploitation activities. In ambidextrous terms, managers must be focused on both exploitation and exploration activities. These managerial capabilities help organizations to reconfigure existing assets and skills to detect and take advantage of new opportunities (O'Reilly and Tushman, 2011).

This paper aimed to collect the characteristics analyzed in the literature necessities for managers to be ambidextrous. Most authors consider that ambidextrous managers host contradictions (Smith and Tushman 2005; Tushman and O'Reilly 1996); they are multitaskers (Birkinshaw and Gibson 2004; Floyd and Lane 2000); and they both refine and

renew their knowledge, skills, and expertise (Floyd and Lane 2000; Sheremata 2000). Global and shared vision and having incentive reward systems allows managers to achieve ambidexterity and to keep all member in the organization involved with the ambidextrous strategy. Furthermore, the importance of bottom-up knowledge inflows for managers' exploration activities, and top-down knowledge inflows for managers' exploitation activities (Mom et al., 2007) has been outlined.

Literature is broader because personal antecedents and leaders' characteristics are also studied, including the different types of leadership. A more extensive review may require finding common aspects between personal characteristics, leadership styles and ambidextrous leaders.

This study is a starting point in identifying the characteristics that ambidextrous leaders must have to achieve organizational ambidexterity that allows a long-term success for the organization, and therefore it could help to design management courses that encourage skills to achieve ambidexterity in future leaders.

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## Visually-impaired children and apps: sharing informal and formal information to guide choice

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### Abstract

*Digital technologies play an important role in the development of partially children, who require early intervention to help sustain and improve their visual capacity throughout childhood, and also to stimulate their other senses so as to prevent any global development deficit.*

*To this end, therapists, parents and teachers must be able to choose from a wide range of suitable, up-to-date digital resources that have been field tested and are well organized so that they can be located easily and rapidly as required.*

*To respond to these needs, the authors have been involved in a research project, which has defined the key features of apps that make them suitable for use by and with visually-impaired children. Consequently, the project developed an online environment that combines structured analytical information from experts with the practical know-how of the user community in a joint effort to support the choice of the most suitable resources to use in different contexts and with different users.*

**Keywords:** *shared knowledge; low-vision; education; rehabilitation; apps.*

### 1. Low Vision and technology: a brief introduction

Visually impaired children typically present a lack of visual acuity and reduced visual field, conditions that are often accompanied by low sensitivity to contrast and altered colour perception. Reduced visual space can be like looking through a keyhole, and for this reason the condition is commonly referred to as keyhole vision. In other cases, images can appear washed out, with low contrast levels, or colours may be perceived in a non-standard



fashion. Generally speaking, visually impaired children have low vision in both eyes both at short and at long range, even when wearing glasses. They are usually classified as being visually impaired when their sight level is only 30% of that of other children. This means that they are unable to perceive small or even standard text and pictures, but they can make out large images when holding these close up<sup>1</sup>.

In such cases, it is vital that rehabilitation should begin at an early age, drawing on a range of stimuli and support systems, including digital technology. Specifically, tablets and apps, which appeal to children with normal and low vision alike, favour task concentration and the exercising of visual effort (Dini & Ferlino, 2016). To employ these successfully visually impaired children, rehabilitation therapists, teachers at school and parents at home need to have ready access to apps that meet the specific needs of the young low-vision user.

To be affective, these apps must be age-appropriate and need to have strong appeal to the child so that they can foster motivation and visual effort making. At the same time, they must have certain usability characteristics in terms of interface and graphics.

## **2. Towards systematic knowledge sharing**

In education, the need soon arose for tools and services to help locate and, in particular, select suitable information for meeting specific needs. The educational research sector responded by developing cataloguing services to help educators locate and select learning resources. These mostly took the form of databases of material compiled according to an objective and neutral approach emphasizing informativeness (Bonaiuti et al., 2017).

The emergence of Web 2.0 (and subsequently of social networking) had an enormous impact on the education sector as elsewhere. Teachers, parents and other stakeholders continued to consult trusted institutional databases and information services, but at the same time the direct experience of others was also seen as a valuable information source. This is especially true in the special education sector, where the experience of others is taking on particular significance, given that accessibility and usability information is generally absent from institutional learning resource databases.

In the effort to identify and select digital resources suitable for visually impaired children, therapists, teachers and parents are currently engaging in informal, experience-based online communication flows. In this light, researchers in the field of special education have the opportunity to act as pivotal mediators, augmenting and adding value to their established,

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<sup>1</sup> <http://www.who.int/mediacentre/factsheets/fs282/en/>

well-trusted institutional documentation services with the integration of structured user-driven knowledge sharing initiatives (Pantazopoulos, 2017).

Hence, there are now two pathways available to those seeking out and selecting apps that can be used with, and by, visually impaired children: first, continue consulting institutional documentation services which provide neutral, objective information (formal structured flows); second, consult forums and social networks where users of different types exchange opinions and experiences on apps (uncontrolled spontaneous informal flows).

Clearly, the challenge facing the research sector is to achieve an optimal combination of these two approaches by combining neutral and objective catalogue information about potentially suitable apps with appropriately filtered experiential input from users so as to gain the best of both worlds. The aim of blending these two is to trigger a virtuous circle of effective knowledge sharing.

This challenge has been taken up by a research team located in Genoa, Italy, which for some time has been active in the field of technology-supported educational and social inclusion of people with visual impairment, particularly by offering documentation services dedicated to those ends. In 2016, the team launched a social-network oriented environment called Sharehab (“Share rehabilitation resources”). This combines formal and informal knowledge sharing about apps suitable for use by children and youngsters with visual impairments of various kinds (Figure 1). The platform is substantially aimed at rehab professionals, teachers and parents.

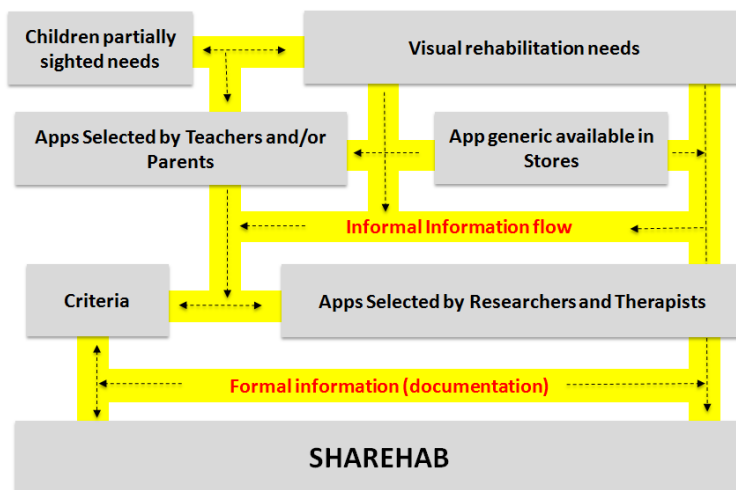


Fig. 1 From apps to Sharehab: the information sharing process



### **3. The Path to Sharehab**

Defining the methodologies and tools adopted in the Sharehab initiative per se is a process that has involved professionals from various fields and backgrounds. The same varied workgroup has also been involved in suggesting the technical specifications and contents of the Sharehab online environment. Project development took place over four phases:

Phase 1: Investigation and definition of the characteristics (graphics and usability) that render apps suitable for visually impaired users, e.g. neutral backgrounds that minimise visual interference with perception of foreground figures and text, simple illustrations with minimal details and bold outlines, etc.;

Phase 2: Empirical validation of these criteria in tests with actual users in the field;

Phase 3: Analysis of initial candidate apps to be catalogued in Sharehab on condition they met the validated criteria;

Phase 4: Design and implementation of the online platform for information and opinion sharing (platform and database).

From the research viewpoint, the crucial aspect of the project was identifying the criteria that render apps usable for the rehabilitation, education and entertainment of children with visual impairment (Phase 1).

Building on past work in the usability of digital resources generally (Bocconi et al., 2006), the research team concentrated on more recent technology, namely mobile apps. The aim was to identify key elements that underpin app usability on the part of visual impaired children.

As well as surveying apps developed specifically with visually impaired users in mind, the team also investigated apps of a more general nature that therapists and parents had adopted effectively for use by and with visually impaired children. Employment of apps in this latter category had often been made possible thanks to guidance from the research team via different channels, and with the application of suitable adjustments (Dini et al., 2007; Bocconi et al., 2006; 2007).

The app surveying phase highlighted a core set of critical technical criteria in apps (e.g. use of colours, shadings, backgrounds, etc.) that have a strong impact on usability by visually impaired children. Other aspects were identified that, while not directly effecting low vision usability levels, were nonetheless of interest to rehab professionals and parents, such as functions for personalizing the app, changing the interaction language, etc. These characteristics are detailed in Panesi et al. (2018).



In Phase 2, the research team closely consulted with the therapists, who possess strong practical experience in low vision rehabilitation. Together the group identified an initial set of 200 apps that are actually usable for these ends. For each app, the therapists proposed possible applications in accordance with the type of visual impairment in question.

Phase 3 involved the design and development of a database to store and manage the data emerging from the experimental and field activities, which would subsequently be made available via the specifically designed Sharehab platform. The catalogue entries describing each app are brief and concise, displaying only a subset of the evaluation data and characteristics collected for each individual app.

Finally, Phase 4 involved the entire project team in the design and implementation of a hybrid online environment. This was intended both to make available the collected information destined for rehabilitation purposes and as a means for sharing the information, knowledge, and evaluations generated by the experience of the active user community.

#### **4. The Online Environment for formal and informal information sharing**

Sharehab can be considered as a hybrid environment, in that it blends documentation, catalogue information, and opinions with the aim of facilitating the identification of resources for low vision rehabilitation. The platform has been optimized for use on mobile devices and provides user-friendly search functions for locating apps to meet the user's specific needs. Only a small number of search criteria are made available: app title, target user age, degree of eyestrain correlated to visual impairment category. This design choice is a deliberate attempt to facilitate use by non-specialist users, such as parents. When the user performs a search, a list of records (under the heading "Occhio alle app!") is generated in response to the search criteria that the user has applied. Filtering functions are available to narrow the list of records so that they align more closely to user interests and requirements. Each individual record on the list comprises an illustrative icon of the app, the app title, a very brief description (in Italian), and a community rating score; to display the complete catalogue entry for the chosen app, the user simply needs to click on the app record title.

The full catalogue entry provides a set of basic information that has been validated by Sharehab researchers. These describe the app and the main interaction features that may impact on usability. There are also indications from therapists that determine what type of visual impairment the app can be used with; this information is the fruit of extensive field tests carried out together with children who have different kinds of visual impairment.



Users who have registered and logged into Sharehab can also add comments and ratings about the listed apps. Further specialized, technical information regarding rehabilitation use is displayed to rehab professional users only.

As explained, the Sharehab catalogue entry for each app specifically addresses visual impairment matters. However, this specialized information is complemented by more general educational information directly available from the corresponding catalogue entry in *Essediquadro*<sup>2</sup>, a general-purpose digital educational resources information service also run by CNR-ITD. The corresponding entries in the two services are interlinked to facilitate navigation and to promote a more inclusive approach to the adoption of mobile apps.

Sharehab also features subsections that showcase apps which have caught the attention of the community and/or have attracted favourable comments or ratings. The platform also includes supplementary information pages.

## **5. Sharehab's target users**

Sharehab mainly addresses the needs of families of children with visual impairment, rehabilitation professionals and teachers. The platform offers users three different access levels (Guest, Basic and Pro) for accessing contents and contributing to the knowledge building process.

Anyone can explore Sharehab as a Guest user, so as to get a taste of the platform and the project itself, and therefore decide whether or not to join the community. Guest users can consult listings of a variety of apps suitable for children with visual impairment and access basic information about the criteria guiding app choice.

At the other end of the scale, rehab professionals, orthoptists and visual rehabilitation therapists can register as Pro users. This grants them access to supplementary technical information regarding particular apps for rehabilitation. The added value at this level lies in the opportunity for professional peers to exchange of know-how expressed in familiar technical, sector-specific language. This regards aspects like the application of technical aids, compatibility with accessibility features, management of involuntary user movement, ergonomics, and experience-based knowledge of target user needs. To identify which apps are best suited to particular rehab needs, Pro users can search the catalogue using a specific menu of general sight function categories. Each function is related to a specific rehabilitation methodology and objective.

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<sup>2</sup> <https://sd2.itd.cnr.it/>

The bulk of Sharehab users register in the Basic category, which effectively represents the core of the Sharehab community. This largely comprises sector professionals, teachers and parents. Basic users can share their experiences and opinions of the apps listed in Sharehab, and can also propose new apps to be listed on the platform based on their practical and/or professional experience. Participation in the community is open to all Basic users who are willing to share their experience and expertise and to enrich the community's knowledge base with their own information, whether of a professional nature or not.

It was decided not to add a general discussion space on the platform, as this could well have ended up being dominated by a small number of highly active, experienced members, possibly discouraging others from sharing their experience. Conversely, a more discreet form of participation was foreseen, whereby users can post comments tied to specific product listings. In this way, the primary focus for user feedback is on the app and on their experience and impressions thereof.

As is the case in most content-centred educational communities (Trentin, 2004), interactions in Sharehab affect the dynamics surrounding the content. Typically, the opinions, ratings, and displayed pages tend to centre around the sections of the platform that highlight the most commonly viewed and highly rated apps, those that have attracted the most recent comments, and the "Top Apps" (combined rating and comment level).

Such features help to provide stimulus and focal points for interaction, especially for new users, without limiting the scope for freedom of expression. There is ample space for sharing experiences, and for informing others about salient characteristics to consider when choosing a usable product that meets specific needs.

The consolidation and growth of Sharehab is grounded in its involving and expanding user community. This comes not just through users sharing opinions and ratings about the apps already listed on the platform, but also by allowing them to propose inclusion of new apps that they themselves have used effectively in their practice and activities. When the Sharehab editorial team evaluates these and shares them on the platform, a virtuous circle of knowledge sharing and knowledge building is generated that is the essential drive force of the Sharehab initiative and the key to its sustainability.

Added value derives from ongoing interaction and exchange between people who share a common objective, in this case support for children with visual impairment. Without Sharehab, this value would be lost to those who could benefit from it most.



## **6. Conclusion**

Given their high degree of manageability, mobile devices like smartphones and tablets now form part of the daily lives of most children and youngsters, including those with visual impairment. They use tablets in particular in a range of different settings: for home entertainment, for learning at school, and also for carrying out rehabilitation exercises.

Given the enormous number of apps available on the market, making a suitable choice for low vision users can be a complex matter. Accordingly, the need arises to identify and apply criteria for selecting apps that propose activities and contents that align appropriately with the end user's age group and, at the same time, provide insight into the characteristics unpinning contents, interface and interactions.

One way to address the challenge of identifying such apps is to rely on authoritative, institutional online cataloguing and documentation services that seek to provide information in a neutral and objective manner. Another is to seek out the experience and opinion of others who have actually had practical experience in using such apps and hence are aware of their potential and limitations.

This latter type of information typically flows in an informal and spontaneous manner within social networking contexts. This form of communication exchange is increasingly becoming part of the research world too as an amplifier underpinning knowledge building processes.

It is our firm belief that children with visual impairment can and should be able to use emerging technologies like apps, so long as these respond to certain requirements. This can be achieved by channelling the informal information spontaneously generated and exchanged online by users within structured documentation services. This is the hybrid approach pursued by Sharehab, which combines formal and informal information in a manner that leaves the way open for dynamic ongoing enrichment. Sharehab's challenge is to respond successfully to the diverse needs of different actors and stakeholders, such as therapists, teachers and parents, who are seeking to select appropriate apps for children with low vision that can then be used in a range of settings and for different purposes, whether it be rehabilitation, learning or entertainment. On a final note, we believe that the Sharehab model could be successfully adopted to meet the needs of other kinds of disability in addition to visual impairment.



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## A Flipped Learning Agile Methodology for teaching in higher education levels

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### Abstract

*This paper presents the results of implementing the Flipped Learning Agile (FLA) methodology as a general framework to manage courses and to encourage proactive learning for students in higher education levels. Flipped Learning is used in combination with Information and Communication Technologies (ICTs) to encourage the student in the self-learning process. It is proposed the integration of an Agile Methodology that includes the use of Scrum and Kanban methodologies, by means of sprints for task scheduling and using a board for activities status, into a Flipped Learning (FL) environment. The proposed FL environment is composed of applications such as YouTube, Google Classroom, and Google Drive. The Scrum methodology was designed for 4 sprints, each one for a week-long. Before applying the FLA methodology, a Motivated Strategies for Learning Questionnaire (MSLQ) was applied in a group of Electrical Circuits students at the University of Guadalajara. To examine the self-regulated learning process, the performance of the students was analysed before applying the FLA methodology; the same MSLQ was carried out after implementing the FLA methodology. The analyses of the last MSLQ show that the implementation of the FLA methodology, by means of the integration of the Agile methodologies of Scrum and Kanban into a flipped learning environment, encourage the self-learning strategy for higher education level students.*

**Keywords:** *Flipped Learning, Agile Methodology, Scrum, Kanban, Learning strategies, sprints, Peer-learning.*





## 1. Introduction

Agile methodologies have improved project development in the industry. The Agile Manifesto (Schwaber, 2004) settled down a development paradigm introducing Scrum and Kanban methodologies (Maximini, 2015; Stellman & Greene, 2016) leading to a faster and more efficient project management. Scrum frameworks allow the completion of complex projects by dividing them into small time-lapsed tasks called *sprints* (Tracy, Frog, & Power, 2014); while Kanban boards are meant to organize these tasks into a categorized status list of activities in the form of a planned task board (Hammarberg & Sundén, 2013; Leopold & Kaltenecker, 2015).

Agile methodologies have probed to improve project management in software engineering fields (Ahmad, Dennehy, Conboy, & Oivo, 2018) as well as in product-service systems (Hernandez, Version, & Hernandez, 2019). Recently, *Industry 4.0*, which can be defined as the integration of *Internet of Things*, *Big Data* and *Artificial Intelligence* into traditional industry (Vaidya, Ambad, & Bhosle, 2018; Xu, Xu, & Li, 2018), has started to make an extensive use of agile methodologies (Cakmakci et al., 2019).

There are also efforts for applying agile methodologies in Education fields. In the work of (Fernanda et al., 2018), a case of study in Universidad Técnica Particular de la Loja in Ecuador, is presented to apply agile methodologies in their teaching-learning process for engineering. Authors present a scrum based framework to plan, develop and follow-up academic activities. As a result, their students became more efficient and self-satisfied, with a higher interaction level in teamwork, as they were actively involved in more stages of the teaching-learning processes than in the traditional method. Also in (Fernanda et al., 2018) is presented an adaptation of the Agile Manifesto principles into the Academic field. Other authors have explored the potential, and evaluate the benefits, of agile methodologies and lean concepts to design teaching units, as (Judd & Blair, 2018) presented in their case of study for an Australian university which adopted these strategies. They found that peer-learning was encouraged in students. Peer-learning is a process where students are stimulated to collaborative learning and efficient teamwork (Nielsen, Johansen, & Jørgensen, 2018). As in agile methodologies is needed to work in teams, peer-learning becomes very important.

There are many instruments to encourage peer-learning. Recently *Information and Communication Technologies* (ICTs) had led to a *Flipped Learning* classroom environments for individual and collaborative online work. The authors in (Basoo-Aránguiz, 2018) present a variety of online tools, like *Google Classroom*, *YouTube*, *Google Drive*, as a technological framework for a *Flipped Learning* (FL) environment



methodology to promote peer-learning and self-regulated learning strategies (Broadbent & Poon, 2015).

In this paper, it is presented a combined *Flipped Learning* and *Agile* (FLA) methodology applied to a case of study for a final project in a group of students for the course of Applied Electrical Circuits at the Universidad de Guadalajara, México. Improvements in student performance were measured by applying a Motivated Strategies for Learning Questionnaire (MSLQ) before and after implementing the FLA methodology.

The objectives of this work are as follow:

- To apply an FL environment to academic activities for a higher education level assignments.
- To apply the Agile methodology, the Scrum framework, and Kanban boards, for the student's activities.
- To obtain and analyze students self-learning and motivational learning beliefs indicators before and after applying the FLA methodology.

## 2. Research methodology and implementation

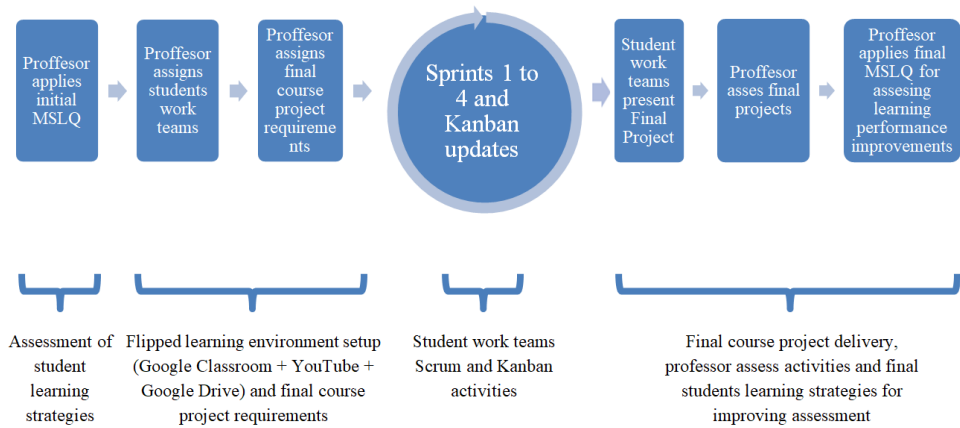
The methodology used is based on a Flipped Learning (FL) environment as presented (Basoo-Aránquiz, 2018), using the online Google Classroom suite as the course management platform, where the professor can publish and evaluate assignments as well as course additional material publishing. Also YouTube and Google Drive were incorporated into the Flipped Learning environment model presented. The inclusion of Agile methodologies was implemented by means of a Scrum framework and a Kanban board for the final course project. The student's performance is evaluated by a *Motivated Strategies for Learning Questionnaire* (MSLQ) before and after the FLA is implemented. As a case of study, the methodology was applied for 4<sup>th</sup>-semester students of Engineering in Energy at the Universidad de Guadalajara in the Applied Electric Circuits course. The student's group was composed of 23 students (18 men and 5 women aged 19 to 31 years old).

The Applied Electric Circuit course program is divided into five thematic units. For the case of study, in order to apply the FLA methodology, it is proposed a new sixth unit to integrate the Scrum framework and Kanban board as well as the MSLQ as a student's self-regulated learning strategies and motivational beliefs assessment.

Tools in face-to-face lectures and online work, such as Google Classroom, Google Drive and YouTube, were used as a flipped learning environment to accomplish the Scrum



framework and Kanban boards tasks. Figure 1 shows the FLA methodology adaptation proposed for academic fields.



*Fig. 1 Flipped Learning Agile Methodology proposed for academic field.*

The MSLQ, as propose (De Groot & Pintrich, 1990; STEM Learning and research center, 2018), was applied at the beginning of thematic unit six and before implementing the FLA methodology in the student's group. Figure 2a shows the MSLQ students register form and Figure 2b shows the MSLQ 0 to 7 questions to carry out the assessment.

**Motivated Strategies for Learning Questionnaire**

\*Obligatorio

**Sección sin título**

Apellido paterno \*

Apellido materno \*

Nombre(s) \*

Género \*

Hombre

Mujer

Prefero no decirlo

Edad \*

Prefiero el trabajo de clase que es retador, de tal manera que aprendo cosas nuevas \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Comparándome con otros alumnos de esta clase, yo espero tener un buen desempeño \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Suelo estar muy nervioso durante los exámenes, de tal manera que no puedo recordar cosas que he aprendido \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Para mí es importante aprender lo que se enseña en esta clase \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Me gusta lo que estoy aprendiendo en esta clase \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Estoy seguro de que yo puedo entender las ideas enseñadas en este curso \*

1 2 3 4 5 6 7

Nada cierto para mí        Muy cierto para mí

Fig. 2 MSLQ online form, (a) shows the student register and (b) the applied questions

After applying the MSLQ, professor publishes, by means of Google Classroom, the final project requirements and assessment policies. Then student’s teams start to work in their own activities using the Scrum framework and Kanban board for scheduling the tasks. After finishing each sprint, students must update their Kanban board. Figure 3 shows an example of Kanban board implemented by a student’s team.

MACETA INTELIGENTE 2019						
PENDIENTES	FECHA DE COMIENZO	FECHA DE VENCIMIENTO	EN PROGRESO	% COMPLETADO	COMPLETADO	NOTAS
conseguir materiales	10/04/19	03/05/19		100%	<input checked="" type="radio"/>	electronicos
conseguir materiales	10/04/19	03/05/19		100%	<input checked="" type="radio"/>	para maceta
realizar el diagrama	10/04/19	03/05/19	realizar el diagrama	75%	<input type="radio"/>	
simular circuito	10/04/19	03/05/19		0%	<input type="radio"/>	
hacer maceta	10/04/19	03/05/19	hacer maceta	75%	<input type="radio"/>	
armar maceta	10/04/19	03/05/19	armar maceta	25%	<input type="radio"/>	
comprobar maceta	10/04/19	03/05/19		0%	<input type="radio"/>	
programar arduino	10/04/19	03/05/19		100%	<input checked="" type="radio"/>	
armar filamento	10/04/19	03/05/19		100%	<input checked="" type="radio"/>	
conseguir planta	10/04/19	03/05/19		100%	<input checked="" type="radio"/>	
hacer calculos	10/04/2019	03/05/2019	hacer calculos	25%	<input type="radio"/>	por el momento se ha complicado

Fig. 3 Kanban board implement by a team of students

After all Scrum sprints were completed and the final project delivered, it was applied an MSLQ again to evaluate the students self-regulated learning strategies improvements. Table 1 shows how questions of the MSLQ evaluates the students learning components.

**Table 1 MSLQ learning components index assessment**

	Learning component	Questionnaire
Motivational Beliefs	Self-Efficacy	2, 7, 10, 11, 13, 15, 20, 22, 23
	Intrinsic Value	1, 5, 6, 9, 12, 17, 18, 21, 25
	Test Anxiety	3, 14, 24, 27
Self-Regulated Learning Strategies	Cognitive Strategy Use	30, 31, 33, 35, 36, 38, 39, 42, 44, 47, 53, 54, 56
	Self-Regulation	32, 34, 40, 41, 43, 45, 46, 52, 55

Using the learning components presented in Table 1, it is possible to assess the students self-regulated learning strategies and their motivational beliefs. A higher index in self-efficacy, intrinsic value, cognitive strategy use, and self-regulation is desired.

### 3. Results and discussion

A comparison of the results between the first and the last MSLQ (for motivational beliefs and self-regulated learning strategies) was carried out, as shown in Table 2.

**Table 2 MSLQs results and its learning components rate change ( $\Delta$ )**

Strategy	MSLQ component	1 <sup>st</sup> MSLQ group results	2 <sup>nd</sup> MSLQ group results	$\Delta$
Motivational beliefs	Self-efficacy	5.51	5.70	+0.19
	Intrinsic value	5.49	5.64	+0.15
	Test anxiety	5.34	5.54	+0.20
	Mean value	5.45	5.63	+0.18
Self-regulated learning	Cognitive strategy use	5.00	5.41	<b>+0.41</b>
	Self-regulation	4.90	5.35	<b>+0.45</b>
	Mean value	4.95	5.38	+0.43

Agile methodologies and flipped classroom framework allowed the students to improve their self-regulated learning strategies, as well as their motivational learning beliefs as shown in Figure 4.

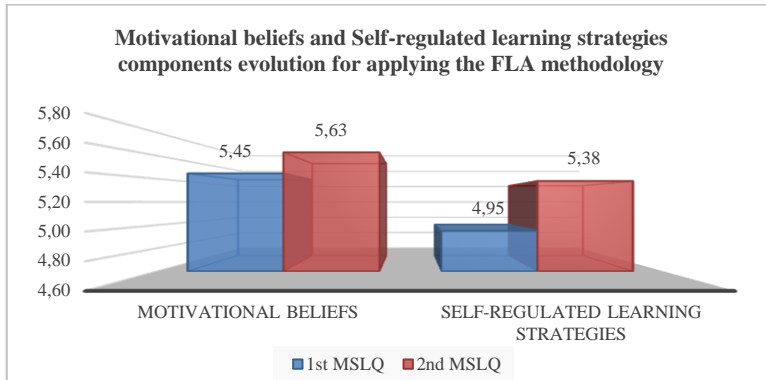


Fig. 4 Motivated Strategies for learning evolution after applying FLA methodology

According to results in Table 2, improvements in self-regulated learning strategies were noticed, changing the score from 4.95 to 5.38 points. While a less significant change was noticed in motivational beliefs strategies, scored from 5.45 to 5.63 points. About specific learning components, “*self-regulation*” score increases from 4.90 to 5.35 points. “*Self-regulation*” is related to an improvement in how students transform mental abilities in task-related skills (Zimmerman, 2001). “*Cognitive strategy use*” score increase from 5.00 to 5.41. “*Cognitive strategy use* assesses” how students learned to use new tools presented (Kauffman, 2004).

#### 4. Conclusions

This paper presents the FLA methodology framework and its implementation results in a case of study for a student’s group at the University of Guadalajara, México. Results of applying FLA methodology show that the method acts mainly on the self-regulated learning strategies and its related learning components. Main advantages obtained after applying FLA methodology are:

- Professors can improve significantly the *self-regulated learning strategies* in their students.
- Students increase self-confidence using the Scrum framework and the Kanban board improving their *learning self-regulation*.

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## Questionnaire design in gamification process for education: a case study at Universidad de Guadalajara – Mexico

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### Abstract

*Gamification techniques have demonstrated that students improve their learning process through mobile applications. However, every teacher creates his/her own questions for the game design, involving classroom response systems through a digital app such as Kahoot!, Socrative, Blicker, Clickers, Plickers, etc., without previous planning of the difficulty in every question formulated to the students. This work focuses on the evaluation design of a questionnaire for the final test of the Power Electronics subject, following Bloom's Taxonomy methodology for every level of critical thinking within the cognitive domain of the learning process for students. Furthermore, an analysis of the V-Aiken for the reliability and validity of each question were taken into account. The final test implementation was carried out at Centro Universitario de Tonalá, Jalisco, Mexico, involving nine students of the Energy Engineering grade of the fifth semester. The results show an analysis of the performance of the students when applying a designed test based on revised Bloom Taxonomy. It was better because the student demonstrates, in a more integral way, his/her mastery skill in different topics of the subject, while the results of the not-designed exam showed a poor student performance because all of their knowledge and skills are not evaluated when it is not applied a proper effective question.*

**Keywords:** *Questionnaire design, gamification in education, Kahoot!, Bloom Taxonomy, V-Aiken.*



## **1. Introduction**

Modern education demands technology innovation (Westera W, 2004). Due to the growth of student population and technology innovation, the learning environment in schools has been changing the way a student can learn interacting with the new educational digital platforms. Nowadays, educational institutions requires the inclusion of new information technologies within a classroom environment where students must have access to online digital tools (Tak, Wong, Yuen, & Wong, 2018). Although technology is gaining greater importance in the modern learning environment and for educational purposes, it is essential to remember that technology serves as a tool for teachers to deliver knowledg to the students. Students perceive gamification activities as a strong tool for the scholar assessment and the student performance, it is an important key to harnessing the power of gameplay for educational purposes (Kingsley & Grabner-Hagen, 2018). The main problem of gamification activities, especially in Kahoot!, is that questions asked on the game are often very easy to answer by students or any other person who wants to play a game of a specific subject. Many times these questions do not follow a methodology to be better formulated or answer options are simple to discard because they are not related to the question (Wang & Hoang, 2017). In other words, the set of questions made by a game results inefficient for the students and have no value for the learning process during the course. Students perceive gamification activities as a strong tool for the scholar assessment and student performance. It is an important key to harnessing the power of gameplay for educational purposes (Kingsley & Grabner-Hagen, 2018). As a consequence, the main objective of this work is to evaluate the differences between a set of normal questions made on Kahoot! and a second set of questions based on the six level of learning skills according to the cognitive domain of Bloom Taxonomy, in order to stimulate critical thinking of students. To this end, Kahoot! was used in the subject of Power Electronics belonging to the Energy Engineering degree at the University of Guadalajara, Mexico, as a case of study.

### **1.1. Bloom Taxonomy**

It is important to evaluate the learning process of students because it is an effective way to provide a valuable feedback on the design and the implementation of the study program in a continuous process and a periodic exercise. (Rajšp, Beranič, Heričko, & Horng-Jyh, 2017). One way to accomplish the above is through a hierarchical model used to classify educational learning objectives into a level of complexity known as Bloom Taxonomy. It divides the way people learn into three different domains. Cognitive is one of those domains, which emphasizes the intellectual performances of people, then is the affective

domain, based on people emotions, and psychomotor which involves manual or physical skills (Bloom, 1956). The goals of the learning process are to acquire new skills, knowledge, and attitudes. Bloom taxonomy is commonly used in applications for exam papers assessment where the cognitive level is the prime objective of a school subject (Sivaraman & Krishna, 2015). Furthermore, it is also applied in scientific writing papers, such as literature reviews, where the author needs to develop and demonstrate the intellectual skills for every one of the six categories of learning in the cognitive domain (Granello, 2001). In the beginning of the 21<sup>st</sup> century Lorin Anderson, a former student of Bloom, revised the cognitive domain in the learning taxonomy making two big upgrades: changing the names in the six categories from noun to verb forms and rearranging the evaluation and synthesis skills as seen in Table 1.1, this new structure of Bloom taxonomy reflects a more active and accurate form of the learning process (Anderson, et al. 2001).

**Table 1.1 Bloom Taxonomy cognitive domain modification.**

Thinking Skills	Original Bloom Taxonomy (Bloom, et al. 1956)	Revised Bloom Taxonomy (Anderson, et al. 2001)
<b>Low Order Cognitive Skill (LOCS)</b>	Knowledge	Remembering
	Comprehension	Understanding
	Application	Applying
<b>High Order Cognitive Skill (HOCS)</b>	Analysis	Analyzing
	Synthesis	Evaluating
	Evaluation	Creating

## 1.2. Gamification in Education: case of Kahoot!

Popular online games have shown very interest in students, fomenting the competitiveness and superiority of the smartest student of the group (Rajšp et al., 2017). Many works have demonstrated that gaming platforms result pleasant and fun to play, even though many of them do not deliver knowledge, only serve as a tool of reinforcing the knowledge of students (Sola Guirado, Castro García, & González Sánchez, 2018; Stott & Neustaedter, 2014). One of the most popular gamification tools being used in the academic field is Kahoot!, which is a free e-learning platform with more than 30 million users (Bicen & Kocakoyun, 2018). Using kahoot! Proffesor can set up conducted learning games, design own tests. Furthermore, questionnaires can be projected in the classroom and each student can answer it via web or smartphone application, also question punctuation, student accumulated score and winner can be displayed motivating a competition environment (Ares, Bernal, Nozal, Sánchez, & Bernal, 2018).

### 1.3. Content Validity

One aspect to consider while designing the questionnaire in Kahoot! is the validity of the questions on the game. Content validity is mainly used to test whether the items possess representativeness and comprehensiveness, and whether or not the items tested fully reflect the contests and theories seen in class. Hence, in order to obtain a valid and reliable measurement instrument of each item, it is a must to follow a systematic procedure to achieve that. One approach is the content validity coefficient and homogeneity reliability coefficient proposed by Aiken (1980), which can be used to quantify the validity rating of each item into one coefficient called “*V value*”. The procedure for determining the *V* coefficient begins with the ratings of *m* items by a single rater. Validity ratings can be made on any convenient scale of *c* successive integers. In this particular case, the ratings will be 4, from 0 to 3. When ratings of *m* items are made by one rater, the *V* coefficient for that rater is computed in Eq. 1.

$$V = \frac{\sum s}{[m(c - 1)]} \#Eq. 1$$

Where *V* is the item validity index; *s* is the score assigned by each item minus the lowest score in the used category  $s = r - l_o$ , with *r* equals to rater category selection score and *l<sub>o</sub>* equals to the lowest scores in the scoring category); *m* is the number of items; and *c* is the number of categories that raters can choose. The *V* index value ranges from 0 to 1. The closer an item to 1, the better it is (Aiken, 1985).

## 2. Methodology

In this research two sets of 13 questions were conducted; the first one evaluating normal questions of the Power Electronics subject and the second one evaluating the questions based on the six levels of learning of Bloom Taxonomy within the cognitive domain. Each item was accompanied by a Likert scale from 1 to 3 to reflect the judge’s opinion with each statement, as seen in Table 2.1.

The Kahoot! session was held in April 2019, using student’s smartphones. The session was divided into two questionnaire application; the normal test was first and the design test (according to revised Bloom Taxonomy) was second. A total of 9 students belonging to the subject “Power electronics” of the Bachelor Degree in Energy Engineering of the Universidad de Guadalajara took both questionnaires. By gender, 11.11% were women and 88.89% were men. Considering age, 90% were students up to 21 years old while the remaining students were over 21 years.

The missing questions of the table were not relevant to write them because they are on the same cognitive level of knowledge, comprehension or application, making the first questionnaire on the Low Order Cognitive Skill (LOCS). The second questionnaire is located on the High Order Cognitive Skill (HOCS) due to the complexity of the formulated questions. Table 2.2 shows the categorization of questionnaire one and two according to the cognitive domain of Bloom Taxonomy. It is notable that many items belong to the Remembering and Understanding skill, while items three and eight only belong to the Applying skill. Furthermore, questionnaire number one consists only on LOCS, while questionnaire number two applies LOCS and HOCS for the item design.

**Table 2.1 Sample questions to rate item of certain cognitive level for both questionnaires**

Cognitive level	Questionnaire statement of the first session	How well does the item evaluate the concept?		
		1	2	3
Knowledge	1. A rectifier is a device which converts...			
Comprehension	2. A single phase bridge rectifier consists of how many diodes?			
Application	3. The AC source has an effective voltage of 120 V, 60 Hz. Calculate DC voltage across the load.			
Questionnaire statement of the second session				
Analysis	4. Why a rectifier transforms the AC energy input into DC energy output?			
Synthesis	5. How would you test a single phase full-wave bridge rectifier?			
Evaluation	6. What protections would you recommend for a safety home electrical installation?			

**Table 2.2 Item categorization based on Bloom’s taxonomy for both questionnaires.**

LOCS and HOCS of Bloom Taxonomy	Questionnaire #1 Items	Questionnaire #2 Items
Remembering	1, 2, 3, 4, 5, 6	1, 2, 3
Understanding	7, 8, 9, 10, 11	4, 5, 6
Applying	12, 13	7, 8
Analyzing	NA	9, 10
Evaluating	NA	11, 12
Creating	NA	13

\*NA = Not Available

The steps taken for this study were:

1. Determining the complexity level of each question according to the cognitive domain of Revised Bloom Taxonomy from the lowest order to the highest order.
2. Evaluating each question previously designed by inviting experts, teachers or researchers to engage in the content validity testing.



3. Checking all the responses given on each item with a significant standard of content validity coefficient (V value).
4. Applying questionnaires #1 and #2 to the students.
5. Analyzing the game’s outcomes for interpreting the results.

### 3. Results

In this section, the results obtained are presented in Table 3.1, where each question was evaluated according to Bloom Taxonomy and calculating the V-Aiken value for the validation of items by three expert judges (J1, J2, J3), with a confidence index (CI) for both questionnaires.

**Table 3.1 Results of the validity calculation using Aiken formula for the questionnaires.**

Item	Questionnaire #1			Questionnaire #2		
	Judge Criteria			Judge Criteria		
	$V_{Aiken}$	95% CI		$V_{Aiken}$	95% CI	
		Lower	Upper		Lower	Upper
1	0.167	0.080	0.254	0.833	0.746	0.920
2	0.167	0.080	0.254	0.833	0.746	0.920
3	0.500	0.413	0.587	1.000*	0.913*	1.000*
4	0.167	0.080	0.254	0.833	0.746	0.920
5	0.500	0.413	0.587	0.833	0.746	0.920
6	0.500	0.413	0.587	0.833	0.746	0.920
7	0.333	0.246	0.420	1.000*	0.913*	1.000*
8	0.333	0.246	0.420	0.833	0.746	0.920
9	0.667	0.580	0.754	0.833	0.746	0.920
10	0.333	0.246	0.420	1.000*	0.913*	1.000*
11	0.667	0.580	0.754	0.833	0.746	0.920
12	0.833	0.746	0.920	0.833	0.746	0.920
13	0.833	0.746	0.920	0.833	0.746	0.920

Note: \*Denotes where V-Aiken coefficient satisfies condition  $V \geq 0.75$ .

**Table 3.2 Outcomes of questionnaire #1 done in Kahoot!.**

<b>QUESTIONNAIRE # 1: Test of Power Electronics</b>						
<b>Rank</b>	<b>Players</b>	<b>Total Score (points)</b>	<b>Correct Answers</b>	<b>Incorrect Answers</b>	<b>Total answers</b>	117
1	Student 9	28,224	13	0	<b>Total Correct answers</b>	106
2	Student 7	27,668	13	0	<b>Effectiveness percentage</b>	90.60%
3	Student 3	26,677	12	1	<b>Incorrect answers</b>	11
4	Student 5	25,864	12	1	<b>Ineffectiveness Percentage</b>	9.40%
5	Student 1	23,264	12	1	<b>Average Points</b>	24,468.22
6	Student 4	22,198	12	1		
7	Student 2	22,198	11	2		
8	Student 8	21,256	11	2		
9	Student 6	20,085	10	3		

Table 3.2 and Table 3.3 shows the outcomes of the games on Kahoot! after the revision of judges on item analysis was done to questionnaire 1 and 2. One aspect to observe was that students who obtained good results in the implementation of the first questionnaire do not achieve the same results on the second questionnaire application. Therefore, the number of correct answers or points obtained during the game do not necessarily make a student more intelligent, but it is subject to several interpretations to really know the level of knowledge of the participants in the game and their skills and mental abilities.

**Tabla 3.3 Outcomes of questionnaire #2 done in Kahoot!**

<b>QUESTIONNAIRE # 2: Modified Test of Power Electronics</b>						
<b>Rank</b>	<b>Players</b>	<b>Total Score (points)</b>	<b>Correct Answers</b>	<b>Incorrect Answers</b>	<b>Total answers</b>	117
1	Student 5	8956	9	4	<b>Total Correct answers</b>	71
2	Student 8	8294	9	4	<b>Effectiveness Percentage</b>	60.68%
3	Student 2	7548	9	4	<b>Incorrect answers</b>	46
4	Student 3	6861	8	5	<b>Ineffectiveness Percentage</b>	39.32%
5	Student 1	6657	7	6	<b>Average Points</b>	6,872.11
6	Student 9	6550	8	5		
7	Student 4	6456	7	6		
8	Student 6	6196	8	5		
9	Student 7	4331	6	7		



## **4. Discussion**

The goal of this study has been to design a proper questionnaire for gamification in education, according to a methodology for a better performance of student's learning objectives by applying the Revised Bloom Taxonomy. It has proven to be a good mechanism to develop and create more effective questions than only "yes or no" answers. Perhaps not many teachers would like the idea to redesign a quiz for the time that involves thinking, analyzing and classifying each question depending on the skill level of the cognitive domain. Although students prefer applying the test on digital platforms and taking quizzes over online games perhaps reality is that educational institutions do not like the idea of changing panorama even though digital tools go hand-to-hand with the new generation students. Overall, content validity is a powerful tool to measure the evaluate student's performance. Bloom taxonomy is ideal for better construction of learning objectives. Kahoot! is a fun, dynamic and interesting platform where competitiveness and learning among people come to challenge.

The first questionnaire showed that questions on the game that lacks complexity and difficulty can be fun to play but the second questionnaire was statistically validated with the use of V-Aiken, showing that questions are more challenging and therefore, requires more time to think and analyze the problem. It is good to enhance student's learning and stimulate their cognitive skills. All of them, LOCS and HOCS, result as important as formative evaluation. Some future research projects that can be done are the addition of a greater number of judges, validators or teacher who are Subject-Matter Experts for a better questionnaire validation of the V-Aiken. Also, the item discrimination index and item difficulty index can take place in order to find those items which are extremely hard to answer or too easy to solve. With that, a more comprehensive analysis can be made to discard questions on Kahoot! games.

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## Improving the effective communication soft skill in higher education engineering studies: an experience through written reports

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### **Abstract**

*With the new paradigm of higher education, courses syllabus are not only addressed to develop the knowledge in some specific contents, but also to let the student acquire a set of the so-called transversal competences or soft skills. Amongst these, the ability of the students to communicate in an effective manner is a soft skill that will present a key role in the future careers of the students. In this paper, the experience in two courses of the Aerospace Engineering Bachelor Degree working on the effective communication through written technical reports is presented. Different enhancements have been introduced over the years, including specific sessions to present best practices for written reports, assessment using rubrics or intermediate deliveries to provide feedback to the students before they deliver the final report. The analyzed courses belong to consecutive years and are taught in both Spanish and English, which provides a wide view for understanding the impact of each feature. With the current configuration, significant improvement in the students written reports readability is obtained. Their works are more rigorous in terms of writing and format. Nevertheless, the effect of these new features on the technical content of the reports is slight. Overall, the content is transmitted by the students in a more effective manner.*

**Keywords:** *key skills, scoring rubrics, transversal competences, effective communication, evaluation.*



## **1. Introduction**

For more than 20 years now, companies have been transmitting to universities their concern about the skills acquired by students in their training cycle. Among others, such as a good understanding of engineering science fundamentals (mathematics, physics, computing...), one of the desired attributes of an engineer is *good communication skills* (written, oral, graphic and listening) (The Boeing Company 1996).

Part of the responsibility of developing such skills relies on the university, in cooperation with their "customers" (i.e. industry, academy, administrations...), and in recognition of their own local resources and constraints. The implementation of the Bologna system (The Bologna Declaration 1999) was the result of the requirements of these "customers", promoting the students to demonstrate (Crooks 1988) not only knowledge of the basis but also a series of competences at the end of their formation.

Under this scope, the Universitat Politècnica de València (UPV) was one of the precursors in the design of a work plan based on a series of 13 specific competences or soft skills, assigned to each course or subject (UPV 2015). These soft skills are characterized for being integrating, transferable, independent, multi-functional and evaluable. Three levels of control are established within them: first level (developed during the 1st and 2nd years of Bachelor's degrees), second level (3rd and 4th years), and third level (acquired in a Master's degree).

The soft skill number '08 - Effective communication' is investigated in this work. This constitutes a key interpersonal skill for many jobs. Effective communication is more than just exchanging information, it is about understanding the intentions behind the information transmitted in the fastest and most direct way. Among the different communication channels, written communication is the one analyzed in this case. Although there are many guides for achieving effective written communication (Koehler 2001), this skill needs to be trained and consequently evaluated (Yusof 2015, Masoud 2019).

This document describes the actions carried out in the frame of two courses of the Aerospace Engineering Degree at UPV that act as "control points" for the aforementioned soft skill. This implies the students face activities planned to develop this skill, followed by an evaluation of their achievements. Indicators for comparison are reported from the academic year 2015-16, the year before scoring rubrics were introduced to conduct the evaluation process (Tiseira 2015). The analyzed courses are sequential in time. This allows to investigate whether training the soft skill during the first course has a noticeable effect on the second one.

## 2. Description of the courses

### 2.1. Aerospace Technology

Aerospace Technology (AT) is a compulsory course offered to second-year students (about 120 students) of the Aerospace Engineering Bachelor Degree at UPV. It takes place during the first semester of the second year (fall semester) and covers 4.5 ECTS. This is the first course of the curriculum that specifically deals with aircraft. It is aimed at providing the students with a general view of Aerospace Engineering and the associated technologies implemented. Thus, it may be seen as a link among the basic disciplines (mathematics, physics, etc., studied during the 1st year of the degree) and the applied ones, specific of this degree. Its contents are divided in 2 parts: atmospheric flight aircraft (with 3 different units) and space vehicles (with 2 units).

In addition to working specific competences of the degree, the students train the UPV “Effective communication” soft skill. This skill is developed in both its written and oral aspects. Hence, the evaluation of this course (Delgado 2006) comprises two open-answer exams (30% of the final grade), two multiple-choice tests (30%), an academic assignment assessed through a written report (30%) and the observation of laboratory sessions (which includes an oral presentation, 10%).

It is important to note that, as part of the training of the soft skill object of investigation, a session within Unit 2 of atmospheric flight aircraft part is specifically devoted to give guidelines to produce written reports, addressing their structure, how to include and reference figures and tables, which language register to use and how to properly cite external information. This session is designed with a practical point of view including recommendations and tips to communicate effectively together with issues to be avoided when writing. Particular examples are extracted from the reports handed by students of previous years.

#### 2.1.1. AT assignment

The academic assignment for which a written report must be handed consists on analyzing a real aircraft on the view of the theoretical lectures. Each student or group of students need to pick a different aircraft. In short, they are asked to perform three different kinds of tasks:

- Research tasks to get to know the aircraft specifications (3-view drawings, weights breakdown, cruise speed, cruise altitude, powerplant...).
- Analysis tasks: reasoning the aircraft configuration and structure, justifying the arrangement of systems within the aircraft according to its mission.



- Simple calculations concerning aerodynamics and performance, with basic tools that will improve in following courses. An analysis of the results is demanded.

Thus, besides applying concepts and providing descriptive work, it is intended that the students get familiar with some order of magnitude of the relevant parameters of real aircraft (weights, thrust, aerodynamic parameters, ...) through self-discovery.

The written report is evaluated through a scoring rubric (Tiseira 2015, Maldini 2010). Indicators of the rubric cover two different aspects: several dimensions merely related to its contents are assessed as 'Unsatisfactory' (0 to 4 marks), 'Fair' (5 to 7), 'Good' (8 to 9) or 'Excellent' (10) whose marks are additive; and language and appearance dimensions deemed to contribute to an effective communication, assessed from D to A. These grades are numerically assigned values from 0.7 to 1 and act as multiplicative factors to the previous ones in order to compute the final grades.

It is important to note that the assignment has suffered some modifications since the introduction of the rubric in the 2016-17 academic year, which are summarized as follows:

- To compensate for the growing complexity of the assignment, it is carried out in groups of 3 or 4 students from the introduction of the rubric in 2016-2017.
- In order to provide feedback to the students prior to the final submission, an intermediate submission was introduced in 2018-19. The impact of this action is analyzed in this work.

## **2.2. Advanced Fluid Mechanics**

Advanced Fluid Dynamics (AFM) is an elective course offered to third-year students of the Degree, although students in its fourth year may also take it (80 to 100 students enroll each year). The course is held during the first semester of the academic year, covering 4.5 ECTS. It is the continuation of a compulsory Fluid Mechanics (FM) course, which is taught during the second year. Both courses are carefully coordinated regarding shared contents, in order to promote the acquisition of the "01 - Comprehension and integration" soft skill (Dolz 2017). The contents treated in AFM are also divided in two parts: the first one can be considered as a continuation or extension of a corresponding unit in FM, meanwhile the second introduce to the student a useful tool to solve all fluid dynamics problems, such as Computational Fluid Dynamics (CFD), and a new fluid dynamic problem, which is turbulence.

The evaluation of this course (Delgado 2006) comprises one written exam (30% of the final grade), one multiple-choice test (30%), observation of laboratory sessions (10%) and one academic assignment (30%), which is designed as a short CFD project.

### 2.2.1. AFM academic assignment

AFM course project consists in solving any wall bounded flow problem the students may be interested in (open proposal) by means of CFD. By letting the students to come up with ideas for the topic of their project, they are involved in the project from the first step, which is setting the focus, refine the issue(s) and identify the stakeholder(s) (NOAA, 2009).

Together with the statement of the assignment, they are given guidelines to carry the project out successfully, and few examples organized by complexity. The evaluation rubric (Maldini, 2010) used to grade the report is also provided to the student in advance (Tiseria, 2015). It contains 5 criteria, 2 of them associated to the soft skill of study (formatting, writing), and the other 3 to technical or specific competences (difficulty of the study, procedure and results) to be evaluated in 4 different levels of performance, from A (highest) to D (lowest). This grading is later transformed to a numeric mark. Teachers also remind the students that they already have guidelines about how to write reports, and provide them again all the related material of AT.

## 3. Effects on the technical contents of the reports

A summary of the grades is presented in Tables 1 and 2 for the last four years and both courses. Results for the Advanced Fluid Mechanics course in the academic year 2015-2016 are not considered in this analysis because that generation of students did not carry out the written assignment the previous year in Aerospace Technology. The use of scoring rubrics allows differentiating the dimensions to be evaluated: Table 1 includes the results of the writing skills dimensions of the rubrics, whilst Table 2 considers the technical content of the reports. Results for the two first years of analysis of Aerospace Technology are not shown in Table 1 because the report was written and handed individually, not in groups, and that would not be comparable to the AFM assignment. The multiplicative factor of AT is converted to a scale of 0-10, so results need to be carefully analyzed or they would be misleading. As far as the evaluation of the technical contents is concerned, the marks the students obtain in the Advanced Fluid Mechanics course are lower than the ones in Aerospace Technology in all cases. This could be associated to the difficulty of the course and the assignment itself, but also to a higher degree of freedom in the selection of the topic in that course. Even though they are warned by the professors in the beginning, some groups select a more difficult topic with the idea of obtaining a higher grade.



**Table 1. Evaluation results of writing skills (max. 10).**

Year	Group	Average	Max.	Min.	Std. dev.
2015-2016	AT	-	-	-	-
2015-2016	AFM	-	-	-	-
2016-2017	AT	-	-	-	-
2016-2017	AFM	6.60	10	4.38	1.36
2017-2018	AT	6.47	10	0	0.23
2017-2018	AFM	5.31	8	3	1.27
2018-2019	AT	6.50	10	0	0.27
2018-2019	AFM	7.33	10	3.75	1.66

From the collected data on the writing and formatting dimensions (Table 1), results vary from one year to another. Only the introduction of the intermediate delivery improves the average result obtained by the students. Even so, the minimum score does not significantly change, probably because this review system is not motivating all the individuals. This would also explain why the standard deviation is higher in the last evaluated academic year.

As it has been said, data on the writing skills are not provided for the Aerospace Technology course during 2015-2016 and 2016-2017. Nevertheless, it is the perception of the authors that the performance of the students in this regard is substantially improving. During the first years reported (2015-2016 and 2016-2017), some students did not include a bibliography section and did not cite external information, despite the warning that this constitutes plagiarism. After this resulting in failed assignments when applying the scoring rubric and after introducing the specific lecture about writing skills, properly referencing has now become a standard among students. Similarly, the formal and impersonal language of written reports is also progressively being adopted by them. Thus, the presented method of assessment forces the students to make an effort on communicating information effectively, hopefully adopting these practices for the rest of their academic studies as the increasing grades in this dimension for the AFM course could suggest.

**Table 2. Technical contents evaluation results (max. 10).**

Year	Group	Average	Max.	Min.	Std. dev.
2015-2016	AT	8.55	10.00	3.50	1.55
2015-2016	AFM	-	-	-	-
2016-2017	AT	8.15	10.00	2.20	2.12
2016-2017	AFM	6.16	9.58	2.92	1.73
2017-2018	AT	8.89	10.00	6.30	1.03
2017-2018	AFM	6.72	10.00	3.75	1.37
2018-2019	AT	9.33	10.00	7.20	0.77
2018-2019	AFM	7.55	10.00	4.17	1.46

Trends observed in the evaluation of the writing itself (Table 1) are not reproduced in the technical part (Table 2). The average grade is similar in the different academic years, and there is always at least one group of students that outstands in this aspect of the reports, but some improvements in the minimum value are observed, as well as a reduction in the standard deviation of the results (less significant in the Advanced Fluid Mechanics course). In the case of Aerospace Technology, there is a reduction in the minimum value and an increase in the standard deviation of the marks showing up during 2016-2017, when the rubric was introduced. After that year, important rises in the minimum grade and reductions in the standard deviation have been observed. Further improvements have been observed during 2018-2019, after introducing intermediate deliveries. This action has also a significant effect in the course of Advanced Fluid Mechanics, the average grade of the technical part of the report increases 0.80 points from one year to the next, increasing 0.40 the minimum value. However, a stronger impact is observed in the dimensions related to the written skills, with an increase of about 2.00 points.

#### 4. Perception of the students

During 2018-2019 academic year, the students of Aerospace Technology took part on a survey about their experience and their results. Two of the questions were about the partial submission and about their performance. The overall opinion was positive towards performing partial submissions, and the students reported that they acquired new skills but

they worked more than they should have. In addition, the subjective feeling of the authors of this work is that students feel somewhat saturated by the amount of work done. Complaints about overwork are not, however, due to the extra care that they have to communicate properly, but due to the level of demand of the technical content.

## **5. Conclusions**

In this work, the experience of developing and assessing the effective written communication in the frame of two Aerospace Engineering courses is reported. Through progressive improvements made on the courses along the years, such as the introduction of a specific session devoted to this skill, the use of scoring rubrics or the splitting of the submission in different deliveries, an enhancement has been obtained in the readability of the reports delivered by the students. Forcing students to develop these skills during a 2nd year course seems to be translated into an improvement of the reports the same students produce in successive years. Even though no significant differences are noticed in the depth of the technical content they develop, they transmit more effectively these contents. With all, designing activities related to writing skills and a coherent evaluation procedure seems to allow students to produce reports that meet the standards in terms of use of language, format, citing and referencing.

## **Acknowledgements**

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## From specialized to core course in Telecommunications degree: Experiences from digital electronic design and verification

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### Abstract

*The European Higher Education Area (EHEA) defines the competences for professional practice of a Telecommunications Engineer. The School of Telecommunication Engineering of the Universitat Politècnica de València (Valencia, Spain) provides an integrated education program consisting of a Graduate (GITST) + Master (MUIT). The GITST course offers four specialization tracks: Electronics, Telematics, Communication Systems and Multimedia for the proper acquisition of knowledge and competences of the future Telecommunications Engineers. In 2018, the graduate program has implemented a structural change in the organization of subjects for reinforcing important skills, in which a course on digital electronics design and verification (Integration of Digital Systems, ISDIGI) has been transformed into a core subject of the study plan. In this paper, we describe the methodology and adaptation of ISDIGI (i.e. a project-based learning intermediate HDL course that includes design and verification abilities) to the new GITST Curriculum. In addition, this paper describes the process of moving from specialized to core subject.*

**Keywords:** Telecommunications, Digital Electronics, EHEA, study plan

## 1. Introduction

Moore's Law states that approximately every two years the number of transistors in a microprocessor is doubled. This means that today's a regular computer has a similar computational capacity as the NASA had when Neil Armstrong step on the moon, and that by 2025 a personal computer will have the computational capacity of a human brain. The advent of digital signal processing (DSP) systems, 32-bit microprocessors with internal DSP capabilities, Application Specific Integrated Circuits (ASICs) and Field Programmable



Gate Arrays (FPGAs) progressively replaced analog technologies by improving the maximum frequency range, stability and digital computing power with increasingly lower costs due to mass production manufacturing technologies. A FPGA is a programmable device that contains logic blocks whose interconnection and functionality can be electronically reconfigured. The FPGA design flow is based on specialized description languages, enabling hardware reuse for developing, testing and deploying digital systems. FPGA-based systems can be found in a wide range of applications, from aero-spatial systems to medical signal acquisition systems, including consumer electronics, power electronics and hardware acceleration. Hardware and software development environments have progressively included Hardware Description Verification Language (HDVL) as an integrated feature. HDVLs are languages that allow us to describe digital circuits together with their verification testbenches.

In 2009, the Spanish Ministry of Science and Innovation established the requirements of the official higher education that qualify for the profession of Telecommunications Engineering (Educación & Deporte, 2014). The current legislation defines the profession of Telecommunications Engineer as a regulated profession whose exercise requires the corresponding official degree, that complies with the new Bologna Plan promoted by the European Higher Education Area (EHEA). This ministerial disposition established the requirements that qualify for the exercise of the Telecommunications Engineer profession and specifically included: “*Knowledge and application of the fundamentals of hardware device description languages*” in the common study branch of the degree. In 2018, the graduate program for Telecommunications Systems Engineering of the *Universitat Politècnica de València* has implemented a structural change in the organization of subjects for meeting the ministerial disposition, in which the subject of Integration of Digital Systems (ISDIGI) has been transformed from specialized branch into a core subject of the study plan.

This update has posed an interesting challenge for both the faculties and students, as it required to change the teaching methodology and syllabus structure to cover a course demand of more than 120 students, when formerly it was prepared for up to 30 students in the Electronics specialized branch. In this paper we describe the rationale and methods for transforming a branch subject into a common subject, the new proposed course structure and the evaluation results after the first year of set up.

## 2. Theoretical framework

Bowden and Marton defined the characteristics that a quality learning environment should provide (Bowden & Marton, 2003). These characteristics included varied set of teaching methods comprising concepts, theories, abilities and competencies which should be embedded into an interactive process between teachers and students, and among students themselves. Another important point was the introduction of realistic activities, in such a way that students can recognise them as socially valued and thus motivate and stimulate their interest towards the course. More recently, the Tuning Educational Structures defined the learning outcomes as “*statements of what a student is expected to know, understand and / or be able to demonstrate after completing a learning process*”. Learning outcomes are a fundamental pillar of the Bologna process and it requires to adapt the objective learning strategy to a more practical educational scenario (Bologna Working Group, 2005). Learning outcomes stand as a very useful tool for the planning and organization of higher education courses. On the one hand, they support teachers on the preparation of their lectures to the achievement of specific objectives defined as knowledge, abilities and competences (ANECA, 2012). Furthermore, they allow the student to meet beforehand the requirements needed to achieve during the course of the subject and, specifically, at the evaluation points.

### 2.1. Multimedia based support

New technologies in the classroom and those elsewhere located, known as virtual classrooms, have changed the way in which higher education is structured, paving the way to evolve from a teacher-directed method to a student-directed one (Abrami, 2005). We aim at including screen-casts and video and audio objects embedded into the educational program so they can be used by students anywhere and at any time they need to reinforce theoretical concepts, put in practice technical concepts and practice the skills of the subject.

### 2.2. Course assessment and evaluation

The increase of students enrolled in the subject (which accounts for a +300%) after the conversion from specialized to core course made necessary to adapt the number of teachers, adding three more lecturers to a course that was initially lectured by three professors. This change posed interesting challenges in the way each lecturer was implementing the course for his respective group of students, but also a risk in the way the tasks and the learning outcomes should be assessed in an objective and fair base. To this end, rubrics have been previously proposed to evaluate very different kinds of technical projects and skills





(Mergendoller, Markham, Ravitz, & Larmer, 2006). Analytical rubrics are useful to split a learning product into several sub-components and evaluate them independently with objective and clearly defined metrics and scores. In this subject, we aimed at defining a standard rubric for the major evaluation assignments students had to develop. The evaluation of this task was carried out by means of iRubric, from RCampus (Rcampus, 2019).

### 3. Case description

#### 3.1. Structure of the subject and methodology

The subject is dedicated to the advanced verification and design of digital systems through the extensive use of System Verilog as verification and hardware description language. The presented program (topics, methodology and evaluation) are intended to provide an outcome-based subject for ensuring the following learning outcomes: 1) To analyse and design complex digital circuits architectures (i.e.: digital signal processing modules, microprocessor, etc.). 2) To use hardware description languages for the modelling and synthesis of combinational and sequential circuits. 3) To develop simple applications in assembly language 4) To implement advanced System Verilog-based automated verification methodologies and 5) To design testbenches that allow the functional validation of a module through hardware description languages. Table 1 depicts the course structure in chapters and the distribution of classroom lectures and the laboratory sessions.

**Table 1. Course structure and distribution**

<b>Chapter</b>	<b>Classroom sessions (hours)</b>	<b>Laboratory sessions (hours)</b>
System Verilog and Verification	10	8
Architectural design and partitions	8	4
High-level synthesis and temporal considerations	8	6
Data processing architectures	10	6

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As presented before, the main objective of the proposed methodology was the acquisition of competences by encouraging a growing autonomy of the students throughout the course. Accordingly, 75% of the percentage in the evaluation was dedicated to practical activities developed in teams from 3 to 6 students, while the theoretical part accounted for 25% and

was evaluated with two multiple-choice tests that had to be done individually. The contents of the course were introduced by means of an expository methodology in classrooms sessions, in addition, teachers motivated the participation of students through open questions or linking with the practical part of the subject. For the practical part, laboratory sessions were dedicated for team work. The teacher acted as a guide or mentor throughout the learning process. Tasks were also completed at home and individual or team tutorials and multimedia based support were also available. Even though the laboratory team was the same through the entire course, the roles of the members had to be swapped on each practical assignment. For instance, in the first project, half of the team should be devoted to design tasks, whereas the other half should be on verification task. In the subsequent projects, the team members who had done the design should move to the verification and so on.

### 3.2. Practical assignments

Laboratory sessions were aimed at developing two tasks (sections 3.2.1 and 3.2.2) and a project (section 3.2.3). Students were gathered into groups from 3-6 members, in which a half of them should focus on hardware design and the other half on the verification. Tasks had an atomic structure with clear and well defined objectives. The project consisted of a pipelined set of tasks (some of which could be developed sequentially or in parallel) with a clear definition of the control points (deliverables and progress reports), mandatory objectives and voluntary developments.

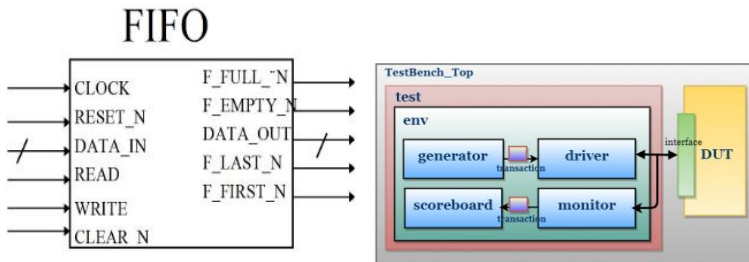


Fig. 1 Materials for task 1  
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#### 3.2.1. Design and Verification of a FIFO stack

Previous digital electronics courses are more focused on developing students design capabilities rather than verification. In this first task, students had to focus on verification and to get used to describe full test-benches with Verilog and learn new advanced

verification methodologies in System Verilog. During this task the student should gradually change their verification methodology from a Verilog based classical one to a System Verilog based self-checking methodology. In addition to functional simulations, developed as in the previous courses, students were provided with a much more powerful and complex testbench based on System Verilog, with the intention, that they understand a modern testbench architecture. During this task, students should add incrementally new verification functionalities such as the RCSG ("random constrained stimuli generation"), assertions, behavioural models or the functional coverage. In this way, students progressively learn the most typical System Verilog verification structures, as well as the types of necessary data for these tasks (Fig. 1).

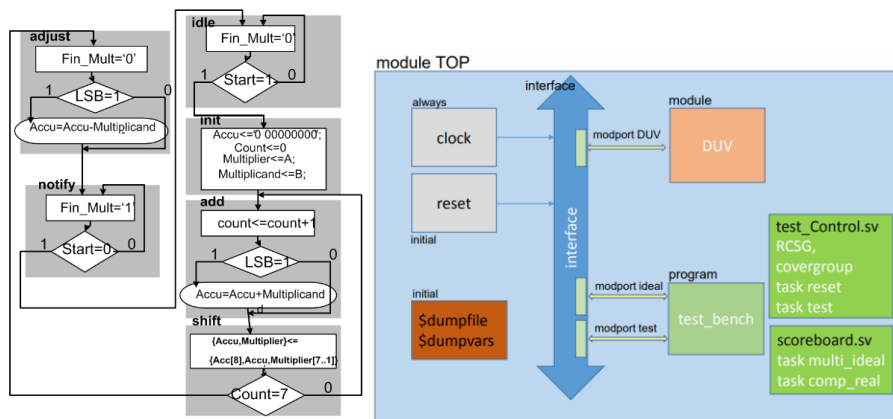


Fig.2 Materials for task 2

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### 3.2.2. Add and shift multiplier

In the second course task, students had to design and verify a parameterized two's complement binary multiplier. The proposed multiplier architecture is based on sums and shifts. The proposed design should be fully described in System Verilog with two hierarchical levels already introduced in the theoretical lessons dedicated to the "control-path" and "data-path" of a digital system and its architectural design (Fig. 2). A System Verilog automated tesbench should be developed to verify the described hardware. Finally, students had to implement their desings on the FPGA-based evaluation boards available in the laboratory.. However, at this stage, students started to miss classroom sessions and attended the practical sessions without the sufficient knowledge to extract the task requirements and draft the FSM (Fig. 2).

### 3.2.3. RISC-V micro-processor

The final task is focused on the design, functional verification and experimental validation of a simple microcontroller based on an instruction subset of the RISC-V architecture. The microcontroller had to be described in System Verilog so that it is synthesizable and can be implemented in the FPGAs in the laboratory. The experimental validation should be carried out in the laboratory through a simple application proposed by each team of students that makes use of the hardware resources available in the test module (Fig. 3). The project therefore covers the aspects of functional verification, microprocessor architecture, hardware segmentation, hardware description using System Verilog, implementation of a complex digital system integrated in a programmable device and assembly language programming of the RISC-V. The microcontroller was developed in four different phases. Phase 1 was focused on the design and validation of the functional units of the processor: instructions and data memories, register bank and arithmetic-logic unit (ALU). In addition, the programming model of the RISC-V architecture was introduced and put into practice by students through a series of simple assembler programs. Phase 2 consisted on the implementation of a single-cycle model of the processor. The priority was to deliver a fully functional model, which had to be validated exhaustively. Phase 2 model was then defined as the golden-model, which then allowed carrying out the verification of the segmented implementation.

Phase 3 was aimed at the hardware segmentation of the processor developed in the previous phase, as well as to the extent possible to carry out the introduction of mechanisms for the detection and control of risks that allow the execution of the instructions implemented without the need to introduce delay gaps or make segmentation stops. Finally, in Phase 4 students had to implement and validate the designed microprocessor in the Cyclone IV FPGA based board available in the laboratory. The objective was then to test simple programs that runs on the microcontroller and, using the elements available in the DE-2 module, carry out a simple application (e.g. control of LEDs, timing, use of the 7-segment displays, etc. ). The program had to allow interaction with the user (i.e. students had to use both the output pins and the input pins of the GPIO module). The final task was presented at the end of the course to a panel formed by the teachers of the subject, this final evaluation was useful to identify those students that contributed differently to the task.

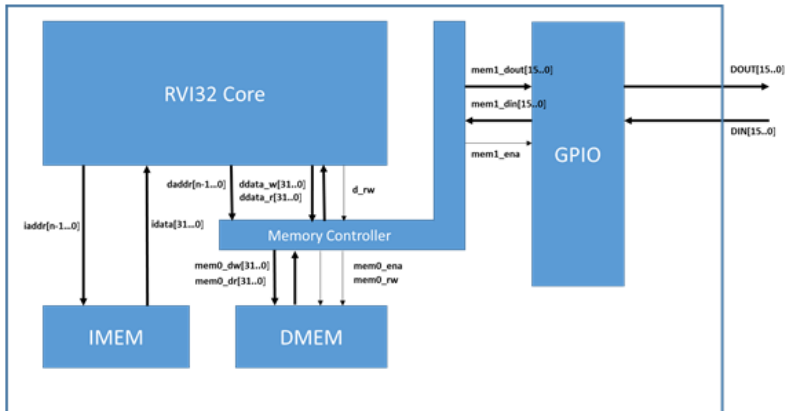


Fig.3 Materials for task 3.

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### 3.2.4. Evaluation and scores

Practical assignments were evaluated using an electronic rubric edited in iRubrics. We implemented three different analytic rubrics which defined three performance levels (indicators), each of them representing a factor for each of the assessed categories: Not implemented (0.0), Implemented (0.7) and Excellent Implementation (1.0). The assessment categories depended on the type of assignment, but the common structure contained Hardware Design (use of parametrization, comments in the code, proper use of System Verilog rules, coding style), Verification (implementation of a testbench, randomization, stimulus generator, cover-groups, timers and interfaces). The mark was in general shared for the whole team presenting the activity. Exceptionally, the grade was differentiated for those students who contributed differently to the task (abandoning team etc).

## 4. Discussion

In this paper we have described the process of converting a specialization course into a common branch course for the curricula of Telecommunication Engineer Degree under the EHEA. The approach presented hereby was successful in the way it enabled a collaboration with new lecturers in the team of professors and provided objective metrics and measurement methods to evaluate the attainment of learning outcomes. The evaluation with rubrics was different categories and objective indicators, a fact that allowed us to have an homogeneous criteria among the six teachers and helped students to know beforehand what

were the evaluating points and the scoring criteria (Martínez, Herrero, & De Pablo, 2011). The proposed approach for laboratory sessions was also satisfactory in the way team members switched on their roles, and tasks (from hardware design to software verification). Nevertheless, we should point out that in two of the assignments, students were provided with basic units of software so hardware designers and verifications could work in parallel. Multimedia based support were mainly videos that helped students in the development of tasks and project. They made compatible the different work rhythms of the teams and avoided team work interruptions. A major limitation was the low attendance rates to the classroom sessions, as it affected the normal development of laboratory. A significant part of the students did not had the knowledge that should be put into practice in the tasks with the consequent delay in the implementation. A secondary limitation was the imbalance in the achievement of the competences detected in some students in comparison with other members in their teams. To face these limitations, forthcoming courses will integrate attendance controls and more multimedia and flipped teaching resources (mini-videos, materials and tests) to mitigate the negative impact of students un-attendance. Self-evaluation, continuous and peer assessment tools will be evaluated in the upcoming courses to avoid imbalances in the teams.

In summary, the case presented describes the year of growth of a subject in which the practical part predominates. Despite the significant increase in the number of both teachers and students, the course has been completed satisfactorily, limitations were detected and improvements are proposed for the upcoming courses.

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## Improvement of transversal professional skills through cooperative work and group dynamics in the UPV Master's Degree in Energy Technologies for Sustainable Development (MUTEDS)

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### Abstract

*This article presents an updating of the structure, methodology and evaluation results after 4 years of teaching (courses 2015-2016, 2016-2017, 2017-18 and 2018-19) of a subject entitled Applied energy technology - Project course belonging to MUTEDS (Master's Degree in Energy Technology for Sustainable Development) at the Universitat Politècnica de València).*

*The presented subject is mainly focused on the improvement of professional skills as multidisciplinary teamwork and leadership, lifelong learning, competitiveness, planning and managing of time and effective communication in English. To work these skills, students have to do the exercise of creating a company (including name and logo) where there are 4 -6 students randomly selected and with different roles; this company evaluates the techno-economic and environmental feasibility of an energy project (related with energy efficiency and renewable energy sources in and specific location) during 8 technical sessions (in which roles change in each session), and present the project proposal in a public competitive event where the students vote for the best work according to their point of view. In parallel, transversal competences associated to the above mentioned professional skills and the academic quality of the reports are evaluated by the professors.*

**Keywords:** *professional skills, cooperative work, group dynamics*





## **1. Introduction**

The implementation of the new educational framework of the Bologna Process has required a redesign and adaptation of the curriculum of bachelor and master degrees, based on skills or competences development (García Manjón, 2008). Within this context, it emerges a new concept of teaching and learning, which is centered on the student and whose objective is that students learn to learn. For that purpose, and according to (Pérez Gómez, 2007), it will be necessary to create situations of uncertainty and dynamic processes where the students put into practice their knowledge and skills. Therefore, a correct development of competences will involve the simulation of real situations that the students will find not only throughout their professional lives but also in their daily lives. In these situations they will apply their knowledge (learning further concepts/tools if necessary) to solve problems that may arise. It should also encourage cooperative work among students, which includes activities such as dialogue, debate, multidisciplinary and multilingual teamwork enriched by the contributions of others, respect for differences, listening, teamwork, etc. This in turn affects the teaching methodology, planning and evaluation (Yániz, 2008).

In this context, the Universitat Politècnica de València (UPV), launched the UPV Transversal Competences Institutional Project (which began as a pilot experience during the 2014/2015 academic year, being the beginning of year 2015/2016 its definitive implementation). It should be noted that its fundamental objective was to establish a strategy of systematic evaluation of transversal competences, defining in which subjects they are acquired and how they should be evaluated, as well as accrediting the acquisition of such competences.

The potential of various active methodologies to enhance the development of transversal competences was analysed in (Robledo, 2015) from the students perspective, resulting the problem-based learning the most useful one, as it combines the acquisition of knowledge with the development of skills, attitudes and useful skills for the professional market; in addition, it is based on promoting the autonomous work of the students, who, organized in groups and tutored by a professor, should try to propose an effective solution to a problem which is characteristic of their professional profile.

This article presents the structure, methodology and evaluation results after 4 years of teaching (2015-2019) of a subject titled Applied energy technology - Project course (AETP) belonging to Master in Energy Technology for Sustainable Development (MUTEDS) at the Universitat Politècnica de València. The didactic techniques considered by professors to encourage participation and motivation of the student in class, the activities

developed to promote the cooperative learning in a dynamic environment, as well as the transversal competences assessment and the impact on the results will be presented.

## **2. Description of the subject**

### **2.1. Background**

The subject under study in this article is framed in the first year of the master MUTEDS of the School of Industrial Engineers (ETSII) at the (UPV). The aim of the master (described in (Master in Energy, 2019)) is to provide its graduates with the necessary knowledge to address professional activity or research work in the energy sector, according to the needs of sustainable development, so improving efficiency and CO<sub>2</sub>/energy savings, and limiting the environmental impact of the processes of generation, transmission and use of energy. The subjects of the master are organized in 3 modules: Module 1(mandatory subjects), Module 2 (optional subjects) and Module 3 (Master´s Thesis).

The subject AETP is mandatory, so it is included in Module 1. All the subjects of Module 1 are taught in English to comply with student exchange agreements with foreign universities, such as the agreement signed with the KTH Royal Institute of Technology in Sweden, to obtain a double degree.

The objective of AETP is the realization of a practical teamwork exercise focused on the design of an energy system for a particular application. The exercise will consist of a project design focused on renewable energies and energy efficiency, and includes the creation of a team, the dynamics of teamwork with different roles, the different phases in the development of a project design, search and compilation of information, discussion and synthesis of possible solutions, and finally an open door “commercial” presentation to sell the project.

### **2.2. Teaching methodology**

In the process of teaching and learning, there are a total of three main actors involved: the student or individual who will learn, the professor, and the subject contents.

As described in (Johnson, 2013), there are different models of teaching and learning that depend on the approach in which each of these actors fulfill its role.

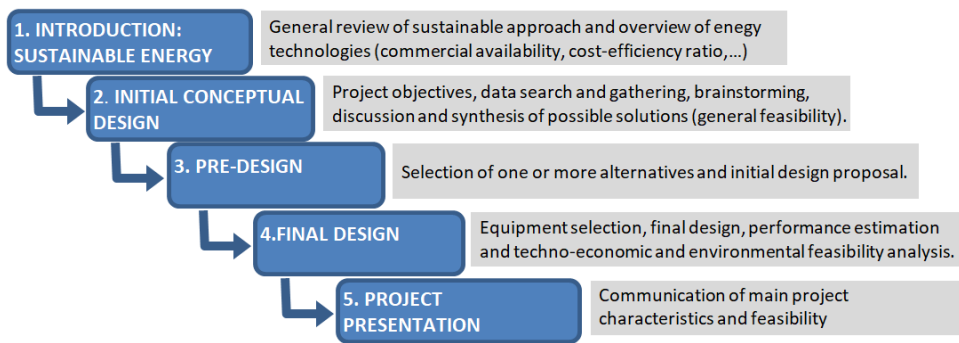
The model of teaching and learning or teaching methodology used in the subject under study in the present work is a student-centered model. In this model the main actor is the student. The professor is a figure that provides the necessary tools for students to build their



knowledge, helps on providing sources of information, answers general questions, refers to learning tools, etc., always trying to encourage students motivation. Therefore, within this model of learning, students search, organize, study and finally learn.

### 2.3. Contents: Learning units

The didactic units in which the subject is structured correspond to the phases of development of a project related to energy systems. Unit names and description are included in Fig.1.



*Fig. 1 AETP Didactic units and description*

### 2.4. Organization of the subject: group dynamics and planning

The first day of class students are grouped into groups of 5-6 people randomly selected and assigned to a project type. There will be two types of projects: Project A (PA) consisting of the basic design of a single-family house with almost zero energy consumption; and Project B (PB), which consists of designing an off-grid polygeneration system (electricity, heat and cold) for a single application based on renewable energy, mainly solar, wind, biomass or any other feasible energy resource available in the location of the project.

Due to the fact that the subject belongs to Module 1 (mandatory subjects), the teaching language used is English, which is also highly convenient due to the high number of foreign students (25-30% of students), that are either students coming from international exchange agreements of the master or ERASMUS students. This fact allows forming not only multidisciplinary but also multilingual and even multicultural teams.

The random assignment of students in each group is performed in such a way that it is guaranteed that at least there is one foreign student inside each group. Analogously, gender differences are also covered so that there is at least one female per group.

For each type of project, there will be one responsible professor who guides students along the different stages of the process. Figure 1 graphically shows how the subject is organized.

Depending on the number of students enrolled, there should be a total of 8 groups (4 per project type).

Students choose a company name for their group as well as a logo that will represent both themselves and the philosophy of the project. Within each group, there will be several roles identified:

- **LEADER:** manages the group, takes final decisions in the different phases of the project, and is the spokesperson with the professor.
- **SECRETARY:** makes the summary of each session reflected in the portfolio that will be sent to the professor at the end of each week of class.
- **STAFF:** 3-4 people following the orders and providing support to the leader.

Regarding the planning, it is organized in sessions of about 2-3 hours. The first two sessions are mainly focused on introducing the subject, roles explanation, teams creation and project type assignment. After these initial sessions there should be, at least, 8 teamworking sessions: 6 sessions in which the roles are randomly assigned at the beginning of the semester for each team member (each student has a number inside the team and the role to be performed in each session is assigned according to a calendar for each student number), and 2 last sessions, in which the team has to decide who will be the leader and secretary in each session. All students have to perform each role at least once. The structure of the **teamworking sessions** is presented in the following:

- **Introduction to the session** (10 to about 20 minutes): first, the professor performs a summary of the previous session; then presents the current session objectives, recommended list of tasks to achieve them and recommended tools/methodologies.
- **Teamwork by students in each group** (it is recommended a session duration of about 180 minutes but 120 minutes is also feasible, so that the effective time dedicated to students teamwork would be at least 140 and 80 minutes respectively).
- **Communication of results** to the professor by the leader and resolution of main doubts (limited to 5 minutes per group) at the end of the session. It is important to limit this time to make the leader summarize and organize the session performance and prioritize doubts.

The last two sessions of the course are focused on the project oral presentation. Each team has to do two project presentations: on close-door presentation with the professor (for academic work evaluation purposes) and one open-door presentation (for competences evaluation purposes) to the whole class. In the last session, students will vote for the best project according to this open-door presentation (where time is also limited to 20-30 minutes, and in which all the students have to participate during 4-5 minutes).

## 2.5. Evaluation

The evaluation process has been developed taking into account the new educational framework of the Bologna Process. Therefore, the competences development by students is assessed. According to relevant bibliography (Pérez Gómez, 2007) the approach of teaching and learning based on competences development will be focused on students to construct their own mental models. It is important to emphasize that the development of competences requires to provide safe and comfortable environment in which students feel free and confident to try new concepts or technologies, make mistakes, feeding back, correct and so improve their competences and knowledge. Transversal competences evaluated in the subject are included in Table 1.

**Table 1. Transversal competences evaluated in AETP**

Transversal competences	Description of key aspects in the subject
<b>TC01: Comprehension and integration</b>	Understanding of the objective, data and results integration, consistency of the methodology used and results.
<b>TC05: Design and project</b>	Selection and use of available tools and design methodologies
<b>TC06: Teamwork and leadership</b>	Teamwork during the different class sessions: encouraging debate, synthesis of solutions, innovation, etc. Leading/coordination of the group (for
<b>TC11: Continuous learning</b>	Continuous search for information, new methodologies, new design tools, etc.
<b>TC12: Planning and time management</b>	Distributing and planning the tasks to be performed by the team. Management capacity (for the role of secretary only).

As mentioned in (Cano-García, 2008), to conduct the competences acquisition assessment is necessary to sample executions of students and use observation as a strategy of systematic information collection. This process of collecting the information can be carried out by professors, by peers or by the students themselves (or all of them, in a 360° assessment model). In order to be able to assess the transversal competences through active observation and systematic collection of information, there will be a continuous evaluation

of the teaching-learning throughout the course (specially during the teamworking sessions). Key evaluation elements used during the teamworking sessions are:

- **PORTFOLIO:** consists of a paper document (also available in digital format) with main comments, decisions, notes, etc that stand for the work carried out in each teamworking session.
- **ACTIVE OBSERVATION:** professor has to observe the different teams during the 8 working sessions and make one/two interactions (5 minutes approximately) per team during each session (asking how they are addressing the objectives of the session, how is the work distribution and coordination inside the team,...)
- **LEADER ORAL SUMMARY:** at the end of each technical session, the leader communicates the professor a summary including the achieved goals and main difficulties/doubts found during the working session. The teacher may also ask for further clarifications of any aspect observed during the session or regarding the leader's summary.

The final qualification of the subject is obtained by means of the assessment methods and weights shown in Table 2. Each assessment method is evaluated numerically from 0 to 10 (in order to pass, student must have a mark equal or greater than 5).

**Table 2. Subject assessment methods**

<b>ASSESSMENT METHOD</b>	<b>Description</b>	<b>Weight</b>
<b>ORAL EXAM</b>	Evaluation of oral communication quality, audiovisual support tools, body language, timing, speakers coordination... KEY EVALUATION ELEMENT: ORAL PRESENTATION	40%
<b>ACADEMIC WORK</b>	Evaluation of quality/correctness of contents, coherence, scope, structure and format, ... KEY EVALUATION ELEMENT: FINAL REPORT	40%
<b>TEAMWORKING SESSIONS</b>	Evaluation of the team analysis and resolution of problems capability, critical thinking, motivation, innovation, completion of work... KEY EVALUATION ELEMENTS: PORTFOLIO + ACTIVE OBSERVATION + LEADER ORAL SUMMARY	20%

Regarding the evaluation process, there is rubric to evaluate students work in each of the assessment methods described in Table 2, which is provided to students since the very first day of the subject. The advantage of showing and using appropriate rubric headings is that it allows continuous self evaluation (for the students) which considerably improves the effective learning, as established in (Biggs, 2000).

It must be noticed that transversal competences evaluation doesn't follow this weight distributions shown in Table 2. As their evaluation mostly takes place during the teamworking sessions (specially for TC06 and TC12, where it is the main element). Regarding the transversal competences assessment, UPV established a common scale (A, B, C, D) to indicate the level of development of each transversal competence. In this scale A means excellent (when mark is  $\geq 9$ , out of 10), B appropriate (from 7 to 9), C developing (from 5 to 7) and D (when mark is  $<5$ ).

### 3. Results

Results about students assessment and transversal competences evaluation is included in Fig. 2. It can be observed that results are very positive, looking at the different assessment methods in the last two courses, 2017-18 (Fig. 2.a) and 2018-19 (Fig. 2.b), qualifications are in the range 6 to 10, and final mark was in the range 7 to 10. Taking a look at the evolution of the final mark during three consecutive years, as shown in Fig.2.c, it can be concluded that values are very close, being a slight increase in the average final mark from a value of 8.65 (course 2016-17) to 9.0 (course 2018-19).

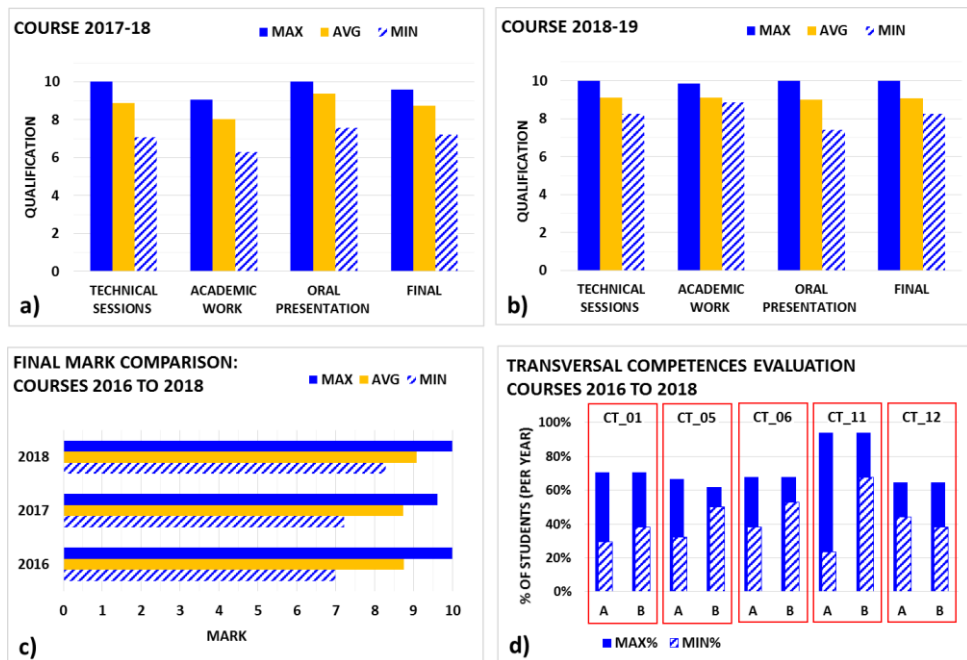


Fig. 2 AETP students assessment and transversal competences evaluation results.

Regarding the transversal competences evaluation, it was observed in the data that 95% of students obtained a qualification of A or B for any of the transversal competences analysed. Therefore Fig. 2.d takes only into consideration those students with A and B qualification, and presents the minimum and maximum percentages for the three courses analysed and for each transversal competence. So it can be concluded that the competences evaluation methodology was adequate or excellent in most cases (about 30-70% of students obtained a qualification of A, depending on the transversal competence). Transversal competences evaluation didn't show any specific trend for last three courses. It was also noticed that students with better transversal competences evaluations usually obtained better final marks in the subject. Regarding the evaluation of the subject carried out by the students, very positive results were obtained, observing a progressive teaching quality improvement with an initial value of 7.8 out of 10 (in course 2016-2017) to 8.6 in 2018-19. This was also confirmed by internal coordination meetings with students where it was also concluded that the key elements to motivate the students were the open-door presentations, the competition between teams and the "company" approach.

#### **4. Conclusions**

This paper presents the description, planning, teaching methodology and experience after 4 years of teaching (courses 2015-2016 to 2018-2019) of a subject titled "Applied energy technology - Project course" (AETP) belonging to the Master in Energy Technology for Sustainable Development (MUTEDS) at the Polytechnic University of Valencia (UPV).

Very good and consistent results in students assessment, transversal competences evaluation and students feedback were obtained. During the last three courses, a progressive improvement in these results was observed.

The fact that students had to work in a simulacrum of real situations such as being members of a multidisciplinary group inside a company that has to carry out a project, and make an oral presentation in competition with other companies, was a key motivation element for the students and it was reflected in the final marks. This, together with the teamworking sessions, resulted in a very useful tool to evaluate transversal competences.

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## The case method: study of a corrosion problem

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### **Abstract**

*The aim of the present work is the application of the case method as teaching-learning methodology for the study of a corrosion problem, in order to obtain more active learning of the student. The educational innovation has been applied in 2018/2019 academic year in the subject of “Manufacturing Processes of Building Materials” imparted in the fourth course of the Chemical Engineering Degree in the Higher Technical School of Industrial Engineering in the Polytechnic University of Valencia. Such educational innovation consists in the description by the lecturer of a real situation about a corrosion problem, so that the students can analyse it and propose solutions individually and in group. At the end of the case it is added questions to help to the students in the analysis. This activity is realized in class, which is evaluated using a rubric. The evaluation of the educational innovation proposed is realized by the scores of the students, the polls of the students, and the autoevaluation of the lecturer. The results show the high scores obtained by the students in the case method and the high grade of satisfaction of the students after applying the educational innovation. The case method permits that the students know real situations that they could find in a professional future, which increase the motivation towards the subject of study.*

**Keywords:** case method, corrosion, real situation, rubric.



## **1. Introduction**

The case method is part of a group of teaching methodologies called "active" due to the role of the student in the teaching-learning process (Bain, 2005).

The origin of the case method dates back to 1870 when Christopher Columbus Langdell introduced it to the Law School of the University of Harvard, substituting textbook reading for case reading. In that way, law students learned the laws facing real situations in which they had to make decisions, base resolutions, and evaluate actions. In the year 1914 the case is formalized as a method of teaching in the program of law under the term of "Case System". Due to its success the method of the case was extended to other disciplines such as business schools, medicine, psychology, political science, social sciences, etc., and in the last decades it has begun to be used in technical areas (Vázquez, 1995).

The method of the case consists in the description by the teacher of a real situation from which a problem to be solved is proposed so that the students can analyze it and propose solutions, favoring in that way the reflection and the learning of the students (Wassermann, 1994).

The description of the case should be clear, easy to read and with adequate terminology. It is advisable to add questions at the end to help the student in the analysis (Labrador, 2008).

The case method consists of several stages (López, 1997):

- Preliminary phase: reading and case study individually for the taking of consciousness.
- Phase of expression of opinions and judgments: reflection and search for answers to questions in an individual way.
- Contrast phase: pooling of analyzed data and responses in small groups. Subsequently, it is done the joint in the whole group. At the end of this stage the teacher can make the synthesis and express his own reflections and opinions on the problem that raises the case.
- Theoretical reflection phase: formulation of theoretical concepts derived from the case in small groups.

The benefits derived from the application of the case method for educational purposes in higher education are (Labrador, 2008):

- Encourages the student's active participation.
- It is based on real situations that the student will be able to find in a professional future, which increases the motivation towards the subject of study.

- It encourages students to work individually and then contrast their reflections with other partners, facilitating meaningful learning.

The aim of the present work is the application of the case method as teaching-learning methodology for the study of a corrosion problem, in order to obtain more active learning of the student.

## 2. Methodology

### 2.1. Context

The **context of the subject** in which the case method is applied corresponds to the subject of "Manufacturing Processes of Building Materials", taught in the 4th year of the Degree in Chemical Engineering at the Higher Technical School of Industrial Engineers (ETSII) of the Polytechnic University of Valencia (UPV). This is an optional subject of the subject "Mentions-ETSII (Industrial Processes)" within the "Itineraries" module. The subject is taught in semester B and it consists of 4.5 credits (2.5 credits of theory, 1.1 credits of classroom practices, 0.6 credits of field practices, and 0.3 credits of laboratory practices). Three general and specific competences are expected to be achieved by the students in the subject: 1) design processes in the different industrial activities in the field of chemical engineering (specific competence), 2) make decisions and reason critically (general competence), and 3) design equipment, installations, and services in the chemical industry (specific competence). The transversal competence of "understanding and integration" is developed and evaluated in the subject, which is check point. The number of students enrolled in the 2018-2019 academic year was 15. The fact of having a small number of students can facilitate the development and evaluation of the case method.

The **context of the case method** within the subject corresponds to topic 6 of "Processing of steel" within the didactic unit 3 on "Manufacturing processes of metallic materials used in construction". The objective of this topic is that the student knows the manufacturing processes of iron and steel and their applications in construction.

### 2.2. Design of the activity

The **teaching objective of the case method** is that the student knows one of the contemporary problems that can arise in the applications of steel in construction: the **corrosion of steel**. For this, the student must be able to:



- Identify the problem of steel corrosion, specifically the corrosion produced by chlorides in marine environments, analyzing their causes and consequences.
- Propose alternative solutions to avoid corrosion, relating them to existing solutions.

### **2.3. Development of the activity**

The case method is carried out within the credits of classroom practices of the subject. To do this, once the explanation of topic 6 on "Processing of steel" is finished, the case method is proposed as an activity to be carried out in class. The duration of the activity in the classroom will be one hour. It is divided in two parts. In the first part, the students are organized in groups of 2-3 people. Students are given the statement of the case. Some time is left in class for the students to read the case carefully and then each group answers the questions proposed. At the end of the class each group gives the task to the teacher. The duration of the first part is about half an hour. The second part of the activity is realized at the beginning of the following class for half an hour. The teacher gives the students the corrected tasks. The answers are shared in the whole group. At the end of this part the teacher makes a synthesis of the activity.

### **2.4. Evaluation of the activity**

The evaluation of the activity is carried out by the teacher based on the task delivered in a group manner through a **rubric prepared with iRubric** (Table 1). Students have the rubric of evaluation during the development of the activity to be able to know previously the criteria with which they are going to be evaluated.

The rubric of evaluation of the case method consists of 4 indicators, which are evaluated with a scale of 0 to 3: not reached (0), in development (1), good/adequate (2), and excellent/exemplary (3). The evidences of the students to be able to perform the evaluation of the activity are:

- **Indicator 1:** Identify the causes of the problem. **Evidence:** answer to question 1 of the case.
- **Indicator 2:** Identify the consequences of the problem. **Evidence:** answer to question 2 of the case.
- **Indicator 3:** Reason (criticizes) the solution already proposed for the problem. **Evidence:** answer to question 3 of the case.
- **Indicator 4:** Proposes new solutions to the problem. **Evidence:** answer to question 4 of the case.

**Table 1. Rubric for the evaluation of the case method (author own elaboration).**

INDICATORS	DESCRIPTORS			
	Not reached (0)	In development (1)	Good/adequate (2)	Excellent/exemplary (3)
Identify the causes of the problem	It does not identify any cause.	Identify few causes and do not explain them.	Identify many causes and partially explain them.	Identify many causes and explain them in detail.
Identify the consequences of the problem	It does not identify any consequences.	It identifies few consequences and does not explain them.	It identifies many consequences and partially explains them.	Identify many consequences and explain them in detail.
Reason (criticizes) the solution already proposed for the problem	It does not reason (criticize) the proposed solution or it does it wrongly.	Reason (criticize) the proposed solution incompletely.	Reason (criticize) the proposed solution in an appropriate way.	Reason (criticize) the proposed solution and analyze it optimally/satisfactorily.
Proposes new solutions to the problem	It does not propose any new solution.	It proposes some new solution, but it does not develop it.	It proposes new solutions, justifies them, and develops them.	It proposes new solutions, justifies them, develops them, and relates them to the existing solution.

The teacher gives feedback to the students of the evaluation of the case method.

### 3. Results

The evaluation of the educational innovation proposed is realized by the scores of the students, the opinion polls of the students, and the autoevaluation of the lecturer.

#### 3.1. Scores of the students

Table 2 shows the results obtained by the students in the case method realized in class in the subject of “Manufacturing Processes of Building Materials” in the 2018-2019 academic year. The number of students that realizes the activity of the case method is 14. The students are organized in 6 groups: 2 groups of 3 students and 4 groups of 2 students. The evaluation of the activity is realized for each group. Each box in Table 2 is divided into two parts: on the left side is shown the number of groups who obtains each of the scores and on the right side is shown the percentage of groups.

The results shown in Table 2 indicate that the students obtain good results in the evaluation of the case method realized in class. For each of the indicators evaluated with the rubric (except for the indicator 1), the highest percentage of groups obtains a score of 2 (good/adequate). There are no students with a score of 0 (not reached). In the case of the indicator 1, the highest percentage of groups (67 %) obtains a score of 3 (excellent/exemplary), while 33 % of the groups obtains a score of 2 (good/adequate).

**Table 2. Scores obtained by the students in the case method realized in class in the subject of “Manufacturing Processes of Building Materials” in the 2018-2019 academic year (author own elaboration).**

Indicator	Scores			
	Not reached (0)	In development (1)	Good/adequate (2)	Excellent/exemplary (3)
Indicator 1	0 0 %	0 0 %	2 33 %	4 67 %
Indicator 2	0 0 %	1 17 %	5 83 %	0 0 %
Indicator 3	0 0 %	0 0 %	5 83 %	1 17 %
Indicator 4	0 0 %	2 33 %	4 67 %	0 0 %

*Indicator 1: Identify the causes of the problem.*

*Indicator 2: Identify the consequences of the problem.*

*Indicator 3: Reason (criticizes) the solution already proposed for the problem.*

*Indicator 4: Proposes new solutions to the problem.*

### 3.2. Opinion polls of the students

Students fill out an opinion poll of the subject the last class day. The opinion poll has two parts. In the first part, the students must fill out a table with the strong points and the weak points about different aspects in the subject. In the second part, the student must assess a total number of 18 items, in a scale of 0 to 10 points, including the case method: very deficient/very low/very inadequate (VD/VL/VI) with 0 points, deficient/low/inadequate

(D/L/I) with 2.5 points, regular (R) with 5 points, good/high/adequate (G/H/A) with 7.5 points, and very good/very high/very adequate (VG/VH/VA) with 10 points.

Fig. 1 shows the results of the opinion poll of the students about the case method realized in class in the subject of “Manufacturing Processes of Building Materials” in the 2018-2019 academic year. The total number of opinion poll processed is 15 (100 % of the registered students). According with the results obtained, the majority of the students considering the case method realized in class as very adequate (7 students, being the 47 % of the polled students). The other students considering the case method as adequate (5 students, being the 33 % of the polled students) and regular (2 students, being the 13 % of the polled students). Only 1 student (7 % of the polled students) indicates do not know/no answer (NK/NA).

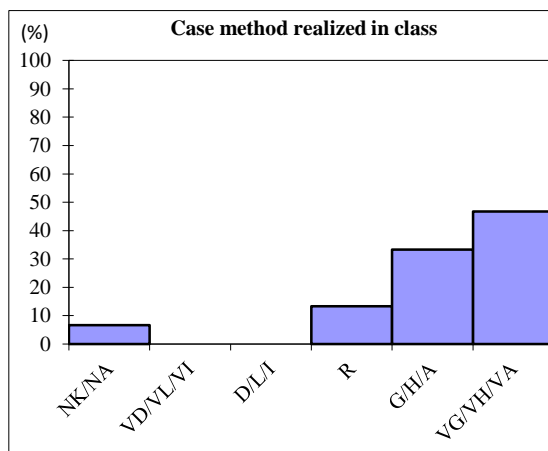


Fig. 1 Results of the opinion polls of the students about the case method realized in class in the subject of “Manufacturing Processes of Building Materials” in the 2018-2019 academic year (NK/NA: do not known/no answer; VD/NL/VI: very deficient/very low/very inadequate; D/L/I: deficient/low/inadequate; R: regular, G/H/A: good/high/adequate; VG/VH/VA: very good/very high/very adequate) (author own elaboration).

The item about the case method realized in class obtains a mark of 7.83 with a standard deviation of 1.82, which indicates high grade of satisfaction of the students.

### 3.3. Autoevaluation of the lecturer

The experience about the use of the case method in class is very positive. The case method is an useful tool for the student and the lecturer. From the student perspective, the case method permits that the students know real situations that they could find in a professional future, which increase the motivation towards the subject of study.

In addition, from the lecturer perspective, the case method allows to apply a teaching-learning methodology for the study of a real problem, as it is the corrosion of the materials,



in order to obtain more active learning of the students. It also allows the lecturer to use a rubric as evaluation tool so that students can know the criteria with which they will be evaluated.

As a proposal for improvement for future courses, a short student poll could be carried out at the end of the activity to know if the case method is an effective way to increase student motivation and participation. It could be realized using the tool of “sondeos” in the e-learning platform PoliformaT.

#### **4. Conclusions**

The present work describes the application of the case method as teaching-learning methodology for the study of a corrosion problem in the subject of “Manufacturing Processes of Building Materials” in the 2018/2019 academic year. The activity consists in the description by the lecturer of a real situation about a corrosion problem, so that the students can analyze it and propose solutions individually and in group. This activity is realized in class, which is evaluated using a rubric. The results show the high scores obtained by the students in the case method and the high grade of satisfaction of the students after applying the educational innovation. The case method permits that the students know real situations that they could find in a professional future, which increase the motivation towards the subject of study.

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## Learning to transform: The pillar that reshapes education

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### **Abstract**

*Education is the key in mankind's journey towards a free, just, and peaceful world; nevertheless, education policies fail to make the top of the lists containing government priorities. Taking into account Jacques Delors' approach regarding the Four Pillars of Education, which appeared for the first time on the 1991 UNESCO Report, and in an attempt to address the need for socially-responsible global citizens, this paper looks at learning to transform as an additional pillar that can help anchor the educational experience in all aspects of the person's life. The article explores the function of education, revises Delors' contribution, attempts to define the renewed spirit of transformation, and explores learning to transform in four distinct stages: learn, reason, act, and reflect. It is through transformation and self-transformation that the learner can alternatively become a teacher while forging relations in groups of people.*

**Keywords:** *Learning, transformation, education, global citizenship.*

### **1. Introduction. The educational function**

In his opening reflection on education, Jacques Delors puts in plain words that education “constitutes an indispensable instrument for humanity to progress toward the ideals of peace, freedom and social justice” (1991). In this sense, the members of the International Commission on Education for the 21st Century have identified a way to service a genuine and harmonious human growth within the role of education in the continuous development of people and societies.

Although it is still true that we can speak with a touch of disappointment about economic and social progress, it is also true that we have become more conscious about the threats that loom over us. This encourages us to participate, from the sphere of education, towards



“sustainable human development, mutual understanding among people, and the renewal of an effectively-lived democracy” (Delors, 1991).

This development is attainable, from the ethical perspective, as long as we rise above a series of tensions the Commission has identified as part of the problems of the XXI century: The tension between global and local, universal and singular, tradition and modernity, short and long term, competence and equal opportunities, knowledge development and human capacity for assimilation; and, finally, between spiritual and material ambits.

Overcoming these tensions involves a life-long task; one in which each day represents an opportunity to develop the potential of the person, to mature his or her talents and creative capacities, to take responsibility for their own actions, and to fulfill their personal project. Permanent education consists of a continuous structuration of the human person, his/her knowledge, aptitudes, and judgment and action faculties (Delors, 1991). According to Francisco Cua, the comprehensive human development consists both on self-awareness and on personal relationships. It involves the totality of the mind, body, intelligence, sensibility, aesthetics appreciation and spirituality, starting in infancy and stretching from that point forward (Cua, n/d). Therefore, this continuous structuration covers the independent and critical way of thinking and judging of each person, which allows decision-making regarding the best courses of action in different life situations.

It is a task that acknowledges self-awareness and responsiveness to the environment while inspiring action.

## **2. The four pillars of education**

In Chapter 4 of the UNESCO Report, Jacques Delors described four roads to knowledge that are inextricably linked and around which education is structured to fulfil its functions. Delors called these learnings “pillars”. For each person, they will become the foundations upon which the understanding of the world will be built. The four pillars of education are:

1. **Learning to know.** Beyond the acquisition of structured knowledge, this pillar is about developing the abilities (competences and skills) required to understand reality. In this sense, it can be regarded both as a means and an end in life (Lee, Choi / Choil, 2017). Learning to know is about perceiving oneself as competent with the abilities cultivated; it is also and about finding satisfaction in the knowledge that has been built; finally, it is learning to think in order to magnify the human experience.

2. **Learning to do.** Learning to know helps understand reality, and learning to do helps face it. It allows the person to participate in professional and social activities to tackle emerging situations. It is the pillar more closely linked to vocational training, and emphasizes the way in which education can be adapted to future work when it is impossible to foresee exactly how that work will evolve (Lee, Choi & Choil, 2017). Learning to do helps develop self-initiative and collaborative competences that make it easier to use information, knowledge and creativity.
3. **Learning to be.** This pillar is a response to the personal invitation to reflect upon one's personality and to explore personal talents. In this stage, the development of abilities is focused on personal thinking processes, judgments based on personal beliefs, and the capacity of autonomy and personal responsibility. Education must contribute to the all-round development of the individual, which is the complete fulfillment of man (Lee, Choi & Choil, 2017). Delors (2013) suggests that this is the hardest thing to achieve in education: fully developing the creative potential of each individual in all its richness and complexity.
4. **Learning to live together.** This pillar is based on understanding others, recognizing interdependence, building a positive perspective of competence and preparing to deal with conflict from the standpoint of respect to pluralism and peace. It includes tolerance, respect, welcome, embrace, celebrating difference and diversity in people, and responding constructively to the cultural diversity and economic disparity around the world (UNESCO, 2012b). When we learn to live together, ties that bind people together beyond differences emerge.

Based on the idea that education is a lifelong task, it is essential to recover the concept of educational society; a notion that recognizes limitless possibilities to learn, not only in learning communities, but in every experience of cultural, economic and social life. With no doubt, this presents a demand that we are called to answer: We need to learn to learn (Delors, 1991).

In 1990, during the World Conference on Education for All in Jomtien, Thailand, the assembly recognized the urgency to contemplate education as an agent that enables people to “survive, fully mature their capabilities, live and work with dignity, participate in development, improve their quality of life, make well founded decisions and continue learning” (Jomtien, 1990).

Learning to learn, and continue learning... But, what for?



### **3. A renewed spirit**

Delors orientating utopia consists on ensuring that the world converges towards increased mutual comprehension, intensifying the sense of responsibility and solidarity supported upon the basis of accepting spiritual and cultural differences. In other words, we are hoping to shape citizens of the world through a conscious and active practice that must originate in schools giving place to a renewed spirit that inspires students to make a positive difference in the world: A transformational spirit.

Oxfam Education's proposal of Basic Competences for Global Citizenship recognizes Jacques Delors' perspective of the person as a whole, and enriches it through education for global citizenship, which allows to add a new pillar to the four learnings presented in the UNESCO Report, one that is aligned with building a more just world: Learning to transform (Oxfam, 2005).

Learning to transform therefore entails shaping the "renewed spirit that promotes the realization of common projects, searching for intelligent and peaceful solutions to unavoidable conflicts" (Delors, 1991) and developing the competences required to engage in responsible interactions while building a more just and sustainable world; in brief, to act in the quest of the common good, because education is a social experience.

This renewed spirit should impregnate not only the students. All the actors that conform the educational society need to deploy their abilities to contribute to the transformation: parents, principals, and the local community are also participants in this learning process. We are encountering a spirit that transforms and is transformed, making space to a society in which each member will alternatively become educator and learner (Delors, 1991).

### **4. What is transformation?**

"Do not conform to the pattern of this world, but be transformed  
by the renewing of your mind." (Rom. 12:2)

María Moliner's Dictionary for the use of Spanish defines transformation as "giving a different form or appearance to something or someone", "transmutation in another thing", and, in the case of electricity, "changing with the help of a transformer". In the quote by the apostle Paul cited at the beginning of this section, the term employed in early Greek is metamorphosis (*μεταμόρφωσις*), a word that the Dictionary of the Spanish Language of the Royal Spanish Academy (RAE) defines as "a move that someone or something does



from one state to another”; and when analyzing living beings, it is a “change that they experiment during their development and that manifests itself not only in the variation of form but also in the functions and in the genre of life”.

Adapting Moliner’s definition to educational society, the possibility of achieving change through a transformer becomes an evident and reachable learning goal; this means, a transformational agent, a transformative leader. Considering the definition proposed by the RAE, it is possible to assume that change is experimented throughout the development of skills but that it originates in human nature. As long as it is sustained with the adequate nutrients, the person transforms altogether; very much like the caterpillar, which is not disguised as a butterfly, but actually is one.

If transforming (and transforming oneself) depends on an important measure of the “adequate nutrients”, it is also required that these nutrients are effectively assimilated because genuine transformation starts with an internal change. Learning to transform is a gradual process that emerges from a renewed state of mind, a new attitude, and culminates with the external expression of concrete activities once a series of conditions from the educational sphere are being met:

- a. Searching for the truth, observing reality as it is (learning to know, stemming from conceptual contents)
- b. Being conscious and contemplating reality from the perspective of the common good (learning to live together, stemming from the behavioral contents)
- c. Educating in justice; reflecting on what is fair (learning to become, stemming from the attitudinal contents)
- d. Identifying what is missing and rehabilitating reality (learning to do; stemming from experiential contents)
- e. Finally, socializing change, sharing achievements, and moving from being a learner to being an educator.

By alternatively shifting from learner to educator, the person is called to “feel oneself with the other” (Ballesteros n/d). Global citizenship therefore becomes a collective action that allows to transform the world through a dynamic process, improving it to guarantee the common good. Transformational leadership emerges from a pedagogy of full participation. In this sense, Robinson (2009) acknowledges the importance of developing a sense of cultural identity in students, an idea of their place in the world so that they will be able to choose their standpoint in any scenario.



## **5. Learning to transform**

Learning to transform is supported on the postulate that people have the power to change themselves and to change things. The concept has been analyzed from the perspective of sustainable school transformation (Crossley & Corbyn, 2010), and sustainable development (UNESCO, 2012; Rieckmann, 2018).

In 2012, the UNESCO presented the Education for Sustainable Development Initiative, which included a conceptual model for ongoing, lifelong learning based on Delors' four roads to knowledge, adding an additional pillar: Learning to transform oneself and society, in the understanding that when individuals and groups gain knowledge, develop skills, and acquire new values as a result of learning, they are equipped with tools and mindsets for creating lasting change in organizations, communities, and societies.

The importance of learning to transform is based on specific claims of the newer generations; young men and women who will develop critical thinking skills and who will be able to ask themselves transcendent questions. It is a responsibility of schools to equip children and young adults with the knowledge, skills and values that will promote their participation in society.

By learning to transform, students will be able to acknowledge the complexity of global affairs and to discern the global dimension as a part of everyday life in their local surroundings. In this way, they will discover and understand their relation with the environment and the people they share the planet with (Oxfam, 2005).

Learning to transform is educating for global citizenship; it is about accompanying the development of persons who want to understand the way the world works in all aspects (environmental, cultural, economic, social and technological). Being a global citizen, the individual who learns to transform is conscious about his/her environment, realizes that he has a role in it, and is willing to take action while respecting and valuing diversity. The person we are talking about takes responsibility for his/her actions, finds social injustice offensive, and participates in community life (Oxfam, 2005).

It is possible, then, to speak about a process inspired by Mark Sanborn's potential matrix (2017) and Bustos, Hernández & Riojas' social justice approach (2011); one that organizes learning to transform in four distinct stages that correspond to the areas outlined in Sanborn's personal development route (Learn-Reason-Act-Reflect):

1. Learn: It is based on knowing the content (topic, problem), considering it from multiple perspectives, trying to understand the causes that provoked it and the

consequences that it would bring about. Individuals acknowledge previously established beliefs and develop cultural competence.

2. Reason: Entails a critical consideration of what can be done based on the problem, connects it to the values and global perspectives in order to understand the nature of power and action. Individuals plan actions to raise awareness and to experiment.

3. Act: Consists on planning and executing actions as a global citizen would, both individually and collectively. In the sense of praxis, it is a reflection-action about the world in order to transform it (Freire, 1986).

4. Reflect: It is based on reconsidering, questioning, celebrating and learning from actions that have been taken.

The process is also supported by Vygotsky's Theory of Sociocultural Cognitive Development (Moll, 2013), since social interaction in a context always influences learning.

## 6. Final considerations

Richard Leblanc affirms that when learning occurs, the person is transformed the moment in which synapsis and neurons form a connection and structure a thought; this transformation is notorious even in minor details such as facial features.

Learning to transform entails transcending the traditional notion of competence, including attitudes, conditions and needs; increased reliability, knowledge of disciplines, credibility, domain of relevant skills, interpersonal, communication and decision-making abilities; intelligence and intuition, all of which are immerse in a personal commitment for change (Cua, n/d).

Change will find its way when communities assume the responsibility for their own development and their innovation capacity; when we value the role of the educational society orientated towards improving the quality of life and towards achieving the common good (Delors, 1991).

To transform and to transform oneself into an agent of change or a transformational leader requires a new state of mind. This new mentality is not only about accepting different points of view or opinions, nor about the mere ability to perceive or detect something. It requires to take a stand, to show a conduct, an orientation, an attitude, and an inclination. Just as Paul exhorted the Romans: to transform oneself, one requires to be renewed "in the spirit of the mind".



This is an open invitation to assume the knowledge of reality, stemming from the commitment to action, as a vital instrument. The change that we need and desire will only be possible if we learn to transform. The starting point for the transformation of the world and for our own transformation needs to be based on what is familiar and constant; the near and the daily, feeling one with the other to find each other and to find a way to be and to do things (Ballesteros, n/d).

As Paulo Freire has stated, education does not change the world, but it does change the people who will change the world (Freire, 2000).

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## The development of Business English courses using online technology to address the emerging needs in the Cypriot context

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### **Abstract**

*The global financial crisis, the implosion of the local economy in Cyprus, as well as European and global trends pertaining to the modernization of Higher Education (HE), have urged educational administrators, departments and faculty members to rethink the mode of delivery of their traditional face-to-face courses and redesign them with the support of electronic online platforms, Moodle is a case in point, in blended learning mode or entirely in Distance Learning mode and thus increase student enrollement and satisfaction as well as minimize costs for their respective institutions. Towards these goals the utilization of the Moodle Learning Management System has been in a gradual manner widely accepted and has been increasingly gaining popularity at the European as well as at the global level in helping converting traditional courses into online ones apart from introducing options for blended learning. In this paper, I present initially the rationale behind the need to redesign and deliver a Bachelor degree in Business Administration in Distance learning mode in the first language of the majority of the enrolled students, Greek. Then I move on to describe the steps taken in order to offer for the first time the course BADM231 (Business Communications) in Greek using the Moodle Learning Platform to convert the traditionally taught course while I also present and discuss the associated challenges prior to launching the course in entirely Distance Learning Mode in Spring 2018. Finally I briefly report on the solutions sought and their implementation and I close by setting the goals for the future.*

**Keywords:** *Distance Learning, Electronic Learning Platforms, 21<sup>st</sup> century learning, Effective teaching and learning, Language in the Workplace*



## **1. Introduction**

Learning through the internet has been increasing gaining popularity in the field of HE in Europe (Rys and Chadaj, 2014) and beyond (Habiba and Crowdhury, 2012), while at the same time the demand for offering courses in the mother tongue – particularly in multilingual environments - has intensified in many countries (Cf. Bamgbose, 2004; Jayaram, 1993). The incessant competition in securing student numbers intact in times of economic recession has led educational management in institutions, particularly in the private sector, to redesign courses traditionally taught in the island's widely spoken official language, Greek.

This in turn has increased the demand for lecturers fluent in the mother tongue, to redesign, administer and deliver courses entirely in Greek. This process has been slow, as the change did not only imply translating the slides from one language to the other; it has led to a number of associated challenges, including finding appropriate bibliography and relevant resources in the target language.

In the sections that follow, I explain in detail the rationale as well as the steps taken in order to convert the course BADM231 (Business Communications) in Greek as BADM231DG (Επιχειρησιακή Επικοινωνία) which was offered for the first time under the Distance Learning Programme of the University of Nicosia, in Spring semester 2018 under the degree Business Administration (Διοίκηση Επιχειρήσεων).

## **2. Educational Needs in the Cypriot context**

### **2.1. Background**

Cypriot economy relies mainly on two major sources, tourism and services. Following the haircut in 2013, when many companies imploded, educational administration in the private sector in particular has been involved in a process of making strategic decisions to safeguard interests and income while assisting to the boosting of the overall economy. The University of Nicosia, loyal to its contribution to society, has recorded the recurrent need to offer courses in Greek, to its local, i.e.: face-to-face audiences but also abroad, mainly in Greece and in countries where there is a strong Greek presence, i.e.: Canada, Australia and the US among others.

Further to this, the haircut of the funds in the two main banks on the island, the merge of these two banks and the inclusion of the island to the EU emergency support mechanism, have had a number of overt and covert consequences for the Cypriot market. Instantaneously, many companies' payrolls could not run as funds over 100000 euros were subjected to a haircut. As a result, many people were made redundant immediately or sucked depending on their contractual agreements. At the same time, many individuals saw a lifetime's savings turn to ashes. Many had to seek psychological support in order to deal with the losses. The vast majority of employees, both in the public and private sector had to sacrifice parts of their salaries to contribute to the improvement of the country's finances: a percentage had to be paid to the government in the form of "special contribution". Others had to accept greater deductions in their salaries in order to avoid layoffs in personnel and secure the number of posts within companies.

Loan agreements were also on a certain extent in jeopardy as households found themselves overnight unable to pay off mortgage agreements and/or other loans. Numerous loan agreements were renegotiated, others became cases for mediation following directives from the Financial Ombudsman while some were sent off to court. All the aforementioned changes, have had an impact on the overall economy. Private universities, whose primary income comes from student tuition suffered great losses as many students could not afford to pay their fees. Several easements were offered to students while at the same time, management urged departments to come up with alternatives to respond to the emerging needs and increase income.

### **3. The significance of e-learning as a means to boost education and income**

According to Sloman (2001), e-learning allows the delivery of information, communication, education and training with the use of online tools. The flexibility of electronically-based approaches allows for teaching, learning and training to be conducted anywhere, anytime. As such, it leads to major savings in operational costs, including travel and accommodation expenses, facility maintenance and utility costs. Learning can occur synchronously or asynchronously allowing dispersed users to access online learning tools from various locations while remaining committed to work or personal obligations (Cf Matijašević-Obradović et al 2017).

With the implementation of e-learning tools most activities are centrally monitored and recorded allowing participants to watch them either at the same time or whenever they so wish. Possibly the most popular learning platform in Higher Education is Moodle which provides a free, open-source platform for distance learning. The platform may be used as a





primary tool for teaching and learning, for courses that are offered entirely in Distance Learning mode for example, but also as an additional tool to complement learning offered in the traditional face-to-face mode. The software allows for easy creation, management, delivery and modification of courses, it is as safe as other software used in other organisations in the field of Higher Education, but also beyond it (Kovačević and Gavrilović, 2011) and it is increasingly growing in popularity in the global scale (Milićević and Milić, 2014). The Moodle educational platform can be accessed by different users such as teachers – who create and regulate the content, students – who can view the uploaded content and submit coursework, assignments and access forums for the courses they are registered to, and finally guests - users who are not logged on to the system with a username and password, but may view some courses in full, or limited content in some.

This way, the platform allows for access to students and lecturers in a password protected format, in a cost effective manner for the provider - UNic is a case in point - while also in an indirect manner provides information for the courses to the public, functioning as a marketing tool for prospective students. Through the platform, people from the industry may also enroll to particular courses/modules of interest without formally registering to a certain degree, promoting this way lifelong learning.

Having briefly presented the advantages of using the online platform Moodle I move on to present how my course BADM231 has been adjusted in such a way to facilitate students who wish to improve their communication in Greek at the workplace.

#### **4. Converting BADM231 (Business Communications) face-to-face to BADM231 DG (Επιχειρησιακή Επικοινωνία) using the Moodle platform for Distance Learning.**

I have been offering the course BADM231 (Business Communications) for more than a decade in English in face-to-face mode, prior to being asked to offer it in Greek for the needs of a new degree offered entirely online in Distance learning mode in collaboration with the School of Business, namely BBA (Bachelors in Business Administration). Till that date, the course was offered only in face-to-face mode in English, while there was online material available through the password protected platform accessed by UNic full-time and part-time faculty as well as students registered for the particular course namely the Intranet.

The textbook used for the course has been “Business Communications Today” by Bovee and Thill first edition in 2000), which apart from the theoretical materials, included exercises at the end of each chapter and has gradually included a lot of online material

accessible through the publisher's platform. For the needs of the particular course I had created my own slides, which were used in class for the course's delivery and were also available online through the Student Intranet to the students registered in my sections.

Changing the language of delivery led in turn to a number of changes in the course which were necessary not only to deliver the materials in an effective manner but also to ensure the same standards of quality with the face-to-face mode. For this reason, the changes in the course occurred in a series of steps presented in this section. The course had to be created on the Moodle platform in a way that is familiar to Moodle users (See figure 1).

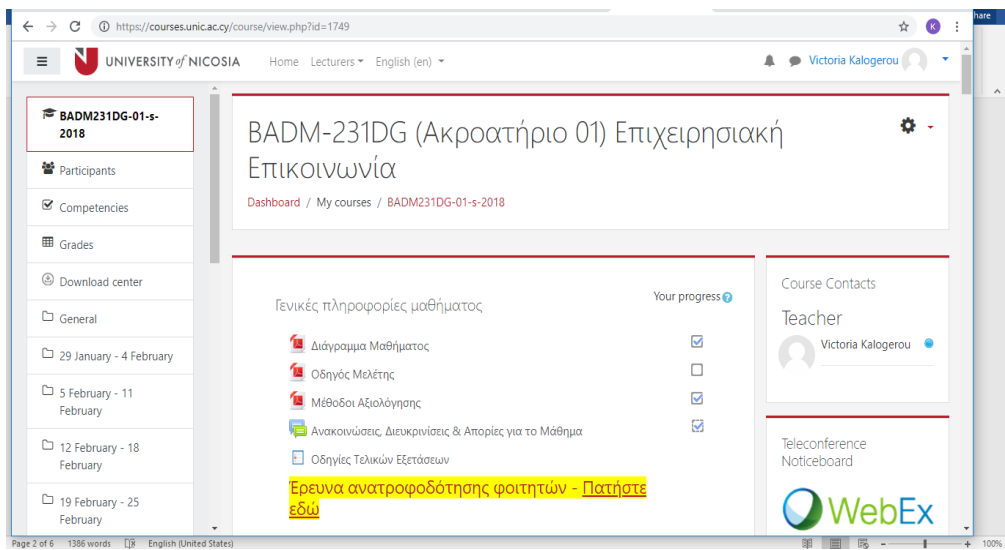
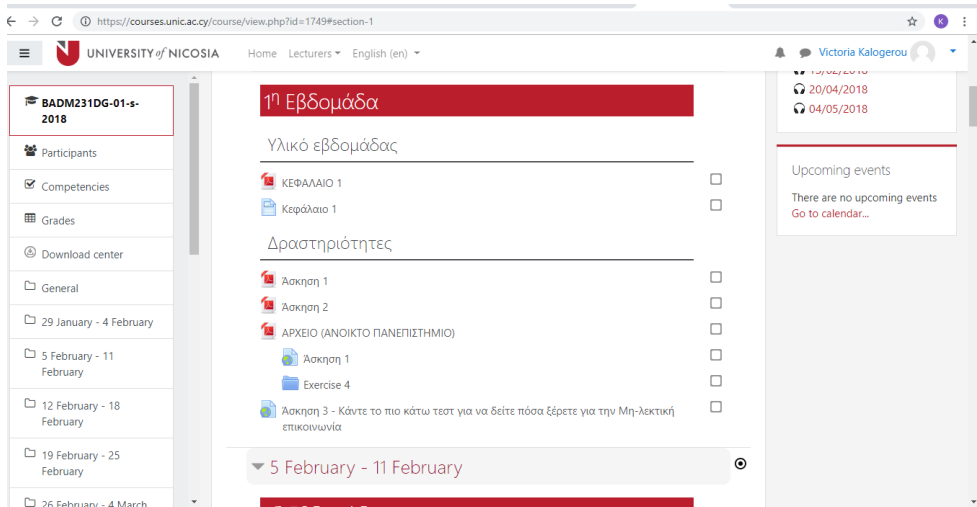


Fig. 1 Introduction to the course

Once this was done the materials, including slides, examples, exercises and assessment tools had to be translated in Greek. This was associated with a number of challenges as it had to be ensured that the translated terms corresponded correctly to their equivalents used at the workplace in Greece and do not sound strange, foreign or are associated with negative connotations in the target language. This required additional research and discussions with experts in the field mainly in Greece where the standard Modern Greek originates in.

At the same time, while it is common practice for courses to be delivered in the target language and for terminology to be maintained in the language of origin as well as maintaining the same book, usually the version used for the american audience, I was struck

by how weird this seemed in a course offered entirely in DL mode. For this reason, I searched extensively for original sources (i.e., emails, memos and formal letters, etc.) in Greek thus creating a brand new database more useful for students who enrolled in this course and mode. These sources were first checked and readjusted to abide by the General Data Protection Regulation (GDPR) enacted in Cyprus in May 2018 and then they were converted to PDF format and uploaded in the appropriate sections on the Moodle platform as shown in figure 2.



*Fig. 2 Original sources used in the appropriate sections of the course.*

At the same time, forums and discussions had to be held in the target language and questions and answers had to be entirely in Greek to ensure the uniformity of the course, but also to enable all participants to follow them in spite of their competence in English language as shown in figure 3.

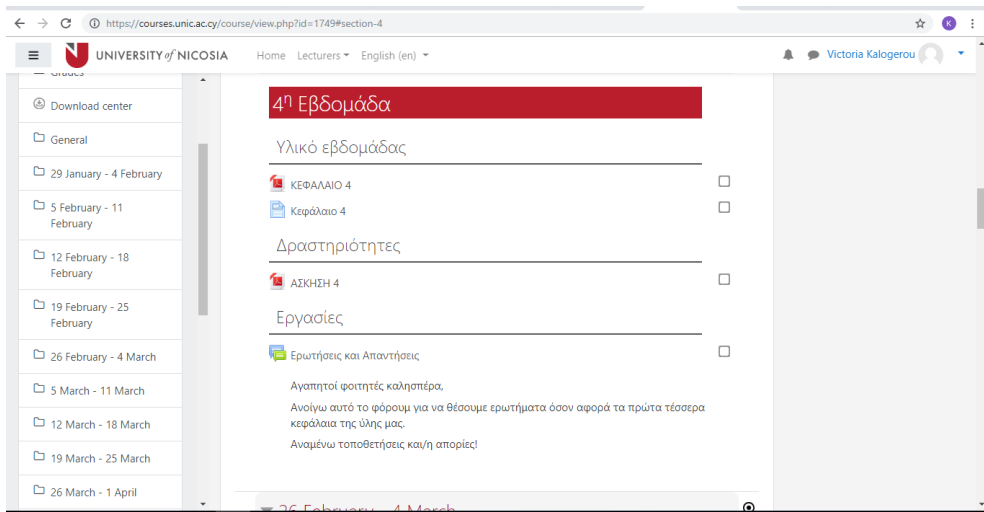


Fig. 3 Forums and discussions

Finally assessment had to be adjusted to Greek in order to enable students tackle the tasks helping them thus improve their performance in the final face-to-face examination in the examination centres which counts for 60% of their final grade. Offering assessment tools via the platform also helps in promoting autonomous learning as shown in figure 4.

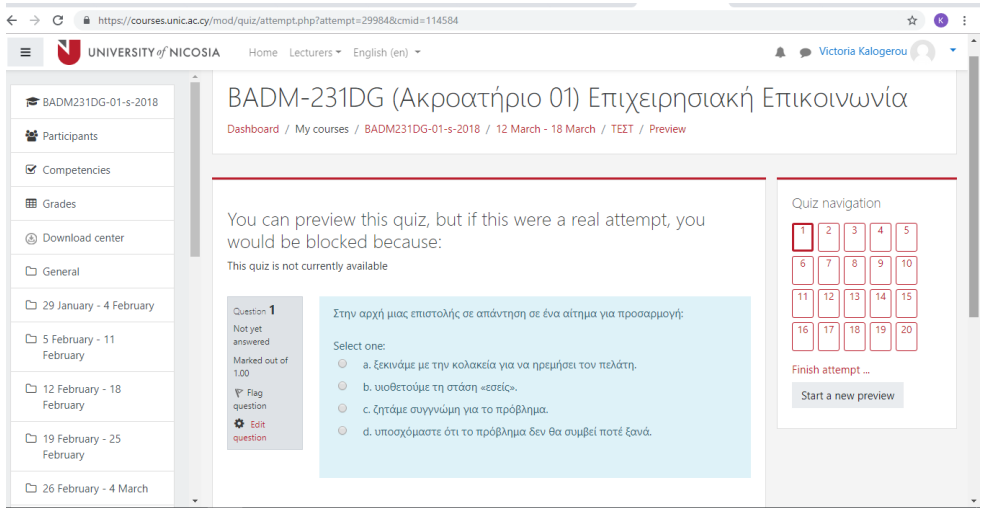


Fig. 4. MCQs and online assessment

Finally, upon completion of the course students could evaluate the course and the lecturer as in the face-to-face courses as shown in figure 1 (highlighted). As with the face-to-face

courses changes/alterations/modifications occurred to the course based on the immediate feedback from students following the WebEx sessions but also informal feedback through telephone conversations and emails. In addition to these, the formal evaluation of the students also added to the changes that needed to occur in order for the course to be offered in a more effective manner.

## **5. Conclusion**

In this paper, initially the rationale behind the conversion of courses leading to a Bachelor degree in Business Administration in Distance learning mode in the Greek language are presented. Then, the steps taken towards the conversion of the traditional face-to-face mode of delivery for my course BADM231 (Business Communications) to the online delivery using the Moodle Learning Platform are described. Further to offering a degree in Distance Learning mode to those who wish to improve their communication in Greek at the workplace as this is the main language of communication or to students who wish to study part time or from a remote location, this conversion has also replaced the prior decentralized organizational structure of the courses leading to a BBA degree which consisted of various and sometimes incompatible modules. Uploading courses on the Moodle platform made it easier to operate, maintain and update courses by one unit, i.e. a dedicated Distance Learning Support Centre at UNic, catering not only to the faculty's and students' needs but also abiding by the internal and external standards of quality and compliance. Offering the course in Greek by using the online platform has also demonstrated the need for offering Business communications in Greek to those who handle almost entirely their day-to-day communication at the workplace using the Greek language. Future work shall focus on improving the delivery and materials for the course as well as researching whether a face-to-face delivery in the form of a module or a short course might be of interest to the organization.

## **Acknowledgments**

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## Innovative Business Models in Tourism Industry

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### **Abstract**

*This study examines the business models of four emblematic Digital Disruptive Intermediaries (DDIs), Airbnb, TripAdvisor, Expedia and Booking.com. The sources are constituted mainly by surveys, articles and expert opinions which are the main argumentation sources. The best practices for ideal business models in tourism industry through the analysis of the DDIs are the findings of the study. The main functions of the DDIs are Cataloguing, Reordering or filtering, Ranking and Recommending, Bundling, Sharing, Intent Casting, Channelling Actors, Pricing and Matching Actors. The originality of the paper derives from the SWOT analysis of the business models of the four well known DDIs. There is no previous analysis which evaluates the business models and discloses the main functions they perform.*

**Keywords:** *Tourism Industry, Digitalization, SWOT Analysis, Business Model, Digital Disruptive Intermediaries.*

### **1. Introduction**

Advances in technology offer new capabilities for all the industries (Chen et al., 2012). Now, we are in the midst of a new revolution driven by the power of digital technology and the Internet (Schwab, 2017). Information and Communication Technologies (ICT) are used not only to enhance efficiency, access, timeliness, transparency and accountability, helping the tourism industry to provide adequate services (Bethapudi, 2013; Cantoni & Xiang, 2013; Benckendorff et al., 2014); these developments have also enormous implications for every aspect of tourism (accommodation, hospitality, catering, transportation, entertainment, events, attractions, leisure, information and services) (Zongqing, 2004; Lee & Yuan, 2018).

The new models are reducing costs, breaking away from old patterns of fee arrangements, and increasing efficiency through unique structuring and use of technology (Baden-Fuller





& Mangematin, 2013). A great example of this evolution can be found in the pressure put on aviation companies to deliver services at lower costs (Franke, 2004; Wensveen & Leick, 2009). On one hand, companies are being asked to re-evaluate processes from back - end operations to matter - based project management, while on the other hand they are being expected to create and implement new strategies on everything from budget forecasting to reducing costs (Baden-Fuller & Morgan, 2010; Casadesus-Masanell & Heilbron, 2015).

Changes were also observed especially since the beginning of the 19th century in the network of travel agencies (Holloway & Taylor, 2006). While until then, travel agencies mainly organized the travellers' trips, the new look of the tour operator offers the journey as a final consumer product (the ready-made package tour) almost in line with the standards of industrial production of large-scale material products, while at the same time, sets the basis for changing the type of trips from individual to recreational trips (Murison, 2015; Adenwala, 2014). This study examines the business models of four emblematic digital disruptive intermediaries (DDIs), Airbnb, TripAdvisor, Expedia and Booking.com through SWOT Analysis.

## **2. Baseline**

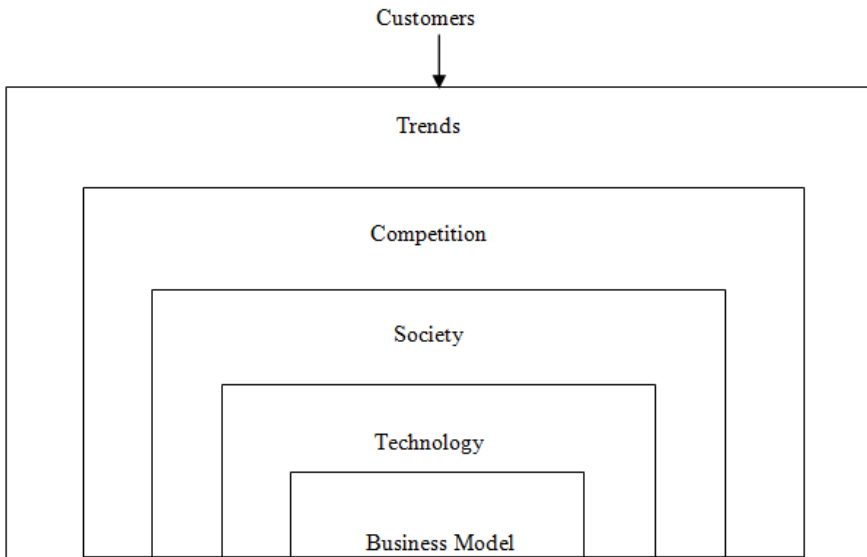
The term disruptive technologies was coined by Bower and Christensen (1995). Digital disruption is the effect that changes the fundamental expectations and behaviours in a culture, market, industry or process - caused by, or expressed through digital capabilities, channels, or assets. Advancing technology and globalization are the main causes for digital disruption (Dunning, 2014). Disruptive innovations either create new markets by bringing new features to non consumers or offer more convenience or lower prices to customers at the low end of an existing market (Christensen et al., 2004).

*"Traditional travel distribution in which high street travel agencies played a dominant role was revolutionized with online travel agencies and direct distribution through airlines and hotels websites acquiring a key role, low-cost carriers and online travel agencies were the clear winner of the online travel revolution over the last years, changing the way that today consumers plan and book their trips " (Carroll & Sileo, 2014). "Tour operators suffered the rise of independent travel and, today, they are embracing the online and mobile channels in order to stay competitive" (Horner & Swarbrooke, 2016).*

Business model is the way earnings are generated and dates back to the earliest days of business (Laudon & Traver, 2014). A business model describes how an organization creates and offers value. Value is used in the broadest sense and is not just an economic value, it can also be a social or other value. The main uses of business models not only describe and

categorize businesses but they are used by managers internally in a business to explore future growth opportunities (Osterwalder & Pigneur, 2010).

Inspired by these insights, it is emphasized that business models can be used to categorize the business world and explore the nature of business model categories and what these categories might mean for managers provide a potentially rich agenda for cognitive researchers (Reinhold et al., 2017). Business model environment map by Stampfl (2015) structures the interactions between business models and their environment. This map is suitable for identifying risks and opportunities for business model innovation in tourism industry (Figure 1).



*Fig.1 Digitalization in business models of tourism industry  
Authors' adaptation*

The changes in business models arise from the influence of digitalization on the business models and the development of new business models as well as the change of the existing ones (Moutinho et al., 2011).

There are changes to customers with different customer behaviour and for well-informed customers. Digitalization plays an important role on the customers' behaviour. Understanding customer's behaviour and especially customer information behaviour can help industrial managers to develop, optimize search engine, and customize their websites to meet the needs of their customers (Ha & Love, 2005). The Internet has become one of the most important sources of customer's information, especially for young and better educated customers. Customers of different gender, age, nationality, educational background and life style display different search (Law et al., 2009). Many people prefer to

book online when they have previously travelled to a destination and they feel familiar with the place, although many still treasure their established relationships with travel agents (Law et al., 2009). The authors also state that *"Travellers require different information from the Internet at different stages of travel. For instance, before departure, the availability of information can affect travel planning, whilst later on customers may seek reassurance from review sites that they have selected the right products and services found that upon arrival, the information that visitors receive can influence their venue decisions. For customers searching on the Internet for the lowest room rates, the travel websites of search engines play an important role in information searching, and Google in particular is perceived to be the most important tool."*

There are changes in competition with new competitors from other regions, digital competitors and tendency towards monopolisation. Mobile technologies provide a new and convenient way for tourists to gather information from any location, and perhaps more significantly for the destination they have been introduced (Weber, 2009).

There are also technological changes with exponential development of digital technologies and data; technologies affect all areas of business and private life and digitalization enables new business models (Law et al., 2009). Technology cannot determine social or economic activity. And yet it creates opportunities for entrepreneurial activity. It is an important force for dissolving barriers to entry to old economic activities and facilitating the development of entirely new industries - or to put it in the contemporary vernacular, disrupt previous businesses (Kenney, 2017). The increasing ability to process data is so important because digital problems that were too difficult to solve in one time period, become amenable to solution later as processing power increases. The adoption of IT can enhance the competitive advantage of a business presented a complexity framework that models the relationship between IT and tourism (Law et al., 2009).

Today, the integration of hardware and software provides a tight customer experience, meaning that probability to use technology during travel is almost a normal fact. This has got the impact that people use their mobile phones and its social networks to get recommendations while travelling. Mobile technologies support location based services, interpretation and dynamic interaction with tourism suppliers analyzed tourists' usage intentions with mobile guides (Buhalis & Law, 2008; Rasinger et al., 2007).

Globalization, with interaction among the people, companies and governments of different nations driven by international trade and investment and aided by IT and mobility is another trend (Stampfl & Prügl, 2011). Sometimes, businesses only need to understand the trends, the maturity and the capability to innovate, learning from other industries in order to always search for new markets and new needs of the customers. Of course, all must be in a multi-channel device interaction, but above all the mobile interaction is mandatory in our

days and in the future. Expectedly, there will be a great relevance for the tourism industry in the near future (Adey et al., 2014).

The various Tourism aspects, Globalization, Technology and Business models with emphasis to major technological advancements are depicted in figure 2.

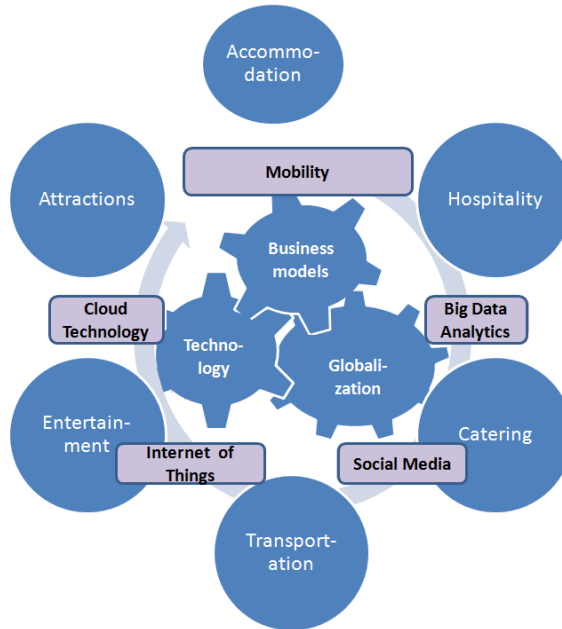


Fig 2. Globalization, Technology and Business models in tourism aspects  
Authors' adaptation

### 3. Approach

The context of the present paper is to examine the practices that a few tourist companies use to become successful by gaining wealth and competitive advantages.

The sources are constituted mainly by surveys, articles and expert opinions which are the main argumentation sources (Expedia1, 2017; Gyódi, 2017; Uenlue, 2017; Hospitality Industry, 2017, Guttentag, 2015, Filieri et al., 2015). The aim of the study is to understand at which level of their business models adapted digitalization and this is investigated through the study of companies' strategies. In addition, the attention is focused on what improvements due to digital technologies make them winners against the competitors. These "leader" companies were taken into consideration and analyzed, to indicate the consequences of digital disruption, the strategies that each company uses to differentiate

from the competitors in the competitive environment and how they take advantage of the digital technologies and succeed as digital disruptors. The selected companies are Airbnb, TripAdvisor, Expedia and Booking.com because they are the most emblematic tourist companies. Nevertheless, the choice was not easy and someone can argue that there are many more DDIs such as Agoda, Trivago, Couchsurfing. They are considered as the most indicative business models.

Airbnb uses an aggregator business model; it does not have a linear business model like the traditional hotel chains. It is a community based, two sided online platform that accommodates the process of booking private living spaces for travellers (Botsman and Rogers, 2010). On one side are the owners' that list their space and earn rental money and on the other side are the travellers that are provided with easy access to rent private homes. Personal profiles provide information about the host and what it offers. Airbnb receives commissions from both hosts and guests upon every booking (Bashir and Verma, 2016).

Customers use TripAdvisor in order to plan their vacations. It uses a click based advertising business model which means that TripAdvisor displays clickable button that leads to a booking page for hotels through the advertiser. These are cost per click advertisements. The advertiser will pay only if the user clicks on the link which leads them to the advertiser's page away from TripAdvisor and gets paid for each click regardless if it leads to booking or not. The costs of the click are determined in an auction system (Miguéns et al., 2008).

Expedia is based on the the merchant business model since the platform buys hotel rooms and then resells them to travellers. *"The merchant gets the rooms cheaper by buying the rooms very early as well as in bulk. Often, the merchant bundles them with airfares, rental cars and other things"* (Weigert, 2018). The merchant model also allows individual hotel bookings. But the packages are dealt, more attractive to those who do not want to research flights accommodation and other things separately.

Booking.com is based on the agency business model. This model uses the same revenue with the old travel agency commissions. Booking.com has contracts with the hotels listed on it and gets a 10%-30% commission on each booking through its site. In booking.com, hotels pay for ranking higher with a higher commission. The difference to Cost per Click (CPC) adds is that the hotels pay only for successful bookings (Garrigos-Simon et al., 2017). *"Offering hotel rooms on a commission basis has the benefit of not owning the inventory and thus not having cash tied as well as not carrying the unsold inventory risk"* (Yun et al., 2017).

The elements that a business model is made up of, when followed in a correct manner, help a company achieve the success that it is obligated to have. Regarding the parts of this approach SWOT Analysis were selected as suitable tools for presenting strategies that a business uses to achieve a few of the aims that it may have.

## 4. Empirical Study

The results of SWOT Analysis of Airbnb (AirBnB1, 2017; AirBnB2, 2017), (TripAdvisor1, 2017; TripAdvisor2, 2017), Expedia (Expedia1, 2017; Expedia2, 2017) and Booking.com (Booking.com1, 2017; Booking.com2, 2017) are portrayed in table 1.

**Table 1. SWOT Analysis of four business models  
(authors' elaboration based on the aforementioned studies)**

	<b>AirBnB</b>	<b>TripAdvisor</b>	<b>Expedia</b>	<b>Booking.com</b>
<b>Strengths</b>	<p>Peer to Peer collaborative consumption on business model</p> <p>A powerful end “cool” image and reputation</p> <p>Highly skilled employees</p> <p>A portfolio of properties that serves many registered users</p> <p>Online trust and verification systems</p> <p>A primary focus on customer support</p> <p>A beautifully crafted design of their website</p> <p>A young entrepreneurial and innovative organization</p> <p>A core focus on hospitality</p> <p>Fund raising capability</p>	<p>Strong international presence in 45 countries</p> <p>Feature like “Just For You” which offers personalized recommendations help in its customer retention strategy</p> <p>Prominent acquisitions have made it a strong brand</p> <p>Nearly 3000 people are a part of the organization</p> <p>Pioneer in Hotel and flights booking, vacation rentals, restaurant finding, travel guides</p>	<p>Broad range of hospitality service and online travel offerings</p> <p>Strong portfolio of travel brands</p> <p>It has presence in global market space, so the risk in revenue growth is less</p> <p>Strong brand name coupled with high customer loyalty</p> <p>It has over 10,000+ partners for hotels, airlines etc</p> <p>Nearly 15000 people are employed with the brand</p> <p>Acquisition of smaller players has strengthened its position</p> <p>Global presence in about 60 countries</p>	<p>Good Returns on Capital Expenditure</p> <p>Highly successful at go to market strategies</p> <p>Highly skilled workforce through successful training and learning programs</p> <p>Strong dealer community</p> <p>High level of customer satisfaction</p> <p>Strong distribution network</p> <p>Strong Free Cash Flow</p>
<b>Weaknesses</b>	<p>Legal and lobbying internal capabilities</p> <p>Lack of focus on the positive environmental impact</p> <p>Lack of differentiation of the business</p> <p>Incentives to promote trust and verification</p> <p>A robust and full end to end service</p> <p>Provides undifferentiated services and products</p>	<p>Theft of email addresses from its database creates a sense of insecurity among its customers</p> <p>Controversies regarding the validity of reviews done about hotels put a question mark on its core value proposition</p>	<p>Intense competition from other service providers means limited margins and slow market share growth</p> <p>Provides undifferentiated services compared to that of competitors</p>	<p>Inability to compete with the leading players in the industry in terms of innovation</p> <p>Financial planning is not done properly and efficiently</p> <p>Not very good at product demand forecasting leading to higher rate of missed opportunities compare to its competitors</p> <p>The profitability ratio and Net Contribution % of Booking.com are below the industry average</p> <p>Organization structure is only compatible with present business model thus limiting expansion in adjacent product segments</p> <p>There are gaps in the product range sold by the company</p>

## 5. Discussion and Conclusions

This study examined the digitalization and digital transformation in the tourism industry through the SWOT Analysis of four emblematic Digital Disruptive Intermediaries (DDIs), Airbnb, TripAdvisor, Expedia and Booking.com.

Airbnb uses an aggregator business model, TripAdvisor uses a click based advertising business model, Expedia makes the majority of its revenues through the merchant business model and Booking.com is based on the agency business model.

The four companies use different business models thus different practices. Their primary business requirement is the ability to respond to new, unforeseen or unpredictable business requirements and customer demands, in order the willingness to embrace disruption to be achieved. Their reorganization of the allocation of demand and supply leads to a disruption of tourist markets, particularly those that were formerly monopolised.

The functions of these DDIs in tourism industry are:

- *Cataloguing* – They provide a comprehensive and structured catalogue of products or services from multiple suppliers.
- *Reordering or filtering*- They offer functionality to reorder or filter structured lists of products and services to find a suitable offering.
- *Ranking and Recommending* – They use algorithms to rank-order products or services, based on certain criteria or to provide individual recommendations.
- *Bundling* – They create and offer integrated bundles of products, content or services, that are often sourced from multiple suppliers.
- *Sharing* – They allow sharing of digital, often user generated, content between users of the intermediary's platform.
- *Intent Casting* – They allow users to spell out their needs/intents for sourcing a product, service or project funding from others.
- *Channelling Actors* – They provide customers with the ability to select supplier-provided products, content or services and routes customers to the supplier's digital platform.
- *Pricing Functions* – They engage in comparing and/or setting prices of products or services sourced from suppliers.
- *Matching Actors* – They offer ways of pairing customers with the right suppliers of products, content or services, often by way of specialised algorithms.

However, success in tourism industry requires a long-term commitment to full business transformation and willingness to embrace disruption. Solution must promote agility and flexibility. The primary business requirement is the ability to respond to new, unforeseen, or unpredictable business requirements and consumer demands.

It is impossible to conduct a study that does not contain weaknesses. Therefore, there are some limitations in this study as well. Only four disruptors were examined. Apart of the aforementioned Agoda, Trivago, Couchsurfing there are many more such as GetYourGuide, Musement, FareHarbor, Klook, Peek etc which have to be analysed in

future studies. With other methods of analysing such as PEST Analysis, Business Model Canvas and Porter's 5 Forces Business Analysis, a more complex and thorough study could validate the results.

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## An empirical evaluation of e-learning usage in the higher education context

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### Abstract

*E-learning has been adopted for several years in Greece and abroad, and it is considered an integral part of blended learning. E-learning systems accumulate a vast amount of data which may be very valuable. The educational organizations may exploit the power provided by e-learning, if they analyze the usage and the content of the courses. An early assessment of the of e-courses use may provide useful information to the educators, in order to make educational interventions in their teaching material. This study suggests that the evaluation of e-learning usage may be carried out with the assesment of variables and metrics related to teacher training material and student trafficking. We propose three metrics which are combined efficiently, in order to quantify the quality characteristics of the courses and offer useful insights about the educational material and e-learning usage. This case study was implemented in the e-class platform of a Greek Higher Education educational institute. This platform created by the Greek Universities Network (GUNET) is very popular in Greece, since the majority of the Greek universities have adopted it. The results of our study confirmed the validity of our suggested approach, and highlighted the need for a more learner-centered focus and active participation of the students.*

**Keywords:** *E-Learning, E-class, Metrics, Regression analysis.*



## **1. Introduction**

E-learning systems can be used and adopted by academia, as well as by private and public organisations. Nowadays, there are many different types of e-learning systems which may support various styles of learning such as: individual, collaborative, content management, activity management, formal, informal and workplace learning.

An important goal of e-learning is that it should be equivalent or better to the learning provided through other methods, such as the traditional face-to-face and classroom-based teaching. E-learning has various advantages, since it allows learners to access the teaching material on a 24/7 basis at any place, facilitates an interactive and student-centered learning (Martínez-Caro, 2015) and enables the instructor to monitor the learners' progress continuously (DeLima, 1999). However, e-learning may have various disadvantages such as limit to the role of instructors, to allow inappropriate use from the learners (e.g. cheating, plagiarism), etc. (Arkorful & Abaidoo, 2015).

For several years, the educational institutions have adopted e-learning systems since they may: i) provide their services with a low cost and a high quality standard (Selim, 2007), ii) provide asynchronous learning to those who have working or family commitments and iii) enhance their presence and become more popular (Shen et al., 2008).

E-learning systems must be usable in order to be accepted by academic users, regardless of their background and experience (Harrati et al., 2016). Some researchers Hogo (2010), Hassanzadeh et al. (2012) have suggested metrics and statistical methods in order to assess the usability of the e-learning systems.

The aim of this study is to evaluate the usability of an e-learning system, in order to understand the users' level of satisfaction and suggest the ways to improve it.

We analyze the log data from the eClass platform used in the Accounting and Finance department of the Eastern Macedonia and Thrace Institute of Technology (TEI EMT). In order to evaluate the usability level of the platform, we estimate various usability variables and metrics suggested by the authors in their previous research (Valsamidis et al., 2014).

## **2. Approach**

This paper evaluates the e-learning platform usage at the Accounting and Finance department of TEI EMT. The evaluation method that was adopted was based on indexes and metrics that are analysed over the next sections. This data includes all the online

courses regardless their type (Mandatory or Optional) and their category (Theory, Laboratory or Mixed). In addition some other attributes are used in this research such as the course code and semester, the course files size, number and the duration of students visits.

The next two steps of the adopted approach are the calculation of the indexes and the computation of the proposed metrics. These stages are also the basis of the e-learning system evaluation, which is the goal of this work. In particular, we describe the Average Files Size, Visits Per Duration, Course Usage and User Perception metrics. After the calculation of these metrics we can conclude on specific outcomes regarding the usage of the e-platform from the students.

For each course we define ten attributes which are presented in Table 1.

**Table 1.** *Attributes of the courses*

Attribute	Description	Type
Course ID	Unique identification code of the course	Constant
Semester	The year in which the course is taught	Constant
Type	If it is compulsory or optional	Constant
Category	If it is theory or lab or mixed	Constant
Files	Number of available files	Variable
Size	Total size of the existing files	Variable
Visits	Number of visits by all users	Variable
Duration	Duration of visits by all users	Variable
VPD	Visits Per Duration	Metric
AFS	Average File Size	Metric
CUP	Course Utilization and user Perception	Metric

The above attributes are selected due to certain educational goals. The main goal is to examine the factors that may affect learners' activity and are divided to three main categories (i) course primitive such as Semester, Type, Category, (ii) course content such as Files and Size and (iii) course usage by learners such as Visits and Duration.

Based on the attributes of table 2, we can compute the following metrics that reflect users' behaviour related to the educational material.

Average Files Size (AFS) which reflects the contents of the courses in the e-learning platform. It is a metric that expresses the average size of files related to the number of files per course. The results of this metric reflect how the volume of uploaded files in each course is shaped. Usually, the larger the volume of data, the higher the traffic, but this is not the only criterion.

$$\text{AFS} = \text{Size} / \text{Files} \quad (\text{S/F}) \quad (1)$$

Visits Per Duration (VPD) is another metric that expresses the number of visits on the course pages per duration. This metric is directly related to students' interest, as the lower the prices are, the greater the attachment of the students to the posted instructional material, with no rapid interchanges between the posts.

$$\text{VPD} = \text{Visits} / \text{Duration} \quad (\text{V/D}) \quad (2)$$

The third proposed metric is related to the course quality and is called smooth or distinct Course Utilization and user Perception metric (CUP). This metric expresses how smooth or abruptly-randomly visit time duration of users per course is distributed over the academic semester. In order to calculate the CUP metric measurements of daily or at least weekly total visit time per course are required. Then for each one of the evaluating e-learning courses a ratio estimate is calculated according to the following formula:

$$\text{CUP} = \frac{\max(D(x)) - \min(D(x))}{(\sum(|D(x_{i+1}) - D(x_i)|))} \quad (3)$$

Where  $D(x)$  is the daily or weekly total duration of visits,  $\{x\}$  is the weekly or daily dataset and  $D(x_i)$  the daily or weekly value of total visit time for  $x_i$  day or week accordingly. If  $\text{CUP} \rightarrow 0$  then we have smooth course utilization over time while if  $\text{CUP} \rightarrow 1$  we have only distinct weeks of course utilization. In cases of  $\text{CUP} > 1$ , we assume that such courses maintain either a one time utilization or abnormal utilization of very low and very high. We consider such courses as flapping or abandoned courses.

Considering the aforementioned indexes and metrics we can group them in three distinct categories.

The first category of attributes is related to the course. The attributes of these categories most of the times remain stable over the time. However, useful outcomes can be reached if they are analysed in combination with the attributes of the other metrics. In particular, the semester that course is taught gives an estimation of attendees' experience in higher education. It would be interesting to examine whether novice learners of first years have similar performance with their fellows of higher years who are more expert in the skills of academia. The course category allows the researches to study whether it could affect learners' activity since compulsory courses are typically more challenging than optional courses. Similarly, the type of the course is used to examine if learners behavior is different in practical lab courses or theory courses.

The second category of attributes is related to the courses' online educational content. More specifically, the number of files and their corresponding sizes give an estimation of the content quantity, which is a crucial factor of online educational content. On one hand, if the

number of files and their size are small, this might be due to the weakness of the educator to upload enough educational content into the online platform. On the other hand, if the course has a lot of files with big sizes this could lead learners to face the cognitive overload problem and not study the course effectively.

The third category of attributes helps researchers to discover learners' activity and follow up in a course. The variables number of visits and duration may indicate whether learners find course useful and like to visit its pages. For example, if learners visit more pages of a specific course for a long time, this means that course content is interesting and useful for them. This could reflect the course quality. Consequently a good course in terms of quality may help learners at their study.

The last step of the proposed approach is to apply a regression analysis over all the attributes of table 1, in order to find dependencies that may affect the usage of the online courses.

This step exploits the available data in order to find, through regression analysis, course attributes that affect learners' e-learning usage.

Regression analysis can be used to explore the relationship among different characteristics of each performance metrics and to predict the upcoming evaluation of both courses-educators and students based on past knowledge (Kotsiantis and Pintelas, 2005; Feng et al., 2005; Myller et al., 2002; McDonald, 2004). Some regression techniques have been used to predict student's performance from log and test scores in web-based instruction using a multivariable regression model (Yu et al., 1999) to identify variables that could predict success in colleges courses using multiple regression (Golding and Donalson, 2006).

Some of the goals of the present research uncover how the learners might improve their performance and in which way they will visit more often the educational content in the platform, as more visits means greater interest and more updated content for each course. It is investigated whether the attributes such as the number of visits and the duration are affected by the educational content. Educational content is expressed as the number of files and their corresponding sizes. Other attributes such as the academic semester in which each course corresponds, the type (compulsory/non-compulsory) and the category (theory, laboratory, mixed) of each course are also investigated to validate whether they affect the output attributes.



### 3. Case Study

In this section a case study is presented based on the Open eClass E-Learning dataset, collected from the Department of Accounting and Finance, of TEI EMT. The collected dataset is of the winter semester of 2017-2018.

**Table 2: Tracked data of winter semester of 2017-2018**

Course	Semester	Type	Category	Files	Size	AFS	Visits	Duration	VPD	CUP
AD1101*	1	C	T	27	15712,91	581,96	16379	32441	1,98	0,37
<u>AD1104</u>	1	C	T	30	60328,72	2010,96	8923	17269	1,94	0,61
<b>AD1108</b>	1	C	L	54	15074,78	279,16	11974	19141	1,6	0,94
AD1103*	1	C	M	11	7551,95	686,54	13585	19913	1,47	0,37
<u>AD3105</u>	3	C	M	11	2085,92	189,63	19369	30822	1,59	0,70
AD5110*	5	C	T	70	45654,87	652,21	7987	12343	1,55	0,22
<b>AD5111</b>	5	O	L	51	20523,31	402,42	13477	28241	2,1	0,81
<b>AD6105</b>	7	O	T	33	4862,36	147,34	869	963	1,11	0,25
<b>AD7110</b>	7	C	T	9	28499,45	3166,61	458	1363	2,98	0,37
<b>AD7105</b>	7	O	T	45	24542,12	0	517	1038	2,01	0,41
Mean				34,1	22483	811,6	9353	16353,4		

It includes E-class logged data for 38 department courses. 10 of these courses are 1st semester courses, 10 of these are 3rd semester courses, 7 of these are 5th semester courses and 11 are 7th semester courses.

29/38 courses are compulsory (Type: C), while 9/38 of optional subject (Type: O). 5/38 are theoretical courses that include assesment exercises (Category:M), 5/38 are optional courses with Laboratory exercises (Category: L) while the others are theoretical courses with oral presentation only (Category: T). Due to lack of space a representative data sample of 8 out of 38 courses has been evaluated, indicatively taken from all types and categories. Table 4 shows the metric measurements of this set taken out from the E-Learning platform.

Table 2 presents the course metric values, automatically calculated from the E-Learning platform. These metrics are the number of course content files and associated file size, course visits expressed by the total number of course requested URIs and total duration that

expresses the total course session time as indicated by platform logins and logouts-session expirations. In table 2, the metrics VPD and AFS mentioned in the previous section are indicators of each course visits' rate and mean delivered content size accordingly. The mean number of files per course is 34.1 for all study courses while the mean filesize is 22483 KB. The mean number of total visits for all courses is 9353 while the mean course total duration time for all courses is 16353,4 min.

Subsequently we try to define the factors that affect the number of visits for each course. We initially test one by one using appropriate tests, which variables affect the number of visits. The results are shown in Table 3.

**Table 3: One Way ANOVA**

Variable	p-value
Type (C, O)	0.142 <sup>1</sup>
Semester (1, 3, 5, 7)	0.038 <sup>2</sup>
Category (T/L/M)	0.533 <sup>2</sup>
Files	0.065 <sup>3</sup>
Size	0.224 <sup>3</sup>
AFS	0.734 <sup>3</sup>
Visits	<0.001 <sup>3</sup>
VPD	0.322 <sup>3</sup>

<sup>1</sup> T-test

<sup>2</sup> One Way ANOVA with Tukey Multiple Comparison Correction

<sup>3</sup> Pearson Correlation

We notice that only the variables "Semester", "Total Files" and "Duration of visits" affect the "Number of visits".

More specifically:

- First semester students have significantly more visits than those of the 7<sup>th</sup> semester (p-value=0.038 and corresponding -95% Confidence Interval (283.35, 11444.67)).
- The more files we have the more visits we have (Pearson Correlation Coefficient= 0.303, p-value=0.065 – indicatively significant).
- The length of visits is affected by the number of visits, which is self-evident (Pearson Correlation Coefficient= 0.907, p-value<0.001).

Initially we tried to investigate whether the number of visits depends on other data which were recorded, using multiple linear regression. The variables that included in the final model as significant are "Number of Files", "Type" and "Semester". Moreover satisfied the

assumption of linearity/multicollinearity (all VIF test are between 1.05 and 1.61) and this of lack of autocorrelation (Durbin Watson = 1.88). Finally F testis 4.79 with six degrees of freedom, p-value=0.002 and adjusted R2=37.8%, so the following model can not be used to predict the mean number of visits because of its relatively low adjusted R2.

The values of the variables of the coefficient, VIF and p-value are represented in Table 4.

**Table 4: Results of regression analysis**

	<b>Unstandardized coefficients</b>	<b>VIF</b>	<b>p-value</b>
constant	4344.1	1.238	0.010
Number of files	97.34	1.059	0.022
type3*	7367.1	1.079	0.006
type2*	2599.65	1.575	0.149
sem3	95.57	1.483	0.960
sem5*	-4792.49	1.617	0.027
sem7	-4803.81	1.238	0.014

\*sem3, sem5 and sem7 are dummy variable for semester. First semester is the reference category.

\*type2 and type3 are dummy variable for type of course. Theoretical courses is the reference category.

The equation of linear regression is:

$$\langle \text{Number of visits} \rangle = 4344 + 97,3 * \langle \text{Number of files} \rangle + 7367,1 * \langle \text{Lab} \rangle + 2599,6 * \langle \text{Mixed} \rangle + 95,5 * \langle \text{3}^{\text{rd}} \text{ semester} \rangle - 4792,4 * \langle \text{5}^{\text{th}} \text{ semester} \rangle - 4803,8 * \langle \text{7}^{\text{th}} \text{ semester} \rangle$$

That is:

- For each one file added to the platform, we have an average of 97 more visits.
- The web-pages of the lab-courses have an average of 7367 more visits than the corresponding web-pages of theory-courses.
- The course of the fifth and seventh semesters have an average of 4792 and 4803 respectively less visits than those of the first semester's courses.

## **4. Discussion and Conclusions**

The aim of this study was to analyze and evaluate the e-learning system eClass which runs in the Department of Accounting and Finance of Technological Educational Institute of EMTh. Our assessment was based on the use of the indices method. The online has many features, the so-called tools, such as documents, videoconferencing, wiki, questionnaires, etc., which are distinguished in active and inactive. It is clear that the availability of as many active tools as possible contributes to make the most of the platform's potential.

The processing and evaluation of data leads to the conclusion that not all of the platform's capabilities are used as there are several lessons that do not contain files. There are also several inactive tools. Therefore, the eClass of the department of Accounting and Finance of TEI EMTh operates less satisfactorily compared to the corresponding platform of other universities and Institutions.

From the learners' point of view, by activating more tools on the platform will be an incentive for more frequent use of the platform, it will increase their interest, and will increase e-learning traffic. In general, familiarizing learners with computer use and technology which is constantly increasing, will make platform use easier and more demanding. Modern tools such as video, videoconferencing, etc. attract their interest.

From the teachers' point of view, it is possible to inform them, through the statistics provided by the platform, about its use by the learners on a daily, weekly, or monthly basis. Updating through statistics is an important aid for teachers to take care of feedback on their course. Comparing with the pages of their colleagues of the department as well as of other universities would be an incentive to take full advantage of the platform's potential.

The use of the platform offers both learners and teachers the opportunity to contribute more to the department's courses, each with its own role. However, the maximum performance of the platform will be achieved if it is more learner-centered, giving the learner the possibility of more active participation in it and not just as a passive consumer. Essentially, by participating in problem solving and creative discussions with educators and fellow learners, s/he will get a full picture of the subject of his/her studies and will want to participate in expanding the platform's actions.

The optimal operation of the digital platform of the department and the e-courses provided by it, is an important aid, but it can not substitute for traditional teaching. Instead, these two areas, e-learning and traditional teaching, are interdependent, as there is no e-learning available without the second and experienced staff involved.

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# Next Generation Programming for Chinese Kids' Education

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## Abstract

*Based on the comparative analysis of children's programming games/toys, this paper explores the design of children's programming games/toys for Chinese kids' education. This research on the following four contributions: 1. designing children's programming games with Chinese characteristics; 2. strengthening interaction to increase children's interest; 3. avoiding visual impairment to children; 4. designing children's programming games/toys based on artificial Intelligence. These make use of the existing children's programming environment, design programming tool for Chinese children. In addition, this study has designed the basic functions and opened them to GitHub, which is expected to attract more study and work together to create a more better tool for kid programming .*

**Keywords:** *Children programming games; Computer thinking; computer education; UI of Chinese characteristics; Traditional culture; Programming statement module; Artificial intelligence; Linear regression model; Convolutional neural network; Image recognition.*

## 1. Introduction

With the rapid popularization of computer and mobile phones, computer science and technology has become an indispensable part of modern education. Many foreign countries carried out computer-related education for children many years ago. Even in recent years, some very good graphical programming tools have emerged, these tools take computer thinking as the theory of guiding children's programming, and put computer programming into children's way, help children to program. Children could learn how to use programming tools to make children's games/toys by themselves, which is very popular with children and parents. Comparatively, our children's computer education is still in the initial stage in China. This paper focuses on how to use the existing programming



environment for children to research and design suitable programming games/toys for Chinese children. Based on the comparative analysis of domestic and international children's programming games/toys, this paper tries to find out suitable programming games/toys for Chinese children. The primary research focuses on the following four aspects: first, design children's programming games with Chinese characteristics, the second, strengthen interaction to increase children's interest, third, try best to avoid visual impairment to children, the last designing based on artificial intelligence.

According to above four design directions, this paper mainly designs and studies two types of children's programming games: the first type is about the design of children's toys/games with Chinese characteristics, focusing on the core - learning computer programming thinking, introducing traditional Chinese culture and customs which are closely related to Chinese children's life, and also add two important factors which are derived from the results of children's toys research: "strengthen interaction to increase children's interest" and "try best to avoid visual impairment to children", which are the basic design criteria to design children's programming games for Chinese children. First choose a Chinese traditional festival - Dragon Boat Festival, work out the useful knowledge and data about Dragon Boat Festival, extract and design many UI elements with Chinese characteristics and the cartoon image, let our children's game design and develop with the positive and healthy cultural elements with Chinese characteristics, expect that the culture and values embodied in these games will have a subtle impact on children. Again with the resource of the traditional Dragon Boat Festival and traditional customs, as well as some useful knowledge, to develop three children's programming games, our target is to learn and understand knowledge in the game way. These three separate children programming game projects, implemented within Google Blockly programming environment, but has different themes, such as: Festival tips, Dragon boat racing, and Realgar wine, and each game projects have different forms, but all are basically with familiar programming statement modules such as "If else" statements, Switch statement, the While loop statements and so on, to achieve with connecting these programming modules in logic way, especially the game of "Festival tips" invokes a popular API to implement voice synthesis technology to increase speech recognition, speech output features. This paper work on research within Google Blockly programming environment, design the different useful programming statement modules, logically stitch these encapsulation programming statement module, in order to improve children's logical reasoning ability, and hands-on ability to solve problems, let the children start from playing a game, learn how to use programming tools to make their own games or toys, to train the children's programming concepts, as well as enjoy the experience of studying computer programming thinking.

The second type of children's games is based designing with Artificial Intelligence technology. The part introduced a popular computer technology - artificial intelligence,



with the deep learning library - TensorFlow, in children's games to achieve automatic image recognition, let children could better interact with the games or toys. In this children's game, we compared the Linear Regression Linear Regression model and the Convolutional Neural network model, through importing a handwritten digital data set that contains more than hundred thousand samples and labels, and carried these samples and labels into the training and test model, and adjust the best parameters such as learning rate, the training times, and looking for the best learning rate by compare the loss function values, as well as the final value – the test precision, at last, the Convolutional Neural network algorithm after tuning parameters takes the advantage of image reorganization in the children's game.

Eventually, convince that using the existing children's programming environment, make the programming games/toys for children in China have a lot of education value, this paper is based on analysis of children's programming games/toys at home and abroad, analysis and explore suitable programming games for Chinese children, explore the research from four aspects as above mentioned, and the four children's games that designed in this paper also are fully reflected these four aspects, of course, how to optimally show these goals is a very difficulty and worth exploring question, we expect more children's game designers to study and carry more discussion on this, work together to create a better solution.

## **2. Implementation**

This paper designs and studies suitable programming games for Chinese kids. Training from elementary to more professional , Chinese children can learn and understand computer thinking well. The first stage of game UI design needs more, in order to attract children's interest in this children's game and win their experience, a good set of UI can play an important role, with the theme of this programming game: Chinese traditional festival - Dragon Boat Festival Interplay, Chinese game UI and cartoon image design can help children understand the entire programming game. First of all, it is necessary to collect, learn and organize a large number of Chinese characteristic elements. Of course, we must collect and organize the popular, high-quality and creative UI design materials. The author has designed a set of Chinese characteristics through understanding these materials. The children's game UI, as the children's programming toy/game UI studied in this topic, will be shown in the specific introduction of the following children's programming game. The second stage of the game is based on the learning understanding of the previous stage of the game to carry out deeper computer thinking learning. The "handwritten digit recognition" game is introduced through the application of linear regression Linear Regression model and Convolutional Neural Networks model, including more than 100,000 Handwritten





digital data sets of samples and labels, as well as training and testing thereof, comparing parameters such as learning rate and training times, and comparing the loss function values to find the optimal learning rate, and the final value-test Accuracy comparison, by visualizing the linear regression and CNN algorithm to optimize the parameters, the handwritten digit recognition in the children's game, and finally realize the visualization of the CNN structure to help understand the artificial intelligence thinking.

### 2.1. The main screen for Children's Game

This paper implemented this children's game with four sub-games. The completed main UI interface of the programming game is as followed Figure 1 (a), including the main interface of the children's programming game and the main cartoon image, as well as the game theme "Dragon Boat Festival" and four game project names. They are "Festival tips", "Dragon boat racing", "Realgar wine", and "Handwriting picture recognition", and the traditional elements about this traditional festival are displayed with the game UI, which clearly clarifies the game theme.



Figure 1 (a) The main screen for Children's games, (b) The 5<sup>th</sup> level scene for Realgar wine game

### 2.2. "Realgar wine" Game

The "Realgar wine" game totally has 5 different levels game scenes, this game uses different maps from level 1 to level 5. The types of programming modules that can be used range from one to many, guiding children to think about using different programming module combinations, and even finding the best. The combination of modules to achieve the game goals, such as the game level 2 only provides three programming modules "turn left", "turn right" and "fire", children need to think about which programming modules to use to achieve the purpose of the game, is there still Other splicing module mode, and the game level 5 as shown in Figure 1 (b), adding a loop-like module "repeated () times to execute XX" command, does not limit the number of programming modules used, guiding children

to learn different splicing methods to achieve the game goal,train children to think logically.

### 2.3. “Dragon boat racing”Game

The "Dragon boat racing" game totally has 6 different levels scenes,this game uses different rivers from level 1 to level 6. There are also a variety of programming modules that can be used to guide children to think about using different programming modules and even find the most. Excellent module combination to achieve the game goal, such as level two only provide two programming modules "forward" and "turn right", can only reuse these two modules, guide children to think whether there is a more concise and quick splicing module. The way to achieve the goal of the game, let them form the expectation of a similar "loop statement" function module, and then introduce a new module of this function "repeated XX () times) in the later game level, thus training the child's programming logic. In the implementation of level 6, add a similar if else statement module "if (front / left / right) has a way to execute XX", limit the use of up to 4 programming modules to achieve the game goal, strengthen children's programming logic thinking, as shown in Figure 2 (a).

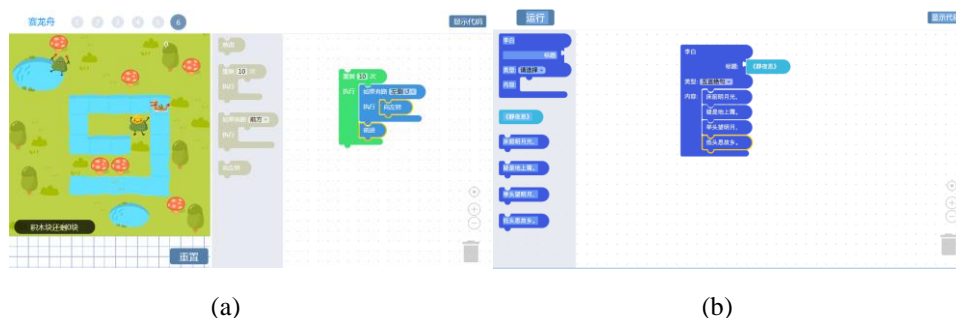


Figure 2 (a) The 6<sup>th</sup> level scene for Dragon boat racing game, (b) 1-4 The main scene for Festival tips game

### 2.4. “Festival tips”Game

There are two areas in the game as Figure 2 (b), the tool area and the work area. Select the appropriate programming module from the tool area and drag it to the work area, and splicing it correctly,then press the “Run” button on the game UI. The game uses the text content in the form of text data. Send it out, and then return the audio file and play it back in the cloud. This paper hopes to use this game to help children experience the smart technology which is commonly used in life.

## 2.5. "Handwriting picture recognition" Game

This "Handwriting picture recognition" game, kids can use the mouse to draw any number in the drawing area, then the game will apply the recognition model of two different algorithms and judge the result of the recognition probability of the input number. The two examples have different probability as Figure 3, such as random hand-painting "1" in the game, the probability that CNN is recognized as 1 is 0.803, and the probability of linear regression being recognized as 1 is 0.534, try other hand-painting, hand-painted in the game. "4", the probability that CNN recognizes as 4 is 0.450, and the probability that linear regression is recognized as 4 is 0.033. as shown in Table 1 below, The handwritten digit recognition is recognized in children's games after visually comparing linear regression and convolutional neural network algorithm tuning parameters.

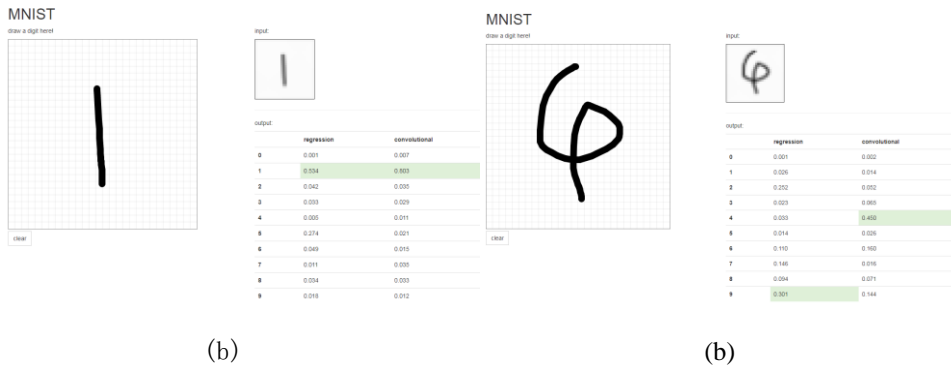


Figure 3. Handwriting picture recognition example, (a) The picture is recognized as 1, (b) The picture is recognized as 4

**Table 1 Comparison for Handwriting picture recognition**

Input(draw a digit)	base	Line Regression	CNN
draw a “1”	0	0.001	0.007
draw a “1”	1	0.534	0.803
draw a “1”	2	0.042	0.035
draw a “1”	3	0.033	0.029
draw a “1”	4	0.005	0.011
draw a “1”	5	0.274	0.021
draw a “1”	6	0.049	0.015
draw a “1”	7	0.011	0.035
draw a “1”	8	0.034	0.033
draw a “1”	9	0.018	0.012

### 3. Conclusion

From the aspect of our games’ architecture, we have created the Game base class for these four children's games studied in this paper, which is used to manage the initialization of all games and define some common methods:

(1) Blockly's toolbar (toolbox) and namespace (workspace) are created during initialization, and the dialog display (showDialog) and hidden (hiddenDialog) methods are defined to display the prompts at the beginning of the game and to display the game. result. The load resource method loadImages is used to load the image resources required for each game.

(2) We also created four game-related classes, namely Dragon Boat, Realgar Wine, Festival Tips, and Handwritten Picture Recognition AI. These four classes are inherited from the Game base class. The initialization of all games is managed by the Game base class. The four game classes define their own methods, such as executing the game play and resetting the game reset. Among them, the handwritten picture recognition AI The class has a getResult method that is used to call the model interface to get the result of the recognition. The method of getVoice in the poetry game Festival Tips is used to retrieve the interface and get the text-to-speech audio file.

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## The effect of Music Festivals on Perceived Destination Images

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### **Abstract**

*Music festival is one of the special event. It is a unique cultural event which continuously held on a particular place and time. It has been confirmed that music festivals can attract people to visit the destinations. Various researches have explored the potential of festivals in forming destination image. It has not been yet explored a link between the music festivals and image formation of the destination. The research aim is to examine the effect of music festivals on the perceived images of destinations. The objectives are to explore music festival in Thailand and to examine the perception of tourists towards destination image influenced by music festival. Five music festivals in Thailand were chosen as the research settings. The data were collected by conducting semi-structured interviews with tourists. The qualitative data are analysed using thematic analysis. The findings show that the destination images are influenced by the music festivals. The perceived images of the destination may similar to the existing images, while some may differ and transferable. The findings also show that the participants perceive images of the place differently during the music festival. The results can be applied to destination marketer in order to create or shape the destination images.*

**Keywords:** *Destination image, festival, music festival*

### **1. Introduction**

Destination image has been widely studied in tourism research for over the last decade. Due to it has been proved that it has an effect on the decision making process. As it is a major factor in the destination selection process of tourists. Destination image role is more than simply awareness in decision making process. A strong favourable image encourages people to visit. Many researchers suggest that a positive images can increase the number of visitors to the destination (Echtner and Ritchie, 1993)



Recently, some studies link destination image with an event. It considers that event image can influence destination image (Erfurt and Johnsen, 2003). Music festival is also studied as the special event which helps generate the number of tourists to the particular places at the particular time. However, the link between the music festival and how the tourists perceived the destination image has not been yet explored.

## **2. Literature review**

The literature on destination image, event, and music festival are explored. In order to understand the link between the areas. Then the image of event and the image of destination is reviewed.

### **2.1 Destination image**

Destination image refers to perceptions and impressions, idea and feelings and also beliefs which individual has for a particular destination (Crompton, 1979; Tasci, 2009). The tourism study also widely discusses the role of destination image in the decision making process to visit the destination (Hunt, 1975). It is believed that destination image can motivate people to travel considered as a pull factor (Crompton, 1979). Images are important because it helps tourists pre-imagine the experience before making a choice (Hunt, 1975; Tasci and Gartner, 2007). The literature is particularly looked at image components (Dann, 1996; Gartner, 1993; Gunn, 1988) and how people perceive, create, interpret, and develop destination image (Beerli and Martin, 2004; MacKay and Fesenmaier, 2000). Gartner (1993) defined cognitive, affective and connotative components. The cognitive image component refers to the facts represented by objects which can be evaluated and measured such as climate, infrastructure, and transportation. While the affective image component refers to subjective feelings about the object such as exciting, relaxing, and boring (Gartner, 1993). Lastly, connotative image component refers to an action component built on both cognitive and affective stages. For instance, people imagine being on the beach in a sunny day. In addition, Echtner and Ritchie (1993) categorise image components into three different dimensions: attribute or holistic, functional or psychological, and common or unique. Some researches study destination image components and intention behaviour. Bigne Alcaniz et al. (2009) find that cognitive image influences intention to revisit, while affective image influences intention to recommend. Elliot et al. (2011) find that affective image has greater influence on tourist beliefs about a destination.

## 2.2 Destination Image Formation Agents

Referring to Gunn (1989), destination image can also be developed at two levels, and organic image and induced image. Gartner (1993) develops eight image formation agents (see table 1.1). The eight formation agents categorise destination image from three main image formation agents: induced, autonomous, and organic. Induced formation agent include traditional forms of advertising for destination. There are 4 subgroups which involve information received from destination or travel agents. An autonomous agent refers to information from media or popular culture which provide information about the destination outside the destination promoter's control. However, it potentially creates images of destination. An organic agent is the actual visit or tourists' past experience (MacKay and Fesenmaier, 1997). This includes opinions of friends and family and word-of-mouth. An organic formation agents are also outside the destination marketer's control (Tasci and Gartner, 2007). In addition, people are likely to be aware of the biased information from destination marketers. Thus, it is believed that induced formation agents tend to have less credibility than the other two groups. On the other hand, autonomous and organic image formation agents supposedly provide unbiased sources of information.

**Table 1.1. Gartner's eight agents of image formation**

Agent	Characteristics	Sources
Overt induced I	Traditional forms of advertising from destination or tourism organizations	Brochures and print media advertising
Overt induced II	Information which is of interest in the travel decision process but not directly associated with a particular destination area	Received from destination or travel agent, wholesalers, and organisations
Covert induced I	Use of a recognisable spokesperson or celebrity through traditional forms of advertising	Television, radio, and print media advertising
Covert induced II	Second-party endorsement through unbiased reports such as newspaper articles	Familiarisation tours for travel writers or special interest media groups
Autonomous	Destination area promoters have no control over what appears in this formation agent	News and popular culture; movies, feature films, songs, art, and literature
Unsolicited organic	Information is not requested but is offered in everyday conversation	Friends and relatives who have been to an area, or believe they know what exists there
Solicited organic	Information sourced by the individual or group who has no interest in the outcome of the decision	Word-of-mouth
Organic	Actual visitation or past experience	Personal experience

*Source: Gartner (1993)*

News coverage and popular culture can provide substantial information about a place for a tourist. The literature confirms the relationship between image formation and the media, including music, literature and film (Thongrom, 2013). The Beatles connects their music with Liverpool city. Likewise, Hip-hop music creates the positive image to New York and Detroit (Xie et al., 2007).





Recently, the researches find the link between event and destination image. Lai (2016) finds that the event image of Beijing Olympic Games has a strong effect of destination image. According to Gartner's image formation agents, an event can affect the destination in two basic ways. Firstly, it indirectly influences destination image by producing onsite event experiences and induced/ autonomous/ organic information for tourists. Secondly, it directly influences destination image through mental contracts such as perception, attitude, and image of the event. The researches show that the event image can change the destination image as it can be transferred (Kenyon and Bodet, 2018; Lai, 2016).

### **2.3 Music Festivals**

The festival means a day or period of celebration, typically a religious commemoration. Now it refers to an organised series of concerts, plays, or movies, typically one held annually in the same place (Oxford Dictionary). The meaning concludes not only religious events but also cultural events for instance Woodstock, New York, USA and Cannes Film Festival, France.

The music festival refers to the event for holding the performance of singers and/or bands together rather than for a particular singer or band. Lashua and Spracklen (2014) describe that music festivals brought fans and bands together in one place.

Mostly, festivals are outdoor and provide food, drink, facilities, public toilets, and related products. Accommodation may or may not be provided. Moreover, festival refers to the continuously happen yearly at the same place. It can be either paid or free entry festival.

Music festivals can be held either one day or several day. It can be either for one or variety genres of music in one festival. For instance, Fuji Rock offers only Rock music bands. While Glastonbury offers Pop, Indy, Rock, Ragge, and Techno music. The music festivals in Europe and America often held in the summer time. While in Asia tend to hold in the cool season. However, there are some festivals, Pentaport Rick Festival in Korea, and Fuji Rock in Japan are in rainy season which become a unique image of the festivals. Moreover, these festivals are likely to locate in where can accommodate a large number of visitors.

Music festivals in Thailand are often held in cool season. Due to the summer season is too hot to have the festival outdoor. In the rainy season, there are more obstacles to set the venue outdoor. In this research studies 5 music festivals in Thailand. Big Mountain Music Festival was first held in February 2009 at Khao Yai, Nakhonratchasima Province. In 2013, it was moved to Kaeng Krajan, Phetchaburi Province. It is considered as the biggest and the best well known music festival in the country. This is a two-day-two-night festival held in December every year. There are main stage and smaller stages performed by singers and bands in different genres such as Pop, Hip Hop, Rap, Indy, Rock, Country and Techno.



Overcoat Music Festival is located at Khao Ko, Phetchaboon Province since 2012. This one day music festival is held annually in December. The slop location provides audiences the good sight of the stage. The music genre for the festival is likely to be pop music.

Season of Love Song at Suan Pueng, Ratchaburi Province was first held in 2010. Its location was changed in 2013 but still in the same sub-district at Suan Pueng. The music which performs in the festival is mostly pop music and followed the theme of love song. This is a one day festival held in November every year.

Samed In Love is located on Samed Island, Rayong Province from 2013. This is a one day festival which used to be held in February then changed to May-June instead. Its location is unique on the white sand beach. The music played in the festival are various genres.

Pattaya Music Festival at Chonburi Province was first held in 2002 at North Pattaya. A year later the venue was expanded to South Pattaya. This is a three-day festival in summer season. It is held in March every year, except in 2012 which held in April. The festival is free entry as the event occupied the large area of the city of Pattaya.

## **2.4 Music Festival impact on Tourism**

The studies link music festivals and tourist motivation and intention to visit. From the literature find that music festival motivate people to travel by the atmosphere and the activities in the festival. Also the desire to socialise with new people who share the same interest motivate people to visit the festival (Gelser and Robinson, 2009; Patterson and Peff, 2010: 96). Tomljenovic, Larsson and Faulkner (2001) add that people desire for pleasure and exciting experience. Bowen and Daniels (2005) find that ‘discovery’, ‘music’, and ‘pleasure’ are the important motivation to the tourists. More recent, Oh, Ahn and Back (2015) study the effects of Korean music via social media on the growth of inbound tourism in South Korea. Schabbing and Steffen (2012) confirm that music festival drawn number of tourist to visit. Nnamani (2014) adds that music festivals play vital roles in generating employment in Nigeria. Waitt and Duffy (2010) explore that music create emotional attachment to places at the study site of The Four Winds Festival. Likewise, Lashua and Spracklen (2014) examine how music transform particular places into tourist attractions. Their research highlight the relations between music, places, spaces and identities.

However, music festival can cause negative social, environmental and economical impacts to the destination. It can also have an effect on the image of destination either positive or negative.

### **3. Methodology**

The aim of this research is to understand how music festivals have an effect on the perceived destination image. This means it aims to understand people from the inside rather than through objective measurement. Consequently, a qualitative research approach is applied to this study

The research methodology follows the qualitative research approach. The data were conducted by the semi-structured interviews with 15 participants using purposive sampling. They must have been to any of the five selected music festivals. Each interview took between 30 to 60 minutes.

The criteria for music festivals choices as the research setting have been set as followed. It has to be held in a natural site; only music festival not including other Pop Culture activities; and continuously held at the same site at least 3 years. Five music festivals were selected 1) Overcoat Music Festival, Khao Koh; 2) Big Mountain Music Festival, Khao Yai; 3) Season of Love Song, Suan Pueng; 4) Samed in Love, Samed Island; and 5) Pattaya Music Festival, Pattaya. The research employ thematic analysis to analyse qualitative data from the interviews.

### **4. Results**

The results show that the participant who visit the destination before visit the music festival have rather greater image of the destination. On the other hand, the participant who visit the music festival without prior visitation to the destination tend to transfer the event image to the destination image. While some images of event and destination emerge to the participant equally. There are 21 codes found during the analysis then the codes was developed into themes as follows (Table 1.2).

**Table 1.2 The perceived images of destination**

	Cognitive	Affective
Khao Koh Overcoat Music Festival	Cold Less pollution Expensive Young to middle age visitor Easy to access Good location	Relax Romantic Not packed Comfortable Safe
Khao Yai Big Mountain Music Festival	Young visitor Easy to access Not expensive Sex and drug Not enough facilities	Party/ wild Dirty Fun Freedom Unsafe
Suan Pueng Season of Love Song	Family visitor Varied attraction Not far from Bangkok Variety of accommodation Not expensive	Romantic Relax Safe
Samed Samed in Love	Limited accessibility Hot Dirty Expensive Alcohol	Trapped Wild party Cool Fun Unique
Pattaya Pattaya Music Festival	Convenient Easy access Food and drink Good music Cheap	International Easy and comfortable Safe

Khao Koh have been mentioned about its cold weather and less pollution air and easy to access. The size of the venue was also mentioned and link with 'not packed'. The perception of cost during and after the festival are varied. However, the cost of travel to Khao Koh is perceived as expensive and affordable for the particular age group of visitor from 25 to 45. Moreover, people connect relax and comfortable with sitting on the grass like picnic. Overcoat Music Festival has influence the image of Khao Koh which used to have a great image of fruit plantation and previous communist area.

Big Mountain Music Festival formed the image of young visitor, easy to access, and not expensive. The festival provides the van from Bangkok which run all day. The fare is not expensive and affordable travel cost for teenager. The age group of visitor is from 15 to 35. However, the festival carries the image of sex and drug which links with fun, freedom and unsafe. The site is a very large area but lack of public toilet and trash bin. After the festival, there are pile of garbage which makes people perceived as dirty. However, the image of Khao Yai is perceived differently. The image of forest and national park is greater than music festival location. Thus the level of transfer the event image to the destination image is low.

Suan Pueng is located not far from Bangkok and it is perceived as a family destination. It is also perceived that variety of attraction. Although there is no public transfer, the cost of travel is perceived as not expensive. Possibly, there are choices on accommodation cost. The image of romantic, relax, and safe are created together with the image of Season of Love Music Festival.

Samed in Love is perceived as unique because its location on the island. It is also linked to limited accessibility because of the ferry timetable. The visitors cannot travel whenever they prefer but have to follow the timetable. As it is located on the island the cost of living is higher than the mainland.

Pattaya's image and Pattaya Music Festival's image are not different. People perceived Pattaya as the place where are a lot of foreigners. There are vans run all day from Bangkok. There are choices of food and drink. The music which plays in the restaurants in Pattaya is at high standard. The music at the Pattaya Music Festival is variety on the main stage and smaller festival.

## **5. Conclusion**

The image of event/ music festival and the image of destination can be transferred. In case that the images of music festival are greater, the images of destination can be changed. On the other hand, the images of destination are greater, like Khao Yai, the images of music festival are not influenced. It can be concluded that the music festival can be used as an image formation agent in order to create, formed and shaped the destination image.

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## Reflections on the creative process, analysis of strategic models for the development of creative thinking in the Industrial Designer

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### **Abstract**

*The purpose of this article is to analyze the different strategic models to understand and identify the factors that hinder the ability to develop divergent, open thinking free of technical and emotional bias to produce new and valuable things, or to apply solutions in a wide variety of ways. Studies on creators in the field of psychology, the process of development of traditional creativity applied in the degree in industrial design of the University Center UAEM Valle de Chalco in Mexico, and analogical reasoning through the sources of inspiration for creative production were taken into account. The information theory called "Hamming Distance" was used to verify if the real estimated value is congruent with the ideal estimated value, numerical values obtained from the different strategic models for creativity and postures emitted by the teachers of the area. As a result, new parameters were obtained to educate more effectively towards a creative thinking of industrial designers.*

**Keywords:** *Strategic models, creative thinking, industrial design.*

### **1. Introduction**

Today academia requires finding new ways with respect to the complex task of achieving, that students develop and consolidate a creative attitude to address academic, social, or business problems, and find the greatest satisfaction in being naturally a creative individual. The aspects of creativity in design related to the problem statement and the concept of originality, aesthetics and functionality are points that are immediately recognized as





significant in a creative process. Among different works, creativity has been defined as a person's capacity to generate a novel and appropriate product (Lubart, 1994; Sternberg and Lubart, 1996; Amabile, 1997; Sternberg, 2001). However, with such a synthesized definition, it is difficult to obtain an assertive view of the processes required to make a creative design product (Kim, Kim, Lee, and Park, 2007).

Therefore, creative problem solving in design may not have been totally reliable. Despite this, some current descriptions show that the project activity in the discipline is characterized by the occurrence of a significant event, fleeting or sudden ideas, designs, analogues; previous experiences; collaborative work between a group of students and teacher or simply the repetition of already solved dilemmas; which attend the creative development. Shroyer, Lovins, Turns, Cardella, and Atman (2018) affirm that researchers and teachers seek to formalize the different techniques to support the generation of ideas and determine their effectiveness based on the quantity, quality, and originality of those developed in design education, with the purpose of identifying indicators of creative evaluation of students in their curricular trajectory, through their different stages (Demirkan and Afacan 2012).

It should be noted that higher education communities do not share a common definition for creativity, for this reason there is less clarity in how it should be taught, evaluated or measured, however, this does not mean that it is misunderstood, there is an important number of researches that have explored almost all its dimensions, which indicates that it represents a high level of analysis, interpretation and techniques, but it remains divisive in some cases (Williams, Ostwald and Askland, 2010). Consequently, researchers and educators must agree to determine a concrete concept of creativity and find a different cognitive process to interpret and solve design problems (Kim et al. 2007).

For this reason, the research area of the degree in Industrial Design of the University Center UAEM Valle de Chalco, has developed a project based on the study of applied techniques for the development and practice of creativity, in the resolution of industrial design projects, analyzing and interpreting the teaching actions that are applied in product design workshops.

## **2. Strategic models**

### *Limited Commitment Mode (LCM)*

Creativity is defined by psychologists as "the production of novel and appropriate ideas in any field of human activity" if the generation of ideas is considered relevant, it is also



worthwhile to work with creativity techniques that are creative and consider the problem, application context and components of a creative process. For this reason, the present study considered some strategic models of training that reflect the personal cognitive characteristics of students (Kim and Kang, 2003). Thus, creativity in design can be improved by identifying students' underlying cognitive abilities (Kim et al. 2007). Some studios of the subject identified that designers use the Limited Commitment Mode (LCM) as a strategy to solve design problems (Goel and Pirolli, 1989; Goel, 1995). Such action defines that, "when working on a particular part of the module, it does not require the designer to complete that module before starting another. You have the option of putting any module on "hold" to attend to other related or even unrelated modules and return to the first one later". In addition, it is possible to work with visual reasoning (cognitive ability) composed of: visual analysis, synthesis and representation (Kim et al., 2005a; Park et al., 2006) and constructive perception that combines perception, which is defined in psychology based on Gestalt theory, as a process characterized by processes of abstraction or search for simplicity or pregnancy and conception (Gilberto, 2004).

### *Cognitive diversity*

Cognitive diversity in designers is seen as an advantage in solving design problems, since the generation of diverse proposals can stimulate consideration of non-obvious alternatives in the approach to design requirements (Cox and Blake, 1991, p. 50); The type of cognitive diversity was defined as "characteristics of typically preferred people and modes of information processing" (Sternberg and Grigorenko, 1997, p. 700). It has also been described as the preference for how a problem is perceived, managed and solved (Kirton, 2003).

Some studies have shown that better results are obtained in solving problems when the equipment is heterogeneous (Basadur and Head, 2001; Hoever, van Knippenberg, van Ginkel, and Barkema, 2012; Mohammed and Angell, 2004). After assessing previous research, Mello and Rentsch (2015) determined four types of cognitive diversity: 1. Stable cognitive variables that are innate features or become consistent in adulthood; 2. Cognitive variables that develop throughout life experiences are relatively stable; 3. Studies on cognitive style diversity have demonstrated advances for teamwork as a function of creativity (Kurtzberg and Amabile, 2001).

### *Inspiring Stimuli*

It is significant to say that the literature on design cognition indicates that, in order to avoid early fixation, designers should outline the general form of a design, before focusing attention on the details of requirements (Damle and Smith, 2009). Within that cognitive process, analog reasoning is developed, which is defined as the process by which information from a source is applied to an objective through the connection of relationships



or representations between both ("source" and "destination") (Gentner, 1983; Moreno et al., 2014).

Although the basics are known about the neurological processes that support design cognition involving inspiring stimuli, including analogies, researchers work to make analogical reasoning in designers inductive and apply it to the creative process freely, in order to respond to the same logic in a design process. They also seek to increase the positive characteristics of design concepts through these inspiring stimuli (Fu et al., 2013; Linsey & Viswanathan, 2014). For Goucher, Moss and Cagan (2019) the inspiring stimuli enhance inductive thinking and closely related mental processes, these stimuli, including analogies, must be presented in time and accurately to designers to be transformed into systematic inspiration for creativity.

Another line of research regarding analogies is analogical distance, considered as a continuum, i.e. a distant domain where the terms "near" and "far" are used, a close analogy would be closely related to the same domain and share significant characteristics, while a lay analogy comes from a distant domain and shares little or no characteristic. Common theories indicate that lay analogies favor the most innovative solutions (Wilson, Rosen, Nelson and Yen, 2010). However, another study has shown that close analogies are easier to apply to design problems but can lead to designer blocking (Jansson and Smith, 1991).

Another research proposed the "fair point" of the analogue distance between a nearby analogy where innovation is restricted and a copy or a block is likely to occur and a very distant one where the analogy is probably located outside the problem to be useful. Additionally, the investigation of Fu et al. (2013) Does mathematical operations for the analogue distance, from the aesthetic analysis of the patents of the United states, assuring that the transfer of knowledge in the analogue distances, is a critical step to stimulate the analogies in the positive design.

In addition, there are key components in analogue reasoning such as recovering relevant information stored in long-term memory (Wharton et al., 2000) as well as selection and analysis of information (Krawczyk et al., 2008) and manipulation, new Configuration and maintenance of the information used in previous projects (Cho, Holyoak and Cannon, 2007). For Folkmann (2010) Analog reasoning can go through the structural model for imagination in design, which is composed of "matrices of ideas" since the axis of the research of the training powers of the design outlining should be directed to a meta-conceptual level that analyzes the structure of concepts and ideas, affirming that the relevant is the construction of the meaning between the interior and the outside in the flexible structures of outlining in the imagination.

The proposed approach serves to examine some of the general factors in the transformation of an internal mental environment into an external physical representation. The proposal implies the identification of three general meta-conceptual concepts or configurations that are designer facilitators to turn ideas into products. The following configurations are within a dichotomy range. 1. Knowledge Budget: Known vs. Unknown 2. Imaginative starting point: all vs. Detail and 3. Focus Degree: vs focus. Out of focus the relationship of concepts defines the model for creativity in design.

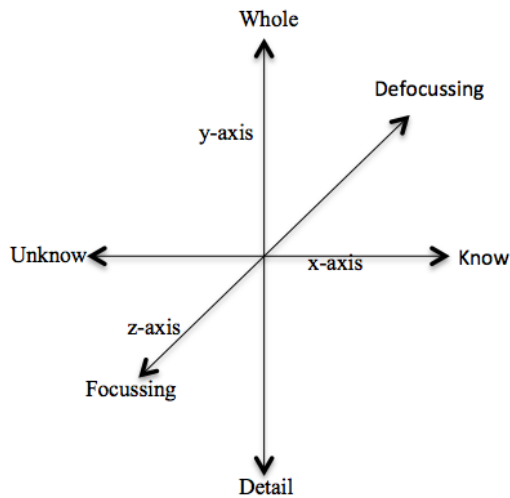


Fig. 1. A Prism of Schematization in Imagination  
Font: (Folkmann, 2010).

### *Creativity (degree in Industrial design )*

In order to identify the factors that drive a creative personality in the industrial designers of the University Center UAEM Valle de Chalco, we took as a base the daily practice that is done in the trajectory of the students, from the first to the eighth semester in which creativity is worked for the development of industrial design projects, specifically in the subjects of design of products and systems, as well as considered the most relevant specific skills of the industrial designer (Sánchez, 2018), (see table 1), these skills facilitated the approach of this research. In addition, 10 out of 20 concepts applied in practice for product design were identified, weighted by level of importance by expert professors in the area of design and innovation.

**Table 1. Most relevant specific competences of the industrial designer**

1. Recognize and analyze discipline concepts, as well as forms and structures in design concepts to apply three-dimensional constructive elements of form.
2. Analyze and interpret the elements of the state of the art, the different areas, sustainability, ergonomics, aesthetics, technology and market to integrate the elements based on design fundamentals, creativity, perception and awareness for the development of design proposals.
3. To interpret systemically the interrelation between human factors and other systems, from ergonomics and anthropometry for their evaluation and application in the design of artifacts and industrial objects.
4. Recognize and accept industrial design projects that guarantee sustainable development and sustainable environmental, social, cultural and economic.
5. Recognize and select the creative application of conventional and next-generation materials in specific design problems.
6. Recognize the project process as a research method for the configuration of Industrial Design objects.
7. Handle computer-assisted design programs for two- and three-dimensional graphic representation of Industrial Design objects, using electronic and printed formats.
8. Perceive, conceive and handle the transition of materials (paper, cardboard, foams, plastic laminates, balsa wood, plaster, plasticine, etc.) for the three-dimensional representation of objects at any scale.
9. Handle the means and tools to perform animations and virtual simulations of Industrial Design objects with specialized software.
10. Handle the means and tools to develop three-dimensional models, using stereolithographic printers or computer-aided numerical control machining centers or equipment.
11. To develop industrial design projects that guarantee sustainable development and environmental, social, cultural and economic sustainability.

*Font: Sánchez, O (2018)*

The undergraduate teachers have worked on the design projects, considering that each one of the mentioned competencies requires creative actions. Therefore, it was decided to study the following 20 concepts applied in the classroom and identify the 10 most important in the creative process.

V1-Lineaments, V2 Activities, V3 Educate, V4 Barriers, V5 Intuition, V6 Imagination, V7 Creative teacher, V8 Critical capacity, V9 Attitude, V10 Techniques and methods, V11 Aptitude, V12 Representation, V13 Context, V14 Research, V15 Experience, V16 Fantasy, V17 Audacity, V18 Ideas, V19 Drawing, V20 Curiosity. (the assigned number is only by ordering)

To validate the information we worked with the "Hamming Distance". The purpose of using this tool was to detect the similarity between the real vectors and the estimated vectors. So it was possible to define the distance that exists between A(x), vector of the real averages in each level of the variables suggested for the creative thinking of the industrial designer, and B(y) vector of the estimated averages in each level of these variables.

Hamming distance

$$\delta[\mu_{A(x)}, \mu_{B(y)}] = \frac{1}{n} \sum_{k=0}^n |x_k - y_k|$$

*A(x) is the vector of the real averages at each level of the variables suggested for creative thinking in industrial design.*

*B(y) is the vector of the estimated averages at each level of the variables suggested for creative thinking in industrial design.*

*It defines the attributes of set A(x).*

*Defines the attributes of set B(y).*

*X<sub>k</sub> is the k-th attribute of set A(x).*

*n is the total of attributes.*

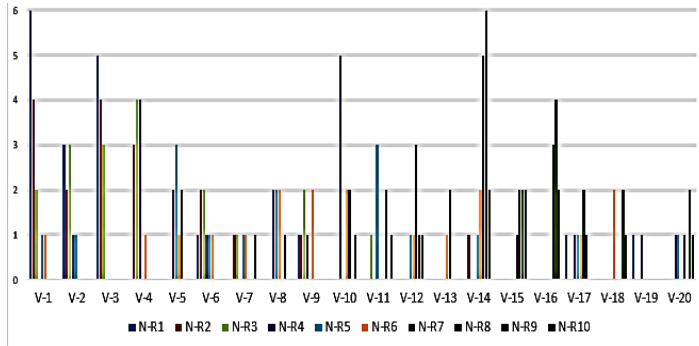
The average distance established between the actual state derived from the research exercise applied to teachers and the ideal state found from the technique used was (1.75). The following graph represents it.

**Table 1. Variable frequency**

Va.	N-R1	N-R2	N-R3	N-R4	N-R5	N-R6	N-R7	N-R8	N-R9	N-R10	Sum	Ve-RealPo.	Ve. IdePo.
V-1	6	4	2	0	1	1	0	0	0	0	14	1.4	4.6
V-2	3	2	3	1	1	0	0	0	0	0	10	2	8
V-3	5	4	3	0	0	0	0	0	0	0	12	2.8	4
V-4	0	3	4	4	0	1	0	0	0	0	12	2.8	5
V-5	0	0	0	2	3	1	2	0	0	0	8	2.2	7
V-6	1	2	2	1	1	1	0	0	0	0	8	1.2	0.8
V-7	0	1	1	0	1	1	0	0	1	0	5	0.5	0.5
V-8	0	0	0	2	2	2	0	1	0	0	7	1.3	0.7
V-9	1	1	2	1	0	2	0	0	0	0	7	1.3	0.7
V-10	0	0	0	5	0	2	2	0	1	0	10	4	2
V-11	0	0	1	0	3	0	0	2	0	1	7	1.3	1.7
V-12	0	0	0	0	1	1	3	1	1	0	7	2.3	6
V-13	0	0	0	0	0	1	2	0	0	0	3	1.7	9
V-14	0	1	0	0	1	2	5	6	2	0	17	4.3	1
V-15	0	0	0	0	0	0	1	2	2	2	7	1.3	0.7
V-16	0	0	0	0	0	0	0	3	4	2	9	3.1	3
V-17	1	0	0	1	1	1	2	1	0	0	7	1.3	0.7
V-18	0	0	0	0	0	2	0	0	2	1	5	1.5	10
V-19	1	0	0	1	0	0	0	0	0	0	2	0.8	0.2
V-20	0	0	0	1	1	0	1	0	2	1	6	1.4	0.6
											38.5	20.5	
											1.75	1.025	

Font: Sánchez, O (2018)





After the study identified the following 10 concepts by level of importance for creative thinking: 1-V14 Curiosity. 2-V10 Fantasy, 3-v16 Attitude, 4-V3 Ideas, 5-V4 Critical capacity, 6-V12 Imagination, 7-V5 Aptitude, 8-V2 Educate, 9-V13 Creative teacher, 10-V18 Representation

### 3. Conclusion

Based on the foregoing, it can be concluded that the educator must have a profile and personality of creator to guide a working group or project, if the teacher limits or rejects free thought, will be hindering the first steps to develop and consolidate A creative personality in industrial design. For Berzbach (2013) The feeling of guilt is one of the greatest barriers to creative life.

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## **TED talk as a simulation tool in a higher education for the learning process and improvement students' motivation: an academic practice with students of the Degree in Business Intelligence and a prospective**

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### **Abstract**

*The main mission of this project is to improve the professional skills of first year students and to measure their motivation, focus on self-learning and professionalism. For that, the professor uses The TEDxtalks methodology as a great tool to develop these essential competences and introduces the student as the protagonist of the self- learning process. The TEDxtalks tool was created to disseminate scientific results of great researchers. It has now become a system of scientific and social dissemination, used to improve formal and informal learning. Also, one of the skills that Spanish people need to work on is their communication skills and these kinds of projects are based on the effective communication competences and others that increase the motivation of students to self-learn and ask about newly acquired knowledge. This educational innovation project tries to use these tools to improve the professional and academic skills and reinforce the human dimension of students and the factor to motivate them to study and learn. It has been evaluated and with the advice of a mentor (subject teacher). The project has been evaluated using a quantitative and qualitative method and the conclusions are interesting because the students recommend it and indicates that their has been an improvement on skills, motivation, values and knowledge.*

**Keywords:** *Higher education, Bologna process, innovation, academic practices, new methodologies, self-learning, professional skills and competences, Tecnology Education, spread ideas, motivations.*



## **1. Introduction**

According to the goals of the Bologna process, the main mission of this project is to start the develop the professional skills of first year students and to measure student's motivation to use the practice of TEDxtalks as a self-learning tools. For that, the professor uses TEDxtalks methodology as a key tool to develop the main new demanding competences and focus on the student like the protagonist of the self- learning process. The TEDxtalks tool was created to disseminate scientific results of great researchers. It has now become a system of scientific and social dissemination, used to improve formal and informal learning. Internet, the new Social Technology Network and platforms, as YouTube, had been managed to open new channels to facilitate massive learning, examples like MOOCs, TEDs and University Channels in YouTube, blogs and other educational platforms. Moreover, one of the skills that Spanish people need to work on is the communications skills and these kinds of projects are based on the effective communication competences, and others that increase the motivation of students to self-learn and ask about new knowledge.

This innovation project tries to use these tools and has several objectives. On the one hand, it aims to increase their motivation. On the other hand, it brings students closer to research studies, while improving their professional skills. Lastly, it has sought to reinforce the human dimension of the students, learning competencies, also values such as respect, ethics, commitment and excellence. All of these activities have been evaluated with the advice of a mentor. Using a quantitative and a qualitative method, the results are interesting because the students approve of the use of practices in the classroom to elaborate and present their TEDxtalks and improve skills, motivation, values and knowledge.

## **2. New Higher education practices: a TEDxtalks simulation as a tools to improve the skills and students motivation.**

### **2.1. The Challenges of Bologna at the present time.**

#### *2.1.1 The context of Bologna Process*

More than two decades ago, the Bologna Declaration established the objectives of the so-called Bologna Plan that sought to modernize the European Higher Education System (EHES) based on a formal convergence. The Bologna Declaration made Europe rethink its teaching methodology and the learning and teaching process. The objectives for the 21

centuries were to adapt them to the new academic objectives and the competences that the students should acquire. Until 2010, the Bologna Process, as well as the configuration of the EHEA, were developed in three levels of performance. On the one hand, the university institutions, which had to face drastic changes, and on the other, the governmental authorities that had to regulate those changes and promote a new context where the quality, the mobility, the employability and the teacher careers are in the center of the model. The operative goals were to adopt a transparent system of comparable degrees, implement a system based on three cycles (degree postgraduate and doctorate), develop the European Credit System (ECTS), promote the mobility; boost European cooperation for the assurance of Quality and promote the European dimension in the curriculum. In May of 2015, the European Commission published a document (*EC; 2015*) and suggest the achievements of Bologna and its quantitative and qualitative limits or disadvantages. It was divided in six areas the limits and benefits. One is the structure of degrees and skills, the second the system was to guarantee the quality, the third the social dimension of higher education, the fourth the long life learning, the fifth the employability and the sixth the internalization and mobility. Although twenty years have passed since the Bologna Plan was signed, it can not be asserted that the project cycle is complete. Among these shortcomings for this Plan to be operational in all participating countries, we can highlight that the main initiatives need to be consolidated: formative mobility, credit transfer, accreditation standards, certification and recognition of competences. In the same way, second generation projects have yet to be defined: the social agenda of the Bologna, inclusion, equity, employability, lifelong learning and the transformation of teaching and learning practices. In Spain, the balance was positive despite the limits, and the results have been an advance. However, different authors such as Michavila (Michavila, F., et al; 2015; 2018), Nuñez C (2015) and other reports as the European Commission (2018), European Commission (2019) or the CRUE (Conferencia de Rectores de las Universidades Españolas) and emphasize that we must continue to focus on building quality culture, adapting the teaching-learning process, developing skills of the new industry drivers (digitalization, globalization...), changes in the employability and the links between Higher Education Institution, The Industrial, Government and the Society.

### *2.1.2. The Develop of skills and competences at the European Higher Education Area.*

Higher Education faced an inevitable global opening with the creation and implementation of the EHEA, which demanded to incorporate new elements and new roles for the agents. The EHEA represented and will represent the greatest innovation in higher education and encourages universities to adapt their activities to the future of the new Knowledge Society and Digital Society. The new stage between 2010-2020 in the strategic conceptual framework for European Cooperation promoted the items related to this entrepreneurial approach to higher education institutions. The creation of a European credit transfer system,



in order to facilitate the mobility and make equivalences between degrees carried out in different countries, was one of the great changes. The learning context became an ecosystem where the student performs learning activities -in the classroom and outside the classroom- with theoretical and practical lessons and is evaluated. With those new ways of doing, the European countries places in the center of the discussion-model the role of the student. Boths linked The University Education with the Professional World.

In Spain, the RD 1125/2003, the indications of the Agency National of Evaluation and Accreditation, made necessary the incorporation of the concept of competences. According to the RD1393/2007 and the RD861/2010 our titles will be designed based on objectives and competencies. Within these competences, there are several types -generic and transversal competences-. "The curricula leading to a degree must (...) have in the center of their objectives the acquisition of skills by students, expanding, without excluding, the traditional approach based on content and teaching hours. (...) The new organization of the teachings will increase the employability of undergraduates (...)". Certainly students and teachers participating in these projects. Mobility, academic results, competitive research projects and papers are examples of indicators, the research made and its impact, the successful of the teaching-learning process. Since 2000, other indicators that showed the successful of Bolonia as the number of universities that offered congress and programs about education and innovation. In conclusion, the connection to the professional world and expectation, the goals of employability highlight, the relevance of the competences and to adapt these professional and academic competences.

In 2012, ANECA published the Support Guide for the elaboration of the official university Degrees and Master in which defines competence as "the set of knowledge, skills, attitudes that are acquired or developed through coordinated training experiences, which are intended to achieve functional knowledge that efficiently respond to a task or problem of daily life and professional, requiring a process of teaching and learning". With this new approach, the role of the student in their self-learning is fundamental and the student is the main protagonist in the achievement of the objectives. Since then, there are many practices related to different methodologies that have been implemented in Spanish universities by the faculty. Studies carried out by the Economics and Social Council in its report on professional competences and employability in 2015, as well as other reports (WEF, 2018; Michavila, 2015) reveal the gap between the needs of the labor market and the profiles of graduates. The evidence on the effectiveness of problem-based learning compared with more traditional approaches in higher teaching and the conclusions of this report Its about the necessity to develop new softskills for the digital challenge and new jobs. With the application of creative and innovative teaching methodologies, the intention is to increase student motivation and enhance these competencies. In this paper we shall focus on the

methodology that permits to increase motivation and develop professional and academic skills. Nevertheless, Spanish universities have clearly contributed to social improvement (Sanchidrian R, Garzon D.; 2013). Apart, the CRUE observatory provides statistics and analyses the key competences and indicators of Spanish universities and promote, in our opinion, an increasing awareness and sensibility in universities concerning measurement.

### 2.1.3. *The TEDxtalks as a proactive tools to improve the competences: our project.*

The needs of improve the skills of the digital students and their motivation have changed the methods of teaching and assessments. The gamification and simulations are examples of best practices (Axelrold, R. 2006; Chin, J. et al; 2009; Marcelo, C. 2015, Zabalza; 2011; Rodriguez et al; 2018; Hoidn, S. et al; 2014). This simulation of TEDxtalks for students is a tools to adapt the students profiles at the market needs. For this reasons, This project dediced to use a new methodology in a transversal subject and do a prospective after to do it in a future at specialist subjects.

The on-line resourses for teaching are incorporated to the new courses and to the informal learning. One of this resources is the TEDxtalks; This tool was created to disseminate scientific results of great researchers. It has now become a system of scientific and social dissemination, used to improve formal and informal learning. Internet, the new Social Technology Network and platform as YouTube had been managed to open new channels to facilitate massive learning, just as it happened with MOOCs, TEDs and University Channels, blogs and platforms. The TEDxtalks has its own effective rules and shows the skills of the great speakers. For that, TEDxtalks offers scientists and other experts a platform to provide scientific information directly to millions of people around the world. The majority of teachers and students use them as a reactive tools to learn as a informal methodology but in this innovation practice we dediced to use them to improve the skills.

In this practice the students in a team group had to choose a topic, research about it, prepare the contend of the TEDxtalks and do a simulation as an speaker in a real situation of performance. In this casce, It's a cross-subject at the Degree in Business Intelligence and Doble Degree Business Intelligence and Business Administration -6 ECTS- and first course. The students dedicated the 30% of the hours to this activities and the assestment was for 30%. The number of the students are 45 -national and foreign students-. The main goal had been improve the self motivation, skills and knowledge of the students and prospective about the impact of this practice to use it in the second course in a specific subject -Financial accounting-. At the end the assetsment of this simulation had be done by a quantitative – success indicators- and qualitative -perception studio-.

At the Table 1.1 Its possible to find the skills to promote divided in six classification.





**Table 1.1. Skills and competences of this innovation project.**

Simulations students TEDxtalks: skills and competences asset ment					
Capacity to looking for information and analyses the social impact of project.	Capacity to research international studies and report and promote evidence based scientific.	Responsibility, Leadership and Planning skills. Team work, planification of activities, focus on excellence	Ethics and sustentability society values	Communication skills: no verb and effective communication skills	Creative presentation and ability to impact

*Font: Authors compile*

The strategy has been defined in three phases that are briefly described below:

Phase 1: Project Design. This stage took place in the first month. The objective has been to create the appropriate atmosphere and train with the following activities:

- Choose the skills and competences (table 1.1).
- Designe the workshop and activities to develop them.
- Adap the TEDxtalks rules for the simulation. Same characteristics but the performer was defined for a team (2 or 3 people) and create the assetsment and rubric.

Phase 2: Initial Implementation Pilot Project. The length of time is until the end of the semester. The aim is to make aware the student. To do this, the strategy puts the focus on five pillars: Introduce the TEDxtalks as a tool to learn and improve the skills, students training, self motivation, research and performance (techniqs and final presentation). The student selected the team and had 20 days to chose 3 topics. In a tutorial session defined the advantages and disadvantages of each topic with the teacher advisor. At the end, They selected the topic that motivates them to prepare an excellence work -Table 1.2-. The topic will be interesting, serious and pioneer with social impact. The students -8 academic hours and 25 external time- prepare the content and the surprise effect of the effectiveness communication. They had Class-session about the rules of the TEDxtalks and the communication skills (written, oral and non verbal communication). At the end, prepared the performance at the theatre salon and did the performance to students and teachers.

Phase 3: First, the evaluation of results (quality and quantitative indicator) and design the new strategic challenges to use the TEDxtalks at Financial Accounting subject. Second, a prospective report -to prepare cuestionaries to first course students (Introduction to financial accounting) to evaluate the perception for using this simulation the next course-.

**Table 1.2. Topics select for students.**

1.Blockchain: easy to understand. 2.He for her: new proposals 3.Ethics and Business analytics 4.Social network and big Data	9 Data Ethics: hope for an ethical world 10.Feel D Music. 11.Big Data and advertinting : new performance and indicators. 12 Security and privacy on internet
5 Artificial intelligence: new capacity-new computer 6 Research and Longevity 7 Music and emotional intelligence 8 Music and the impact in the sences	13 The magic of the music as a therapy. 14 The new energies that move the word. 15 Bilingualism and trilingualism and the open mind

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## 2.2. Results, conclusions and prospective.

The objective is to evaluate this teaching experience based on a Skills that the TEDxtalks promotes.At the end of the innovative project we evaluated the results obtained (Table 2.1). On the one hand, we evaluate the academic results that improved substantially. On the other hand, we conducted a survey to the students to assess their own perception. The 100% of the students answered the questionnaire and the 85% of the prospective study.

**Table 2.1 Main results.**

<p>ACADEMIC RESULTS:</p> <ul style="list-style-type: none"> <li>✓ The 100% of the students participated on time throughout the schedule.</li> <li>✓ Only 10% were delayed in the deadline.</li> <li>✓ All the students exceeded the assetment and improved their performance. The 50% obtained outstanding results.</li> </ul>	<p>MOTIVATION RESULTS</p> <ul style="list-style-type: none"> <li>✓ The 100% of the students introduced their high level motivation to participate in this activities.</li> <li>✓ The factor that motivated students are to do a TEDxtalks and its external implications, the team work, improve the communication skills, the challenge of reduces the fear to be an speaker.</li> <li>✓ 100% Recommended to do in specific subject and not only in cross-subject.</li> </ul>
<p>PERCEPTION RESULTS:</p> <ul style="list-style-type: none"> <li>✓ 100% students saw the TEDxtalks as much to learn as to entertain themselves.</li> <li>✓ Every students valued highly the working of the six competences and considered that they had improved deeply in analytical skills, creativity, communication skills, leadership and ethics.</li> <li>✓ Only the 30% of students considered that they had improved in search of information.</li> <li>✓ The 80% considered the important to measurement the time that students spent in this activity.</li> <li>✓ The 20% would do it as an extra-academic activity.</li> </ul>	<p>PROSPECTIVE RESULTS (Specific subject: introduction of financial subject)</p> <ul style="list-style-type: none"> <li>✓ The majority of students use The TEDxtalks as a system to learn and other to enjoy.</li> <li>✓ The first skills that they consider the TEDxtalks develop are communicative skills, the second creative to present an idea, the third skills about looking for information and the syntesis and applied the knowledge to practical situation.</li> <li>✓ They consider the ethics, hosnesty and human sense are the values less considers.</li> </ul>

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The conclusions about it, revealed considerable concentration in opinion among the advantages to use the TEDxtalks as a proactive tools to improve skills. The two groups of students with regard to the skills needed, the skills received and the additional training needed. The prospective study recommend to use this method at Financial accounting (2º course of Business Administration Degree) and It's possible to use this practice in other subject when the goal is to improve the communication skills and other competences.This research contributes to the scarcel empirical research on the use of TEDxtalks as an

effective learning tools in cross-subject and the motivation of students to use it in specific subject in higher education environment.

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## Training the working memory in older adults with the “Reta tu Memoria”<sup>1</sup> video game

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### Abstract

*The objective of this study was to train the visuospatial and semantic working memory of a sample of Colombian older adults through the design of a serious game. The sample was composed of 20 older adults whose ages ranged from 50 to 77 years and showed signs of normal ageing. The sample belonged to the Edad de Oro group from the Universidad de Ibagué in Colombia. Participation in this study was voluntary, and the socio-demographic data and Mini-Mental state examination questionnaires were administered. The video game’s creative process was developed over six months by a team made up of psychologists and systems engineers. The video game was created using 2D Construct3 game editor, and the use of JavaScript programming language and an advanced knowledge of HTML were required. Before training, two pilot sessions were carried out to adjust the video game structure. After that, the procedure was applied to the sample for 20 sessions. The time spent and errors made in the video game’s five levels were registered. The results show values of significant effect size. In conclusion, the Latin American samples help corroborate the central training hypothesis. Training through video games leads to improved visuospatial and semantic working memory performance.*

**Keywords:** *visuospatial working memory, semantic working memory, video game.*

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<sup>1</sup> “Challenge your memory”

## **1. Introduction**

The decreased birth rate and the progressive increase in life expectancy influence the population's age composition as these relatively reduce the number of younger individuals and increase the older age ranges. The percentage of older adults living in developing countries is expected to increase even more in the coming decades (United Nations, 2017). In these countries, old age is associated with less protection, greater dependency, illnesses and lack of productivity due to the restricted access to economic, social and academic benefits (Rodríguez, 2011).

Working memory is one of the cognitive processes that declines in a clear and linear way as individuals get older (Anguera, et al., 2013; Mammarella, et al., 2013). Working memory is the ability to withhold and use information to carry out complex tasks (Borella, 2017). It is characterised by various processes which depend on the type of content processed (verbal vs. spatial). Cornoldi & Vecchi (2003) developed a model comprising a basic structure and a skill used for active ageing. It showed that training working memory improves performance not only for the trained tasks (or similar work) but also for non-trained tasks (transfer effects). Memory training influences how individuals process information, allowing them to use their own resources in a more flexible way (Borella et al., 2017).

### **1.1 Video games for cognitive training**

Video games entertain people of different ages without distinction. They simulate experiences, provide the user with information and knowledge, who at the same time decides to be actively involved in the screen of the device used. This activates the player's cognitive areas for the purposes of solving the game and allows for the development of skills and abilities that can be integrated in daily life (Perea & De la Peña, 2018).

The positive effects on cognitive functions may depend on the actions taken to develop the video game, such as tracking, storing in short-term visual memory and reacting to multiple aural and visual stimuli, which are continuously changing in time and space (Pavan et al., 2019).

According to Anguera et al. (2013), a supposed cognitive improvement mechanism through video games is provided by what is called the central training hypothesis, according to which the repeated stress in a cognitive system leads to plastic changes in its neural substrates, and therefore, results in better performance.

Younger people are the most exposed to video games in everyday life. In research, samples are formed by children (Egeland, Aarlien & Saunes, 2013) and adolescents (Nuyens et al., 2018). However, the possibility of using video games as a form of cognitive training among

older adults has gained significant interest (Woods et al., 2018). Video games are an alternative to reduce cognitive impairment and improve quality of life (Maillot, Perrot & Hartley, 2012), strengthen memory capacity and improve coordination, repetition and concentration (Connolly et al., 2012).

## **1.2 Serious games**

Serious games are intended to train and develop skills, teach or change attitudes and behaviour (Moizer, 2019). Their dynamics focus on training the individual's functions and they gradually increase in difficulty according to level so as to allow them to improve in each session, with the training of different cognitive skills as a positive outcome (Ballesteros et al., 2014). The human cognition project conducted by Lumos Lab (2019) has developed Lumosity<sup>®</sup>, an online program consisting of different games to improve cognitive flexibility, attention, processing speed, problem-solving and memory. This has become one of the best mental training platforms, available on the web and on iOS mobile devices.

Other programs involving cognitive stimulation, evaluation and neuropsychological rehabilitation are Grador<sup>®</sup>, developed by Ides (2014) and Cogmed Working Memory Training<sup>®</sup> (Pearson, 2016), a computerised solution for attention disorders caused by a poor working memory.

The computerised programs aimed at improving cognitive skills, and memory in particular, require credit card payments and are expensive, so access is restricted for individuals with limited economic resources. Furthermore, despite developing countries' attempts to bridge the digital divide, this is ongoing due to restricted access to digital infrastructures, unaffordable services and the limited use of ICT (Cabrera, Orioy & Gabarró, 2018). Course offerings for older adults to learn how to use ICT is scarce, and some of these individuals are resistant to change and prefer not to use technological resources. Accordingly, this study intends to train the visuospatial and semantic memory in a sample of Colombian older adults through the design of a serious game.

## **2. Method**

### **2.1 Participants**

The non-probabilistic sample was formed by 34 participants whose ages ranged from 50 to 77 years who belonged to the Edad de Oro group from the Universidad de Ibagué in Colombia. 20 of them met the following inclusion criteria of the sample: at least 50 years





old, ageing normally, having neither a neuropsychological nor medical history. It was a minimal risk study which met the American Psychological Association’s ethical standards for research with human beings and participants signed the informed consent.

## **2.2 Instruments**

**Mini-mental state examination.** This examination was developed by Folstein, Folstein, McHugh and Fanjiang (2001), adapted to Spanish by Lobo, Saz and Marcos (2002). It assesses the patient’s level of cognitive state in the following areas: temporal and spatial awareness, fixation capacity, attention, calculation, memory, naming, repetition and comprehension, reading, writing and drawing.

## **2.3 Procedure**

### *2.3.1 Video game design*

The “Reta tu Memoria” video game, designed for this project, was developed using the 2D CONSTRUCT3 framework or game editor based on HTML5 and developed by Scirra (2011). It requires the JavaScript programming language and advanced knowledge of HTML, which allows it to work on any platform (see figure 1). It was based on memory stimulation divided into five levels. The first two levels train the semantic working memory, while levels four and five train the visuospatial working memory (see figure 2 y 3).



*Figure 1. Home page*



Figures 2 y 3. Nivel 4 visuospatial working memory

### 2.3.2 Procedure implementation in the sample

The sample was screened by applying the Mini-Mental instrument to all participants; those who showed signs of cognitive impairment were excluded from the study. Eight days after applying the questionnaire, two sessions were conducted in order for participants to adapt to the use of technological tools (keyboard, mouse) and the video game conditions (home, instructions, help and levels). In all, 20 training sessions were conducted with variable periods between each session in accordance with the participant and the achievements attained. The time, errors and help at each level of the video game were recorded while it was played (see figure 4).



Figure 4. Training session. Fuente: Varela, D. (2018)

## 3. Results

The time and errors recordings were analysed. Due to the few help requests at each video game level, only the first two records were taken into account. Results show that the time at level two of the video game equivalent to semantic memory training was the highest. The average execution time of all sessions was 26.29 minutes, while the fifth level of training in visuospatial memory had the lowest total training time: 16.83 minutes.

The average performance rate was compared for each level between the video game’s first and last training sessions. A decrease in the execution time could be observed at all levels. The average length of level one, first session, was 53.13 minutes while the final session lasted 2.73 minutes. At level two, the first session took 53.73 minutes while the duration of the last one was 3.16 minutes. Level three showed an average time of 1.85 minutes in the first session, and at the end of training, it was a minute. The fourth level had an average initial time of three minutes and ended with 2.22 minutes, while the fifth session started with 2.97 minutes and ended with 1.65 minutes. In the first three sessions, the participants finished the video game in approximately 114.68 minutes and the last two took them 10.76 minutes.

According to the errors made at each level, we found that most of them occurred in levels one and two, and level five showed the least amount of errors. Levels 1 and 2 had the highest average of errors, although there was also a significant decrease in subsequent sessions in relation to the remaining levels. At levels 1 and 2, corresponding to semantic memory, a longer execution time and higher number of errors were observed. However, throughout the training sessions, the time spent and errors made were significantly reduced. The same trend was found at levels 3, 4 and 5, regarding visuospatial working memory. Nevertheless, differences were smaller between time and errors in the initial and final sessions. The training effect size was  $d = -0.82$ , thus indicating a large effect in training semantic and visuospatial working memory through the video game “Reta tu Memoria.”

#### **4. Discussion**

This study aimed to train the visuospatial and semantic working memory of a sample of Colombian older adults through the design of a serious game. Results show improved execution of the semantic and visuospatial working memory in the study sample. However, in the initial sessions, greater deficits of semantic memory were identified compared to the visuospatial working memory, together with further progress during the final sessions.

Levels one and two of the video game involved memorising pictures of faces, their names and then recalling or associating them again when the video game required. The semantic memory consisted of the language knowledge and learning to understand the dialect spoken, written and read, for the purposes of being able to communicate and transfer knowledge for different activities, with increasing degrees of complexity when trained in connection to language, associated with academic life, and other stimuli experienced by individuals throughout their lives (Garín & Cañas, 2017).

Levels three, four and five required locating elements in the virtual space based on memorisation and subsequently evocating visual materials, shapes and colours. The visuospatial memory was trained, which required locating the objects in space and remembering their position (Pérez, Mammarella, Del Prete, Bajo & Cornoldi, 2014). This type of working memory is used when creating and using mnemonics of visual images. It is important for geographic orientation and planning of spatial tasks. As stated above, the characteristics of visual pictures, colours, shapes and locations helped to respond to training (Cornoldi & Vecchi, 2003).

The individuals taking part in memory trainings improve the execution perception during the sessions and show a remarkable decrease in the subjective complaints made (Montejo, Montenegro & Sueiro, 2012). The video game “Reta tu Memoria,” designed according to the culture, traditions and idioms of a particular social group (Garín & Cañas, 2017) was well suited for a group of older adults to use technology and it contributed to minimising the effects of ageing in the working memory (Mammarella, et al., 2013). The efficiency of this type of training through a video game confirms the hypothesis of central training: that the repeated stress of a cognitive system (memory) generated by training, prompts neuroplasticity and is demonstrated in training improvements (Anguera et al., 2013).

The video game’s development has a technological readiness level of 6. In other words, it is possible to have a pilot prototype capable of developing all the functions required within a specific system, having passed feasibility tests in operating or actual functioning conditions. Nevertheless, documents are scarce and it has not reached the pre-commercial phase yet. The game’s graphic design and data storage must continue to be improved.

The study has two limitations to be perfected in future research: the inclusion of an actively trained control group and the incorporation of follow-up sessions to determine whether the effects are stable over time or not. Despite these limitations, data showed that the video game “Reta tu Memoria” at its TRL6 stage is a cognitive strategy that contributes to the research and application areas with samples of limited technological access and to bridging the technological divide between generations, allowing older adults to train their memory by playing and to resolve their daily needs.

## **5. Conclusions**

Working memory is one of the cognitive abilities that is most weakened due to age, training through computerized tasks such as video games, in its classification of serious games, allow developing skills through play and interaction. These tasks motivate the learning, the



participant improves his performance by the feedback of his advances or failures, and experiences the virtual reality in a simulated situation.

The video game "Reta tu Memoria" allowed the repetition of tasks through different levels of semantic working memory and visospatial working memory, achieving indirect stimulation in their neuroplasticity, this was evidenced by the improvement in memory through training sessions. This type of intervention reduces the barriers between new technologies and older adults and improves their cognitive conditions.

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## Digital skills for workplace mentors in construction sector apprenticeships (CONDAP)

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### Abstract

*Employers in the construction industry are regularly and increasingly reporting hiring difficulties, since the sector is experiencing a skills shortage in spite of numerous apprenticeship schemes. According to the European Construction Sector Observatory, the main reason of this skills shortage is two-fold: a) the inadequacy of VET provision, and b) the low attractiveness of the sector to young people, further hindered by the perception of its limited capacity for innovation. Correspondingly, modernising construction apprenticeships is crucial for the development of key skills and the improvement of the employability of young construction workers. Training the trainers and mentors to become more engaged and involved in the design of apprenticeships and to introduce new methods, digital tools, and innovative content during their teaching practices is essential to make training more flexible and effective. Such an approach could effectively address the misalignment between VET offerings and the demand for skills and innovation in the construction sector. This article shows the focus of the European project CONDAP, whose purpose is to improve learning in the construction sector.*

**Keywords:** *Self-learning; Construction site managers; Specific training; Efficient learning.*





## **1. Introduction**

Apprenticeship trainers and mentors, particularly in the construction sector, often appear reluctant to change their ways of teaching and introduce new methods and/or tools during their teaching practices, for reasons related to either their priorities or time constraints. In many cases, trainers and especially mentors' management skills, pedagogical capabilities, and ability to design and carry out a project with apprentices are insufficiently developed. Moreover, they may be facing somewhat increased fears (compared to other sectors) of being substituted by technology; this is especially true for new digital technologies (e.g. use of self-learning/self-paced mobile applications), which are usually not very attractive for senior teachers and trainers (Cárcel & Peñalvo, 2016; QPID, 2000; James, 2003; Fuller, 2005; McDonald, 2007).

Lacking support from digital solutions and tools, apprenticeships are not adequately individualised and flexible, and VET curricula often are delayed in supporting the shift in skills needed for new methods in construction. To this end, key actors for adopting training innovations, namely in-company mentors and trainers, need to improve their own skills through the adoption of digital tools and innovative methods. It is also interesting to introduce knowledge to analyze sustainability in energy scenarios in construction (Peñalvo & Cárcel, 2017; CEDEFOP, 2012).

CONDAP is in an EU-funded project with the objective to enhance the digital skills of mentors in construction apprenticeships, funded by the Erasmus+ programme for the period 2018–2021 (Web 1; Web 2).

## **2. Expected outcomes Condap**

The project aims to enhance the quality and value of apprenticeships in the sector by upgrading the training of workplace trainers / mentors with an innovative methodological approach, digital training resources, and tools that will:

- a) Increase trainers' flexibility and effectiveness (e.g. choose when and how they train, focus on facilitation and not on checking for errors in the performance of learners, foster ICT-based peer to peer learning),
- b) Improve their monitoring & assessment capacity and individual approach towards learners, and
- c) Allow mentors to readily respond to the modernisation of the construction sector.

### **Expected outcomes:**

- An analysis of the current and future training needs of workplace trainers and mentors in the construction sector apprenticeships that would enable them to offer quality training to workers in the construction sector.
- Definition of learning outcomes and learning units for workplace trainers and mentors focused on the use of innovative, digital tools.
- Development of openly available (OERs) digital training material and instructions for workplace trainers and mentors in the construction sector.
- Validation of the developed training course by members of the target group in each partnership country.
- Promotion and dissemination of the produced training resources in the European construction sector.

### **Target groups:**

- Construction sector workplace trainers/mentors
- Employers in the construction sector
- VET providers for construction workers participating in apprenticeships
- Apprentices in the construction sector
- Representatives and associations of employers and employees in the construction sector
- Policy makers/ Regulators or related bodies

## **3. Partnership**

The partnership comprises of 5 partners with high capacity, qualifications and complementary skills from the world of VET and employment, with direct links to apprenticeships, to align mentors' training with specific labour market needs and apprenticeship particularities and meet requirements in terms of efficiency, innovation, and timely implementation.

- INSTRUCTUS is the Lead Partner and specialises in the development of apprenticeship programmes and is the sole issuing authority for Apprenticeship Frameworks for the Building Services Engineering sector; it has the potential to guide work-based training development in the sector and the technical capacity to handle funded projects.

- Vocational Advancement Service of the Construction Industry Association of Berlin-Brandenburg (BFW), as an experienced provider of educational services specialised for the construction industry, operating 3 VET centres, brings unique experience in designing VET



curricula addressing the construction sector needs and previous knowledge in apprenticeship training. Furthermore, it is experienced in European initiatives targeting the skills mismatch in construction apprenticeships.

- University Polytechnic of Valencia (UPV) carries specialised R&D and has expertise in OERs; it offers specialised knowledge on digital opportunities in the construction industry and is experienced in the implementation of ERASMUS+ projects.

- Hellenic Society for the Promotion of Research & Development Methodologies (PROMEIA) has extensive experience in R&D and implementation of research and training activities, being an expert in the development of innovative ICT-based methodologies for learning and training. The organisation is experienced in managing in ERASMUS+ projects for the improvement of workforce skills.

- European Builders Confederation (EBC) represents occupational interests at EU level and brings access to the views of construction companies, providing valuable insights into actual digital skills requirements for workplace mentors. It has extensive experience in EU projects addressing the construction sector and VET innovation and is involved in the blueprint for the construction sector; thus undertakes lobbying and dissemination activities.

INSTRUCTUS and BFW are newcomers to the Action. However, the Lead Partner's staff has extensive experience in relevant ERASMUS+ projects and the organisation is a successor of companies involved in similar projects. BFW has been engaged in European initiatives addressing training-of-trainers on sustainable construction. Both organisations will internationalise and enrich their training activities with CONDAP resources.

The partnership formation will combine partners' complementary expertise to address the particular challenges related to the professionalization of mentors in construction apprenticeships, following a systematic, European VET approach.

#### **4. Overview of project outputs, activities, and events**

The following list provides an overview of the intellectual outputs and multiplier events of the CONDAP project, which will be described in detail in section G:

1. Evidence based learning outcomes for the professional development of workplace mentors in construction sector apprenticeships that will be exploited to upskill mentors with digital skills and competences and innovative teaching practices (O1).
2. VET learning units for mentors as trainers participating in construction apprenticeships, focusing on energy efficiency, sustainability and digitalisation of

construction, and innovative pedagogical orientations for learning and teaching digital construction methods (O2).

3. Open Education Resources (OERs) and Vocational Open Online Course (VOOC) infrastructures supporting the professional development and training of in-company mentors which are engaged in modernised apprenticeship schemes in the construction sector (O3).

4. Pilot testing for the validation of CONDAP learning materials and open online course and the exploitation of project materials as best practices for VET of workplace mentors in construction sector apprenticeships (O4).

5. Development of a systematic approach to support the enhancement of the digital skills of mentors in construction sector apprenticeships, targeting the integration of CONDAP learning outcomes into VET (O4).

6. Two (2) demonstration workshops in UK and Germany to validate CONDAP learning materials and VOOC and promote the project's key results to in-company mentors, employers and VET providers in the construction sector (E1, E2).

7. Three (3) national information days Spain, Greece and Belgium to share and disseminate CONDAP results and to inform in-company mentors, VET providers and construction companies (employers) about the project outcomes and the added value of the developed knowledge resources (E3, E4, E5).

**Most relevant topics addressed:**

- ICT - new technologies - digital competences
- New innovative curricula/educational methods/development of training courses
- Overcoming skills mismatches (basic/transversal)

## **5. Outputs Condap**

Some of the main outputs of the condap project are:

### **Output Identification - IO1**

Output Title

Evidence based learning outcomes for mentors in construction sector apprenticeships

Output description



Development of learning outcomes for workplace mentors in construction sector, in order to address the current misalignment between VET trainings and the demand for skills in the construction sector.

The objective is to identify in-company mentors' training needs, taking into account the digital construction sector challenges, as the main drivers of skills needs (table 1).

**Table 1. Tasks and description of output IO1**

code	Task	Description	Partners' involvement
O1-T1	Methodology and tools for the collection of evidence on mentors' digital skills needs and training requirements	This task regards the development of a methodology and accompanying tools for the identification of current and future training requirements and digital skills needs of workplace mentors in construction apprenticeships. It includes the description of information gathering methods (field research and desk research).	PROMEIA: Preparation and drafting of research methodology and fine-tuning according to partners' feedback. Development of accompanying tools for information collection. All partners except INSTRUCTUS: Translation of information collection tools in own language.
O1-T2	Identification of digital skills needs and training requirements of mentors in the construction sector	a) Field research that will comprise one online survey among construction companies and employers' representatives that will result to the mapping of employers' skills needs in construction sector apprenticeships. b) Desk research on digital construction methods will also be used for the collection of information on workplace mentors training requirements.	INSTRUCTUS: Coordination of task, desk research, coordination of field research and compilation of collected information from all partner countries. Data collection in own country All partners: Data collection in own country and provision of input for desk research
O1-T3	Development of CONDAP learning outcomes	This task will yield a report which will define and present CONDAP learning outcomes as drawn from the training needs analysis of the data and information gathered in O1-T2. The report will elaborate on the skills related to the digital construction methods. The objective is to upskill mentors with (a) digital professional skills and (b) improved teaching practices.	INSTRUCTUS: Analysis of data and information gathered in O1-T2 and drafting of the CONDAP learning outcomes report BFW & UPV: Contribution in defining learning outcomes PROMEIA & EBC: Provision of feedback

## Output Identification - IO2

Output Title

CONDAP learning units and teaching methodology for mentor as trainers

Output description

Development of CONDAP learning units is the basis upon which the VOOC will be developed (table 2). Learning units will correspond to the outcomes specified in the context of O1. The thematic areas will cover digital construction methods related to a) energy

efficiency / sustainable construction and b) digitalisation of construction. This output will also deliver specific guidelines for the course exploitation in the context of apprenticeships; and the development of a methodology for teaching the use of digital construction methods in the context of apprenticeships.

**Table 2. Tasks and description of output IO2**

code	Task	Description	Partners' involvement
O2-T1	Clustering of learning outcomes into CONDAP learning units	This task will cluster the defined learning outcomes into learning units, referring to thematic subject areas, such as the following: 1: Energy efficiency and sustainable construction 2: Digitalisation of construction 3: Other construction practices transforming the industry 4: Organisational, management and communication skills. This output will yield a specialised training curriculum and will set the basis for the development of the learning units in the context of O2-T2.	BFW: Development of the training curriculum based on learning outcomes INSTRUCTUS & UPV: Contribution to the development of the training curriculum PROMEA & EBC: Provision of feedback
O2-T2	Development of CONDAP learning units for construction apprenticeships	This output builds on the training curriculum created in the context of O2-T2 and regards content development of CONDAP learning units. The learning units will be translated in the languages of the partnership.	UPV: Development of the learning units. Drafting of a report presenting the specifications & characteristics. Content translation in own language INSTRUCTUS: Contribution to the development of learning units. Review and Provision of input. Fine-tuning of learning units after their evaluation. BFW, PROMEA, EBC: Review and Provision of input. Content translation in own language.
O2-T3	Innovative pedagogical orientations for learning and teaching digital construction methods and tools	This output will deliver an innovative methodology for the course exploitation in the context of apprenticeships by mentors-as-trainers, so as to enrich the teaching ability of in-company mentors.	BFW: Development of the innovative teaching methodology for mentors and drafting of the relevant report INSTRUCTUS: Contribution to the development of the innovative teaching methodology for mentors and drafting of the relevant report UPV, PROMEA, EBC: Review and provision of input

## Output Identification - IO3

### Output Title

Development of CONDAP Vocational Open Online Course (VOOC) for workplace mentors in construction apprenticeships, based on Open Educational Resources

### Output description

This output includes the adaptation of CONDAP learning units into Open Educational Resources (OERs) and consequently the development of Vocational Open Online Course (VOOC) infrastructures, that will support the professional development of in-company mentors (table 3).

**Table 3. Tasks and description of output IO3**

code	Task	Description	Partners' involvement
O3-T1	Adaptation of CONDAP learning units into Open Educational Resources (OERs)	The task includes the development of openly available digital training resources and materials (videos, slide presentations, FAQs, audiovisual aids), corresponding to CONDAP learning outcomes and units. All learning material will be available online as OER and will be translated in the languages of the partnership.	INSTRUCTUS: Coordination of the activity, creation of educational resources and fine-tuning according to the results of the validation. UPV: Co-develop CONDAP OERs. Translation of materials in own language. BFW, PROMEA, EBC: Translation of materials in own language.
O3-T2	Creation of additional learning material for the CONDAP Vocational Open Online Course (VOOC)	The deliverable regards the creation of additional pedagogical resources to be incorporated in the VOOC (video units, work assignments, collaboration mechanisms that will also be openly available to learners).	PROMEA: Provide guidelines for the creation of additional resources for the VOOC. Translation of materials in own language. INSTRUCTUS: Creation of additional resources for the VOOC BFW: Contribute to the creation of additional resources for the VOOC. Translation of materials in own language. UPV, EBC: Translation of materials in own language.
O3-T3	Development of CONDAP Vocational Open Online Course (VOOC) infrastructure for mentors in construction apprenticeships	This task includes the technical and functional preparation of the CONDAP VOOC (which will comprise the CONDAP learning units, as well as the contextualised training materials produced in O3-T1, O3-T2). Development of the VOOC infrastructures includes: a) the identification & selection of suitable VOOC providers to host the online course and b) the development of the VOOC structure and functionalities. Initial testing of the VOOC within the partnership and provision of feedback is also foreseen in this activity.	PROMEA: Identification of suitable platforms to host VOOC infrastructures and content, development of VOOC structure & functionalities, creation of descriptive materials in English. Development of VOOC structure and functionalities in the five languages of the partnership (EN, DE, ES, GR, FR). Facilitate the operation of the VOOC accounting for the technical aspects. Development of evaluation forms and drafting of the final report on the testing outcome. Fine-tune the VOOC. INSTRUCTUS, BFW, UPV, EBC: Testing of the VOOC and complete evaluation form. Online promotion of the VOOC.

## Output Identification - IO4

### Output Title

Validation of the digital skills and the open online course for workplace mentors in construction sector apprenticeships and exploitation activities

### Output description

The purpose of this output is to develop an EU strategic partnership to promote and facilitate the valorisation and exploitation of project materials as best practices for VET of workplace mentors in construction sector apprenticeships, in order to exploit the project learning outcomes and the VOOC in the context of a more systematic approach (table 4)..

**Table 4. Tasks and description of output IO4**

Code	Task	Description	Partners' involvement
O4-T1	Methodology for the validation of CONDAP learning materials	The task involves the definition of methodology and tools for the pilot-testing and the validation of CONDAP learning materials and open online course, the methods for collecting feedback and guidelines for the drafting of the validation report.	PROMEIA: Preparation of the validation methodology. All partners: Review of the methodology
O4-T2	Pilot testing of the CONDAP learning materials and open online course	This task regards pilot testing of the CONDAP learning materials and VOOC: (a) in the context of running construction apprenticeships in the UK and Germany. Mentors will be trained using the VOOC, the CONDAP learning materials and teaching methodology. Consequently they will apply acquired knowledge into their existing apprenticeship schemes for 1 month. Finally, they will be asked to provide feedback on their CONDAP train-the-trainer experience. (b) by other members of target groups in the partnership countries. Testers will be granted access to the CONDAP course remotely and will be asked to complete an online questionnaire to provide feedback.	INSTRUCTUS, BFW: Pilot testing in running construction apprenticeships and feedback collection. EBC: Pilot testing in the partnership countries (remotely) and feedback collection. PROMEIA: Coordination of the activity and collection of results. UPV: Mobilise contacts to participate to the pilot testing.
O4-T3	CONDAP learning materials validation results and guidelines for valorisation	This output will yield the validation report analysing the results of the pilot-run and presenting conclusions on the validation of the learning materials and the open online course for workplace mentors. Furthermore, the activity includes a road-map for the exploitation of the project results, focusing on suggestions for the systematic use and integration of CONDAP learning outcomes into VET.	PROMEIA: Drafting of the validation report INSTRUCTUS: Drafting of the road-map for systematic integration of CONDAP outcomes into VET. EBC: Co-drafting of the road-map (industry related aspects) INSTRUCTUS, BFW, UPV: Review validation report.



### **Multiplier Events:**

CONDAP demonstration workshops:

Organisation of one-day workshops in partners' countries for the demonstration and dissemination of the learning materials and the VOOC to in-company mentors, employers and VET providers in the construction sector.

Participants: in-company mentors, representatives of construction companies hiring apprentices, VET providers.

CONDAP national infodays:

Organisation of one-day infoday in partners' countries to inform the target audience (in-company mentors involved in construction apprenticeships, VET providers, construction companies) about CONDAP, the project outcomes and the added-value of the developed knowledge resources.

## **6. Conclusions**

The European project CONDAP aims to improve learning in the construction sector.

According to the European Construction Sector Observatory, the main reason of this skills shortage is two-fold: a) the inadequacy of VET provision, and b) the low attractiveness of the sector to young people, further hindered by the perception of its limited capacity for innovation.

Employers in the construction industry are regularly and increasingly reporting hiring difficulties, since the sector is experiencing a skills shortage in spite of numerous apprenticeship schemes.

Correspondingly, modernising construction apprenticeships is crucial for the development of key skills and the improvement of the employability of young construction workers. Training the trainers and mentors to become more engaged and involved in the design of apprenticeships and to introduce new methods, digital tools, and innovative content during their teaching practices is essential to make training more flexible and effective.

## Acknowledgment

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# Utilization of consumer electronics for an economically affordable motorized wheelchair

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## **Abstract**

*A design (sketch) of a prototype electric scooter adaptable to a wheelchair is proposed. A mechanism that allows adapting an electric power unit to a conventional wheelchair is presented. The aim of this design is to create an economic solution to motorize a wheelchair and support the independent mobility of wheelchair users. This is especially relevant as the number of wheelchair users is increasing. The device consists of a self-balancing scooter, serving as the power unit, which is replacing the main wheels of the wheelchair and a metal link, connecting it to the wheelchair. The steering is controlled with two sticks, which directly exerts pressure on the sensor pad and steering unit of the self-balancing scooter. By using a self-balancing scooter and hardware store materials the costs can be kept low and accessible to many people.*

**Keywords:** motorized wheelchair, electric powered, self-balancing scooter, mobility

## **1. Introduction**

The world population is growing and the demographic transition is in place, increasing the number of elderly people (Division., 2017). Thus, the need for wheelchairs is increasing by approximately 3500 units per day (Foundation, s.f.). And given that the quality of life is directly correlated to the mobility of a person (Hudakiva & Hornakova, 2011) making mobility accessible is an important topic. The world report on ageing and health states:



*“When assistive devices are available, affordable and appropriate to older people’s needs and their environments, their mobility, independence and participation can be greatly enhanced.”* (Organisation, 2015). Progress and efforts have been made in this regard. Such as of the wheelchair foundation which distributed over a million wheelchairs (Foundation, s.f.) or innovative devices such as the all-terrain wheelchair, developed by Amos Winter (Winter, 2014). Also, attempts have been made to make power assisted mobility solutions more accessible as well. For example, students of the Bingham Young University have founded the Open Wheelchair Foundation and published instructions to build an electric wheelchair (Hollingshead, 2015). This paper is another contribution to explore options to make power assisted mobility more accessible. Especially for those cases where the physical condition of the person is not sufficient to operate a manual wheelchair and is covering the question of whether there is a way to make motorized wheelchair solutions more affordable. This work has been created in the scope of a university project restricted by a four months-long time frame and a limited budget. Based on those limitations the decision was made, to utilize the benefits from mass production of already existing consumer electronics. Chosen was a self-balancing scooter. The requirements for the design include that it can be used in the daily routine and among other things to being able to turn it on and off from the seated position as well as being able to push the wheelchair manually.

The cost of an electric wheelchair is more than 3000 euros in most cases. The solution that is intended to be provided is the adaptation of an electric scooter to the wheelchair, transforming it into an electric one. Also, with a cost of 10 times lower than what exists in the market.

## 2. Design

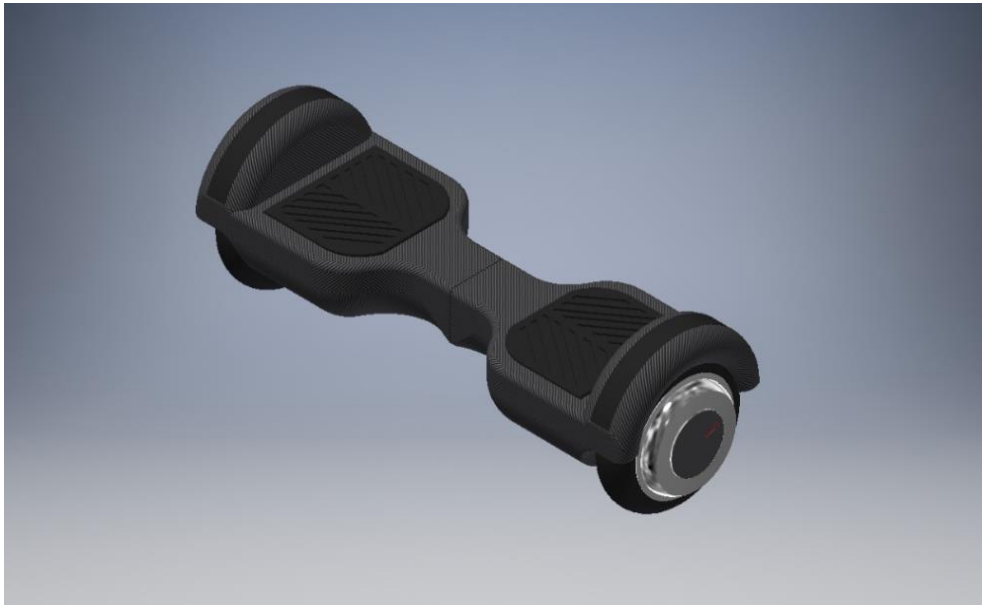
For this design, the wheelchair’s main wheels are taken off. The holes from the wheelchair wheel’s axis are used to connect it to the developed design. This is the only modification which is done to the actual wheelchair. It is possible to assemble the wheelchair in its original form in a few minutes. The self-balancing scooter is used as an electrical motor and power source of this motorized wheelchair.

The self-balancing scooter, as seen in Figure 1, has a gyroscope system which can balance a person standing on it. It can be controlled through weight forth or back, which gets registered by pressure pads, located on the top of the standing platform. When rotating the pedal backwards the wheel will also revolve to the same direction. Pressure has to be applied on the pedals in order to control it. Both of the wheels are able to spin



independently from each other, this allows a very tight turning radius. (CN204223088U, 2014)

In the design, almost the whole weight of the wheelchair and also the weight of the person sitting on it is located right over the scooter and directed to the pressure pads of the scooter. In that case, the controlling pedals are working correctly, the scooter's software measures that a person is standing on it.



*Fig. 1* A self-balancing scooter

The designed structure, which connects the wheelchair to the scooter, includes two mounting plates, one middle axis, a steering assist, and steering poles; the whole assembled design can be seen in figure 2. The mounting plates are sitting on the pressure pads and an axis, which will be referred to as the middle axis, is connected to those mounting plates in a way that allows rotation. The steering assist refers to a spring-mechanism and has the purpose to return the control pedals back to a neutral position when the steering poles are untouched. The steering poles transmit movement to the steering assist, which will result in forwards motion when the pole is pushed forward and backwards motion in the opposite case. A detailed description of the parts will follow. This whole structure is connected to the wheelchair with bolts and nuts, the connection is fixed and it will not allow any rotation or sliding.

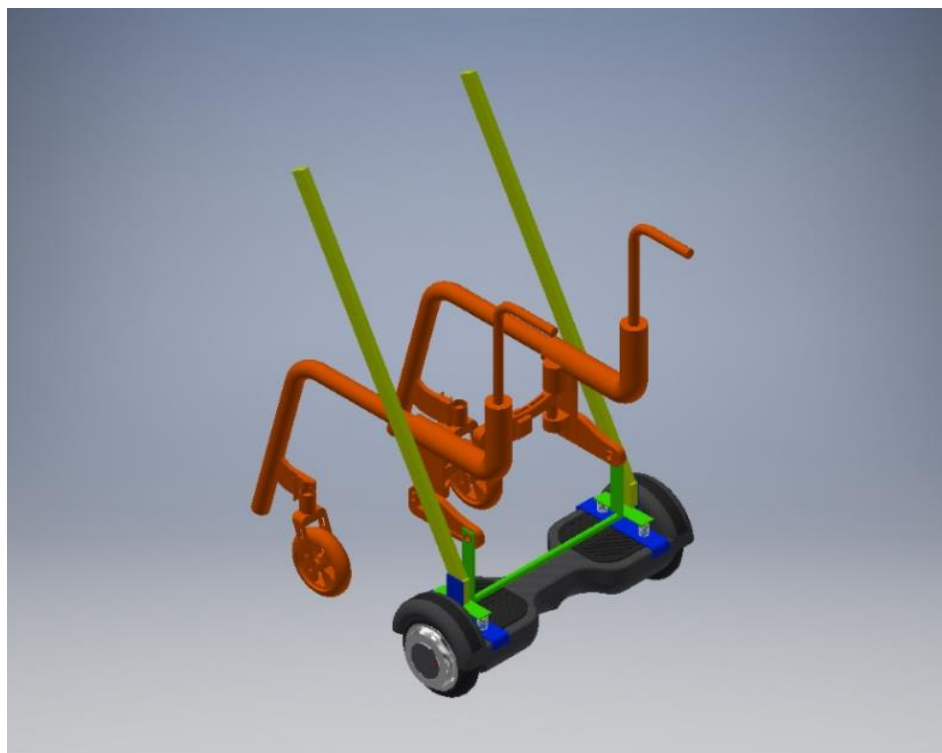


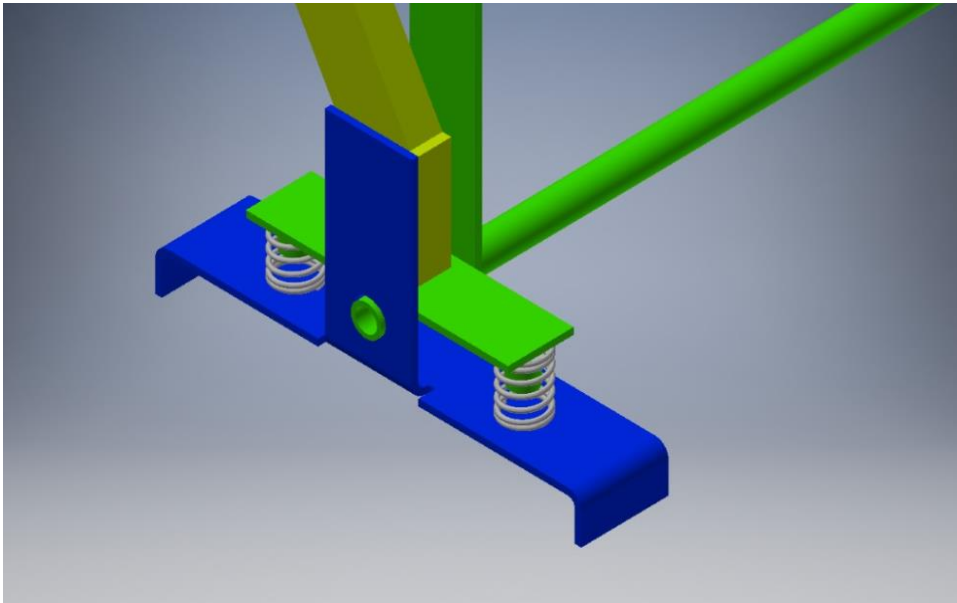
Fig. 2 Assembled structure

Using a self-balancing scooter which is able to turn around its own axis and placing it right under the wheelchair, allows the user to turn on the spot. Making it ideal for the use indoors and tight places like an elevator. Movement specifications like range and top speed depend on the used scooter and the wheelchair model. Manual pushing by another person is able when the scooter is switched off.

The self-balancing scooter itself is connected to the mounting plates with belts, which can be easily disconnected. The connection is pretty stable even without the belts because the shape of the mounting plate disables movement. Belts are added to the design to prevent detaching though lifting the wheelchair up or driving over obstacles. The mounting plate has foam on its lower side, so the scooter doesn't get scratched and avoids noises from vibrations.

The main structure is made out of steel and the steering poles are made out of aluminum because they are not exposed to strong forces and it's lighter and therefore more comfortable for the user. Steel has been chosen for the rest of the construction because it's strong and can be easily modified. Almost all of the weight of the wheelchair and the user sits on the structure so it has to be made out of strong material. There are rubber grips on the steering poles to make them more comfortable to hold.

The Figure 3 shows displays the steering assist. One of the most critical parts is of this design is the steering assist. Without it the wheelchair would continue its movement indefinitely if the user loses the grip on the steering poles. If the user tries to move the steering poles he has to counter a force which is generated by springs at the steering assist. So when there is no external force affecting the poles, the system will return back to their neutral position.



*Fig. 3* Steering assist

Slowing down or stopping can be achieved by steering backwards. Meaning that the person in the wheelchair has to pull the steering sticks towards her-/himself. This will increase the pressure on the back of the pressure pads of the self-balancing scooter and it will slow down until the vertical position is reached. Further backwards steering will lead to moving backward.



Various self-balancing scooters can be used as a power source, an advanced design of the mounting plates would allow them to be adjustable, so the user could change the width of the mounting plates. With this modification, the design does not require a specific scooter. Also with this improvement in mind, it's chosen to use adjustable belts as an attachment mechanism for the scooter.

### **3. Conclusion**

With the presented design, a self-balancing scooter can be adapted to a conventional wheelchair. It is designed considering simplicity, efficiency and costs in order to be accessible and affordable for the maximum number of potential end-users.

The design has been tested and it is suitable for the indoor use as well as the outdoor use. The system (the wheelchair adapted with the electric scooter) is appropriate for people with arm mobility, but only requires a fraction of strength that would be necessary to push the wheelchair manually. This gives the opportunity to increase the autonomy of people, especially considering the increasing aging of the population in the future.

The system has been designed that it can be manufactured with relatively simple pieces such as springs, commercial scooter, welded iron plates, etc. Therefore, the option to create a business and to sell an all in one solution is given. Additional improvements could be an extra battery or an electronic interface for in reach of the end-user, where a charging plug and power switch could be located.

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First and foremost, we would like to express our deep and sincere gratitude to our research supervisor Guillermo Peris-Fajarnés as well as Bernardo Pajares Moreno, María Moncho-Santonja and Ismael Lengua for their support throughout our work. We would also like to give a huge thank you to Professor Pedro Fuentes by giving us his support and providing invaluable guidance throughout our project. Finally, a major thank you to the School of Engineering and Design, the Research Centre in Graphic Technologies and the Universidad Politècnica de Valencia for providing us with a workspace and allowing us to use their workshops.



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## Design of an add-on device for transform a standard wheelchair on an affordable and motorized

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### Abstract

*In the following article a design to adapt a low-cost power unit to a conventional wheelchair is presented. The adaptation is carried out looking for a simple, low cost solution that does not involve any modification or structural alteration of the wheelchair itself. In this work we present a proposal of a mechanical adaptation that will allow connecting a self-balancing scooter to a wheelchair and be controlled by the user as well as by another person. So that the pushing effort is eliminated.*

**Keywords:** *motorized wheelchair, electric powered, self-balancing scooter, mobility*

## 1. Introduction

The world population is growing, and the demographic transition is in place, increasing the number of elderly people (United Nations Department of Economic and Social Affairs, 2017). Thus, the need for wheelchairs are increasing by approximately 3500 units per day ("Analysis of Wheelchair Need", 2019). Given that the quality of life is directly correlated to the mobility of a person, (Hudakova & Hornakova, 2011) making mobility accessible is an important topic. The world report on ageing and health states: "When assistive devices are available, affordable and appropriate to older people's needs and their environments, their mobility, independence and participation can be greatly enhanced." (WHO, 2015). Progress and efforts have been made in this regard. Such as of the wheelchair foundation



which distributed over a million wheelchairs ("Wheelchair Foundation", 2019) or innovative devices such as the all-terrain wheelchair, developed by Amos Winter (Winter, 2012). Also, attempts have been made to make power assisted mobility solutions more accessible as well. For example, students of the Bingham Young University have founded the Open Wheelchair Foundation and published instructions to build an electric wheelchair (Hollingshead, 2015).

This paper is a contribution to explore options to make power assisted mobility more accessible for those whose physical condition is not sufficient enough to operate a manual wheelchair and to discuss in detail, whether there is a way to make motorized wheelchair solutions more affordable. This work has been created as a university project with restrictions such as a four-month time frame and a limited budget. Based on those limitations the decision was made, to benefit from mass production of already existing consumer electronics. Chosen was a self-balancing scooter. The requirements for this design included factors such as that it could be used daily and amongst other things, to be able to switch it on and off from the seated position as well as being able to push the wheelchair manually.

## **2. Design**

For this design, with the purpose to motorize a wheelchair, the following general conditions had to be met:

- Use of a self-balancing scooter as a way of propulsion.
- Universal design allowing connection to different wheelchair-models, with no modification to the wheelchair itself.
- Solutions that can be made without big machinery.
- Plug & play system which the user can attach without any help.
- Controlling the self-balancing scooter without the use of feet.
- Being able to remove the self-balancing scooter and comfortably transport the construction while traveling.
- Stopping when releasing the controls.

The self-balancing scooter, as seen in Figure 1, has a gyroscope system which can balance a person standing on it. You are able to control the scooter by shifting your weight forth or back, which gets registered by pressure pads, located on the top of the standing platform. If you rotate the pedal backwards the wheel will also revolve to the same direction. It is mandatory to have pressure on the pedals in order to control it. Both of the wheels are able to spin independently from each other, this allows a very tight turning radius. (Patent CN204223088U, 2015)



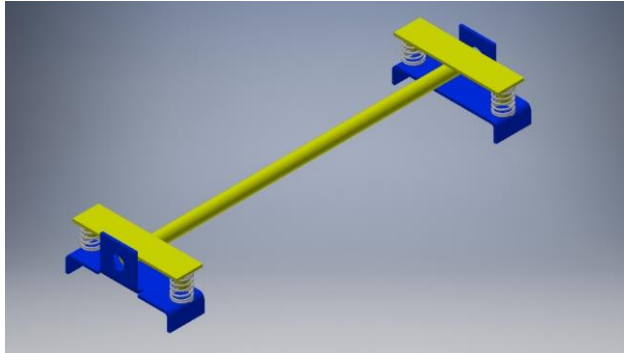
*Fig. 1: A self-balancing scooter*

The idea of a self-balancing scooter behind a wheelchair is like the ‘aidwheels system’. With the aidwheel system, there is a link between the self-balancing scooter and the wheelchair so that the wheelchair can be pushed by the self-balancing scooter ("AidWheels Mobility Solutions", 2019). This approach has the restriction that an extra person needs to stand on the self-balancing scooter to control it.

In order to realize all the above-mentioned requirements, the developed design is based on placing the self-balancing scooter as an electric drive behind the main wheels of the wheelchair, without making any structural modification of the original wheelchair in order to be used and adapted to as many models as possible. The main wheels are lifted from the ground allowing a smaller turning radius to be used independently from the wheelchair model.

The total design consists of two mounting plates, one middle axis, steering assist, two steering wheels, and a support frame. The middle axis is connected to the mounting plates in a way that allows rotation. The steering assist has the purpose to return the control pedals back to a neutral position when the steering is untouched. Movements of the steering are transmitted to the control pedals through a tensioned cable.

In order to connect the scooter to the frame and the rest of the design, a welded and bent construction made from metal was built according to the measurements of the self-balancing scooter. This construction, as shown in Figure 2, now functions as a fixing point for the rest of the construction. Springs are used to move the control pedals back to their initial position, where no movement will result. This will be referred to as the steering assist.



*Fig 2: Mounting Plate with Steering Assist*

The supporting frame has the purpose to lift the main wheels of the wheelchair up from the ground. This allows usage with different kinds of wheels and wheelchair models through the redirecting of the weight of the person to the self-balancing scooter. Traction of the scooter wheels is granted, and pressure can then be exerted on the pressure-pads of the self-balancing scooter, which is required to control it. The disadvantage of lifting the main wheels is that it causes a change in the sitting angle. At this point, a trade-off has to be made, lifting the wheels up higher allowing the wheels to overcome more obstacles but makes the seat angle closer to a horizontal position, which could lead to the driver falling out of the wheelchair. The decision was made in favour of the safety of the user by only lifting the wheels a few centimetres from the ground.

The idea is to design a very light and easy working construction to lift up the main wheels and get the connection. Iron is cheap and robust, but aluminium should be the final material and it is perfectly suitable for this task. For the initial prototype, four wooden beams get screwed together to a construction in which the wheels of the wheelchairs fit perfectly. The newly formed wooden construction is now placed under the wheels.

In the rear part, it is connected with the steel steering assist, which is described earlier in this article. The weight of the wheelchair is now transferred to the scooter and its wheels.

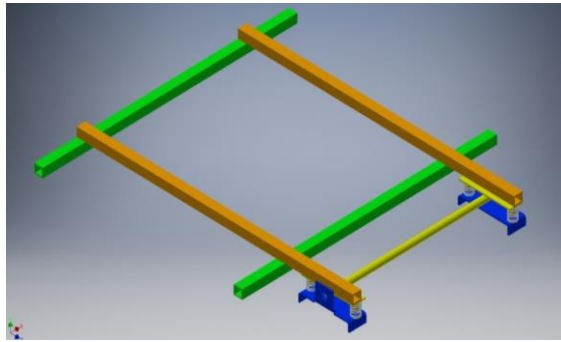


Fig 3: Assembled construction

In the front part, the wooden construction is tied to the wheelchair on each side, lifting up the mainwheels. The distance between the wheels and the ground can be adjusted by the length of the ropes.

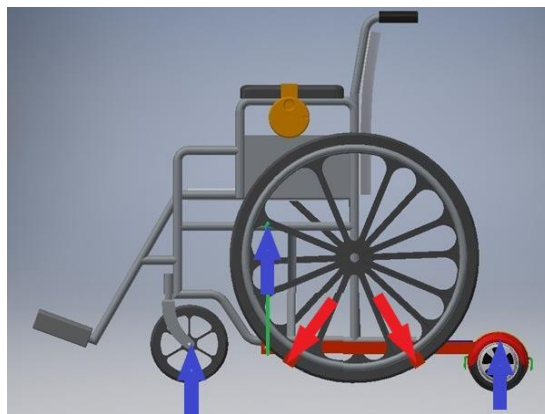
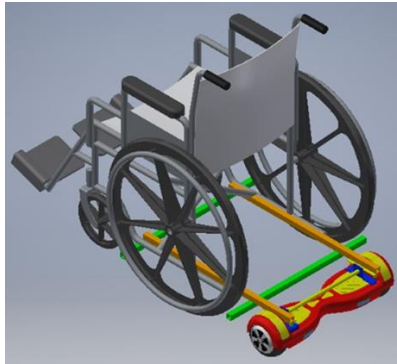


Fig 4: Force vectors

The wheelchair is sitting with its main wheels on the wooden frame, which causes the red forces. The red forces lead to reaction forces, marked as blue arrows, in the ropes (green) as well as in the self-balanced scooter and front wheels.

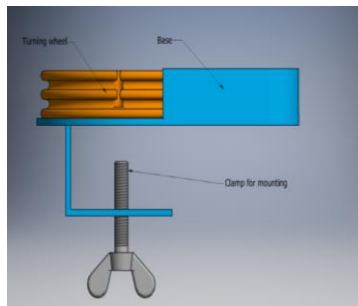




*Fig 5: Assembled Construction with Wheelchair*

In order to control the self-balancing scooter normally the person using it would change the center of gravity from their feet back and forth on the pressure pads to control the wheels individually. This allows for steering by making the wheels spin in the opposite direction from each other. Excluding the use of feet, the controlling has to be done with both hands. Each wheel can individually be controlled into going forwards or backwards allowing for movement, steering and breaking. To control each wheel individually a system with tension cables is used which is most similar to that of a bicycle shifting system.

When rotating the handlebar to shift into a new gear a rotating force is being translated into a pulling force. This is used to tilt the self-balancing scooter backwards or forward. A clamp is used to connect the control to each side of the wheelchair on any desired location as shown on fig. 6.



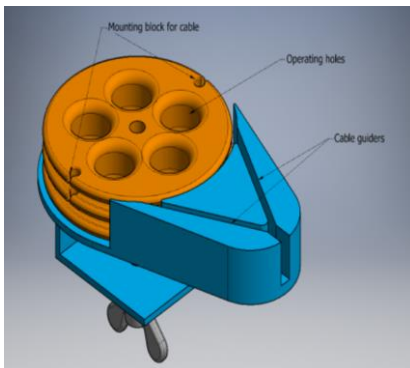
*Fig 6: Controlling System*

Each control unit has two tension cables in it. These cables are the same ones used on bikes. On the tip of the cable, there is a metal block.

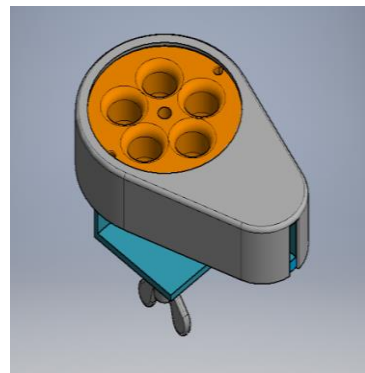


*Fig 7: Cable for controlling System*

This block slides into the turning wheel (shown on fig. 8)



*Fig 8: Opened Case with cable channels*

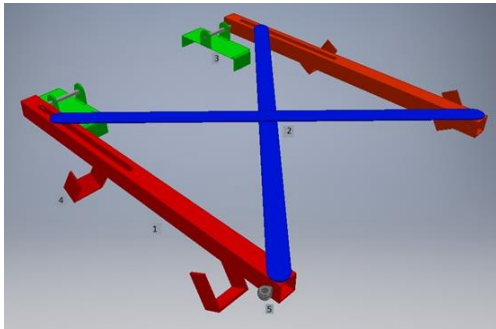


*Fig 9: locked case*

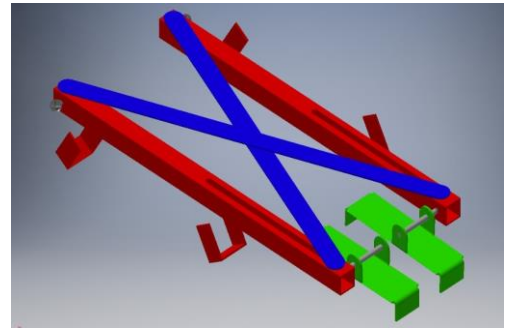
When operating the wheel one of the cables will be pulled and the other one will be loose, allowing the balancing board to tilt to the front or to the back.

If there is the need for a second person to steer the wheelchair, the additional person can stand on the steering system, which is displayed in figure 2. By shifting their weight as if they would ride the self-balancing scooter without the extra construction, the wheelchair can be steered externally.

A foldable solution is also being considered. When the electric drive is not needed, the construction can be easily folded together and does not consume much space. Therefore, the whole construction is much easier to transport and can even be carried around in the back of a wheelchair. The difficulty is that the construction and especially the beams must be still strong enough to carry the weight of a heavy person. For this purpose, a different construction for the self-balancing scooter has been provided, which allows the construction to be folded up.



*Fig 10: unfolded Solution*



*Fig 11: folded Solution*

### **3. Conclusion**

It is possible to adapt a self-balancing scooter to a conventional wheelchair with a simple mechanism. Resulting in an economic motorized wheelchair which can be manufactured over a low-cost parameter. All used materials like the self-balancing scooter, wood and metal can be purchased in any electrical- and hardware store except for the steering system, which resembles a bike shifting system. Based on the function of this solution the main wheels of the wheelchair have to be lifted off the ground. This proposed construction is

kept simple and could be rebuilt by non-professional craftsman at home. This increases the accessibility tremendously and contributes to the satisfaction of the high demand of motorized wheelchairs.

Regarding the ageing of population, the solution is a potential contribution for the increasing needs of assisted mobility. The aim of the work is to contribute with a proposal which is openly accessible via the internet for the end user. So they can copy and build this mechanically simple construction.

However, the proposal is done with room for improvement. Those improvements could be a possible external interface, reducing the mechanical complexity, an extra batteries or a charging device that is directly accessible from the wheelchair.

### **Acknowledgements**

First and foremost, we would like to express our deep and sincere gratitude to our research supervisor Guillermo Peris-Fajarnés as well as Bernardo Pajares Moreno, María Moncho-Santonja and Ismael Lengua for their support throughout our work. We would also like to give a huge thank you to Professor Pedro Fuentes by giving us his support and providing invaluable guidance throughout our project. Finally, a major thanks you to the School of Engineering and Design, the Research Centre in Graphic Technologies and the Universidad Politècnica de Valencia for providing us with a workspace and allowing us to use their workshops.

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## The dynamics of the relationship between just-for-fun online harassment and perceived school safety

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### Abstract

*Based on previous analysis needs, our expert team has implemented the project Keeping youth safe from Cyberbullying financed by Erasmus+ KA2, focusing on the in-depth dynamics analysis of the cyberbullying phenomenon that unfortunately has become more and more present in youth online environments. Our team has designed an online questionnaire with the purpose of collecting descriptive data about youth participants, general perception about the cyberbullying particularity incidents, perceived safety of the educational setting and perceived parental support, and lastly a self-rating evaluation scale on self-efficacy perceptions. A total of 92 participants voluntarily responded to. Present research's focus is the analysis of the association between just-for-fun online harassment type of cyberbullying and youth perceived school safety. Our team has used a curvilinear regression analysis for depicting curvilinear effects, in order to test the hypothesis assuming the curvilinear relationship between youth perceived school safety and just-for-fun online harassment type of cyberbullying. Results confirm the curvilinear relationship, implying the fact that the weaker and as well as the stronger educational context safety is perceived, just-for-fun online harassment type of cyberbullying is present in school; a medium/normal school safety perception triggers a lower just-for-fun online harassment type of cyberbullying incidence in youth. Authors further discuss the implications of these findings, in terms of cyberbullying prevention strategies.*



**Keywords:** *perceived school safety, just-for-fun online harassment, cyberbullying, curvilinear relationship.*

## 1. Introduction

Cyberbullying takes part to a bigger phenomenon that was present before the development of social media, such as bullying which is described as an aggressive behavior, usually characterized by the following aspects: hostile intentions, imbalance of perceived power, and repetition of the hostile behavior (Burger et al., 2015). In this light, bullying can be described as the activity of repeated and aggressive behavior intended to hurt and to humiliate another person, physically, mentally or emotionally.

As the modern civilization developed more and more, bullying started happening while using technological devices as tools to express hostile intentions to other individuals; bullying while using technological devices is known as cyberbullying,, a form of aggression used in the online environment, which implies repeated behaviors that have the intention to harm one or more individuals (Willard, 2005). These behaviors may be represented by posting negative rumors, threats, remarks with sexual content or personal information in the form of comments or messages, which can humiliate or cause harm to the victim (US Legal, <https://definitions.uslegal.com/c/cyber-bullying/>).

In 1993, Olweus has identified the traits of youth being more susceptible to being either perpetrators, either victims, such as:

- Aggressors tend to manifests the need to dominate other persons. Their psychological profile is characterized by impulsiveness, provocativeness, easily annoyed, not following the rules and having an over-rated self-image.
- Victims' psychological profile: passive in behavior and communication, tendency to isolate themselves from the society, cautiousness, sensitiveness, withdrawn tendency, shyness, manifesting insecurities, high levels of anxiety, decreased self-esteem, usually perceived as inapt of defending themselves, and in general not taking any action to stop the perpetrator or the aggression.

One of the reasons for cyber-bullying that are discussed in the literature is the fun factor, which can motivate adolescents to engage in cyber-bullying (Patchin & Hinduja, 2010; Kyriacou & Zuin, 2016; Compton et al., 2014; Smith et al., 2008). Similar to traditional bullying, the fun factor serves as a good motivator for engaging in cyberbullying aiming to entertain one self and peers, regardless victim's wellbeing,, more often in asynchrony contexts. It is stated in literature that in the case of non-physical contact, then the



perpetrator's level of empathy is known to be decreased (Smith et al., 2008). As regard to Olweus (1993) descriptions, the aggressor is more likely to engage in just for fun bullying because they are more likely to see the fun factor as a good motive to engage in this kind of actions (because they feel more superior and they see their actions as justifiable).

Explanations on cyberbullying are also brought by social interconnections and peer influence. A study evidenced that the chances of becoming a victim of cyberbullying are increased when socio-anxiety, interpersonal communication deficiencies to with friends and in general with the social group, and also the lack of appropriate social skills are present. (Betts, 2016; Navarro et al., 2012). Since the vast internet is able to provide anonymity the perceived perpetrator and victim roles may dramatically interchange in the virtual realm (Wilton & Campbell, 2011). The perpetrator can be any person and in most of the cases they are not physically robust, so they might instead be the victims of classical bullying, caught in an acting negative spiral of revenge (Compton, L., Campbell, M.A., & Mergler, A., 2014) towards anybody who mistreated them. Perceived anonymity eliminates social judgment in the peer group along with any other concern of being disposed or disapproved (Wilton& Campbell, 2011; Willard, 2005).

One important reason of the bullying and cyberbullying phenomenon discussed in literature is victimization (Akbulut, 2010; Wilton & Campbell, 2011). Therefore, some individuals who became victims have the tendency to bully other people in school or cyberspace with the purpose of coping with the victimization psychological context and enhance the better feeling about themselves. In this light, studies from literature showed that the perceived school climate can be a good predictor in traditional bullying and cyberbullying (Casas, J.A., Del Rey, R. Ortega-Ruiz, R., 2013; Ortega-Barón, J., Buelga, S., Cava, M.-J., 2016). For instance, a research showed that youth who experienced cyberbullying in both perpetrator and victim situations, perceived a weaker climate or poorer educational when compared to youth that did not experience cyberbullying (Cyberbullying Research Center, 2010).

## **2. Research methodology**

Based on previous analysis needs, our expert team has implemented the project Keeping youth safe from Cyberbullying financed by Erasmus+ KA2, focusing on the in-depth dynamics analysis of the cyberbullying phenomenon that unfortunately has become more and more present in youth online environments. Our team has designed an online questionnaire with seven sections with the purpose of collecting descriptive data about youth participants, general perception about the cyberbullying particularity incidents,





perceived safety of the educational setting and perceived parental support and lastly a self-rating evaluation scale on self-efficacy perceptions. This research's interest is to take a closer look and to analyze the dynamics characterizing the cyberbullying situations, taking into account youth perceived just-for-fun online harassment acting.

This paper is concerned with analyzing the relationship between just-for-fun online harassment and perceived school safety, with regards to the fact that the scientific literature depicts implications on cyberbullying behavior based on how safe the educational environment feels like to youth.

The two self-rated single items that assessed perceived school safety and just-for-fun online harassment are: **Item 14** – “Please rate on a 1 to 5 scale how safe is your school?”, where 1 = strong disagreement and 5 = strong agreement with the statement; **Item 28** – Please respond with YES or NOT to the following question: “Did you ever online harassed somebody, together with your peers, with the purpose of just having fun?”

When analyzing the relationship between perceived just-for-fun online harassment and school safety, our team has assumed that the single-item research variables are in a curvilinear relationship. Thus, with the purpose of testing the curvilinear hypothesis, we have computed a quadratic regression analysis for depicting curvilinear effects, considering the dependent variable just-for-fun online harassment.

The research targeted a heterogeneous random sample of 92 youth participants with a range of ages between 18 and 30, 10,9% being masculine and 89,1% feminine, coming from both urban and rural. Regarding sample's level of education, 63% finished high-school, 22,8% have a bachelor and 14,2% have a master diploma. The majority of sample target group, 68.2% have between 1 to 3 years online experience with different social media environments.

### 3. Results

With the purpose of statistically testing our assumption stating that just-for-fun online harassment and perceived school safety are in a curvilinear relationship, we have computed a quadratic regression analysis for depicting curvilinear significant effects.

Consistent with the scientific literature conclusions, in a curvilinear relationships variables are both growing in the same direction up to a specific point, statistically depicted as a positive correlation. After reaching this point, one of the variables starts to decrease, meanwhile the second variable continues to increase, depicted as a negative correlation significant coefficient.



We have calculated a high correlation coefficient between Item 28 just-for-fun online harassment with a MD=1.03, and SD=0.179 and Item 14 youth perceived school safety (MD=4.64, SD=0.656) of  $r = -0.368$  significant at a  $p < 0.01$ , result that gives us incentives in further implementing the curvilinear regression analysis. In the present quadratic model of regression, the DV is just-for-fun online harassment, and the independent variable included in the 1<sup>st</sup> step perceived school safety, and in the 2<sup>nd</sup> step squared perceived school safety.

In Table 1 there is presented the fitting coefficients of both our computed regression models, linear (1) and quadratic (2). As depicted in the 1<sup>st</sup> Model, the one that assumes a linear relationship, the variable just-for-fun online harassment is accountable for 12% of the variance in perceived school safety ( $F = 14.103$  significant at a  $p < 0.01$ ). In the 2<sup>nd</sup> Model, assuming a curvilinear relationship, the variable just-for-fun online harassment is accountable for 33% of the variance in perceived school (  $F = 28.748$  significant at a  $p < 0.01$ ).

**Table 1. Regression models for just-for-fun online harassment and perceived school safety.**

Descriptive Statistics			
	Mean	Std. Deviation	N
Item 28	1.03	.179	90
Item 14 – perceived school safety	4.64	.656	89
Perceived school safety sqrt	21.9674	5.33380	89

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.368 <sup>a</sup>	.135	.126	.167	.135	14.103	1	90	.000
2	.589 <sup>b</sup>	.347	.332	.146	.211	28.748	1	89	.000
a. Predictors: (Constant), Perceived school safety									
b. Predictors: (Constant), Perceived school safety, Perceived school safety_sqrt									



**ANOVA<sup>a</sup>**

<i>Model</i>		<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
1	Regression	.393	1	.393	14.103	.000 <sup>b</sup>
	Residual	2.509	90	.028		
	Total	2.902	91			
2	Regression	1.006	2	.503	23.599	.000 <sup>c</sup>
	Residual	1.896	89	.021		
	Total	2.902	91			
a. Dependent Variable: Item28						
b. Predictors: (Constant), Item14						
c. Predictors: (Constant), Item14sqrt						

**Coefficients<sup>a</sup>**

<i>Model</i>		<i>Unstandardized Coefficients</i>		<i>Standardized Coefficients</i>	<i>t</i>	<i>Sig.</i>
		<i>B</i>	<i>Std. Error</i>	<i>Beta</i>		
1	(Constant)	1.498	.125		11.976	.000
	Perceived school safety	-.100	.027	-.368	-3.755	.000
2	(Constant)	3.977	.475		8.369	.000
	Perceived school safety	-1.387	.241	-5.096	-5.752	.000
	Item14sqrt	.159	.030	4.750	5.362	.000
a. Dependent Variable: Item28						

All computed Beta standardized coefficients (B= -0.368, B= -5.096, B= 4.750) prove to be statistically significant at  $p < 0.01$  providing high consistency to both linear (1) and quadratic (2) models. The switch from positive to negative of the Beta coefficient sign shows that the effect develops in the opposite direction, which clearly illustrates the curvilinear relationship between online just-for-fun bullying and perceived school safety. And finally, the adding of 11% predictive capacity by including the squared perceived school safety variable known to be responsible for the curve in the regression line, depict once more the consistency optimization of the model supporting the assumption of the curvilinear relationship between just-for-fun online harassment and perceived school safety.

#### 4. Conclusions and discussions

The relational educational climate is present in all the theoretical literature, be it the relational climate between the equal, and the teacher-student relations, or between the school management and the teachers. The concept of relational educational climate is one of the central elements in our study.

The school climate is analyzed in terms of its positive and negative aspects: a positive school climate is characterized by the positive management of school unit, positive relationships between teachers, positive relationships between teachers and students, positive relationships between peers and school opening to the community, along with the



negative climate that is built up in antithesis with the positive one. The effects of the school climate are multiple, at behavioral, cognitive, affective, attitudinal and motivational levels. A positive school climate supports adaptive, socially accepted behaviors and discourages the adoption of risk behaviors.

The school climate has also been seen as a determining factor in school behaviors, including behavioral problems like harassment, aggression and delinquency and health issues like psychosomatic symptoms and substance abuse. All these effects influence each other and directly and indirectly affect school success. Among the factors influencing the perception of the school climate are the gender, the socio-economic background of pupils, the pupils' competitiveness, and their satisfaction with the school and the level of stress generated by the teachers' expectations.

School climate studies prove that elementary and middle school students are more satisfied with school safety than the high school students. As pupils go further into the school system, they become more bloated, which leads to their increasing dissatisfaction with school and a poor perception of the educational setting climate. On the other hand, as they enter the educational cycle, the expectations of the pupils towards school increase and the latter does not meet their desires, resulting in a new source of dissatisfaction and an unfavorable perception of the school climate.

Current's study curvilinear relationship shows that the weaker and as well as the stronger educational context safety is perceived, just-for-fun online harassment type of cyberbullying is present in school; a medium/normal school safety perception triggers a lower just-for-fun online harassment type of cyberbullying incidence in youth..

Up to now, our research members are unaware of other published results indicating a curvilinear relationship between just-for-fun online harassment and perceived school safety. Our research conclusions might be useful in enhancing knowledge on the dynamical aspects of cyberbullying incidents.

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## The identification of improvement strategies in continuous assessment using sentiment analysis in the Operational Research course

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### Abstract

*The University aims is to graduate professionals with high levels of competence to impact society positively. In consequence, the institutions apply different educational strategies to focus on improving the curricular competencies until mastery the whole competences topics. An alternative highly applied is continuous assessment, which is a form of educational examination that evaluates the progress of a student throughout a prescribed course. A critical course in the engineer formation is Operational Research; this course focuses on scientific management supported by mathematical models such as decision theory, stochastic scenarios, simulation, mathematical optimization etcetera. The goal of this work is to diagnose the continuous assessment strategy apply to Industrial and System engineer students enrolled in Operational Research course, to do that, applying a sentiment analysis which is a text classification tool that analyses an incoming message (in this case a perception essay) and indicates whether the underlying sentiment is positive, negative or neutral. Furthermore, the Techniques applied to group the emotions of anger, anticipations, disgust, fear, joy, negative, positive, sadness, surprise, and trust. Taking into account the initial results, the authors highlight alternatives such as the flipped classroom, gamification as educational strategies to implement in futures courses looking to improving the continuous assessment positive perception.*

**Keywords:** Continuous assessment strategy, Operational Research, Sentiment Analysis.



## 1. Introduction

The bachelor engineers from *Universidad Autónoma de Bucaramanga* (UAB) are capable of leading industrial processes with social and environmental responsibility. Moreover, the professionals' profiles are diverse such as innovator engineers, directors, public employees, and entrepreneurs, among others. For this, the UAB has been working in three institutional values: 1) Ethics 2) Aesthetic and 3) Logic; this last one cover the different learning-teaching strategies which every professor with autonomy could apply in the different Faculties (*Universidad Autónoma de Bucaramanga*, 2012). Framed in this academic freedom, some professors apply continuous assessment of knowledge and skills as education methodology, because it allows creating a summative assessment, which evaluates the learner at the end of the course (Delgado & Oliver Cuello, 2006).

Furthermore, as Núñez-Peña et al. cite (2013), this methodology permits to reduce the stress level of the students since, some of them feel panic, helplessness, and disorganization mental when they are required to solve a mathematical problem (Richardson & Suinn, 1972). Taking into account the continuous assessment benefits, during the first semester of 2019, the authors applied this methodology to the students enrolled in Operational Research course considering productive activities such as software developing tasks, group test, interactive participation, fieldwork, among others. Taking into account preliminaries works is possible to apply machine learning techniques using non-structure data to assess the students' experiences (e.g., academic performance, methodology perceptions, classroom management, and teacher theme domain) (Duarte-Duarte, Talero-Samiento, & Arias-Tabares, 2019). In this work, we conduct and quantitative evaluation using sentiment analysis or emotion artificial intelligence, this is one of the fastest-growing research areas in computer science, making it challenging to keep track of all the activities in the area (Mäntylä, Graziotin, & Kuutila, 2018). Sentiment analysis is a method to systematically identify, extract, quantify, and study affective states and subjective information (Hartman, Stone, Dunphy, Smith, & Ogilvia, 1967; Liu, 2010) applied to reviews and survey responses.

In consequence, this work has three more phases. In Section 2, are expose the steps to transform the answers into numerical representations and its representative analysis, in Section 3, there are the main results structured by polarity and sentiments. Finally, Section 4 contains the conclusions and discussions of this work.

## **2. Materials and Methods**

### **2.1. Data collection**

The authors construct a database from the answers of an open-ended survey focuses on the experiences of 39 students during the Operational Research course. The students are from the Industrial and Systems Engineers programs at UAB courses (4955, 5106 and 52540) located in the city of Bucaramanga, Colombia. The students wrote about their expectation, desires, and improved opportunities with answers length between 400 and 600 words in the Spanish language. As the next step, and to prepare the corresponding analysis, the authors generate 38 different documents in flat texts format and translate verbatim to English for the present manuscript.

### **2.2. Data transformation**

This work uses a specific format called tidy tables (an answer transformation structure), where each variable is a column (in this case Group, Gender, and Answer), each observation is a row (a student perception or answer), and each type of observational unit is a table. The tidy text format as being a table with one-token-per-row. A token is a meaningful unit of text, such as a word, that the researchers are interested in using for analysis, and tokenization is the process of splitting text into tokens. This one-token-per-row structure is in contrast to the ways text is often stored in current analyses, perhaps as strings or in a document-term matrix (Fay, 2018). In order to make the transformation, we use the Tidytext package programmed in statistical software R by Silge & Robinson (2016), because this package allows the data manipulation with a standard set of “tidy” tools: dplyr (Wickham, Francois, Henry, & Müller, 2019), tidyr (Wickham & Henry, 2017), ggplot2 (Wickham, 2009), and broom (Robinson, 2017).

### **2.3. Polarity**

The polarity of the perceptions could be calculated after a transformation of the answers from the structure of the tidy table to a word frequency list, for this, the algorithm analyzes which words are used most frequently in the answers, later, the words contained in the list are contrasted to a lexicon dictionary. This phase applies the lexicon created by Bing Liu which includes 2006 positive words, 4783 negative words and includes mis-spellings, morphological variants, slang, and social-media mark-up (Ding, Liu, & Yu, 2008). After calculating the tokens polarity, those values are added to obtain an overall polarity to each answer.





## 2.4. Sentiment composition

The perceptions can be cluster by the emotions which they contain. (Kiritchenko, Zhu, & Mohammad, 2014), to do that, the words in the list are contrasted to the Word-Emotion Association Lexicon, this lexicon is a list of English words and their associations with eight basic emotions (anger, fear, anticipation, trust, surprise, sadness, joy, and disgust) and two sentiments (negative and positive) (Mohammad & Turney, 2013). After the allocation of the emotions by Group; they are analyzed in percentage format to make comparisons.

## 3. Results

Showing up next the overall sentiments (including emotions). Figure 1, represents the three courses (a.k.a Groups); for the most part, the Groups have a positive trend, which means a good perception of the methodology applied by the Professor. The x-axis indicates the answer number and the y-axis the overall polarity. On the other hand, Figure 2 shows the main words and their polarity contributions, in this work, the students usually use words related to excellent satisfaction, and improvement desires, the x-axis indicates the polarity and the y-axis is a word list. Figure 3 indicates the word frequency separated by polarity; in this research, the negative words results are related to bad experiences in past courses o anxiety when the students solve mathematical problems.

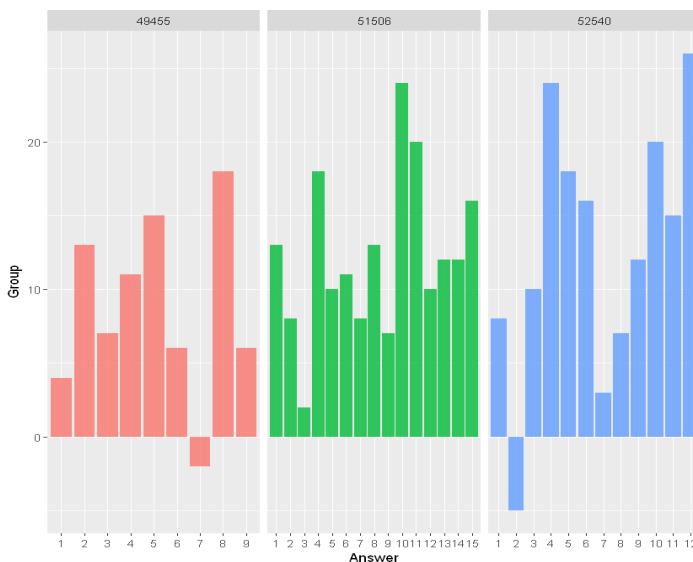


Fig. 1 Overall polarity

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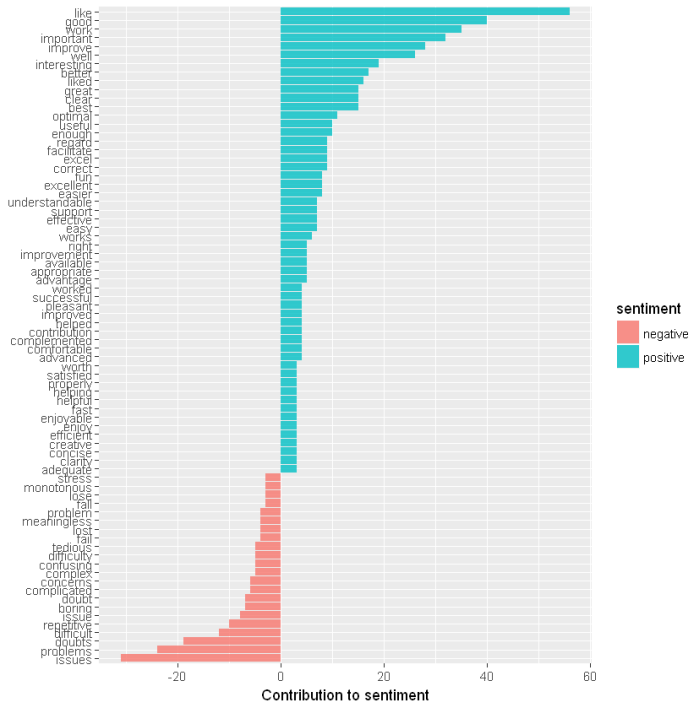


Fig. 2 Contribution to sentiment

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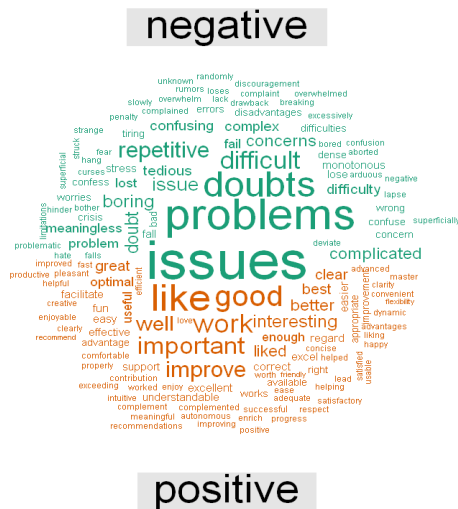


Fig. 3 World cloud

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Finally, Figure 4 shows the emotions in four clusters, three for each course, and one for the whole students. The percentages indicate that in the 49455 group, the students have the most positive perceptions follow by 51506 group and 52540. Moreover, 49455 group almost does not have emotions related to adverse perceptions such as fear, sadness, anger, or disgust.

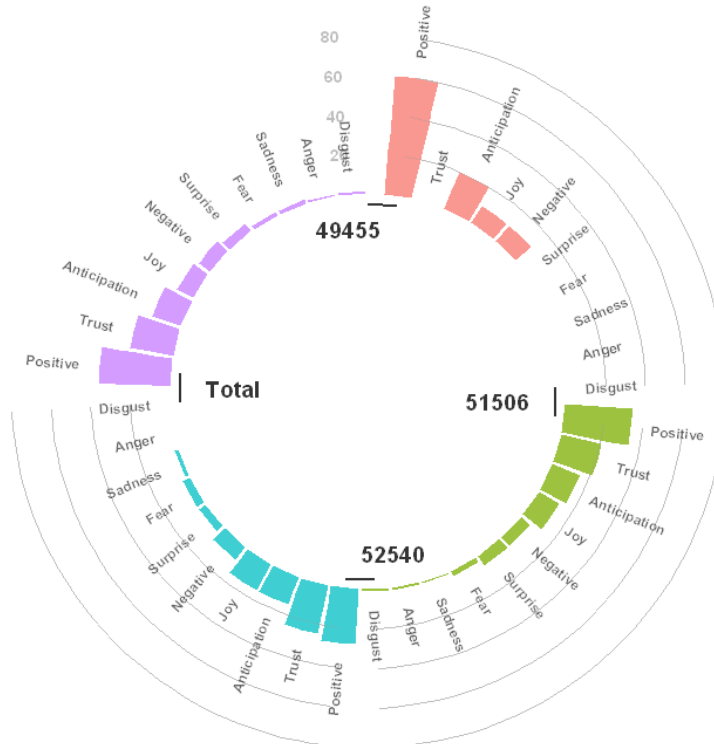


Fig. 4 Sentiments composition by group  
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To contextualize the results, we select randomness some students' answers to identify the polarities and emotions. Next, the following quotes are some examples of students' answers. For the most part, the conflicting emotions are related to past experiences in previous courses: *"I study this subject for the second time, and it is difficult for me the methodology of the previous teacher, and that is why I lost."* Other negative perceptions are related to the anxiety while the students solve mathematical problems: *"The subject is complicated for me. So I started a crisis about whether the career I had chosen was the best career for me."* In terms of positive perception, most students feel comfortable with the methodology: *"This subject makes me love my profession much more and see how beautiful it is."*, *"The teacher dominates the subject, and in each class, we entertain in a pleasant*

learning experience. I also want to thank the UAB and the people in charge of the headhunting process.”, “I have had the pleasant surprise of receiving more than I expected.”, “This subject went from being a boring and uninteresting class to a class that forms levels of logic, analysis; it is also a fun subject.”, “I like that the teacher is flexible with the types of work (fieldwork, software development, workshops without a computer) and how he evaluates.”. Finally, in terms of opportunities for improvement, students want methodologies such as flipped classroom or gamification: “I would like a platform with extra exercises and explanatory videos to be able to review, learn and resolve doubts.” Or “I would like to use several tools oriented to the topics that we see in class and be able to apply them in a company.”

#### 4. Conclusions and discussions

This research work aims to identify opportunities for improvement in the continuous evaluation strategy to make the student's experience of Operations Research more pleasant in the future since this subject is traditionally stressful and students do not usually get good grades. For this, we apply the Sentiment Analysis technique since it allows to quantify a polarity and grouping the emotions of the perceptions of the individuals under study. Besides, from applying a filter of emotions to the answers, it was possible to identify strengths, weaknesses, and opportunities for improvement, which makes this work an exciting and fruitful experience. However, the methodology can be improved because in this work the authors translated the answers, and the analysis may be biased, therefore, for future work, it is proposed to work with lexicons in Spanish and make the work more robust by applying machine learning techniques such as recommend Song et al. (2017).

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## Destination Satisfaction in Senior Tourism: A Case Study

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### Abstract

*In this paper, we present a study which analyzes the experiences of elderly people, when travelling as tourists to specific destinations. With this specific profile we searched results that help us to determine their prospects in tourism. The research is also focused on a specific country, Ireland, although cross-cultural studies are being developed in Spain. The surveys are carried out in three touristic places chosen because of their popularity with our target audience. We conduct a survey in which we elicited the expectations that exist before visiting that destination regarding the perceived reputation of that tourist destination and of the quality of the services offered. These aspects also relate to the degree of hospitality of its inhabitants. This allows us to determine the tourist experience in the destination, focusing on the emotions of the visitor to the destination and of the level of disconnect from everyday life that is achieved. We establish the degree to which their feelings on the destination are discussed in social networks – an important point as this group have not traditionally used social media to a significant degree. We try to establish by means of a quantitative study the tourist profile of these people of advanced age, which is an area of research that has received little attention to date. For this reason, the study reveals knowledge of a new visitor profile in tourist destinations, determined by the experience lived.*

**Keywords:** senior tourism, expectations, reputation, tourist experience

### 1. Introduction

The impact of tourism in the economic growth of countries and local destinations has been widely confirmed (Song, Dwyer, & Cao, 2012; Tugcu, 2014; Webster & Ivanov, 2014). Tourism destinations are central to the tourism industry (Kozak & Rimmington, 1999). The centre for Strategic and International Studies (2000) describes global ageing as the





challenge of the new millennium (Batra, 2009). Obviously, from an operator or destination perspective, repeat visits have been intuitively used as an indicator of the positive perception of the “product” in question, with repeat purchase indicating a positive attitude (Oppermann 2000).

The impact of perceptions of attributes of products and service on satisfaction has received considerable attention in the literature (e.g., Baker et al. 2002; Berry, Seiders, and Grewal 2002; Bitner 1990; Oliver 1993; Lemon & Verhoef 2016). This is not to say that there is not some anecdotal evidence and/or intuitive wisdom that some people return to the same destination over and over again (Oppermann 2000). Prior research has suggested that the customer’s assessment of an experience influences key outcomes such as customer satisfaction (Lemon & Verhoef 2016) and recent research has also focused on the value of relative metrics (e.g., satisfaction relative to competitors) as potential good predictors of customer behavior (Keiningham et al. 2015).

The characteristics of senior travelers have become an important area of interest because of the market size and its potential for growth (Horneman, Carter, Wei, & Ruy, 2002). Senior or mature travelers are already important to the tourism industry, and they will grow in importance as the segment grows in size and wealth (Reece, 2004). Pleasure travel has been found to be an important issue positively affecting the quality of life of seniors. Although in most developed countries the relationship between quality of life and tourism for seniors has been investigated, the issue has not been examined widely outside this sector (Lee & Tideswell, 2005).

It is helpful to understand how customer experience is related to more focused constructs, such as customer satisfaction and service quality. Customer satisfaction could be one of the components of customer experience, focusing on the customer’s cognitive evaluation of the experience (Lemon & Verhoef 2016). Dramatic improvements in health care and life expectancy have produced rapid growth in the world’s senior population. At the end of the twentieth century, 11 percent of the world’s population was aged 60 or above, and it is estimated that 20 percent will be 60 years or older by 2050 (United Nations Population Division, 1998, cited in Hall, 2006:12-13). The study in marketing is an incipient area of investigation in tourism that must be thoroughly explored in order to understand the complex environment in which tourism firms and destinations operate (Zeng & Gerritsen 2014).

The objective of this study is to analyse the interaction between three key variables: expectations, experience and engagement. Related to satisfaction and social media in relation to a specific tourists destinations. We test our hypotheses in the context of three tourist locations in Ireland: Waterford, Bray and Dun Laoghaire, which are popular tourist destinations for elderly people. Surveys were conducted which were analysed using

structural equation modelling. All points of view help us in the development of the project for the future. A more in-depth analysis can be found (Gómez-Aguilella, 2018).

This paper is organized as follows. In Section 2 we describe the satisfaction in senior tourism. In Section 3 we present our model and hypotheses. Our method, and analysis of the outcomes of the survey are described in Section 4. Finally, Section 5 presents our conclusions and limitations.

## **2. Satisfaction in Senior Tourism**

The aging population in many industrialized countries draws attention from the tourism industry mainly because of its substantial size, increasing purchasing power and more time available for travel after retirement (Esichaikul, 2012). The senior market has been thus cited as one of the most important consumer segments of the tourism industry. (Shoemaker, 2000; Bai et al., 2001; Horneman et al., 2002; Jang and Wu, 2006). Understanding the travel motivations and behavior of elderly people is fundamental to travel businesses that compete for this potential growth market (Crompton, 1979; Jang and Wu, 2006). Customer satisfaction has been the dominant customer feedback metric for years, and marketing and consumer researchers have conducted thousands of studies on the antecedents of satisfaction, the measurement of customer satisfaction (in specific contexts), and the behaviour a land financial consequences of customer satisfaction (Bolton and Drew 1991).

To identify the traveler profiles of the elderly, Anderson and Langmeyer (1982) examined two senior groups and reported that both over-50 and under-50 groups are likely to take pleasure trips for rest and relaxation and for visiting family and relatives, but over-50 groups are more likely to visit historical sites. Javalgi et al. (1992) revealed that non-seniors are a better-educated group than seniors and are more likely to engage in a detailed information search process before making a purchase decision (Esichaikul, 2012). In terms of market potential, people older than age 65 constitute an important market segment because they have discretionary income and time to travel (Javalgi, Thomas, & Rao, 1992; Brewer, Poffley & Pederson, 1995; Moscardo & Green, 1999; Moisey & Bichis, 1999). The senior market for persons aged 55 and older possesses a relatively large share of all discretionary dollars (Blazey, 1987; Javalgi et al., 1992).

In promoting tourism, it is also important that visitors receive a high quality experience or a high level of satisfaction from their holiday along with other tourism experiences which are associated with visitors' perceptions (Sharma and Dyer, 2012). Understanding the travel requirements of senior tourists will be useful for travel planners and marketers to design



specific market strategies and to adapt tourist products to the potential needs of senior tourists (Esichaikul, 2012). In so doing, their level of satisfaction will be increased.

### **3. Hypotheses**

Anderson, Fornell and Mazvacheryl (2004) have investigated the long-term effects of customer satisfaction and concluded that satisfied consumers make recommendations to others, therefore securing future income (Kobylanski, 2012). We start from the assumptions as postulations made from the data. These serve as the basis for initiating the research or argumentation (Gómez-Aguilella, 2018). Users of social networks that are subject to information influence are expected to show a greater need to acquire information and guidance from contacts with greater knowledge (Chu & Kim, 2011). Most models on tourism destination choice include a reference to the importance of previous experience on the destination choice process, often symbolized by a feedback loop after the actual destination experience into the evaluative stages of future destination decisions (e.g., Chon 1990; Mansfeld 1992; Woodside and Lysonski 1989). Therefore, it is argued that:

#### **H1: Expectations of Satisfaction has a direct influence on Experience of Satisfaction**

Woodside and Lysonski's (1989) model of traveler destination choice included previous destination experience in the traveler's variables that influence destination awareness as well as traveler destination preferences (Oppermann 2000). This facilitates their engagement in the user-generated contents of social networks (Chu & Kim, 2011). The benefits of travel for seniors include a change in everyday routine as well as an opportunity to gain new experiences (Batra, 2009). Therefore, it is proposed that:

#### **H2: Experience of Satisfaction has a direct influence on Engagement**

Laroche et al. (2012) revealed that social networking communities promote shared awareness, society's obligation, rites and traditions, trust, and customer loyalty. A year later, Brodie et al (2013) specified the reach of consumers in online participation suggesting that consumers with a good level of engagement present greater loyalty, empowerment, connection, emotional attachment, trust, and above all satisfaction (Gómez-Aguilella & Cardiff, 2019). These effects have consistently been shown in customer satisfaction research at both the individual and aggregate levels (e.g., Bolton and Drew 1991; Rego, Morgan, and Fornell 2013; Verhoef and Van Doorn 2008). Bolton and Lemon (1999) show that prior experience influences current satisfaction, which in turn influences future usage (Lemon & Verhoef 2016). In the marketing literature, but also the tourism literature, repeat purchase and/or visitation often is taunted as something to be desired (Oppermann 2000).

Furthermore, destination “familiarity has been proposed as both a positive and negative factor in image evaluation. Mostly it has been associated with a more realistic impression of destination based on past experience” (MacKay and Fesenmaier 1997, p. 543). Klenosky (2002) has shown that before tourists make their travel decision, they formulate a more positive affective destination image when the destination-related emotions match their motives and the benefits pursued. Based on these findings, it is argued that:

**H3: Engagement has a direct influence on New Expectations of Satisfaction**

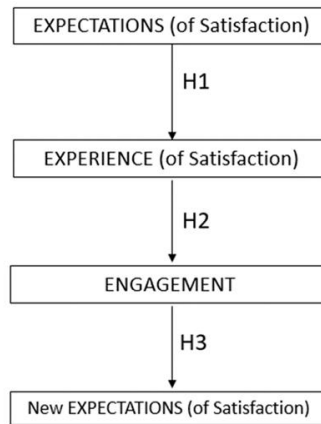


Figure 1: Model

**4. Research method, results and analysis**

**Table 1. Measuring scales**

Variable	Number items	References
<b>Expectations (of satisfaction)</b>	10	Baloglu and McCleary, 1999, Echtner and Ritchie, 1991; Beerli and Martín, 2004, Gallarza et al., 2002; Kim and Richardson, 2003; Beerli and Martín, 2004.
<b>Experience (of satisfaction)</b>	15	D. Buhalis and A. Amaranggana, 2015) DiCicco-Bloom and Crabtree 2006; Jordan and Gibson, 2004; Finn et al. 2000; Patton and Cochran,2002.
<b>Engagement</b>	15	Nunnally and Bernstein, 1994, Sprott, Czellar & Spangenberg, 2009

We conducted our studies on a specific country, Ireland. The surveys are carried out in three touristic places: Waterford, Bray and Dun Laoghaire, which are popular tourist destinations for elderly people. The study was conducted over one month (between April-May 2019).

Regarding the survey, we collected a total of 75 valid questionnaires from visitors to Waterford, Bray and Dun Laoghaire, in Ireland. The participants were presented with a set of questions related to each of the variables being analysed. Participants were asked to express their opinions by indicating their position on each question on a scale anchored at 1 (completely disagree) to 5 (completely agree).

In order to design these questions properly, we followed the approach of several authors who have proven the goodness of the scales used in previous researches (see Table 1). Concretely, for expectations (of satisfaction): Baloglu and McCleary, 1999; Echtner and Ritchie, 1991; Gallarza et al., 2002; Kim and Richardson, 2003; Beerli and Martín, 2004. For experience (of satisfaction): D. Buhalis and A. Amaranggana, 2015) DiCicco-Bloom and Crabtree 2006; Jordan and Gibson, 2004; Finn et al. 2000; Patton and Cochran, 2002. And for engagement: Nunnally and Bernstein, 1994, Sprott, Czellar and Spangenberg, 2009.

Table 1 records the measuring scales for each of the three variables and statistics related to the principal demographic characteristics of the participants are summarised in Table 2. The analysis of the data obtained in the questionnaires demonstrates the hypothesis and the relationships between variables. From the measurement of the variables (expectation, experience and engagement) and the number of items used for each scale, as well as the references used, the instrument was validated by first contrasting the model with a confirmatory factor analysis structural equation.

**Table 2. Sample Characteristics**

<b>Demographic variables</b>	<b>Description and Percentage</b>	
<b>Age</b>	56-65: 83%	65+: 17%
<b>Gender</b>	Male: 63%	Female: 37%
<b>Education level</b>	University: 25% Professional training: 26% Secondary: 30%	Primary: 17% Without studies: 2%
<b>Main occupation</b>	Employed (including self-employed) 57% Retired: 28% Work at home: 15%	Stopped: 0% Student: 0%
<b>Location</b>	Ireland: 100%	

Our results are shown in Table 3. It has been demonstrated that there is a strong relationship between the variables.

Table 3. Variable and average

Variable	Average rating scale Likert
<b>Expectations (of satisfaction)</b>	3.5
<b>Experience (of satisfaction)</b>	2.82
<b>Engagement</b>	2.7

While the quantities of data available for analysis were quite small, the findings of hypotheses result in positive feedback (Table 4).

Table 4. Relationships in model

H	Relation	Results
H1:	<b>Expectations → Experience</b>	accepted
H2:	<b>Experience → Engagement</b>	accepted
H3:	<b>Engagement → New Expectations</b>	accepted

## 5. Conclusions and limitations

When destinations then associate sociodemographic, lifestyle, or other variables with the individual tourist loyalty types, one hopefully arrives at distinct categories especially with respect to their choice of information sources. In turn, this will allow destination to specifically target the desired loyalty types (Oppermann 2000).

While the results of this study cannot be generalized due to the limited geographical coverage both with respect to origin and destination and due to the low response rate, this exploratory study does suggest that the behavioral measure of loyalty by itself can be a reasonable or even good predictor of future tourism destination choice. It certainly purports the notion that past experience has an influence on future behavior in a tourism destination choice context (Oppermann 2000).



A possible limitation of this research is that it focused mainly on data collected from Irish seniors and is not representative of the total senior pleasure tourists in Ireland. Another possible limitation lies in the fact that the research based on the selected literature focused only on three variables: expectatives, experience and engagement. Further study could discriminate among nationalities and gender, as travel behavior and travel experience for different nationalities and genders may differ.

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## Digital game-based learning for D&I: conceptual design of an educational digital game *Chuzme*

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### **Abstract**

*There is a demand for tools facilitating intercultural, diversity and inclusion (D&I) education. Video games are one of the most advanced new media technologies, so it is only natural to suppose that they can offer remarkable possibilities for fostering learning in the area of intercultural, D&I education. This article explores theoretical guidelines in the design of Chuzme, a serious educational game that focuses on raising cultural self-awareness, the acknowledgement of cultural bias, and aims to generate positive attitudes towards migrants, refugees and expatriates amongst its players and to train to be an inclusive leader. It is hoped that this will serve as a useful reference to guide the development of similar titles in the future.*

**Keywords:** *Educational digital games, refugees, diversity and inclusion (D&I), game-based learning*

### **1. Introduction**

The science of learning has shown that humans learn more effectively via active learning than via passive learning (Schank, 1995). The characteristics of active and engaged learning are necessary components for education in today's world because it allows students to employ critical thinking skills, analyse, evaluate and synthesise in order to make decisions and determine the course of their actions (Dickey, 2005). The five-year compound annual growth rate for game-based learning products on the planet is 20.2%, and revenues are expected to double to \$8.1 billion by 2022 (Adkins, 2017).

A digital game is an effective resource to make students engage with a complex subject such as cultural studies and D&I education (Shliakhovchuk, 2019). In this regard, serious games (SG), i.e. those not primarily meant to entertain, offer unique possibilities for creating educational tools for intercultural communication. SGs allow experimentation in



controlled environments, something that can, for example, be useful for simulating interactions between culturally different participants. SGs can also be used as persuasive tools to influence players' ideas and behaviours.

## 2. ATMSG model as a background of *Chuzme* design

Several frameworks have been developed to cater for the development of video games in both general and particular cases (e.g. MDA, DPE) and many researchers have attempted to define the structure of video games (Harteveld, 2011; Ralph & Monu, 2015; Schell, 2008 among others).

When designing *Chuzme*, several models were reviewed to identify the one best suited for the project. After careful consideration, to support *Chuzme's* game design phase, the ATMSG model (Callaghan, McShane, Eguíluz, & Savin-Baden, 2018; Carvalho et al., 2015) was chosen for its complex and dynamic view on serious games, while the overall design process was guided by the serious instructional design process, developed by Becker & Parker (2011) as a combination of simulation design (SD), game design (GD) and instructional design (ID). The serious instructional design process consists of six phases. The first phase, "Discovery", encompasses the needs analysis and rough outlines for framing the project in its proper context. This phase identifies the game's main objectives and premise and also develops a general understanding of who the game's intended users are, how these users will obtain what they need, and how one can know that they have. During the second phase, "Research", materials and facts are gathered, and limitations and original systems are defined. Figure 1 summarises models.

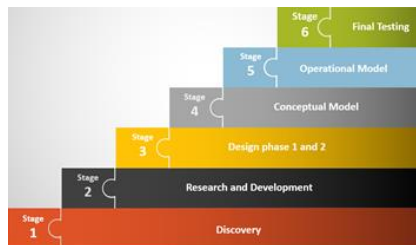


Fig.1 Game design process (adapted from Becker & Parker (2011))

The third phase, "Design phase 1 and 2", is where the game takes shape. Here, the Activity Theory-based Model's perspective is used. In this model, educational SGs are intricate, dynamic systems composed of three main activities—playing, learning, and teaching—and they have two subjects—the learner (player/student) and the instructor (responsible for game design and development). These subjects have different motives (e.g. have fun, fulfil

a course requirement, or engage students). ATMSC's hierarchical structure focuses on different levels of detail, providing a flexible tool to analyse and design interaction and gameplay, dividing activities into actions and the game itself into smaller pieces (Callaghan et al., 2018; Carvalho et al., 2015). Figure 2 describes the five-step approach to applying ATMSC.

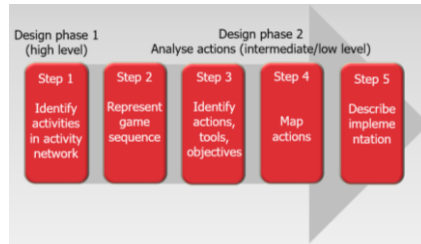


Fig. 2 Five-step approach for applying ATMSC (adopted from (Callaghan et al., 2018; Carvalho et al., 2015).

During the fourth phase, “Conceptual model”, detailed design documents are elaborated (pre-programming). Then follows the fifth phase, “Operational model”, which is where the programming of the game takes place. The sixth and final phase, “Final testing”, may be listed as a separate phase of the model, but the testing should actually start as soon as the first playable prototype is ready. These phases propose an overarching framework comprising conceptual and technical frameworks for enhancing intercultural skills.

There is the temptation for beginning game developers to jump right into a project and start writing code and drawing pictures. This is a mistake because unless there is a clear direction for the project, their work will be poorly focused. It is hard to design a full-fledged game that tackles intercultural issues and is a huge amount of fun at the same time. Still, it is possible to deal with these issues through short games that are effective and inexpensive tools. *Chuzme* is meant to be one such game, and this article takes a detailed look at the conceptual design of this game.

### 3. *Chuzme* game design

Educating for intercultural education demands learning approaches and environments that require the development of systems thinking and problem-solving. Shen, Wang, Ritterfeld, (2009) analysed America's Army-Operations (2002), Objection (2008), Re-Mission (2006), Electrocardiogram (2008), Londoner (2007), Hate Comes Home (2008), and Darfur is Dying (2006) and recognised that narrative-related elements such as character and dialogues, humour, and social interaction together with sophisticated and high-quality presentation and a gameplay structure with complexity and diversity bring a certain level of

enjoyment while playing educational games. Romero, Usart, & Ott (2015) added that in order to facilitate learning and skill development, games should contain authentic and enriched learning scenarios, game rules with endogenous and exogenous reinforcement, and a certain level of competition. Thus, when designing a game with a high potential for promoting the development of complex systems thinking and facilitating a systemic understanding of D&I issues, complexity is an element that should definitely be included.

### *The backstory of Chuzme*

A simple and easy-to-understand backstory was designed to engage and immerse the learner in the game and to offer a technology-enhanced constructivist setting endowed with virtual manipulation. The emphasis lies on comprehension, observation, problem-solving abilities, exploration and thought. *Chuzme* invites players to explore the settings, objects and characters within the game from the first-person perspective.

In *Chuzme*, the player is a talented young entrepreneur who applied with his Big Idea to the biggest and best-known accelerator, Y Combinator from Silicon Valley, who received notification from it that his Big Idea passed the initial level of selection and now Y Combinator would like to meet the team behind the Big Idea. If the team is accepted, it will fly to the San Francisco Bay Area to spend the next three months developing their ideas and business plans. Y Combinator offers \$120,000 for a seven per cent share of the company, legal assistance, group events featuring influential speakers such as the CEOs of Google, PayPal, etc. The climax is Demo Day when the team presents their Big Idea to the 450 deep-pocketed invitation-only investors.

### *The game mechanics of Chuzme*

The game starts when the player receives notification from Y Combinator that his Big Idea has been accepted for further development. The next step is to present a team that stands behind the Big Idea. Y Combinator notes that the people in the team are often more important than the idea itself, which tends to change significantly during the accelerator process. The most successful teams benefit economically and educationally when they are culturally and gender diverse. Consequently, the objective of the game is to build a culturally and gender-diverse team of four people of C-level talent and to provide equal opportunities for immigrants, refugees and expatriates of both genders. After the objective is explained, the player is put into a city co-working place where they need to pick the team members from a group of people, basing his choice on the candidates' profiles and assuming that they are all high-quality professionals in different stages of their lives that somehow contributed to this Big Idea.

In the first level of the game, the player has to rely on his "gut feeling" to choose 10 people (out of 32) whom he thinks might be a good fit for the Dream Team (Picture 1). The gamer

is offered a free in-game hints on what is gender-balanced working environment, what is diversity and why it is all important. The choice is done under 60 second pressure. The pictures of people are randomly generated from the <https://thispersondoesnotexist.com/>.

Ideally, if the player is male: among ten chosen candidates, at least five women should be included. If the player is a female among ten chosen candidates should be at least five males. If less, in-game hints about diversity and inclusion will be offered to read. A player starts a level with some complimentary points. If the player makes a good gender balance during this level, he is given points for keeping gender balance and ethnical diversity at the end of the



Pic.1 First level of the game "Gut reaction"



Pic. 2 Second level of the game "Expat bubble or Migrant struggle?"

level. Points are discounted if there is no gender balance or ethnical diversity. At the end of the level, he is shown a leader board of other people who passed the level before him and who make gender-balanced and ethnically diverse choices in the shortest period of time. The personal score is displayed, and the level of gender and diversity in the team. The option to replay the level is offered as well.

During the second level "Expat bubble and Migrant struggle?", 10 shortlisted candidates show the short story of their lives, and the player has two missions during this level. The first mission is: to place the candidates into refugee, migrant or expatriate selection based on their background that is offered as a written file (Picture 2). At the beginning of the level, a player is offered a free in-game hint to help to distinguish on who is refugee, migrant or expatriate before starting the selection. If he can distinguish well, he is given points for each correct placement. If a player is mistaken, points are discounted from his score. The option to correct file placement is offered, but the correct answer will not bring 10 points. After the first mission is activated, the in-game hints could be consulted as well, but now they will cost 3 points per each link consultation. The first mission is over when all profiles are sorted correctly. To take a decision on the profile, 20 seconds are given, thus, the shortest first mission could last 200 seconds. During the second mission, a player needs to choose 6 candidates out of 10 who will be invited for a personal interview keeping in mind the gender and cultural diversity. Thirty seconds are given to accomplish the mission.

At the end of the level, a leader board of people who make the best choice in the shortest period of time is presented. The personal score, gender balance and diversity level are displayed as well.

The third level called “Tell me who your friends are, and I’ll tell you who you are” and its mission is to ask the shortlisted candidates four questions from a list of questions provided and choose three perfect candidates to include in the Dream Team based on their answers. There are three categories of questions: general information about a person, sensitive personal questions, work experience related questions. Questions cover a wide range of bias. The player must ask four questions from all three categories. A player can listen to the answers from all candidates or only from the ones she/he selects. There is no time pressure at this level. But a player can’t replay the answers from the previous questions: one question -> answers, second question -> answer, etc. Audio files with the answers to the questions are provided. At the end of the level, when four questions are being asked, a player is invited to form the Dream Team.

The game ends (successfully) when the diverse team is formed: two female and two male, one refugee, one migrant and one expat. The player is notified that he receives four tickets to fly to the San Francisco Bay Area and the amount of \$120,000 has been transferred into its account. There is also an option to play a secret bonus level before quitting the game. However, this option is added to check if a player liked the game and would like to go on with more playing. If the player fails to form the gender- and diversity-balanced team within the time allotted, a player is notified that Y Combinator bars him/her from any future participation. There is a choice to restart the game.

### *The Interaction Design*

*Chuzme* uses storyline, characters, gameplay, and behavioural procedures as mechanisms to influence mediating variables. The game includes situations in which players could find themselves, problems they could encounter, and their solution. The emotions that a player draws from the personal experience of playing are a sense of achievement (mastery of in-game skills), a sense of empowerment (performing acts that cannot be performed in real life), and a sense of experimentation (taking a certain role) (Salmond, 2016). The fact that the game is educational means it needs to be adapted to everybody, including those who define themselves as non-gamers, which in turn means developing easily accessible and simple-to-control game. Ideally, gameplay should not exceed 5–20 minutes (Baaden et al., 2018).

### *The Gameplay*

Every effort was made to let players gather information through clear visual and auditory media that provides information. For example, players learn about people in front of them



by listening to their story, rather than by reading (audio file), even though the game provides some material in the form of text and photographs.

#### *In-game hints for student guidance*

*Chuzme* allows players to make progress regardless of their previous knowledge level or background thanks to its in-game hint system. *Chuzme* includes hints that are delivered when requested and at a cost to the player established by the designer. Some hints such as those that help users deal with the interface are provided at no cost. These hints guide players who need it but do not disturb those who can do without. Providing these breadcrumbs to players broadens the audience by including those that might otherwise have found the game confusing.

#### *Measure the transference of knowledge and assessment design*

Student assessment in educational games, designed as an explicit representation, possesses great potential for tracking and assessing students' learning outcomes if to make comparison with less interactive educational media. Educators highlight and score relevant actions, generate feedback, identify and rectify inaccurate assumptions, which is essential in educational games during the de-briefing stage after the game is played (Garris, Ahlers, & Driskell, 2002).

The nature of the subject matter and the basic design of the game gives all that is needed for in-game assessments, although a determination of whether or not the player has met the performance objectives will happen outside the game. Measuring what players are learning is straightforward and is accomplished in several possible ways: 1) in-game survey at the beginning of the game (questionnaire about player's background, later to be used to evaluate personal bias and cultural stereotypes) and 2) through group or individual interviews after the gameplay experience. However, an instructor is free to choose any methodology of introducing this game in class, pre and post knowledge assessment.

Moreover, data is collected from in-game traces to see if the game is having an impact on the attitudes of the players. The feedback generated from the in-games traces is expected to enhance learner's awareness of their own bias and stereotypes, to improve the alignment between their expressed behaviour and intended behaviour. Participants' in-game traces can be rated, annotated and evaluated by educators and contrasted with participants' own opinions during group or individual interviews.

As a result, the holistic approach to research and design, and a mix of different methods for data collection and analysis lead to the valuable measuring of the knowledge transfer to the player. This is crucial for educational games; however, to date, few games have attempted to do so.





It's worth noting that *Chuzme* is not supposed to be a standalone title but to be integrated as an educational tool. As I was mentioned before, the role of the teacher is very important with respect to if and how this game becomes a learning process. In other words, the teacher is to provide elements of analysis and reflection that allow learning to happen using the contents of the game.

### *Implementation Details*

When designing a video game, the right platform and format choice is the key. Using casual gaming approach broadens the pool of potential players. Thus, concerning the technical aspect, *Chuzme* could be implemented into Unity 3D, a cross-platform game engine that offers advanced lighting and rendering options, pipeline optimisation, physics management, built-in support for spatialised audio, multitasking, complex animations and networking. Interaction implements a client-server architecture in which the server handles the simulation state and controls the projected screen, and the clients are the players' devices. Finally, an AR Foundation Package could be used as a software library that can be integrated into Unity, thus supporting the game deployment on different mobile platforms (iOS, and Android). For accelerating the development of the app in Unity for the HoloLens AR glasses, Microsoft Mixed Reality Toolkit will be used.

*Chuzme* intends to make use of visual and sound channels. Otherwise, the player quickly becomes overloaded with one modality usage and will be lost. Sound effects and music drive interest or increase scenario effects (Baaden et al., 2018). Interesting modality to develop for AR solution is touch (e.g. manipulation by hand with augmented reality applications). The new HoloLens 2 has been announced this year as an evolution of the previous model with tracking of both hands and fingers to allow the direct manipulations of AR figures with bare hands.

### *Validation*

The first informal evaluation of the concept and game mechanics presented as a recorded video clip happened during Sietar Congress 2019, held in Leuven, Belgium, from 30th of May till 1st of June (Sietar is a Society for Intercultural Education, Training and Research). Ten leading experts from intercultural, diversity and inclusion fields were asked to see the video clip and to share their viewpoints on the concept, dynamics and mechanics of the game, possible inconsistencies and disharmony of the flow of the game. At the end of a watching session, the recorded video was discussed, rated, and evaluated by expert observers. To summarize user feedback and reactions, it is worth noting that 10 out of 10 experts highlighted: 1) strong concept of *Chuzme*; 2) the capability of *Chuzme* to engage the user in meaningful learning; 3) saw the game as a possible tool to practice diversity and inclusive teambuilding; 4) described a concept of the design of a game as thought-provoking. Nine out of 10 experts pointed to the potential of the game to facilitate a critical



reflection on the bias and stereotypes. The experts unanimously stated as possible application domains of *Chuzme* in intercultural and D&I education.

#### 4. Conclusions

Developing an educational game is a multifaced and challenging endeavour due to its having to satisfy experts and novices alike while the integration of gameplay and learning content (Kelly et al., 2007). The logically consistent, well-designed conceptual model called Activity Theorybased Model of Serious Games (ATMSG) was used as a theoretical guideline in the designing of *Chuzme* which helped to identify the main elements for improving the educational outcomes expected of the game.

A description of various mechanisms--such as storyline, characters, gameplay, and behavioural procedures--was provided to help understand the mediating variables this video game is meant to influence and to show how these elements are interconnected and how they contribute to achieving the desired learning outcomes. Prior to constructing the video game, we conducted formative work to make sure that the game's characters, the storyline, problems, and solutions are realistic and appealing to the intended audience. Behavioural-change components that are embedded in the gameplay and help advance the storyline, such as goal setting and goal review, were tested with professionals of the field. *Chuzme* enables the player to make choices for their character and to observe the short- and longer-term consequences of their choices for themselves and others. Connecting goals to personal values, providing choice and performance-related feedback and structuring the game in levels that are gradually challenging all aim to enhance the intrinsic motivation of the player and help to see the big picture. The use of in-game measurements and analytics allows the instructor to monitor the learner's retention and to check whether the intended learning outcomes are achieved.

As future work, completing the implementation of *Chuzme* and a game-prototyping with crude interface sketches and playable prototypes are planned. Quantitative and qualitative approaches to be elaborated to perform a thorough evaluation of the game and to demonstrate the significant advantages of using video game in D&I education. Further evaluation will also serve for evaluating the efficacy of the chosen reference framework in guiding the design of D&I games. The game design will surely evolve after further testing, and the impact of those changes will naturally be evaluated, including by the means of in-game analytics.

It is hoped that this guideline will serve as a helpful reference to guide the design and development of similar titles in the future. But of course, there is not a "one-game-fits-all"



approach that will assist equally students with gaining requisite skills. Clearly, it is important to continually seek methods, strategies and exemplars conducive to designing optimal digital game-based learning environments (Dickey, 2005).

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## What Do They Eat? A Survey of Eat-Out Habit of University Students in Taiwan

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### **Abstract**

*Main purpose of this research is trying to understand food likeliness of Taiwan college students, and probe whether these food are healthy. Three survey steps are taken as: step 1, market survey for what kind of foods are selling around the campuses; step 2, questionnaire investigation for students food preference; step 3, analyzing whether these favorite foods are healthy or not. The result shows: major consideration for students food selection are “taste” and “price”; 63% of students are taking food or snacks late at night at least once a week. Top three most favorite foods are: Taiwanese fries (yan su ji), carbon grilled chicken and fried fish steaks. Quantities of these foods are small, prices are low, and easy access from roadside food stands. Problems of them are high calories, easy to accumulate free radical in human body, plus insanitary food processing environment. They are harmful to student health. We suggest Taiwan government take it seriously.*

**Keywords:** *College student, diet healthiness, food safety, food nutrition.*

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## **1. Introduction**

Convenient and fast are two major incentives for people to bring to-go food to work place or school (Lee, 2013); Yet, unhealthy eating behavior and custom will make serious adverse result for people's health. Recent researches indicated that the trend of people getting cardiovascular and chronic diseases are getting younger (Chen and Yan, 2015), cardiovascular disease is no more a problem of senior people (Liu and Yang, 2010). In the long run, it is easy to cause problems of uneven nutritious taking and higher risks in getting obese and high blood pressure, blood fat and blood sugar (Luo et al., 2012). Hence, modern consumers are thinking highly on food safety and nutrition.

In addition to traditional cafeteria, lots of snacks, fried, iced and other instant foods are emerging in college campuses. Although they provide variable selections and solve students' diet needs, they are temptation for unbalanced diet. Meanwhile, lots of businessman are aiming college students and setting up food processing and stands within 100 campus meters (Zhou, 2010). These snacks are seducing students, making them sick if ate unhygienic food. Research reveals that most students are unaware importance of diet (Su and Fan, 2016). Eat casually, like to buy from food stands, and drive by convenience (Shen et al., 2015). More than 70% of college students taking custom or taste as their choice (Li, 2018). Therefore, healthy diet should be an important issue. Understanding their eating preference and custom are important to their eating activities and health.

Up to this date, there are limited papers on the health issue around Taiwan college campuses food stands and shops, and their relations with college students diet habit and health. Most papers are focusing on students self-conscience health, health idea, and diet activities (Chen and Yen, 2015); college students food knowledge and diet activities (Luo et al., 2018); or educate college students hygiene knowledge and skills (Chih et al., 2016). Little researches are on their diet habit and foods around them. Consequently, purpose of this research is investigating Taiwan college students diet preferences and habits, then analyzing their consumption patterns and healthiness.

## **2. Theoretical Analysis**

Research shows, nutritious knowledge has positive correlation with diet activity. Nutritious knowledge influences diet activity. Diet activity has profound influences on health. Unhealthful diet activities will increase probabilities for getting chronic diseases and obsesses (Chen et al., 2016). Unfortunately, most college students are not pay attention to

health issue (Luo et al., 2017), Li (2013) indicates: college students often taking fried food and late night snacks while watching TV or reading books. They are not eating in a regular manner, unbalanced nutritious taking, loving high calorie food, and high ratios of eating late night snacks (Hang et al., 2009), taking irregular diet habit and lack of nutritious knowledge (Wang; Su and Fan, 2016). Research indicates, nowadays college students are not having enough nutritious conscientious, not attach importance to health, have lots of opportunities for eating outside, and poor quality of diet and nutrition (Chen and Yen, 2015). A great portion of students have unreasonable protein taking, deficient nutrition knowledge, not eating breakfast, and irregular diet habits. Hence, there is a need to increase college students nutrition knowledge, make them take a reasonable and balance diet (Liu et al., 2013). We have to strengthen college student education and promote healthful diet(Li, 2018 ; Wang, 2016).

Health consciousness is raising, healthy diet has being valued highly, People are paying more attention on low fat, low sodium and low cholesterol foods, and eating seasonal food with its original flavor and nutrition(Yang et al., 2015). “Diet education” is an education of diet activities (Yan et al., 2015). Diet activities are activities of taking food nutrition. It is a part of life style, not only teaching nutritious knowledge and wishing to change nutrition and health attitude, but other factors need to be considered (Fu and Jien, 2009). A lot of experts agreed that diet education is helpful for Taiwanese’s nutrition knowledge, diet habit, sense of food safety and social development (Yan and Zeng, 2014).They suggested that college education should include correct nutritious knowledge, and thus improve students’ diet activities for better health conditions (Chen et al., 2016).

### **3. Research Methods and Process**

#### **3.1. Data Collection**

Target of this research is based on college students in Tainan, Taiwan,201. A college was chosen by random. Questionnaires were distributed by the researcher between April 8-22, 2017. Total number of questionnaires distributed were 172, number of valid collected were 98, collected ratio 56.9%. The distribution of the people that participated in the final sample were: 40 males, 58 females;74 people, were staying in dormitory.

#### **3.2. Research Tool**

Information collection of this research was done through questionnaire survey. The questionnaire was “Diet habit in campus survey”. Based on the research purpose, the author





observed kinds of food served around Tainan city campuses, interviewed related persons around campuses (such as students, teachers, administrative staff, and visitors), reviewed related webpages and documents, then developed the questionnaire. Contents of the questionnaire includes: basic information, diet habit, and most favorite foods. Basic information and diet habit are single choice, most favorite foods are multiple choices.

### **3.3. Data Analysis**

Collected information was analyzed through SPSS (22.0version), descriptive statistics includes: ratio, average, and standard deviation.

## **4. Result and Discussion**

### **4.1. Diet Habit of College Students**

Sample information shows, college students' acceptable expenses within the campus for a meal is NTD73.83. Diet with other/s is the highest ratio (45 person, 45.9%), then occasional with other/s (39 person, 39.8%), the least is eating alone (14 person, 14.3%). Considerations of their choices are: highest ratio for "taste" and "price", 38 persons (38.8%) and 25 persons (25.5%) respectively; then "habit" and "convenience", 14% (14.3persons) and 13%(13.3persons) respectively; the least are "hygiene" and "service", only 8 persons (5.2%) chose hygiene, and no one chose service. Frequencies of buying late night snacks are: most of them buying 1-2 times (62 persons, 63.3%) a week, 24 persons (24.5%) 3-4 times, as shown in Table 1. Overall statistics shows: diet habit for most students is going with other/s, taste and price are key factors that affect their diet choices. This indicates that most of them are eating around the campus; taste, price and convenience are their major considerations; and hygiene is not important for them. Most students ate late night snacks 1-2 times a week. Such diet habit is a worrying scenario.

**Table 1. Students diet habit and consideration factor (n=98)**

Variable		n	Ratio
Diet within the campus	Alone	14	14.3
	Go with other/s	45	45.9
	Uncertain	39	39.8
Major diet consideration	Habit	14	14.3
	Taste	38	38.8
	Convenience	13	13.3
	Price	25	25.5
	Hygiene	8	8.2
	Service	0	0.0

#### 4.2. Most Favorite Foods of College Students

In order to probe students' favorite foods, this research sorted out 68 kinds of foods for students multiple choices. The result shows, top ten students favorite foods in order are: small steamed bun (soup dumpling), Taiwan fries (yan shu ji), sushi, omelet rice (dan bao fan), light fried chicken cutlet, deep fried chicken cutlet, steak, smelly tofu, grilled chicken, and spaghetti (Table 2). It shows, features of students' favorite foods are snacks, fried, and flour related high calorific foods.

**Table 2. Ranks of favorite foods of college students**

Food	n	%	ran
Small steamed bun	64	66	1
Taiwan fries	61	62.9	2
Sushi	59	60.8	3
Omelet rice	58	59.8	4
Light fried chicken cutlet	58	59.8	4
Deep fried chicken cutlet	56	57.7	6
Steak	53	54.6	7
Smelly tofu	46	47.4	8
Grilled chicken	51	52.6	9
Spaghetti	51	52.6	9

Further analysis of food ingredients and nutrition shows in Table 3 and Table 4. This table indicates: top ten college students favorite foods are available from food stands around campuses. These foods are processed and sold by roadsides. Their hygiene environment are not good, cooking facilities are simple, and food qualities are not secured (Zhou, 2010). Meanwhile, these foods ingredients are high fat, high calorie, and less cellulose. Except sushi, fats of all these foods are exceeding 30% of “daily diet suggestions” published by National Health Bureau of Ministry of Health and Welfare, R.O.C.(Taiwan) (Health Promotion Administration ,Ministry of Health and Welfare, 2018). Most students are not reaching suggested ratio of the three nutrition taking: protein 10-20%, lipid 20-30%, carbohydrate 50-60%. Also, main ingredients of Table 4 are lacking vegetables. Only 27 students (27.6%) in this research chose vegetable salads. This reveals that most college students’ diet are imbalanced, short of vegetables, and less cellulose taking. They are harmful to health.

**Table 3. Favorite foods ingredients of college students**

Type of food	Main ingredients	Weight/per serve
Small steamed bun	Flour, minced pork, scallion	105g
Taiwan fries	Chicken breast, flour, fried oil	200g
Sushi	Rice, vinegar, sugar	125g
Omelet rice	Egg, rice	400g
Light fried chicken cutlet	Chicken, fried oil	200g
Deep fried chicken cutlet	Chicken breast, fried oil	200g
Steak	Beef and noodles	170g add 124 g
Smelly tofu	Tofu, fried oil	150g
Grilled chicken	Chicken, sauce	85g
spaghetti	Sauce, spaghetti	248g

**Table 4. Favorite foods nutrition analysis of college students**

Type of food	fat	carbonhydrate	protein	cellulose	calorie
Small steamed bun	43%	37%	20%	3.7g	250
Taiwan fries	65%	10%	25%	0.6g	610
Sushi	3%	85%	12%	1.1g	189
Omelet rice	35%	49%	16%	2.8g	380
Light fried chicken cutlet	67%	9%	23%	0.6g	541
Deep fried chicken cutlet	44%	29%	27%	1.2g	470
Steak(beef)	55%	0%	45%	0g	214
(noodle)	18%	23%	10%	5.2g	170
Smelly tofu	52%	10%	38%	1.8g	189
Grilled chicken	53%	0%	47%	0g	201
Spaghetti	33%	47%	20%	5.2g	350

## 5. Conclusion

Results of this research are: students' acceptable average dining expenses is NTD 73.83 per person per meal; highest dining habit is going with other/s, least ratio is dining alone; most of them are eating at cafeteria; major choice considerations are taste and price. 63% of students take late night snacks at least once a week. Notably, their diet requirements are merely convenience, likeness, cheap; and not care about hygiene and service. This research also found that top ten favorite foods for college students are available around campuses. These foods are cooked and sold by the roadsides.

Food safety is a potential concern. College students like to eat Taiwan fries, light fried chicken, deep fried chicken, steak, smelly tofu, grilled chicken and spaghetti. These are high fat, high calorie foods, which are having adverse impact toward students' health. In spite of these facts, this research discovered that these favorite foods are not complying with daily diet norms. The three nutrition taking ratio for college students are following far behind "daily diet suggestion" (protein 10-20%, lipid 20-30%, carbohydrate 50-60%), and short of vegetables and cellulose taking. Researches indicated repeatedly that, never ignore taking enough vegetables and fruits; it keeps healthy (Health Promotion Administration, Ministry of Health and Welfare, 2018); Nutrition and hygiene are key factors for college students health. Unfortunately, most college students are not paying attention to them. Therefore, school cafeterias are bearing responsibilities for solving these problems (Zeng, 2016).

Flourishing of campuses vicinity dining and potential problems should be improved, and provide a safe and hygienic dining environment for college students (Peng et al., 2017). After all, we cannot simply count on individual behavior change. Social environment need to be changed (Liu and Yang, 2010). Since convenience is a major consideration for college students dining, we suggest Taiwan government take it seriously.

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## Analysis of segmentation methods for acne vulgaris images. Proposal of a new methodology applied to fluorescence images

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### **Abstract**

*Acne vulgaris is one of the most common human pathologies worldwide. Its prevalence causes a high healthcare expenditure. Acne healthcare costs and effects on individuals' quality of life lead to the need of analysing current acne evaluation, treatment and monitoring methods. One of the most common ones is manual lesion counting by a dermatologist. However, this technique has several limitations, such as time spent. That is the reason why the development of new computer-assisted techniques are needed in order to automatically count the acne lesions. Nonetheless, the first step is automatic acne lesion detection on the skin of patients. The aim of this work is to propose a new methodology to solve the acne images segmentation problem, so that the implementation of a system for automatic counting is possible. The results would be a decrease in both time spent and diagnosis errors. With this objective, after doing a systematic review on the state of the art of acne images segmentation methods, fluorescence images of the face of acne patients are obtained. This image modality enhances visualization of the acne lesions. Finally, using the fluorescence images, a segmentation algorithm is implemented in MATLAB.*

**Keywords:** *image segmentation, acne vulgaris, MATLAB, fluorescence imaging, machine learning, image processing.*



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## **Resumen**

*El acné vulgar es una de las patologías más comunes en el ser humano. Su prevalencia supone un elevado coste económico, el cual, junto con el impacto en la calidad de vida de los pacientes, conlleva la necesidad de analizar los métodos actuales de evaluación, tratamiento y seguimiento del acné. Entre los métodos de evaluación y seguimiento más comunes se encuentra el recuento manual, por parte del dermatólogo, de las lesiones. Esta técnica, sin embargo, presenta limitaciones tales como el tiempo necesario para llevarla a cabo correctamente. Por este motivo, surge la necesidad de desarrollar nuevas técnicas asistidas por ordenador que permitan realizar el recuento de manera automática. Para ello, es necesario, en primer lugar, la detección automática de las lesiones de acné en la piel del paciente. El presente estudio propone una nueva metodología para resolver el problema de la segmentación de imágenes de acné, que permita el desarrollo de un sistema de conteo automático, para reducir el tiempo de consulta y los errores diagnósticos. Con este fin, tras realizar una revisión sistemática para conocer el estado del arte en técnicas de segmentación propuestas para acné vulgar, se obtienen imágenes de fluorescencia del rostro de individuos con esta patología, pues dicha modalidad de imagen facilita la detección de las lesiones. Con las imágenes se genera un algoritmo de segmentación utilizando el software MATLAB.*

**Palabras clave:** *segmentación de imágenes, acné vulgar, MATLAB, imágenes de fluorescencia, aprendizaje automático, procesado de imágenes.*

## **1. Introduction**

Acne vulgaris is an inflammatory chronic disease of pilosebaceous units —a pilosebaceous unit is formed by all the hair follicles related to the same sebaceous gland. The main affected regions are face, neck, chest and back. Clinical manifestations are seborrhoea or overproduction of sebum, the presence of non-inflammatory and inflammatory lesions on skin (open and closed comedos, and pustules and papules, respectively), and scars (Williams, Dellavalle, & Garner, 2012). It is the most common dermatological pathology worldwide (Zouboulis, 2014). 85% of adolescents suffer from acne (Ramli, Malik, Hani, & Jamil, 2012).

In order to monitor and treat acne properly, a precise and reliable method to establish acne severity is needed (Becker, Wild, & Zouboulis, 2017). Currently there is a wide range of acne grading systems, which shows the lack of a global standard. These systems can be divided into two groups: those based on manual lesion counting and the ones that use a model photography (Ramli et al., 2012; Becker et al., 2017) Several studies (Lucky et al., 1996; Becker et al., 2017) have proved lesion counting to be an objective and reliable method.

Beyond classical methodologies for the evaluation and monitoring of acne vulgaris, new computer-based techniques —sometimes applied to new image modalities, such as fluorescence images or polarized photography— have appeared to solve current limitations. These limitations include time spent and human errors and lead to an increase of economic costs. The aim of this study is to develop a new methodology to automatically count acne lesions by implementing a segmentation algorithm on fluorescence images. To achieve this, it is necessary to analyse the state of the art on segmentation methods applied to acne vulgaris images, so the first original contribution of this work is the first systematic review for acne images segmentation methods.

### 1.1. Fluorescence images

One of the characteristics of acne is the colonization of hair follicles by bacteria *Propionibacterium acnes* (*P. acnes*) (Williams et al., 2012; Zouboulis, 2014). Several studies (Patwardhan et al., 2017; Xu et al., 2018) have shown that substances secreted by *P. acnes* called porphyrins are the cause of acne lesions fluorescence. Porphyrins absorb ultraviolet (UV) light and emit red fluorescence in response (Borelli et al., 2006; Youn, Kim, Lee, Kim, & Park, 2009). Consequently, it is possible to enhance the visualization of acne lesions using fluorescence images of the skin of acne patients.

## 2. Systematic review

To conduct a systematic review on acne images segmentation methods, an adapted PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) (Liberati et al., 2009) standard was used. The analysis includes all studies published until April 2019 and explores four databases: Scopus (<https://www.scopus.com/home.uri>), PubMed Central (<https://www.ncbi.nlm.nih.gov/pmc/>), Web of Science (<https://www.recursoscientificos.fecyt.es/>) and Google Scholar (<https://scholar.google.es/>). PICO (Population, Intervention, Comparison and Outcome) model was used. With the



selected inclusion and exclusion criteria, a total of 20 studies were included in the systematic review.

The review shows that current segmentation methods for acne vulgaris images can be divided into two groups: those algorithms based on classical image processing techniques (Ramli, Malik, Hani, & Yap, 2011a; Chen, Chang, & Cao, 2012; Khongsuwan, Kiattisin, Wongseree, & Leelasantitham, 2012; Humayun, Malik, Belhaouari, Kamel, & Yap, 2012; Liu & Zerubia, 2013; Min, Kong, Yoon, Kim, & Suh, 2013; Malik, Humayun, Kamel, & Yap, 2014; Chantharaphaichi, Uyyanonvara, Sinthanayothin, & Nishihara, 2015; Alamdari, Tavakolian, Alhashim, & Fazel-Rezai, 2016; Kittigul & Uyyanonvara, 2016; Budhi, Adipranata, & Gunawan, 2017; Maroni, Ermidoro, Previdi, & Bigini, 2017) —they consist of a series of steps or operations that have to be applied to an image, for instance color space transformations or contrast modifications. The other group refers to machine learning algorithms (Fujii et al., 2008; Ramli, Malik, Hani, & Yap, 2011b; Madan, Dana, & Cula, 2011; Arifin, Kibria, Firoze, Amini, & Yan, 2012; Chang & Liao, 2013; Malik et al., 2014; Khan, Malik, Kamel, Dass, & Affandi, 2015; Alamdari et al., 2016). There is no preference between one group or another, since nowadays both types of methodologies are being proposed by research groups. In addition, there is a lack of uniformity in the evaluation of results for each study, which makes the comparison of these segmentation methods difficult.

In order to perform segmentation, different image modalities are used, but conventional photographs are the most common modality. Fluorescence images are used in only two studies (Son, Han, Jung, & Nelson, 2008; Khongsuwan et al., 2012).

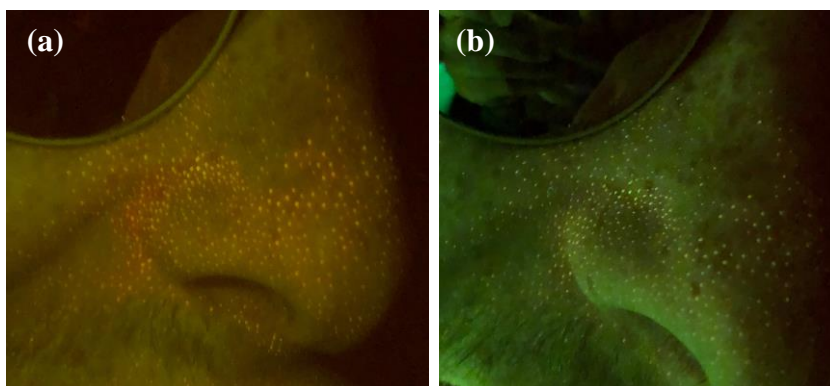
An analysis of limitations for each study included in the systematic review showed that algorithms based on classical image processing techniques cannot be totally automatized, mainly because there are some parameters that need to be manually adjusted (Son et al., 2008; Humayun et al., 2012; Budhi et al., 2017; Maroni et al., 2017). That is why in the present work machine learning algorithms are chosen for the implementation of the proposed methodology.

Moreover, there is a research gap on segmentation methods for different image modalities. As previously reported, there are only two methodologies proposed for fluorescence images. In this study the authors hypothesise that fluorescence imaging can be a useful modality to segment and automatically count acne lesions, since it is easy to capture the images and lesions are visually enhanced.

### 3. Materials and Methods

Before the implementation of the algorithm, fluorescence images are obtained in the laboratories of *Centro de Investigación en Tecnologías Gráficas*. These are photographs of the face of mild acne patients. Figure 1 shows two of the obtained images.

Two different lamps were used —Wood’s lamp and a LED lamp— both emitting UV light. The capture sensor was a standard RGB camera which corresponds to the model of the iPhone X smartphone. In order to avoid the most common interferences in this kind of images, two highpass filters from UQG Optics were used —cutoff wavelengths of 515 nm (OG-515) and 530 nm (OG-530).

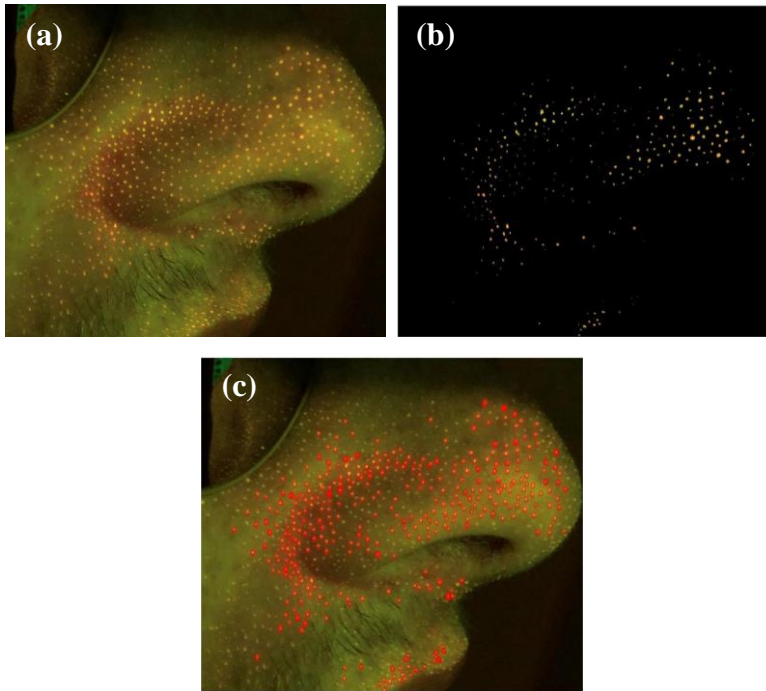


*Fig 1. Two of the images captured in the laboratory, for the same subject. (a) Image obtained with a LED lamp and OG-530 filter. (b) Image obtained with Wood's light and OG-515 filter*

The segmentation algorithm was implemented using MATLAB R2018b and is based on k-means clustering with automated selection of the desired cluster —the one which contains lesion pixels. The k-means algorithm allows the method to detect acne points without human intervention.

### 4. Results

Figure 2 shows the input and output images for one of the fluorescence images used in the implementation of the segmentation algorithm. This algorithm segments the image in order to detect acne lesions and finally demarks and counts these lesions automatically.



*Fig 2. (a) Fluorescence image obtained with LED light and OG-515 filter. (b) Result of segmentation for image (a). (c) The algorithm demarcates detected acne lesions on input image. Another output is the number of detected lesions. In this case it was 477.*

#### **4.1. Future work**

The results of the validation of the algorithm, as well as the code details, will be reported in a future publication. Although it has been shown, through visual qualitative inspection, that the method distinguishes healthy skin and acne points properly, it is necessary to objectively evaluate that. Concretely, the algorithm ability to distinguish between true acne lesions —red points— and light reflection —white points— has to be quantified. Sensitivity, specificity, precision and accuracy will be calculated, using manual segmentation as ground truth.

## 5. Conclusions

Automated counting of acne lesions has been proposed to solve current limitations of evaluation and monitoring methods for acne vulgaris. Although the new methodology is yet to be validated, it is clear that the use of machine learning algorithms such as k-means enables clinicians to objectively and quickly evaluate the severity of acne. Furthermore it has been proven that fluorescence imaging is a useful modality to easily segment and detect acne lesions.

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# Perceptions and behaviour of cruise tourists during their visit to a port of call

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## Abstract

*The purpose of the present research is to assess the perceptions of authenticity and crowding of cruise tourists visiting a port of call and its influence on their future behavioural intentions. The research was carried out in the city of Valencia, because it is one of the main Spanish cruise ports and is a representative city of the Mediterranean ports of call for the cruise business. A total of 467 valid interviews were obtained. For the analysis of data, the Statistical Package for the Social Sciences (SPSS version 22.0) was used. The findings reveal that Valencia is perceived as an authentic destination with moderate levels of human and spatial crowding. The analysis also demonstrates that there is a significant relationship between the assessed perceptions and the post-visit behavioural intentions, although, in the case of crowding, the association varies depending on the nature of crowding.*

**Keywords:** *Perceptions, behaviour intentions, cruise tourists, destination, port of call*

## 1. Introduction

The European region that most attracts cruise tourism is the Mediterranean, with Spain positioned as the country with the second largest volume of passengers (9,270,000 in the year 2017) (Ministry of Development 2018). The evolution experienced by some Spanish Mediterranean ports (Valencia and Barcelona, among others) in recent years, has turned them into modern and contemporary cities that, together with their rich history and culture, have enabled the growth of this type of tourism (Garay 2015; Sanz and Buzova 2014). According to reports published by the International Association of Cruise Lines (CLIA), the



impact of the economic activity of the cruise ship industry in Spain is a turnover of more than 1.481 billion euros, generating a total of 31,233 jobs (CLIA Europe 2018).

Past research on cruise tourists' perceptions and behaviours onshore has focused on traditional variables such as satisfaction, expenditure, motivations or tourist activities (Andriotis and Agiomirgianakis 2010), while studies exploring emerging constructs gaining increasing attention in the recent tourism literature, such as destination authenticity and perceived crowding, are scarce (Knudsen et al. 2016; Sanz et al. 2019). The existing body of research shows that these types of perceptions may condition the perceived destination attractiveness, diminishing the quality of the experience and affecting positively or negatively tourists' post-visit behavior (Sanz et al. 2019).

Considering all the aforesaid, The purpose of the present research is to assess the perceptions of authenticity and crowding of cruise tourists visiting a port of call and its influence on their future behavioural intentions.

## **2. Methodology**

The study's target population was cruise tourists visiting the city of Valencia. Finally, a total of 467 valid interviews were obtained.

Of the total survey responders, 45.4% were men and 54.6% women. The average age was 57 years, 64.1% of the sample represented tourists over the age of 55 years. In terms of education, 38.8% had completed high school studies, with 54.4% having university studies. Almost half of the respondents were retired or retiring (49.5%), with a significant percentage (33%) of employed people. With regard to nationality, European tourists predominated, coming from the United Kingdom (43%), Germany (15%), France (2.8%) and Italy (11.8%), whilst 10.1% and 3.2% respectively came from the US and Canada; the remaining 11.7% are citizens from other parts of the world.

For the analysis of data, the Statistical Package for the Social Sciences (SPSS version 22.0) was used, which offers several statistical procedures for the descriptive analysis of the information.

### 3. Results

#### 3.1. Authenticity and perceived crowding

Table 1 collates the score given by the respondents to the items that allow an assessment of authenticity of Valencia as a port of call.

**Table 1. Perceptions of authenticity by cruise tourists**

	Mean	Standard Deviation
<b>AUTHENTICITY</b>		
I liked the information I received about Valencia and found it interesting.	5.39	1.33
This visit provided me with insights about Valencia's heritage.	5.39	1.41
During the visit to Valencia, I felt connected with the history, legends and historical personalities.	5.00	1.45
I enjoyed the unique atmosphere/ambience of Valencia.	5.67	1.34
I felt connected with the locals and their culture during the visit to Valencia.	5.05	1.50
I liked the way Valencia blends attractive landscape/ scenery/ historical town.	6.15	1.34

*Font: own elaboration*

The results permit the conclusion that, in general, Valencia is perceived as a genuine port of call, as it offers a combination of modernity and history (6.15 of average), together with a unique environment (5.67 of average), aspects that evoked the greatest feelings of attraction.

In relation to crowding, Table 2 collates this perception, differentiating between human crowding (the number of people) and spatial (mobility problems), since both types can affect tourists' satisfaction and their behaviour in very different ways (Díaz-Sauce et al. 2015; Zehrer and Raich 2016).

Table 2. Cruise tourists' perception of crowding

	Mean	Standard Deviation
<b>HUMAN CROWDING</b>		
Valencia seems very crowded to me.	4.09	1.72
Valencia was a little too busy.	3.74	1.69
There were a lot of tourists in Valencia.	4.71	1.64
There was much traffic of people in Valencia.	4.29	1.76
<b>SPATIAL CROWDING</b>		
I felt suffocated during my visit in Valencia.	2.61	1.73
I felt nervous about being surrounded by too many tourists during my visit in Valencia.	2.57	1.78
I was disturbed by the contact of too many people while visiting Valencia.	2.48	1.75
I felt that space was missing in the tourist areas because of the many tourists in Valencia.	2.69	1.78
Moving around at tourist areas was inconvenient in Valencia.	2.61	1.77

Font: own elaboration

As may be seen in Table 2, the perception of overcrowding does not yield results that are too alarming (the highest mean value is positioned at 4.71 up to 7), although clearly the evaluations of human crowding are markedly higher than those of spatial crowding. The cruise tourists interviewed were more of the opinion that there are very many tourists in Valencia, rather than with a lack of space or mobility problem.

### 3.2. Post-visit behavioural intentions

The intention to revisit and any recommendation of the destination (see Table 3) are considered key variables of a tourist's post-visit behaviour (Papadimitriou et al. 2015).

**Table 3. Port-visit behavior**

	Mean	Standard Deviation
<b>REVISIT INTENTION</b>		
I would visit Valencia again on a cruise trip.	5.84	1.37
I would visit Valencia again as a land tourist.	5.67	1.54
<b>INTENTION TO RECOMMEND</b>		
I would recommend Valencia to my friends and relatives.	6.01	1.27
I would recommend Valencia for a cruise trip to my friends and relatives.	5.96	1.33
I would recommend Valencia as a cruise destination on social media (e.g. Facebook, Twitter, Instagram).	4.69	2.20
I would recommend Valencia as a holiday destination on social media (e.g. Facebook, Twitter, Instagram).	4.69	2.19
I will post photos about Valencia on social media (e.g. Facebook, Twitter, Instagram).	4.48	2.31
I will post positive comments about Valencia on tourist review sites (e.g. Tripadvisor, cruise critics).	4.26	2.37

*Font: own elaboration*

In general, tourists expressed a desire to visit again and to recommend Valencia to their friends and family, both as a tourist destination and a cruise one. However, online recommendation did not score as high (mean below 5) as the traditional “word of mouth”, which may be explained by the interviewees being of a more advanced age and, therefore, less familiar with social media.

### 3.3. Relationship between post-visit perception/behaviour

It is especially relevant not only to know the individualised behaviour on the variables discussed above, but also to understand the relationship between them. To do this, and in response to the nature of the variables analysed, different correlation analyses were performed, obtaining the results shown in Table 4.

Table 4 Correlations: perceptions-post visit intentions

	Authenticity	Human crowding	Spatial crowding
<b>INTENTION TO RETURN</b>			
Pearson's correlation	0.524	0.065	-0.115
Sig (bilateral)	0.000	0.163	0.013
<b>INTENTION TO RECOMMEND</b>			
Pearson's correlation	0.546	0.110	-0.178
Sig (bilateral)	0.000	0.033	0.000

There is a clear relationship between the perception of destination authenticity and behavioural intentions. Thus, the more authentic Valencia is perceived to be, the more likely it is to receive a return visit in the future, and to be recommended to others.

In relation to over-crowding, it is clear that the relationship with behavioural intention varies according to the type of crowding perceived (human or spatial). Thus, cruise tourists who perceive heightened levels of crowding due to reduced space have a weaker intention of returning and recommending Valencia to other people.

However, being in Valencia, whether with many or few people (human crowding) does not seem to affect the intention to return in the future. Nevertheless, the results obtained in relation to the human crowding, and the intention to recommend, are surprising, since a positive relationship between both variables is shown. The fact that a tourist perceives a destination as crowded with many people could influence positively at the moment of it being recommended, and perhaps it is the case in levels of not too serious over-crowding, such as those obtained about Valencia.

#### 4. Conclusions

In relation to perception analysis, this research moves away from the study of more habitual factors such as: the satisfaction, the average expenditure, the motivations or the activities carried out in destination, by offering information on other variables, the study of which is scarce, or non-existent, in relation to cruise tourists.

In general terms, tourists consider Valencia to be an authentic destination, perceived as a port of call with a unique atmosphere, combining perfectly its modernity and history. This fact contributes in a very positive way to reinforce the tourist's post-visit behaviour, since

the greater the authenticity perceived, the more likely is the intention to return, and to recommend Valencia as a tourist and cruise destination.

The values obtained on the perception of over-crowding have not been too high, so it may be concluded that it really does not present a major problem in Valencia city. Despite not being identified as a major problem, it is a variable that requires special attention, since the results have shown that it can affect tourist behaviour both positively and negatively. Thus, it is clear that the lower perception of marked spatial crowding, the higher the intention to return to Valencia, and to recommend it as a port of call. However, the perception of human crowding only seems to influence the intention to recommend the destination and, surprisingly, in a positive way; perhaps this is due to the fact that the level of human crowding tolerated by the tourist was not surpassed.

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**CASTELLANO**



## Estudio histórico y epistemológico de la óptica como base para la enseñanza en 2º de Bachillerato.

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### Resumen

*En este trabajo analizamos los textos originales de los grandes científicos sobre la naturaleza de la luz destacando los avances principales que aportaron, y proponemos una relación entre dichas ideas clave y los estándares de aprendizaje que han de ser adquiridas por nuestros alumnos. A partir de estas ideas clave y teniendo en cuenta los posibles obstáculos asociados, desarrollaremos el estudio de la óptica de manera constructiva, para que tanto los alumnos, como el profesor, aprovechen en mayor medida el proceso de enseñanza-aprendizaje.*

**Palabras Clave:** *óptica, estudio histórico, obstáculo conceptual.*

### 1. Introducción

Hay muchas razones para incorporar la historia de la ciencia en la enseñanza de la física (Galili y Hazan, 2016), incluso puede inspirar estrategias de enseñanza que se pueden utilizar como principio organizador del currículo (Matthews, 1994). En nuestro caso, nos permite establecer las ideas clave que tienen que comprender nuestros alumnos, y nos ayuda a detectar los obstáculos que previsiblemente encontrarán los estudiantes, estableciendo un paralelismo entre sus ideas intuitivas y las mantenidas en algún momento de la historia de la ciencia. El desarrollo histórico de las ideas sobre óptica, y las similitudes entre las ideas de las estudiantes y aquellas de los primeros científicos han sido discutidas previamente (Dedes 2005; Galili 1996; Galili y Hazan 2000).

La hipótesis fundamental de la epistemología genética es que hay un paralelismo entre el progreso realizado en la organización lógica y racional del conocimiento (historia de la ciencia), y el proceso psicológico formativo correspondiente (Piaget, 1975). Es por ello que las normas que el sujeto epistémico elabora en el curso de su génesis, podrían ser



comparables a las normas que son inherentes al pensamiento científico (Piaget y García, 1989). La explicación de cualquier fenómeno ha de buscarse en su propia génesis, lo que confiere un papel muy importante a la historia de la ciencia, tanto en la práctica educativa, como en reflexión sobre la educación.

En este sentido, desde nuestra perspectiva constructivista del aprendizaje, creemos que para comprender bien un concepto hemos de analizarlo desde su origen. Creemos que es muy importante una adecuada adquisición de los conceptos de haz de luz, y rayo de luz para poder comprender la formación de imágenes en la óptica geométrica. Para poder comprender la visión del color consideramos necesario estudiar la naturaleza heterogénea de la luz como solución a las teorías de la modificación. Así mismo, consideramos necesario que los alumnos conozcan que la retina del ojo posee estructuras sensibles a la luz roja, verde y violeta respectivamente, para explicar la visión del color, y que los cambios de curvatura del cristalino tienen como función la acomodación del ojo para la visión de objetos situados a diferentes distancias.

Consideramos el principio de Huygens-Fresnel como base de la explicación de la óptica ondulatoria, así como la necesaria asunción de que la luz se propaga en línea recta y en todas las direcciones en un medio homogéneo, pudiendo producir sombras nítidas, dado que las longitudes de onda de las vibraciones de luz son muy pequeñas comparadas con el tamaño de los objetos visibles. Así mismo consideramos que los alumnos han de comprender que el índice de refracción se explica como la relación entre las velocidades de propagación de las ondas antes y después de la refracción. Por otra parte, han de conocer que la velocidad de la luz que sale de las estrellas es siempre la misma, independientemente de la estrella que la emita, es decir la velocidad de la luz es una constante en nuestro universo. Finalmente creemos que es básico que comprendan que la luz visible es un caso particular de onda electromagnética, es decir es la propagación en el espacio de campos eléctricos y magnéticos perpendiculares.

## **2. Presentación de resultados**

En un estudio previo (Hevia-Artime y Álvarez, 2017), habíamos relacionado dichas ideas con las posibles dificultades que los alumnos pueden encontrar para alcanzar los indicadores de comprensión previstos por dicha ley. A continuación, partiendo de las obras originales (que detallamos) presentamos las ideas clave que han permitido avanzar en el estudio de la óptica física, relacionadas con los criterios de calificación que establece la LOMCE (Ley Órgánica par la Mejora de la Calidad Educativa).



**Tabla 1. Relación entre las ideas claves en la enseñanza de la óptica derivadas del estudio de la obra de los principales científicos y criterios de calificación que establece la LOMCE para la asignatura de Física de 2º de Bachillerato.**

Ideas claves en la enseñanza de la óptica derivadas el estudio de la obra de:	Criterios de calificación que establece la LOMCE para la asignatura de Física de 2º de Bachillerato.
<b>Kepler (Kepler, 1604)</b>	
<p>Concepto de rayo de luz</p> <p>Concepto de haz de luz</p>	<p><b>Bloque 5. Óptica Geométrica</b></p> <ul style="list-style-type: none"> <li>- “Describir los fenómenos luminosos aplicando el concepto de rayo”.</li> <li>- “Explicar en qué consiste la aproximación paraxial”.</li> <li>- “Plantear gráficamente la formación de imágenes en el dioptrio plano y en el dioptrio esférico”.</li> <li>- “Explicar la formación de imágenes en espejos y lentes delgadas trazando correctamente el esquema de rayos correspondiente e indicando las características de las imágenes obtenidas”.</li> <li>- “Explicar el funcionamiento de algunos instrumentos ópticos (lupa, microscopio, telescopio y cámara fotográfica) utilizando sistemáticamente los diagramas de rayos para obtener gráficamente las imágenes”.</li> </ul>
<b>Newton (Newton, 1704)</b>	
<p>La luz “blanca” es de naturaleza heterogénea.</p> <p>La luz no se modifica al interactuar con los objetos.</p>	<p><b>Bloque 4. Ondas</b></p> <ul style="list-style-type: none"> <li>- “Explicar por qué y cómo se perciben los colores de los objetos”.</li> </ul>
<b>Grimaldi (Grimaldi, 1665)</b>	
<p>La luz se propaga no sólo de manera directa, por refracción o por reflexión, sino que existe un cuarto modo, por difracción</p>	<p><b>Bloque 4. Ondas</b></p> <p><b>7. “Reconocer la difracción y las interferencias como fenómenos propios del movimiento ondulatorio”.</b></p>
<b>Hooke (Hooke, 1665)</b>	
<p>La luz se propaga en línea recta y en todas las direcciones en un medio homogéneo.</p> <p>La velocidad de la luz, aunque muy grande, es finita. La luz ha de ser un movimiento de vibración muy rápido y esta vibración ha de ser muy corta.</p>	<p><b>Bloque 5. Óptica geométrica</b></p> <ul style="list-style-type: none"> <li>- “Describir los fenómenos luminosos aplicando el concepto de rayo”.</li> </ul> <p>Germen para el desarrollo de la teoría ondulatoria de Huygens.</p>

<b>Huygens (Huygens, 1690)</b>	
<p>La luz es un movimiento sucesivo impreso a la materia.</p> <p>La luz se propaga mediante ondas esféricas.</p> <p>Todos los puntos de un frente de ondas son centros emisores de ondas secundarias.</p> <p>De todo centro emisor se propagan ondas en todas las direcciones del espacio con velocidad distinta en cada medio.</p> <p>Las ondas se cruzan sin confusión y sin destruirse unas a otras.</p> <p>Cada punto del espacio al que le llega una onda, se comporta él mismo como emisor de una onda esférica.</p>	<p><b>Bloque 4. Ondas</b></p> <ul style="list-style-type: none"> <li>- “Visualizar gráficamente la propagación de las ondas mediante frentes de onda y explicar el fenómeno empleando el principio de Huygens”.</li> <li>- “Reconocer la difracción y las interferencias como fenómenos característicos de las ondas y que las partículas no experimentan”.</li> <li>- “Explicar los fenómenos de interferencia y la difracción a partir del Principio de Huygens”.</li> </ul>
<p>El índice de refracción se explica como la relación entre las velocidades de propagación de las ondas antes y después de la refracción.</p>	<p><b>Bloque 4. Ondas</b></p> <ul style="list-style-type: none"> <li>- “Definir el concepto de índice de refracción e interpretar la refracción como una consecuencia de la modificación en la velocidad de propagación de la luz al cambiar de medio”.</li> </ul>
<b>Malebranche (Ferraz, 1974)</b>	
<p>Explica por primera vez la relación entre los colores y las distintas velocidades de vibración</p>	<p><b>Bloque 4. Ondas</b></p> <ul style="list-style-type: none"> <li>- “Reconocer la dependencia del índice de refracción de un medio con la frecuencia y justificar el fenómeno de la dispersión”.</li> </ul>
<b>Euler (Euler, 1746)</b>	
<p>Introduce la noción de frecuencia de la vibración luminosa para explicar los colores.</p> <p>Atribuye la frecuencia más alta de la vibración luminosa al color violeta, y la más baja al color rojo</p>	<p><b>Bloque 4. Ondas</b></p> <ul style="list-style-type: none"> <li>- “Relacionar la visión de colores con la frecuencia”.</li> <li>- “Explicar por qué y cómo se perciben los colores de los objetos”.</li> </ul>
<p>Considera la luz como una onda elástica sinusoidal que se propaga en el éter.</p> <p>Unifica los fenómenos eléctricos y magnéticos, proponiendo el éter luminoso.</p>	<p>Germen de la teoría de Young y posteriormente Maxwell</p>

<b>Bradley (Bradley, 1728)</b>	
La velocidad de la luz que sale de las estrellas es siempre la misma, independientemente de la estrella que la emita.	<p><b>Bloque 4. Ondas</b></p> <p>- “Conocer el debate histórico sobre la naturaleza de la luz y el triunfo del modelo ondulatorio e indicar razones a favor y en contra del modelo corpuscular”.</p>
<b>Malus (Malus, 1810)</b>	
La doble refracción no era el único modo de polarizar la luz. La luz reflejada también podía tener “lados”.	<p><b>Bloque 4. Ondas</b></p> <p><b>15. “Comprender las características y propiedades de las ondas electromagnéticas, como su longitud de onda, polarización o energía, en fenómenos de la vida cotidiana”.</b></p>
<b>Young (Young, 1802)</b>	
La retina del ojo posee estructuras sensibles a la luz roja, verde y violeta respectivamente.	<p><b>Bloque 4. Ondas</b></p> <p>- “Relacionar la visión de colores con la frecuencia”.</p> <p>- “Explicar por qué y cómo se perciben los colores de los objetos”.</p>
Los cambios de curvatura del cristalino tienen como función la acomodación del ojo para la visión de objetos situados a diferentes distancias.	<p><b>Bloque 5. Óptica Geométrica</b></p> <p>- “Describir el funcionamiento óptico del ojo humano”.</p>
<p>Dos ondas de luz que se superponen pueden interferir la una con la otra.</p> <p>La luz viaja en línea recta, pudiendo producir sombras nítidas, dado que las longitudes de onda de las vibraciones de luz son muy pequeñas comparadas con el tamaño de los objetos visibles.</p>	<p><b>Bloque 4. Ondas</b></p> <p>- “Conocer el debate histórico sobre la naturaleza de la luz y el triunfo del modelo ondulatorio e indicar razones a favor y en contra del modelo corpuscular”.</p> <p>- “Explicar fenómenos cotidianos (los espejismos, el arco iris, el color azul del cielo, los patrones en forma de estrella que se obtienen en algunas fotografías de fuentes de luz, entre otros) como efectos de la reflexión, difracción e interferencia”.</p> <p>- “Reconocer la difracción y las interferencias como fenómenos característicos de las ondas y que las partículas no experimentan”.</p>
<b>Young – Fresnell</b>	
<p>Las ondas de luz son periódicas y el color es función de la longitud de onda.</p> <p>La luz es una onda de naturaleza transversal</p>	Germen de la teoría de Maxwell



<b>Fresnell (Fresnell, 1827)</b>	
Principio de Huygens-Fresnell	<p><b>Bloque 5. Óptica Geométrica</b></p> <ul style="list-style-type: none"> <li>- “Explicar en qué consiste la aproximación paraxial”.</li> </ul>
Explicación de la difracción	<p><b>Bloque 4. Ondas</b></p> <ul style="list-style-type: none"> <li>- “Reconocer la difracción y las interferencias como fenómenos característicos de las ondas y que las partículas no experimentan”.</li> <li>- “Explicar los fenómenos de interferencia y la difracción a partir del Principio de Huygens”.</li> </ul>
Explicación de la dispersión de la luz	<p><b>Bloque 4. Ondas</b></p> <ul style="list-style-type: none"> <li>- “Reconocer la dependencia del índice de refracción de un medio con la frecuencia y justificar el fenómeno de la dispersión”.</li> </ul>
<b>Maxwell (Maxwell, 1865)</b>	
<p>La luz visible es un caso particular de onda electromagnética.</p> <p>Explica matemáticamente las ondas electromagnéticas como la propagación de campos eléctricos y magnéticos perpendiculares</p> <p>Explicar matemáticamente la dispersión de la luz al atravesar un prisma.</p> <p>Relaciona la velocidad de la luz con las constantes eléctrica y magnética</p>	<p><b>Bloque 4. Ondas</b></p> <ul style="list-style-type: none"> <li>- “Identificar las ondas electromagnéticas como la propagación de campos eléctricos y magnéticos perpendiculares”.</li> <li>- “Reconocer las características de una onda electromagnética polarizada y explicar gráficamente el mecanismo de actuación de los materiales polarizadores”.</li> <li>- “Relacionar la velocidad de la luz con las constantes eléctrica y magnética”.</li> <li>- “Identificar las ondas electromagnéticas que nos rodean y valorar sus efectos en función de su longitud de onda y energía”.</li> <li>- “Describir el espectro electromagnético, ordenando los rangos en función de la frecuencia, particularmente el infrarrojo, el espectro visible y el ultravioleta, identificando la longitud de onda asociada al rango visible (alrededor de 500 nm)”.</li> <li>- “Evaluar la relación entre la energía transferida por una onda y su situación en el espectro electromagnético”.</li> </ul>

<b>Hertz</b>	
<p>Producir por primera vez en el laboratorio radiación electromagnética</p> <p>Descubrir un detector capaz de detectar dichas ondas.</p> <p>Las ondas electromagnéticas se reflejaban, se refractaban y podían difractarse y polarizarse como las ondas de luz, viajando en línea recta con una velocidad que era del mismo orden que la velocidad de la luz.</p>	<ul style="list-style-type: none"> <li>- “Explicar cómo se generan las ondas de la radiofrecuencia”.</li> <li>- “Reconocer la importancia de las ondas electromagnéticas en las telecomunicaciones (radio, telefonía móvil, etc.)”.</li> <li>- “Identificar distintos soportes o medios de transmisión (los sistemas de comunicación inalámbricos o la fibra óptica y los cables coaxiales, entre otros) y explicar de forma esquemática su funcionamiento”.</li> </ul>

### 3. Análisis y discusión de resultados.

Nuestro análisis histórico de las obras de los principales autores sobre la naturaleza de la luz, en busca de un paralelismo entre el desarrollo de las diferentes teorías y la construcción de los conceptos que realizan los estudiantes durante el aprendizaje de la óptica geométrica y ondulatoria, nos ha permitido encontrar las ideas clave que hemos de lograr que comprendan nuestros alumnos. En este trabajo hemos mostrado su relación con los criterios de evaluación planteados en el marco de la actual ley educativa, en base a los cuales los alumnos serán evaluados. Hemos comprobado como efectivamente, las ideas que nosotros consideramos clave en el desarrollo de la óptica, y que mostramos destacadas para cada autor en el cuadro anterior, son la base de los criterios de calificación, y por tanto han de ser adquiridas por nuestros alumnos, y en base a ellas ha desarrollarse la práctica educativa.

### 4. Conclusiones

A partir de estas ideas clave en la enseñanza de la óptica, teniendo en cuenta los posibles obstáculos asociados, se puede desarrollar el estudio de la óptica de manera constructiva, para que tanto los alumnos, como el profesor, aprovechen en mayor medida el proceso de enseñanza-aprendizaje. Hemos de basar nuestra enseñanza en la adquisición de dichas ideas por parte de los alumnos.

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## La sostenibilidad en las universidades públicas valencianas: una comparativa cronológica y con otros campus españoles

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### Resumen

*El papel que juega la universidad en la sociedad podría cuantificarse mediante los estudios de indicadores de sostenibilidad. Tanto en el ámbito nacional como internacional se están redefiniendo las estrategias de implementación de líneas de sostenibilidad a partir de programas y redes internacionales como: “Sustainable Development Solutions Network” (Naciones Unidas), The International Sustainable Campus Network, the Association for the Advancement of Sustainability in Higher Education (EEUU) o the Environmental Association for Universities and Colleges (Reino Unido). En España existe la comisión denominada “CRUE-Sostenibilidad” donde se desarrolla la temática de la calidad ambiental y desarrollo sostenible en las universidades españolas. Dicha comisión ha creado una herramienta orientada a realizar un diagnóstico sobre la sostenibilidad ambiental en la universidad española.*

*Actualmente se están desarrollando, a un ritmo significativo medidas sobre sostenibilidad, haciendo necesaria su evaluación a través de herramientas concretas. El análisis que se presenta en el artículo utiliza el ranking UI GreenMetric desarrollado por la Universidad de Indonesia. En este ámbito, el objetivo del artículo es analizar los indicadores de sostenibilidad de las universidades públicas pertenecientes a la Comunidad Valenciana. Desde una perspectiva temporal, se posicionarán a los centros valencianos en el crecimiento de los indicadores en comparación con la evolución de otras universidades españolas durante el periodo 2017-2018. Además, se desarrollaran las estrategias a seguir en materia de sostenibilidad comparando el plan de actuación de unas universidades con otras. Todo ello permitirá poner en conocimiento el grado de compromiso y responsabilidad que tienen las universidades con el fin de cumplir los objetivos de desarrollo sostenible.*



**Palabras clave:** *UI GreenMetric, Universidad publicas valencianas, sostenibilidad*

## **1. Introducción**

La gran actividad existente en los campus universitarios, junto con la creciente preocupación por el cambio climático ha derivado en la necesidad de analizar su impacto medioambiental, para poder mitigar los efectos adversos. En esta línea, se han desarrollado índices con la finalidad de cuantificar la contribución de estas instituciones, como Green League 2007 o Environmental and Social Responsibility Index 2009 (Grindsted, 2011). Sin embargo, estos índices no han tenido la trascendencia que se esperaba, de ahí que Univesitas Indonesia (UI) desarrolló en 2010 un ranking “green” a nivel mundial de las universidades con objeto de valorar su implicación en todos los aspectos de la sostenibilidad, denominado UI GreenMetric. Dicho ranking ha sido utilizado como instrumento de apoyo al desarrollo sostenible de los centros de educación superior, tal y como muestran los trabajos de Suwartha y Sari (2017) y Sonetti et al (2016), concretamente éste último realiza una comparativa entre una universidad italiana y otra japonesa. Más recientemente, Drahein et al (2019) utiliza el UI GreenMetric para analizar la sostenibilidad en las universidades brasileñas, mientras que Parvez y Agrawal (2019) lo hacen sobre los centros de educación superior de India.

Actualmente están aflorando una gran diversidad de instrumentos con objeto de medir la sostenibilidad, haciendo necesaria su evaluación mediante de herramientas concretas. En este ámbito, el objetivo del artículo es analizar los indicadores de sostenibilidad de las universidades públicas pertenecientes a la Comunidad Valenciana a partir del ranking UI GreenMetric. Desde una perspectiva temporal, se trata de posicionar los campus valencianos en el crecimiento de los indicadores, realizando una comparativa con la evolución de otras universidades españolas durante el periodo 2017-2018. Además, se analizarán las estrategias a seguir en materia de sostenibilidad contrastando el plan de actuación de los distintos campus. Todo ello permitirá poner en conocimiento el grado de compromiso y responsabilidad que tienen los centros de educación superior en el cumplimiento de los objetivos de desarrollo sostenible.

El resto del artículo se estructura de la siguiente forma. En la sección 2 se desarrolla la metodología aplicada por el ranking UI GreenMetric. En la sección 3 se compara la evolución temporal de las universidades españolas según los indicadores ambientales. En la sección 4 se analizan en profundidad los centros valencianos según cada uno de los componentes del UI GreenMetric. En la sección 5 se explican los planes estratégicos en



materia ambiental de cada universidad. Por último, en la sección 6 se resumen las principales conclusiones.

## 2. Metodología. Ranking UI GreenMetric

UI GreenMetric World University Rankings fue iniciado en 2010 por Universitas Indonesia (UI) con el objetivo de poder valorar las políticas de sostenibilidad de las universidades. En 2017 se han evaluado 619 universidades repartidas por más de 76 países contemplando el marco conceptual de medio ambiente, economía y equidad, llegando a 718 en 2018. El ranking este compuesto por distintos indicadores ponderados según relevancia:

- Infraestructuras: aporta información sobre la política de ambiental seguido por el centro. (ponderación del 15 %)
- Energía y cambio climático: explora sobre aplicación de energías renovables y eficientes en los edificios universitarios, (ponderación del 21%).
- Reciclaje: mide los programas y tratamientos de residuos implantados en los campus.
- Agua: evalúa el consumo de agua, así como los programas de conservación y protección del hábitat.
- Transporte: valora las políticas de transporte referentes a la limitación de vehículos en el campus, el fomento del servicio público y la bicicleta
- Educación e investigación: estima el papel de la universidad como centro de aprendizaje de la sociedad en temas de sostenibilidad.

Estos cuatro últimos indicadores tienen todos ellos un peso del 18% en el índice global.

## 3. Evolución temporal de las universidades españolas según los indicadores ambientales

En España, desde el 2007, un grupo de universidades trabaja en la evaluación de los campus y han establecido indicadores para determinar su aporte a la sostenibilidad. Sus resultados parciales son recogidos en el estudio de Alba et al (2012) donde concluyen que la gestión de residuos es la actuación con mayor avance entre los centros españoles. En este artículo se propone analizar el UI GreenMetric explicado en la sección 2. A continuación,

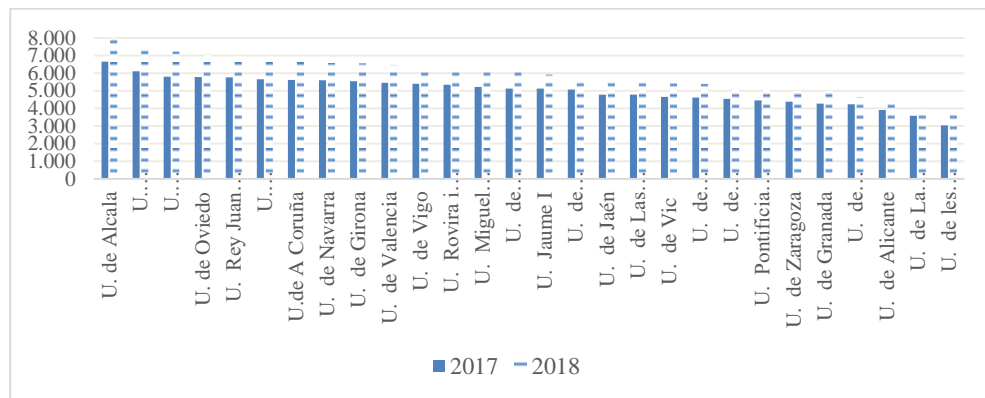




en el Gráfico 1 se exponen los valores de la puntuación global obtenida por las 28 universidades españolas que han participado en el UI GreenMetric en 2017 y 2018.

Los resultados reflejan una creciente implicación de todas las universidades analizadas, con crecimientos comprendidos entre el 25,37% de la universidad de les Illes Balears y el 9,92% del campus de Valladolid. Se confirma que las políticas de sostenibilidad aplicadas en España están teniendo una gran acogida en los centros de educación superior, otorgándoles una mayor competitividad tanto a nivel nacional como internacional. La Universidad de Alcalá, es la que ocupa la primera posición, cuenta con un Programa de Calidad Ambiental, un Plan integral de sostenibilidad y una Oficina de Participación, Análisis e Iniciativas Ambientales (Ecocampus); En segundo lugar, la Universidad Autónoma de Barcelona es reconocida por su innovación en la infraestructura con el uso de “piel bioclimática”, que controla la temperatura interna de los edificios y reduce hasta un 62% el consumo de energía. Seguidamente, cabe destacar la tercera posición de la Universidad Autónoma de Madrid, la cual es líder por su relación de cursos y asignaturas sobre sostenibilidad, publicaciones y eventos relacionados con el medio ambiente y la cantidad de organizaciones estudiantiles que se dedican a garantizar el cuidado del entorno. En su conjunto, se puede valorar positivamente todas las actuaciones en materia de sostenibilidad que están llevando a cabo los centros de educación superior, permitiendo mejorar los valores de ranking UI GreenMetric en un 17,79% en media entre todas las universidades españolas.

**Gráfico 1. Resultado global del UI GreenMetric por universidades (2017-2018)**

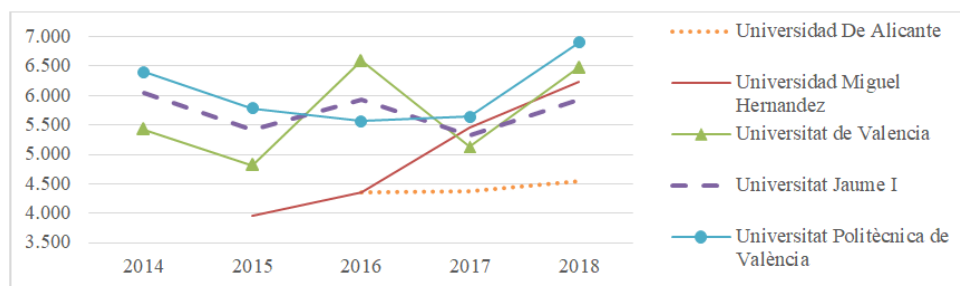


Fuente: Elaboración propia a partir de datos de UI GreenMetric

#### 4. Análisis de la sostenibilidad en las universidades valencianas

Los centros de educación superior valencianos van tomando posiciones relevantes en los temas de sostenibilidad, siendo sus prácticas fructíferas a través del reconocimiento otorgado por los rankings internacionales. Siguiendo con los objetivos de la investigación, en el Gráfico 2 se muestra el comportamiento de los 5 centros valencianos en el ranking UI GreenMetric en el periodo 2014-2018.

**Gráfico 2. Evolución temporal del resultado global del UI GreenMetric en universidades públicas valencianas**



Fuente: Elaboración propia a partir de datos de UI GreenMetric

La Universitat Politècnica de València (UPV) ha liderado la primera posición del ranking en todo el periodo analizado a excepción de 2016 (Gráfico 2). Se trata de un centro donde destaca la Red de Voluntarios UPV, un Máster Universitario en Cooperación al Desarrollo de esta institución, jornadas, encuentros y congresos vinculados a la Agenda 2030, así como la apuesta de la universidad por incluir los valores de los ODS en su plan estratégico. En segundo lugar, ocupando la posición 112 del ranking, se encuentra la Universitat de València (UV). Se trata de un campus que ha decidido incluir la sostenibilidad como un eje fundamental de su estrategia, impulsando iniciativas para un desarrollo sostenible en todos los ámbitos que le corresponden. En tercer lugar, aunque algunos años ocupaba la segunda posición, la Universidad Jaume I también presenta buenos resultados en el ranking UI GreenMetric (posición 154). Este centro cuenta con una Oficina de Prevención y Gestión Medioambiental. El resto de universidades valencianas situadas fuera de la provincia de Valencia tienen unos valores de sostenibilidad menores pero con tendencia creciente en 2017 y 2018.

A continuación, en la Tabla 1 se analizan los componentes del UI GreenMetric para las cinco universidades valencianas analizadas en esta sección. El análisis por componentes indica que tanto el factor residuos como el de educación están liderados todos los años por una misma universidad, la UPV y la UV, respectivamente. En el caso de los residuos, el

reconocimiento está avalado por las políticas de sostenibilidad y compromiso con el medio ambiente de la UPV, suponiendo un nuevo impulso para una universidad que no solo se preocupa por la búsqueda de la excelencia formativa, sino que además promueve valores y condiciones fundamentales para el presente y el futuro de la humanidad. Por otra parte, en el componente de educación ambiental la UV destaca por sus cursos y masters en materia de sostenibilidad, así como las conclusiones obtenidas en las investigaciones realizadas por el denominado “Grupo de Investigación sobre Sostenibilidad y Educación Superior”.

**Tabla 1. Componentes del ranking UI GreenMetric para las universidades valencianas**

	Situación e infraestructura	Energía y cambio climático	Residuos	Agua	Transporte	Educación e investigación
<b>2018</b>						
UPV	700	1200	1650	525	1175	1650
UV	825	975	1425	500	950	1800
UA	250	800	1275	525	775	925
UJI	1150	1000	1125	575	1125	950
UMA	775	1275	1200	775	950	1250
<b>2017</b>						
UPV	633	1175	1701	383	913	835
UV	640	895	1476	475	613	1030
UA	396	671	1425	407	913	559
UJI	834	958	1203	650	1012	675
UMA	738	1224	1551	660	713	561
<b>2016</b>						
UPV	215	1093	1551	400	1167	1138
UV	751	1031	1476	775	965	1596
UA	171	682	1275	407	977	839
UJI	919	870	1326	775	976	1071
UMA	820	567	1224	10	913	827
<b>2015</b>						
UPV	356	1550	1725	700	762	689
UV	532	1025	1575	475	163	1047
UA	-	-	-	-	-	-
UJI	420	875	1725	675	831	891
UMA	535	575	1200	438	527	684
<b>2014</b>						
UPV	397	1645	1725	750	1350	529
UV	565	1545	1500	625	400	786
UA	-	-	-	-	-	-
UJI	232	1385	1725	1000	925	779
UMA	-	-	-	-	-	-

Nota: UPV: Universitat Politècnica de València; UV: Universitat de València; UA: Universidad de Alicante; UJI: Universidad Jaime I, UMA: Universidad Migue Hernandez

Fuente: Elaboración propia a partir de datos de UI GreenMetric



Los otros tres componentes no muestran la uniformidad anterior. En el factor transporte la UPV lidera 3 años y la Universidad Jaime I de Castellón el resto, en energía nuevamente la UPV obtiene mayor puntuación durante 4 años mientras que la Universidad Miguel Hernández tan sólo en 2017. La gestión del agua es el componente con un liderazgo más diversificado, se van alternando unos centros y otros siendo de nuevo la Universidad Miguel Hernández líder los dos últimos años analizados. Por último, en infraestructuras ha sido la universidad castellanense la que ha liderado dicho factor durante 3 años.

## 5. Plan de actuación en materia de sostenibilidad de las universidades valencianas

El plan de actuación constituye la mejora que deben realizar las universidades valencianas para llegar a ser más sostenibles a nivel internacional. Siguiendo con la herramienta básica del ranking UI GreenMetric se puede cuantificar el plan de actuación en materia de sostenibilidad de la siguiente forma.

Si se tiene en cuenta que el valor máximo del resultado del ranking UI GreenMetric es de 10.000 puntos, el recorrido de mejora es calculado como:

$$\text{Recorrido de mejora} = \frac{(10000 - \text{valor ranking}(i,t))}{\text{valor ranking}(i,t)} \times 100 \quad (1)$$

Donde “*valor ranking (i,t)*” es la posición que ocupa la universidad “i” en el momento “t”. De esta forma el valor del recorrido de mejora está comprendido entre 0 y 100, donde los valores menores representan universidades con un recorrido menor porque están más implicadas en todos los aspectos de la sostenibilidad. A continuación, a partir de los datos facilitados por UI GreenMetric, se han calculado los recorridos de mejora de 2017 y 2018 de las universidades valencianas (Tabla 2).

Los resultados muestran el gran esfuerzo realizado el último año por todos los campus valencianos, el recorrido de mejora de todos ellos ha disminuido significativamente. En primera posición se encuentra la UPV con un recorrido de 44,9%, lo que implica necesita mejorar un 45% para ocupar los primeros del ranking UI GreenMetric. En el extremo se encuentra la UA, que a pesar de los esfuerzos realizados el último año, debe más que duplicar sus esfuerzos para llegar a dicho objetivo. En definitiva, se puede afirmar que los centros valencianos están cada vez más implicados en todos los aspectos de la

sostenibilidad, siendo latente su empeño en mejorar e ir escalando posiciones en los rankings internacionales.

**Tabla 2. Evolución del recorrido de mejora de las universidades valencianas**

	Recorrido mejora 2017	Recorrido mejora 2018
UPV	77,3%	44,9%
UV	83,6%	54,4%
UMH	92,0%	60,6%
UJI	95,3%	68,8%
UA	155,8%	119,8%

Fuente: Elaboración propia

## 6. Conclusiones

Los centros de educación superior están aportando su granito de arena para crear un mundo más respetuoso con el medio ambiente y reducir la huella ecológica de los consumidores, destacando algunos de ellos por sus iniciativas y logros. En este artículo se ha tratado de realizar un análisis comparativo entre las universidades españolas, haciendo especial referencia a los ubicados en la Comunidad Valenciana. El ranking UI GreenMetric publicado por la Universidad de Indonesia ha sido la herramienta base en la realización de la investigación. Según el Grupo de trabajo sobre Evaluación de la Sostenibilidad Universitaria perteneciente a la CRUE (2018), todos los campus tienen responsables políticos en materia de medio ambiente y se ha alcanzado un control de los aspectos ambientales, agua, energía y residuos, existiendo una falta sistemática de la implementación de acciones de mejora para los mismos. En este artículo también se ha constatado que las universidades valencianas han sabido liderar su gestión de energía, agua, residuos, educación e infraestructura en algún momento del tiempo.

Sin embargo, el plan de actuación de los centros valencianos debe estar enfocado a mejorar todos los aspectos de la sostenibilidad, siendo la UA la que mayores esfuerzos debe hacer. En el otro extremo se encuentra la UPV, se trata de la universidad valenciana mejor valorada por el UI GreenMetric 2018, teniendo menor recorrido de mejora que el resto de campus valencianos para ocupar puestos relevantes a nivel internacional.

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## Lecciones aprendidas a partir de la experiencia de la aplicación del aprendizaje basado en proyectos en el Grado en Ingeniería Química de la UPV

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### Resumen

*El aprendizaje basado en proyectos (ABP) es una metodología docente consistente en proponer un proyecto con solución abierta que los alumnos deben resolver. Para ello, deben adquirir una mayor responsabilidad de su propio aprendizaje, reflexionando y adoptando decisiones en el grupo para resolver el proyecto. Con esta metodología se logra un aprendizaje integrador y el desarrollo de competencias tales como trabajo en grupo o gestión del tiempo, útiles en su profesión. Un grupo de profesores, llevamos desde el curso 2004-2005 aplicando esta metodología en asignaturas experimentales obligatorias de Ingeniería Química en la UPV a través del desarrollo de un proyecto de diseño. La implantación del EEES, supuso la adaptación del ABP para su desarrollo en la asignatura de Experimentación en Ingeniería Química III de Grado. Este trabajo relata el planteamiento para la implementación de esta metodología, así como las dificultades encontradas y las lecciones aprendidas, fruto de la experiencia adquirida en tres cursos académicos. Para ello, se analizarán los datos recogidos a través de encuestas anónimas realizadas a los alumnos, así como las conclusiones de las reuniones de “focus group” realizadas. Las conclusiones obtenidas servirán para mejorar la aplicación de esta metodología en los próximos cursos académicos y de guía para otras asignaturas de la titulación.*

**Palabras clave:** ABP, ingeniería química, proyecto, experimentación, diseño





## **1. Introducción**

El Ingeniero Químico se pretende que sea un profesional con amplios conocimientos en la rama de la Química y al mismo tiempo con capacidad para concebir, proyectar y controlar las industrias de proceso y todos aquellos elementos que las componen. De acuerdo con ello, su formación debe comprender tanto la adquisición de conocimientos como la puesta en práctica de los mismos. Asimismo, un ingeniero debe ser capaz de resolver problemas reales, lo que supone realizar un estudio cuantitativo lo más exacto posible de los parámetros implicados en el mismo, a lo que contribuye la experimentación. Por ello, tradicionalmente, los planes de estudio del ingeniero químico han incluido una parte importante de experiencia práctica en laboratorio, la cual es esencial para entender los fundamentos de la Ingeniería química (Peñas et al., 2006).

A raíz de la adaptación de las universidades españolas al Espacio Europeo de Educación Superior, las titulaciones de Ingeniería Química existentes se transformaron en las actuales titulaciones de Grado y Máster en Ingeniería Química, dando continuidad al planteamiento inicial establecido en relación a la experimentación, existiendo asignaturas específicas como materia obligatoria. El análisis de los planes de estudio actualmente vigentes de Grado muestran al menos dos asignaturas cuatrimestrales de 6 créditos ECTS que se imparten entre el segundo y cuarto curso de todos los planes de estudios. En el caso de la UPV, la titulación de Ingeniería Química anterior al Grado contenía cuatro asignaturas obligatorias de experimentación en las que se realizaban prácticas de laboratorio por grupos. En la última de esas asignaturas, a partir del curso 2004-2005, se llevó a cabo la implantación de la metodología del ABP, (Sancho et al., 2007; Sancho et al., 2009) lo que permitió relacionar las prácticas realizadas a través de un proyecto de diseño de una instalación industrial, con excelentes resultados (Arnal et al., 2012).

El ABP es una metodología de enseñanza-aprendizaje que se basa en plantear a los alumnos la realización de un proyecto, definido como un problema complejo de solución abierta, en el que es necesario la investigación, la reflexión y la toma de decisiones para su resolución (Blumenfeld et al., 1991). El profesor actúa como guía en el proceso y no como principal fuente de información. Esta metodología proporciona a los alumnos la oportunidad de realizar un proyecto en un entorno de trabajo simulado (Kuntalp et al., 2010), lo que mejora su motivación al ver que el resultado final es un proyecto real. Además, facilita un aprendizaje autónomo e integrador, y el desarrollo de habilidades y destrezas tales como el trabajo en grupo, gestión de la información, pensamiento creativo o la toma de decisiones (De Miguel, 2005).

Con la adaptación de la titulación al proceso de Bolonia, el número de asignaturas experimentales en el Grado se redujo a tres. A pesar de ello, se decidió trasladar el planteamiento de la metodología ABP a la última asignatura experimental de la titulación, “Experimentación en Ingeniería Química III” (Sancho et al., 2017). Este trabajo recoge el análisis de los resultados obtenidos tras la aplicación de la metodología en la asignatura a lo largo de tres cursos académicos y describe las estrategias adoptadas para continuar mejorando su implementación en los próximos cursos.

## 2. Innovación metodológica

Experimentación en Ingeniería Química III es una asignatura experimental de tercer curso cuatrimestre B de 4,5 créditos ECTS y es la última de las asignaturas experimentales del Grado en Ingeniería Química de la UPV.

La aplicación de la metodología del ABP se realiza en la Unidad Didáctica 1, que tiene por título “Diseño de un proceso industrial” y una duración de 10 semanas. En ella, los alumnos realizan prácticas de laboratorio que están relacionadas con las etapas del proceso productivo a diseñar, estudiando las variables que afectan a éste y recogiendo datos que se utilizarán posteriormente en el proyecto. En cada sesión, el alumno realiza un informe diario a modo de trabajo académico, pudiendo de esta forma dedicar el tiempo fuera del aula al desarrollo del proyecto. La elaboración del informe en el laboratorio es una metodología nueva para los alumnos, dado que en las asignaturas previas de experimentación, el informe se realiza mayoritariamente tras la finalización de la práctica. Para la resolución de las dudas del proyecto y obtención de feed-back sobre el desarrollo del mismo, los alumnos pueden consultar a los profesores concertando sesiones de tutorías. No obstante, en la planificación de la asignatura se incluye una sesión de tutorías grupal (semana 6) con el fin de tener al menos un punto de control de desarrollo del trabajo a lo largo del semestre. Finalmente, en la semana 10 se incluye una sesión para la defensa oral del proyecto. Las sesiones que incluye esta unidad y su relación con el proyecto se muestran en la Fig. 1.

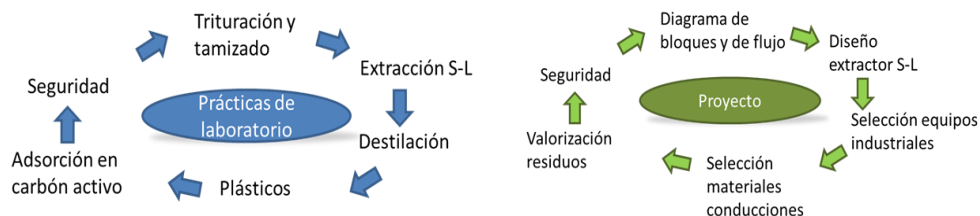


Fig. 1. Diagrama de relación de las prácticas de laboratorio con el proyecto de diseño

La evaluación de la asignatura se realiza a través de los informes diarios de cada práctica realizados en el laboratorio (20 % de la nota final), el proyecto de diseño (30 %), el examen oral (10 %), que consiste en la presentación del proyecto, y el examen (10 %). El 30 % restante corresponde a la unidad didáctica 2.

### 3. Objetivo

El objetivo de este trabajo es analizar la implementación del ABP en una asignatura experimental de GIQ y proporcionar recomendaciones para el éxito de su aplicación en el desarrollo de un proyecto de diseño.

### 4. Metodología

Para analizar la implementación del ABP en la asignatura en los tres últimos cursos (con un número de alumnos matriculados entre 64 y 81) se han utilizado distintas herramientas:

**-Recopilación de la opinión del alumnado sobre la metodología implementada (contenidos, trabajo académico y tutorías):** a través de una encuesta de opinión anónima de 7 preguntas (ver Tabla 1.1), con una escala de Likert de 4 niveles (A: Totalmente de acuerdo, B: Parcialmente de acuerdo, C: Parcialmente en desacuerdo, D: Totalmente en desacuerdo).

**-Recopilación y procesado de las respuestas obtenidas en las reuniones de grupo.** Cuando se han percibido desviaciones en el desarrollo de la asignatura, se han realizado reuniones de “focus group”, entre los profesores y un representante de cada grupo de trabajo, para tratar diferentes aspectos sobre la asignatura.

**Tabla 1.1. Preguntas de la encuesta de opinión sobre la metodología ABP implementada**

<b>CONTENIDOS</b>
1-Los contenidos tratados son de aplicación profesional
2-La asignatura permite relacionar y aplicar conocimientos de otras asignaturas
3-El número y tipo de prácticas de laboratorio han sido útiles para la realización del proyecto
<b>TRABAJO ACADÉMICO: INFORMES DE PRÁCTICAS</b>
4-La realización de los informes durante la sesión de laboratorio mejora la calidad de los mismos
5-Realizar los informes en el laboratorio supone una descarga de trabajo significativa
<b>TUTORÍAS</b>
6-Las tutorías han sido útiles para orientar la organización del proyecto y analizar la progresión a lo largo del cuatrimestre
7-Considero que las sesiones de tutoría son indispensables para el desarrollo del proyecto con éxito

## 5. Resultados y análisis

### 5.1 Análisis del nivel de satisfacción de los estudiantes

Se analizará el nivel de satisfacción de los estudiantes con los contenidos impartidos, con la metodología de realización de informes en el laboratorio y con las tutorías.

#### 5.1.1 Contenidos

En primer lugar se muestran los resultados sobre la opinión de los estudiantes al respecto de la selección de contenidos de la asignatura y su relación con el proyecto a desarrollar. En la Fig. 2 se muestran los resultados para cada curso académico (16-17, 17-18 y 18-19) y la pregunta que corresponde (preguntas 1, 2 y 3). Como se observa, en todos los cursos académicos la suma de las respuestas de total (A) y parcialmente de acuerdo (B) es superior al 90 %, en todas las preguntas planteadas. Por ello, se deduce que los alumnos están muy satisfechos con los contenidos de la asignatura porque: son de aplicación en su futuro profesional (pregunta 1); están relacionados con otras asignaturas de la titulación (pregunta 2); y, tal y como se desarrollan en las prácticas de laboratorio, ayudan al desarrollo del proyecto final (pregunta 3).

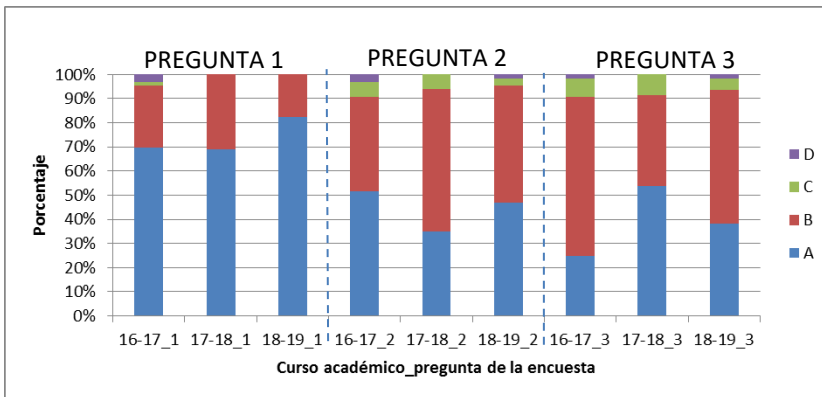


Fig. 2 Nivel de satisfacción con los contenidos de la asignatura

#### 5.1.2 Informes de laboratorio

Respecto a los informes de laboratorio, los resultados se muestran en la Fig. 3.

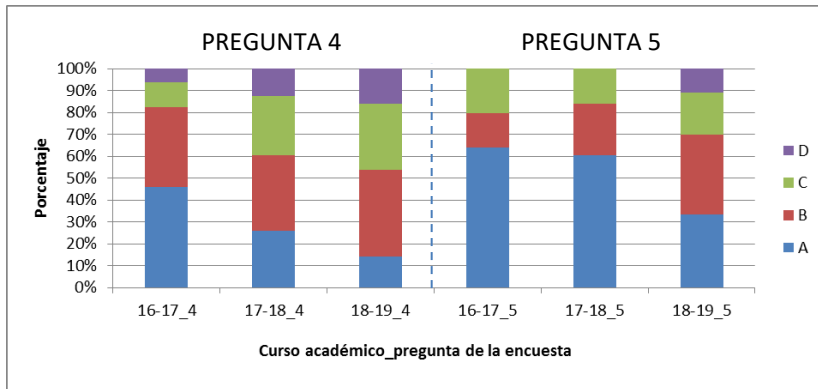


Fig. 3 Nivel de satisfacción con la metodología de realización de los informes de laboratorio

La opinión de los alumnos respecto del cambio de metodología que supone realizar los informes en el laboratorio muestra que el nivel de satisfacción es medio, ya que al menos el 50 % de los alumnos están total o parcialmente de acuerdo en considerar que esta metodología ayuda a mejorar la calidad de los informes respecto a realizarlos fuera del laboratorio (pregunta 4).

Respecto a si realizar el informe en el laboratorio supone una descarga de trabajo fuera del aula (pregunta 5), la opinión de los alumnos es similar en los cursos 16-17 y 17-18 con, al menos, un 80 % de los alumnos total y parcialmente de acuerdo, y un 70 % en el curso 18-19. En este curso se observa que el porcentaje de alumnos totalmente de acuerdo y parcialmente de acuerdo disminuye un 10 % y se incrementa en esa misma proporción en alumnos que están totalmente en desacuerdo.

Se debe tener en cuenta que los alumnos del curso 2016-2017 habían realizado informes en el laboratorio en la asignatura de experimentación previa (en al menos dos prácticas), por lo que habían tenido la oportunidad de practicar este tipo de metodología, y por ello valoran positivamente la ventaja que supone. Los alumnos del curso 2017-2018 solo lo habían practicado en una sesión de laboratorio de la asignatura de experimentación previa y los alumnos del curso 2018-2019 es la primera vez que realizan los informes en el laboratorio, por lo que no están habituados a esta metodología. Por ello, esto puede suponerles más esfuerzo y lo valoran en consecuencia más negativamente. Este resultado provocó la reunión de “focus-group” con los alumnos del curso 2018-2019 con el fin de conocer con mayor detalle su opinión a este respecto.

### 5.1.3 Tutorías

Respecto a la utilidad de las tutorías para la organización del trabajo y el desarrollo del proyecto, los resultados de valoración se muestran en la Fig. 4. En ella se observa que hay una valoración positiva o muy positiva en el 90 % de los casos.

En concreto se observa que:

-La utilidad de las tutorías (pregunta 6) ha sido valorada muy positivamente por los alumnos. Al menos un 65 % de los alumnos lo valoran muy positivamente (A), y entre positivo y muy positivamente (A y B) un 85 % de los alumnos. No obstante, destaca el incremento del 10 % de los alumnos que están parcialmente en desacuerdo con la utilidad de los tutorías en el curso académico 2018-2019.

-La necesidad de asistir a tutorías como herramienta indispensable para poder desarrollar el proyecto (pregunta 7) ha sido valorada en conjunto como muy necesaria (A) o necesaria (B) para el 95 % de los alumnos, si bien es verdad que la opinión ha ido empeorando a medida que transcurren los cursos académicos, observándose un incremento del triple de alumnos que han pasado de muy satisfechos a parcialmente satisfechos del curso 2016-2017 al actual.

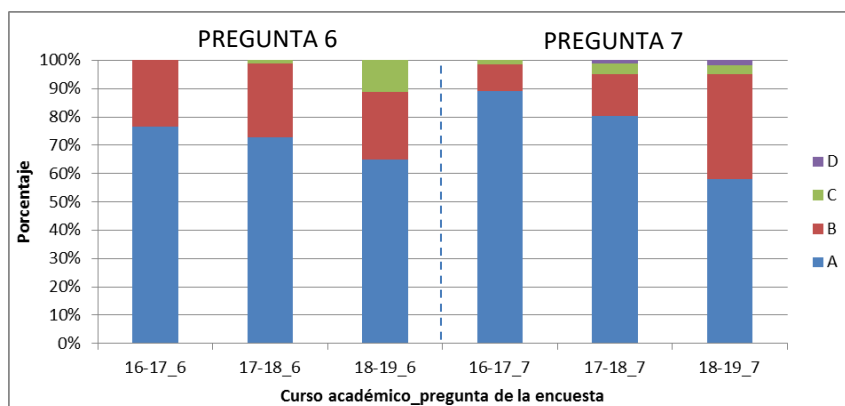


Fig. 4 Nivel de satisfacción con las tutorías

Por tanto, se observa una tendencia a la reducción de la satisfacción de las tutorías para la elaboración del proyecto en el último curso académico. Este empeoramiento ha sido objeto de análisis en las reuniones de “focus-group”, que han dado lugar a las conclusiones que se describen en el siguiente apartado y a analizar el uso de esta herramienta.

El gráfico de la Fig. 5 muestra la distribución de tutorías a lo largo del cuatrimestre y el número de tutorías por grupo en media.

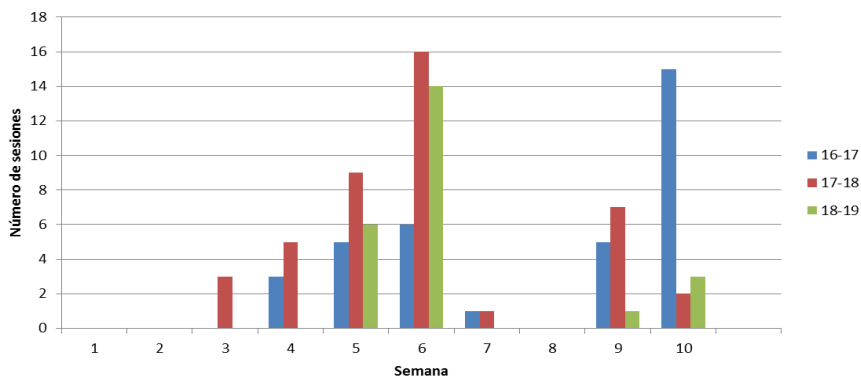


Fig. 5 Distribución de las tutorías a lo largo del cuatrimestre

En el registro de tutorías se observa que la asistencia a éstas comienza en la semana 3-4 tanto para el curso 16-17 como el 17-18, que coincide con la realización de la práctica que constituye el eje del diseño (Extracción S-L). Sin embargo, se aprecia un comienzo más tardío en el curso 18-19, situándose en la semana 5.

En el curso 16-17, se observó que aunque la asistencia a tutorías era progresiva, el máximo se concentraba en la semana 10 que era la de las tutorías grupales y la previa a la entrega del proyecto de diseño. Por ello, en los cursos siguientes se planificó la tutoría grupal a mitad del semestre para tener ese punto de control del trabajo con tiempo suficiente para seguir desarrollándolo a partir del feed-back proporcionado. Para los cursos siguientes se observa que el número de tutorías posee una distribución de campana de Gauss. Éste aumenta progresivamente hasta la semana 6, que es donde se sitúa el máximo de la campana, coincidiendo con la tutoría grupal. En la semana 7-8 hay una disminución o ausencia total de asistencia a tutorías coincidiendo con una semana de exámenes parciales y un periodo de vacaciones, y se reanudan aunque con una menor intensidad hasta la entrega del trabajo en la semana 10.

Respecto a la media de sesiones por grupo, resaltar que, en media, los cursos 16-17 y 17-18 reflejan una asistencia de, al menos, 1.3 sesiones de tutoría por grupo para la resolución del diseño y en el curso 18-19, de 0.7 sesiones de tutoría por grupo. Esto significa que algunos grupos (en concreto un 50 % de ellos) resolvieron el proyecto de forma autónoma sin la guía y la supervisión del profesor-tutor. Por tanto, este escaso uso de las tutorías y un comienzo más tarde de su uso para la orientación en el proyecto explicarían su peor valoración en el curso 2018-2019.

## 5.2 Dificultades detectadas y decisiones de mejora adoptadas

La reunión de “focus-group” fue necesaria para el curso 2018-2019 debido a una serie de anomalías detectadas en el desarrollo del semestre y de los trabajos, en comparación con los cursos anteriores. Las cuestiones planteadas a los alumnos, y sus respuestas han sido recogidas en la Tabla 1.2, estructuradas por tema, aspectos positivos y aspectos de mejora. En base a la información recogida y a la experiencia acumulada por los profesores, se toman decisiones que se podrán aplicar en los cursos siguientes con el fin de mejorar la asignatura. Las mejoras más relevantes son las siguientes

- Coordinación con los profesores de las asignaturas previas para trasladar esta metodología de trabajo en el laboratorio y así que los alumnos adquieran mayor experiencia en ella, antes de cursar la última Experimentación.
- Recomendar el inicio del proyecto en la semana 3 del cuatrimestre y un grado de avance del proyecto del 60-70 % al alcanzar las semanas 6-7 (tutoría grupal), para que no se les acumule el trabajo al final.
- Respecto a la disponibilidad de los profesores, reducir el tiempo de respuesta de la cita por parte del profesor, nombrando un único interlocutor de cada grupo con el profesor para concertar la misma. Advertir a los alumnos de los periodos de mayor concentración de tutorías y el incremento del tiempo de respuesta en esos periodos al solicitar tutorías.

**Tabla 1.2. Aspectos positivos y negativos del ABP derivados de la reunión de “focus-group”**

Tema	Aspectos positivos	Aspectos de mejora
Contenidos	Alto nivel de satisfacción con el hilo conductor de las prácticas Planteamiento diferente y motivador frente a las asignaturas previas de experimentación	---
Informes de prácticas	Prefieren la metodología aunque les cuesta adaptarse a realizar el informe en el laboratorio	Algunas prácticas requerían dedicación adicional fuera del laboratorio lo que incrementa su carga de trabajo
Tutorías	Necesarias para hacer el proyecto	Dificultades de coordinación con el profesor para concertar cita: disponibilidad y tiempo de respuesta  Dificultad de coordinación de los alumnos
Proyecto	Es necesario trabajar en equipo  Aprender a organizarse el tiempo y la carga de trabajo	Necesario más tiempo para su desarrollo  Dificultades para organizarse el trabajo y el tiempo, sobrecarga al final del semestre



Finalmente, cabe señalar que, aunque algunos alumnos sugirieron desglosar el proyecto con entregables a lo largo del semestre para evitar la acumulación del trabajo al final del mismo, otros pidieron no hacerlo para poder aprender a regular la carga de trabajo y a planificarse y organizarse de cara a proyectos futuros. Los profesores compartimos el segundo enfoque, dado que les hace ser más responsables de su propio aprendizaje y fomenta la planificación y organización del tiempo. Por ello, no se realizarán cambios a este respecto. No obstante se les advertirá en la presentación de la asignatura de las consecuencias de no realizar un trabajo progresivo: prisas, desencuentros, mayor presión, menor calidad del trabajo, dedicación exclusiva al proyecto en las fechas próximas a la entrega, toma de decisiones precipitada, ausencia de supervisión por parte del profesor, etc.

## **6. Conclusiones**

-Para el éxito de la implementación del ABP en asignaturas experimentales, es importante relacionar todas las prácticas de laboratorio bajo un mismo hilo conductor y que éste tenga su traslado a un proyecto.

-La organización de la asignatura debe permitir una dedicación mayoritaria del tiempo fuera del laboratorio a la realización del proyecto, por lo que se recomienda la realización de las memorias de prácticas en paralelo a la sesión de laboratorio.

-Las tutorías son necesarias y útiles para el desarrollo del proyecto. Es recomendable una sesión obligatoria a modo de tutoría grupal como punto de control del desarrollo del trabajo. El profesorado debe tener flexibilidad y disponibilidad suficiente para concertar las citas con los alumnos y debe saber que implementar el ABP supone una sobrecarga de trabajo considerable en forma de sesiones de tutoría. Los alumnos deben ser responsables y organizados para distribuir la carga de trabajo a lo largo del semestre y no concentrar el desarrollo del proyecto en las semanas previas a la entrega.

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## Estado del arte en la valoración de la propiedad industrial en Santander a partir de la Metodología de Lógica Difusa

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### Resumen

*En el presente Artículo se desarrolla con el fin de valorar el estado del arte de la propiedad industrial en el departamento de Santander mediante la metodología de la Lógica Difusa, para lo cual se realizó un diagnóstico bibliométrico de los métodos más relevantes que se emplean para la valoración de la propiedad intelectual. La investigación se desarrolla en tres etapas las cuales fueron: construcción de un diagnóstico bibliométrico de los métodos más relevantes; seguidamente se propuso una nueva metodología en la valoración de propiedad industrial a través de la lógica difusa y finalmente se presenta un análisis de la incidencia que se presentaría con la aplicación del método de lógica difusa para valoración de patentes en Santander.*

*Para llevar a cabo el desarrollo del proyecto se propone un enfoque mixto, (cualitativo y cuantitativa), el primero parte desde la perspectiva del investigador (deductivo) y el segundo desde la perspectiva de los investigados (inductivo); con el enfoque cuantitativo se podría decir que es una investigación exploratoria, descriptiva y analítica de tipo documental*

*El método cualitativo es subjetivo y se utiliza la entrevista con expertos, igualmente la teoría del caso.*

**Palabras clave:** *Propiedad intelectual, Valoración, Propiedad Industrial, Lógica Difusa, protección activos intangibles, invenciones, creaciones.*

### 1. Introducción

El estado del arte es una manera de investigación documentada que posibilita el estudio del conocimiento acumulado mediante textos escritos en una determinada área (Londoño,



2014); se puede plantear desde tres perspectivas fundamentales: recuperar para escribir, comprender y recuperar para trascender; la perspectiva de recuperar para escribir busca lograr balances e inventarios bibliográficos para dar cuenta del estado del conocimiento actual mediante la lectura resultando una bibliografía con descripción detallada; en los textos enfocados a la comprensión es fundamental entender con claridad los elementos planteados en distintas áreas de conocimiento; y recuperar para trascender la producción reflexivamente posibilitando cuestionar, criticar y construir direccionando la información obtenida (Gómez, 2015).

Sin importar cuál sea su abordaje su ejecución metodológica se resume en tres pasos: contextualización, clasificación y categorización; además es complementado por la fase de análisis para la estructuración del mismo. De este modo el estado del arte accede al movimiento de la información, crea demanda de conocimiento y los compara con otros conocimientos semejantes para obtener diferentes comprensiones del tema tratado al ofrecer más alternativas de estudio. (Londoño, 2014)

En este caso teniendo claro el concepto del estado del arte se puede tomar el tema de estudio que es la propiedad intelectual, según la OMPI (Organización Mundial de la Propiedad Intelectual) la Propiedad Intelectual P.I se relaciona con las creaciones de la mente humana en el campo de la técnica como lo son las invenciones (patentes, modelos de utilidad, diseños industriales), los signos distintivos ( marcas, nombres comerciales, enseñas, y secretos comerciales); igualmente hace relación con obras literarias, artísticas o científicas y sus afines como fonogramas, fotografía, audio visuales entre otros. (OMPI, 2017)

El derecho de propiedad intelectual permite al creador de cualquier marca, derecho de autor, patente, entre otras disfrutar los beneficios de la protección de su ingenio así se encuentra en el artículo 27 de la declaración mundial de los derechos humanos; su importancia fue contemplada en el convenio de París para la protección de la propiedad industrial en 1883 que contenía métodos para la protección de las invenciones, marcas, dibujos y modelos industriales un seguro para la competencia desleal; y el convenio en Berna para la protección de obras literarias y artísticas en 1886, la OMPI se encarga de dirigir los dos tratados. (OMPI, 2017)

Los derechos de propiedad intelectual retribuyen la creatividad y el esfuerzo por la innovación e invenciones, promoviendo el desarrollo económico, social y cultural de un país (OMPI, 2017); las creaciones protegidas por la P.I tienen en común la exclusividad de su creador pero que puede ser transmitida a un tercero y el alcance que este confiere según sea la ley. (Robledo, 2004)

En Colombia la propiedad industrial es regida por la Superintendencia de Industria y Comercio (SIC), ella se encarga de las solicitudes para los registros de propiedad industrial; Colombia es un país emergente en Latinoamérica, según el Banco Mundial la renta per cápita en este país, para el año 2011 fue de 7.077 dólares americanos quedando en el puesto 81 en el ranking mundial, superando a países como Ecuador o Perú pero por debajo de Costa Rica o Panamá, aunque para los periodos de 1996 y 2007 se dejaron de solicitar cerca de 698 patentes de los residentes del territorio, a lo que se puede decir que la inversión ya existente en el país no aprovecha el sistema de patentes en su totalidad según la inversión en innovación y desarrollo, este contratiempo se debe a la falta de información y de conocimiento de las ventajas que se obtienen por el sistema de registro y la carencia de oficinas en otras zonas del país. (SIC, 2017)

En Santander la propiedad industrial ha iniciado su camino con el fin de posicionar al departamento como innovador, esto se debe a que en marzo del 2016 los empresarios de la región reciben sus patentes de invención y registros marcarios de la SIC, se entregó cerca de 40 marcas y 13 patentes de invención en los municipios de Bucaramanga, Socorro, Floridablanca, Piedecuesta y Barrancabermeja posicionando al departamento dentro de los tres más innovadores del país; así mismo en el año 2010 y 2015 la región presentó más de tres mil marcas para que fueran registradas, al mismo tiempo solicitó ochenta y cinco patentes de invención; para el 2010 se hicieron seis solicitudes de patentes y para el 2015 finalizó con diecinueve creaciones lo que significó un aumento del doscientos por ciento (200%) pero aun teniendo estos datos el departamento se posiciona en el cuarto lugar para esta fecha siendo Bogotá, Antioquia y Valle del Cauca los líderes. (Zona Franca de Santander, 2016)

Con la explicación anterior sobre el tema de investigación se realiza una valoración de las metodologías utilizadas en el departamento de Santander mediante el estado del arte, con el fin de buscar otras metodologías como lo es la lógica difusa. Actualmente los métodos de valoración de los activos intangibles como lo son las patentes, signos distintivos, modelos de utilidad, están divididos entre las siguientes categorías: los basados en el mercado, basados en el costo y los basados en cálculos aproximados de beneficios económicos pasados y futuros.

Por otra parte existen modelos alternativos que permiten llegar a valores numéricos a partir de variables expresadas, es ahí donde la lógica difusa toma su lugar siendo una herramienta diferente a la lógica clásica; la lógica difusa es razonada en la teoría de los conjuntos difusos el cual el grado de pertenencia de un elemento a un conjunto está definido por la función perteneciente que alcanza los valores en el intervalo  $[0, 1]$  teniendo más opciones intermedias de tolerancia; además contempla la fuzzificación que es realizado en todo momento siendo una técnica matemática en el que un cuerpo de la variable a medir se convierte en el valor de la función de pertenencia. (Medina, 2010)

Con fundamento en la situación anteriormente se realiza una valoración del estado del arte de la propiedad industrial en tres etapas las cuales fueron: construcción de un diagnóstico bibliométrico de los métodos más relevantes; seguidamente se propuso una nueva metodología en la valoración de propiedad industrial a través de la lógica difusa y finalmente se presenta un análisis de la incidencia que se presentaría con la aplicación del método de lógica difusa para valoración de patentes en Santander.

Con el análisis del estado del arte se busca adquirir conocimientos en la valoración de activos intangibles necesarios para cualquier empresa logrando incrementar su valor en sus activos intangibles, y por ende generar atractivos para el empleo laboral, asimismo es una estimulación para la creación de empresa con ideas de negocio innovadoras elaborando sus respectivos registros nacional e internacional.

## **2. Marco Metodológico**

Para llevar a cabo el desarrollo del proyecto es necesario conocer el enfoque con el que se trabajara conociendo la existencias de dos tipos de metodologías, una el enfoque cualitativo que podría decirse que es una investigación exploratoria, descriptiva y analítica de tipo documental y la otra el enfoque cuantitativo, el primero parte desde la perspectiva del investigador (deductivo) y el segundo desde la perspectiva de los investigados (inductivo).

Técnicas e Instrumentos de Recolección: La técnica que más se adapta a la investigación es la observación, por medio de escalas de evaluación. El autor con que más se asemeja el tema del proyecto es Roberto Camargo Moreno, su proyecto relaciona la lógica difusa como metodología para valorar marcas, al igual siendo un estado del arte se toma en cuenta otros autores. .

Inicialmente se realiza un estudio bibliométrico mediante bases de datos como Scopus y un programa para la clasificación llamado Vantage point los cuales clasifican los autores más consultados y referenciados.

En el enfoque cualitativo se fundamenta en la indagación orientada al cambio y toma de decisiones con un pensamiento crítico social constructivista y dialógico puesto que la subjetividad es el instrumento para su desarrollo, igualmente se realiza indagación con la estructuración a partir de hallazgos durante la investigación y se validan las conclusiones mediante diálogos de interacción en este caso la entrevista. Luego de obtener lo anterior (investigaciones bibliométricas, entrevista) se realiza el análisis comparativo entre los resultados y de acuerdo a lo encontrado se realiza la evaluación de efectividad de esta

nueva metodología de valoración, así mismo se efectúan las conclusiones del tema. (Casal, 2014)

### **3. Estado del Arte**

Para la realización del estado del arte se analizaron las metodologías utilizadas en ellos ya sean las comúnmente usadas o nuevas metodologías como la lógica difusa.

Resaltando que existen varios métodos de valoración de activos intangibles se tomara como referencia el proyecto “Valoración de Activos Intangibles en Programas de Emprendimiento: Caso del Parque del Emprendimiento de la Ciudad de Medellín”; el objetivo propuesto por el autor es mejorar y aumentar la cultura del emprendimiento como elemento del desarrollo local mediante la valoración del activo intangible del lugar; el proceso consta de tres etapas: la identificación y selección de los activos intangibles, la selección del método de valoración, y la valoración y análisis de los resultados; los activos identificados fueron el capital intelectual, capital relacional, la marca, lo cual se midió utilizando la herramienta de la ingeniería económica como es los flujos de caja trayéndolos al presente proporcionando el valor de los activos en la ciudad.

También se analizó la tesis doctoral de Cristina Álvarez Villanueva “Hacia un nuevo modelo de valoración de intangibles” existen una gran cantidad de métodos de valoración como lo son: market capitalization method (método de capitalización de mercado, MCM), return on assets methods (métodos de retorno sobre activos, ROA) y el direct intellectual capital (métodos directos, DIC), métodos Scorecard (SC).

El MCM son apropiados para exponer el valor del capital intelectual intangible en una organización y realizar comparaciones o benchmarking, pero no contienen información sobre la composición del capital intelectual intangible y su enfoque económico brinda una perspectiva parcial; el método ROA además de ofrecer valor económico del capital intelectual y son convenientes para el benchmarking o comparaciones se basan en las normas de contabilidad habituales siendo más fácil la comunicación de estas, pero al igual que el método MCM no contienen la composición del capital intelectual ni el enfoque económico brinda una perspectiva total.

Por otro lado el método DIC que son caracterizados por estimar el valor económico de los activos intangibles permiten la valoración de los componentes del capital intelectual, admiten la combinación de valores monetarios y no monetarios, son fundamentados en eventos y son excelentes relacionando causa-efecto, pero son medidas específicas de la



organización, no es adecuado para realizar comparaciones y su dificultad depende de la cantidad de componentes y valores que se obtengan; y finalmente se encuentra el método SC el cual identifica los componentes del capital intelectual generando indicadores en los tableros de mando, este modelo permite obtener un gran número de resultados para la elaboración de políticas de actuación de manera más rápida y cercana a la compañía por lo que son de fácil adaptación a la detección y corrección de errores en los procesos de la compañía, pero se ven afectados cuando se hacen cambios en el contexto y es tedioso analizar la cantidad de información que este nos da por lo que la obtención de un resultado numérico es complicado. (Villanueva, 2010)

Otro proyecto sobre el tema es “aplicación de la metodología de opciones reales para la valoración de patentes con potencial comercial, caso de estudio originado a partir de un proyecto de i+d+i del valle del cauca” realizado por Gustavo Adolfo Sandoval Reina con el fin de utilizar la metodología de opciones reales para determinar el valor de estos activos intangibles de propiedad industrial para la organización, el autor nos muestra las ventajas y desventajas de los enfoques de costo, mercado, ingresos y enfoque cualitativos que le dan una puntuación a las patentes con base a la fuerza y amplitud de los derechos; los proyectos I+D+i con patentes se asemejan por la incertidumbre en cada etapa de desarrollo, la flexibilidad para decidir y buscar mayores beneficios para el propósito, cada fase permite cerrar un punto que es decisión del evaluador continuar o finalizar, las dificultades de ejercer el enfoque de opciones reales (OR) son el obtener la gran necesidad de información y el poco conocimiento que se tiene de la orientación, cuando se requiere decisiones rápidas este método pierde fuerza por la disminución de la flexibilidad de la misma forma cuando se tiene poca incertidumbre ya sea por la exclusividad o monopolio del negocio. (Reina, 2012)

Por otro lado el autor Roberto Camargo Moreno con su tesis “Aplicación lógica difusa en valoración financiera de marcas” tiene como objetivo exponer la utilidad de la técnica lógica difusa al momento de valorar intangibles uniéndola al método de valoración de múltiples precio/venta de Damoran determinado el valor de la marca para aquellas empresas que no cotizan en la bolsa; esta combinación posee la ventaja de manejar información cuantitativa y cualitativa al mismo tiempo; la metodología empírica que se utilizó fue cuantificar los factores de fortaleza de la consultora analizada por lo que fue necesaria una encuesta a expertos de mercadeo. (Moreno, 2013)

Consecuentemente la lógica difusa accede acercarse a la subjetividad del tema como alternativa y complementaria al enfoque estadístico, no es posible la utilización de cada modelo disponibles por lo tanto se debió seleccionar alguno con la importancia de la definición de parámetros a evaluar, el método de flujo de caja percibió una mirada más holística de valoración con el equilibrio de factores a lo que mediante una aplicación de un

múltiplo conveniente a las ganancias; aunque, los resultados obtenidos por la metodología de Interbrand y Demodaran no fueron los esperados puesto que no reflejan el valor estimado de la marca (valor negativo), cuando se empleó la lógica difusa se instaura un valor positivo más real con beneficios en la toma de decisiones en el uso de la incertidumbre formando una mayor exactitud en la conducta del parámetro difuso, además observar los factores competitivos que el cliente piensa que son más importantes al momento de adquirir el producto llegando así al diseño de estrategias para mejorar la imagen en el mercado y con la competencia. Los resultados de este proyecto nos afirma el manejo de la lógica difusa como método de valoración puesto que los resultados fueron los esperados. (Moreno, 2013).

Con el fin de obtener resultados de los métodos para la valoración de patentes en Santander se realiza un análisis bibliométrico. Esta búsquedas fueron limitadas a las áreas de Administración, economía, contabilidad, negocios, econometría, finanzas e ingeniería, y en el periodo de tiempo comprendido entre el año 2000 y 2018, utilizando las bases de datos Scopus y EbscoHost, y en segunda instancia debido a la ausencia de hallazgos satisfactorios en ellas, se amplió la búsqueda a la base de datos de la Universidad Industrial de Santander (UIS) y resultados en Google Scholar. La TABLA 1 presenta los resultados en cantidades de publicaciones que se obtuvieron en cada base de datos según las palabras claves de búsqueda utilizadas.

**Tabla 1. Cantidad de artículos o trabajos de investigación publicados en bases de datos indexadas sobre Valoración de patentes y el método lógica difusa**

<b>Palabra clave de búsqueda</b>	<b>Scopus</b>	<b>EbscoHost</b>	<b>Base de Datos UIS</b>	<b>Google Scholar</b>
Valoración de patentes en Santander	0	0	0	0
Patentes Santander	0	0	0	0
Lógica Difusa Santander	0	0	0	0
Lógica Difusa Bucaramanga	0	0	0	0
Valoración patentes	1	0	1	15100
Patentes	450	1041	20	75600
Lógica difusa	37	5845	8	15000
Valoración capital intelectual	101	108	0	16200

*Fuente: Elaboración propia*

Como se puede evidenciar en los resultados, no existe ninguna publicación en base de datos indexada con respecto al uso de métodos de valoración generales o específicos en lógica difusa para el caso de valorar las patentes en el departamento de Santander. Sin embargo si se encuentra que es muy nutrida la publicación para casos de valoración de patentes pero con el uso de diferentes métodos y técnicas, y en especial para el caso de capital intelectual

en general. Por tal motivo se procedió a analizar cómo ha sido la publicación para estudios de valoración de capital intelectual, valoración de patentes y utilización del método de lógica difusa.

Un análisis particular sobre el uso de la lógica difusa señala varias aplicaciones o intereses investigativos. En el caso de la base de datos Scopus, entre el año 1997 y 2018 se realizó un máximo de 7 publicaciones en el año 2011 del total de 37 en ese periodo. El comportamiento de publicación tiene una tendencia hacia dos publicaciones anuales con picos en los años 2011 a 2015. En el caso de la base de datos EbscoHost con 5845 publicaciones sobre el uso de la lógica difusa entre 2000 y 2018, el comportamiento de publicación es más constante y abundante.

Una revisión particular sobre estas publicaciones señala que el uso o utilidad de la lógica difusa que los investigadores han explorado se enfoca en la medición del capital intelectual, control y análisis de procesos químicos y físicos, toma de decisiones (selección de proveedores, contratistas, métodos, productos, software, servicios), análisis, valoración y evaluación de riesgos, análisis estratégico (internacionalización, competitividad, inversiones), y pronósticos. Sobre estos temas, se puede demostrar que no existen trabajos específicos de análisis o valoración de patentes con el método de lógica difusa, y que el tema más cercano es el uso de este método para la valoración del capital intelectual (Ver Tabla 2)

**Tabla 2. Listado de publicaciones del uso de lógica difusa para la valoración del capital intelectual (intangible assets)**

Base de datos	Título publicación	Autores	Nombre publicación	País	Año
Scopus	Aproximación a la medición del capital intelectual organizacional aplicando sistemas de lógica difusa	Hurtado S.M., Laserna E.Z., Pedraza D.L., Mazo F.G.	Cuadernos de administración	Colombia	2016
EbscoHost	Metodología fuzzy para avaliação de ativos intangíveis empresariais.	Legey Júnior, Pedro Paulo Silva; Vilela, Lamounier Erthal; Pereira Barbosa, José Geraldo	Revista de Administração FACES Journal	Brasil	2010

<b>Base de datos</b>	<b>Título publicación</b>	<b>Autores</b>	<b>Nombre publicación</b>	<b>País</b>	<b>Año</b>
Google Scholar	Valoración del capital intelectual en las entidades financieras de Ocaña, Norte de Santander	Ruedas J., y Sanchez H. D.	Tesis doctoral	Colombia	2014

*Fuente: Elaborado a partir de la información obtenida en la base de datos Scopus*

El análisis bibliométrico sobre los trabajos alrededor de patentes logra encontrar grandes cantidades de producción intelectual. En las bases de datos como Scopus se encontraron 450 publicaciones, en EbscoHost 1041 de estas. Acerca de los temas tratados sobre publicaciones en el tema de las patentes, un análisis demuestra que los enfoques o intereses de investigación se concentran en: análisis del potencial práctico, funcional o comercial de una patente específica, análisis de la relación de la producción de patentes con variables como la inversión extranjera en un país o la inversión interna del país en investigación y desarrollo, análisis o valoración de la capacidad de investigación e innovación de una región o grupo de instituciones con base en la producción de patentes, análisis o propuestas sobre legislación de patentes, propuestas de gestión tecnológica con base en patentes, la industria farmacéutica entre otras,

Por otro lado, sí existe evidencia de estudios y desarrollo científico sobre la valoración de patentes con diferentes técnicas diferentes a la lógica difusa, y valoración de capital intelectual utilizando la lógica difusa.

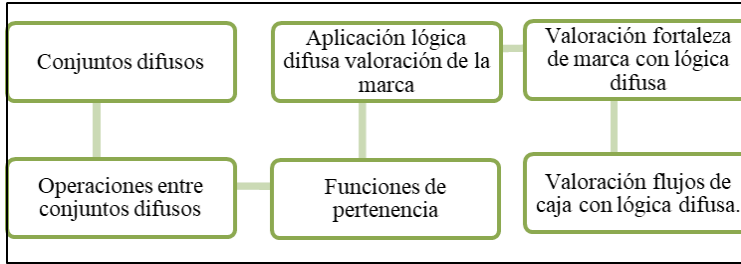
#### **4. Metodología para la Valoración de Propiedad Industrial a Través de la Lógica Difusa en Santander**

La lógica difusa tiene gran utilidad porque permite tratar problemas demasiado complejos, mal definidos o para los cuales no existen modelos matemáticos precisos. Debido a este tipo de lógica se ha permitido modelar y resolver situaciones consideradas intratables desde el punto de vista de la lógica clásica. En la lógica clásica una proposición sólo admite dos valores: verdadero o falso, la lógica usual es bivalente o binaria. Existen otras lógicas que admiten además un tercer valor posible (lógica trivaluada) e incluso múltiple valores de verdad (lógica multivaluada).

Para el departamento de Santander, con base en la fundamentación teórica de la presente investigación se estableció la siguiente metodología de aplicación del método de lógica difusa para la valoración de propiedad intelectual, en la Ilustración, se observa el



procedimiento y las variables que se deberán tener en cuenta para la aplicación del método de evaluación enunciado:



**Ilustración 1. Proceso de Evaluación de Propiedad Industrial por Lógica Difusa.**

*Fuente: Autor*

## 5. Conclusiones y recomendaciones.

No existe ninguna publicación en base de datos indexadas con respecto al uso de métodos de valoración generales o específicos en lógica difusa para el caso de valorar las patentes en el departamento de Santander. Sin embargo si se logró identificar una publicación muy nutrida en los temas de valoración de patentes pero con el uso de diferentes métodos y técnicas, y en especial para el caso de capital intelectual en general.

En el análisis particular sobre el uso de la lógica difusa se observaron varias aplicaciones o intereses investigativos. En el caso de la base de datos Scopus, entre el año 1997 y 2018 se realizaron un máximo de 7 publicaciones en el año 2011 del total de 37 en ese periodo. Se logró establecer que el comportamiento de las publicaciones tiene una tendencia hacia dos publicaciones anuales con picos en los años 2011 a 2015. En el caso de la base de datos EbscoHost con 5845 publicaciones sobre el uso de la lógica difusa entre los años 2000 y 2018, el comportamiento de publicación fue más constante.

Para la aplicación del método de lógica difusa en el departamento de Santander, en torno a la valoración de patentes en Santander, se deberá implementar un procedimiento, el cual inicia con la determinación de los conjuntos difusos, para luego identificar las operaciones entre conjuntos difusos, generar las funciones de pertenencia, aplicar lógica difusa valoración del intangible, su fortaleza con lógica difusa y finalmente valorar los flujos de caja con lógica difusa.

Sin embargo es importante resaltar que actualmente la Cámara de Comercio de Bucaramanga, entidad encargada de la valoración de patentes en Santander, no cuenta con toda la información requerida para la aplicación del método de lógica difusa, razón por la

cual se recomienda establecer una base de datos que permita tener los insumos necesarios para la aplicación de esta novedosa metodología en el departamento de Santander.

Además se recomienda tener en cuenta variables lingüísticas o de entrada para el caso de patentes, modelos de utilidad, valoración de empresas, desarrollo de marcas, que deben ser tenidas en cuenta para futuras investigación de estado del arte en esta temática.

Por consiguiente las aplicaciones que se han dado a partir de la introducción de la metodología de la lógica difusa en el año 1965 por el científico Lofti Zadeh han evolucionado y hoy en día es posible calcular el volumen de negocio que se generan en todo el mundo.

Con la teoría de conjuntos difusos se engloba una estructura más organizada en la que se incluyen operaciones de agregación, medición más específica de información y un sistema de cálculo para los números difusos, siendo así una herramienta eficaz y versátil tanto para el modelo verbal como numérico.

Sin embargo como todos los modelos aplicados a la hora de valorar un activo intangible tiene un rango de dificultad ya que el método de lógica difusa depende de la interpretación y la intuición humana a la hora de cuantificar y seleccionar las variables.

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## Monitorización de la cooperación alcanzada y estimación del rendimiento en trabajos en equipo

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### Resumen

*En este trabajo se analiza la relación entre el nivel de cooperación alcanzado en equipos y el rendimiento obtenido por los mismos durante el desarrollo de trabajos en grupo en varias asignaturas. El objetivo último es la monitorización en tiempo real del nivel de cooperación alcanzada por los equipos de alumnos con objeto de corregir a tiempo posibles problemas de funcionamiento interno de los mismos. Se busca además familiarizar al alumno con herramientas y estrategias para trabajo cooperativo que muy probablemente van a encontrar en su futuro laboral.*

*Keywords: innovación educativa, trabajo cooperativo, herramientas TIC.*

### 1. Introducción

La iniciativa de innovación que aquí se describe surge como respuesta a la falta de información sobre el funcionamiento interno de los equipos de alumnos que abordan el desarrollo de trabajos en grupo en las asignaturas de grado y máster. Si bien siempre resulta interesante conocer dicha información, en asignaturas donde el trabajo en grupo es la principal actividad evaluada supone una información esencial. Se trata pues de medir de forma objetiva el grado de cooperación alcanzada en los equipos como complemento a la valoración subjetiva de los profesores. En las asignaturas que se han planteado como objetivo resulta además especialmente importante valorar la competencia de capacidad de cooperación del alumno.

La duración de las actividades colaborativas a evaluar es un aspecto de suma importancia, ya que condiciona en gran medida las interacciones entre los estudiantes (Viswanathan, 2017). Gran parte de los estudios que podemos encontrar en la literatura corresponden a actividades colaborativas en el ámbito de una sesión docente, es decir, en torno a una hora.



En todo caso, existen también algunos estudios sobre equipos de estudiantes que trabajan juntos durante varias semanas o un semestre completo utilizando herramientas tales como foros, wikis, Chat o repositorios de código. Este tipo de trabajos es sin duda mucho más acorde al planteado en nuestro trabajo, ya que vamos a considerar trabajos en equipo cuya duración es de 12 semanas. En el informe Horizon sobre Educación Superior (INTEF, 2017) se proporcionan algunas de estas alternativas para el aprendizaje colaborativo, como son los wikis, Google Docs, las redes sociales y las aplicaciones de mensajería. En Perera (2009) se utilizan métricas de uso de wikis y repositorios de código en el contexto de un proyecto sobre programación desarrollado en equipos de entre 5 y 7 alumnos durante 12 semanas. En Anaya (2011) se utilizan métricas de uso de foros en el contexto de una tarea colaborativa de 12 semanas desarrollada en equipos de 3 alumnos pertenecientes a la Universidad Nacional de Educación a Distancia. En ambos casos, el nivel de colaboración alcanzado tanto por los equipos como por cada uno de sus miembros se valora por parte de expertos y después se intenta inferir dicho nivel a partir de las métricas mediante diferentes técnicas como *clustering*, *data mining* y *machine learning*. También el uso de las redes sociales, junto con la potencialidad ofrecida por herramientas TIC colaborativas como *Slack* o *Teams*, pueden fomentar la cooperación entre alumnos y permitir una mayor participación, fomentando el aprendizaje cooperativo (Chawinga, 2017).

## 2. Objetivos del estudio

1. Familiarizar al alumno con herramientas y estrategias de trabajo cooperativo con las que se van a encontrar en su futuro laboral.
2. Medir y monitorizar el nivel de cooperación alcanzado por los alumnos durante el desarrollo de los trabajos en equipo de las asignaturas.
3. Estimar el rendimiento obtenido por los equipos a partir del grado de cooperación alcanzado en los mismos.

## 3. Metodología

Nuestra iniciativa de innovación parte de los fundamentos del trabajo en equipo, el aprendizaje basado en proyectos y el trabajo cooperativo.

La experiencia de trabajo en el pequeño grupo orientado a la solución del problema es una de las características distintivas del Aprendizaje Basado en Proyectos (ABP). En estas

actividades grupales los alumnos toman responsabilidades y acciones que son básicas en su proceso formativo (Kidder, 2012), y por ello se considera que esta forma de trabajo representa una alternativa necesaria en la formación de profesionales, especialmente en el caso de técnicos. Un método que además resulta factible para ser utilizado por los profesores, con mayor o menor intensidad, en la mayor parte de las disciplinas.

A la hora de diseñar una actividad de trabajo cooperativo, es importante tener en cuenta los cinco aspectos que harán que funcione bien la actividad: Interdependencia positiva, Exigibilidad individual, Interacción cara a cara, Habilidades interpersonales y de trabajo en grupo y Reflexión del grupo (Peña, 2010).

La propuesta se enmarca en el contexto de tres asignaturas sobre Gestión y Gobierno de Servicios de Tecnologías de la Información repartidas entre dos grados (informática y telecomunicación) y un máster (informática) impartidos en la Escuela Politécnica de Ingeniería de Gijón. Esta temática tiene una fuerte conexión con el mundo empresarial, ya que aborda la estrategia, diseño, construcción, operación y mejora continua de los servicios basados en las tecnologías de la información y las comunicaciones (TIC). El trabajo en grupo planteado en las asignaturas se orienta hacia la gestión de un servicio real e innovador definido por los miembros de cada equipo, de tal modo que los alumnos puedan trabajar en un entorno similar al empresarial.

La metodología a seguir es común para las tres asignaturas implicadas, dedicándose buena parte de las sesiones de prácticas de laboratorio al desarrollo de los trabajos en grupo de la asignatura. Con estas sesiones presenciales, los alumnos disponen de tiempo suficiente para interacción cara a cara, discusión de ideas, toma de decisiones, etc. y permite a los profesores una valoración directa de la comunicación en los equipos, íntimamente relacionada con la cooperación. Además, los alumnos disponen de tiempo no presencial en la planificación de la asignatura para avanzar en el trabajo de forma individual, potenciando la cooperación en este caso mediante las herramientas TIC proporcionadas, por ejemplo, la comunicación vía mensajería instantánea o Chat.

La herramienta TIC utilizada por parte de los equipos de trabajo para mejorar la cooperación entre sus miembros es *Teams* de Office 365, que ofrece un entorno colaborativo para que los estudiantes puedan interactuar y compartir información relativa a proyectos comunes. Entre las funcionalidades proporcionadas por *Teams* podemos destacar mensajería instantánea, audioconferencia, videoconferencia, planificación de reuniones y bloc de notas de clase compartido (estructurado en tres partes principales, una de solo lectura para los alumnos, otra colaborativa entre los miembros de equipo y otra privada para cada alumno que solo puede ver el profesor). La herramienta está además disponible tanto para equipos de escritorio como para dispositivos móviles (apps para Android e iOS), de modo que permite la colaboración desde cualquier ubicación.



### 3.1. Plan de trabajo desarrollado

Las tareas llevadas a cabo para cubrir los objetivos planteados son las siguientes:

**Objetivo 1:** Familiarizar al alumno con herramientas y estrategias de trabajo cooperativo.

1. Concienciar al alumno sobre la importancia de la cooperación en los desarrollos en equipo en el contexto laboral.
2. Tutorar a los alumnos sobre las estrategias utilizadas en aprendizaje cooperativo.
3. Plantear el uso de las herramientas TIC propuestas como base del trabajo cooperativo de los alumnos.
4. Plantear trabajos en equipo de carácter realista a desarrollar por parte de entre 3 y 4 alumnos durante unas 12 semanas y en los que se garantice tanto la interdependencia positiva como la interacción cara a cara.

**Objetivo 2:** Medición y monitorización de la cooperación alcanzada.

5. Extraer medidas de las variables de interés que permitan las herramientas de cooperación utilizadas y utilizarlas como métricas.
6. Valorar el grado de cooperación percibido por los profesores durante las sesiones presenciales de trabajo en equipo y utilizarlo como métrica.

**Objetivo 3:** Estimación del rendimiento de los equipos.

7. Valorar el rendimiento alcanzado por los equipos al final del período de desarrollo del trabajo en equipo en base los resultados alcanzados.
8. Analizar la relación entre el rendimiento alcanzado por los equipos y los valores de las métricas de cooperación seleccionadas.
9. Obtener las expresiones que mejor estimen el rendimiento de los equipos y los miembros de los equipos a partir de las métricas de cooperación seleccionadas.

## 4. Resultados

Se resumen a continuación los resultados obtenidos en relación a cada objetivo planteado.

**Objetivo 1:** Familiarizar al alumno con herramientas y estrategias de trabajo cooperativo.

En este sentido la experiencia ha sido satisfactoria tanto para docentes como alumnos. Se realizó una encuesta final a los alumnos donde se les pedía valorar la contribución de la herramienta *Teams* sobre varios aspectos del trabajo en equipo de la asignatura:

Coordinación, Comunicación, Cooperación, Sentimiento de equipo y Resultados alcanzados. La media global obtenida para las tres asignaturas del estudio fue de 5,23 en una escala de likert de 7 niveles.

**Objetivo 2:** Medición y monitorización de la cooperación alcanzada.

En la tabla 1 se muestran las métricas cuya obtención fue finalmente viable. Las métricas de comunicación vía Chat se obtuvieron directamente a partir de los informes de uso de la herramienta *Teams*. Inicialmente se pretendía obtener estas métricas una vez a la semana aproximadamente para analizar la evolución a lo largo del semestre, pero no fue posible debido a que los informes de *Teams* de momento solo pueden ser generados por parte del administrador general de la herramienta. Así las cosas, solo fue posible y razonable obtener las métricas agregadas al final del semestre.

**Tabla 1. Métricas de cooperación**

<i>Métrica</i>	<i>Definición</i>	<i>Forma de cálculo</i>
<i>Chat</i>	Comunicación vía Chat individual	Linealmente entre 1 mensaje y la mitad de la media para el total de alumnos
<i>Med.Chat</i>	Comunicación vía Chat en el equipo	Media de las métricas individuales de los miembros del equipo
<i>Desv.S.Chat</i>	Desviación de la comunicación vía Chat en el equipo	Desviación estándar de las métricas individuales de los miembros del equipo
<i>Com</i>	Comunicación oral en el equipo	Valoración subjetiva por parte del profesor de la comunicación oral entre los miembros del equipo durante las sesiones presenciales de trabajo en equipo (unas 20 horas en total)

En la figura 1 se muestran los valores de la métrica Chat a nivel individual para los 73 alumnos correspondientes a las tres asignaturas incluidas en el estudio. Se puede apreciar que en torno al 11% de los alumnos han intercambiado un número de mensajes con sus compañeros de equipo significativamente mayor que el resto. Además, hay un 4% de alumnos que no han intercambiado mensajes y optaron por utilizar su propio servicio de mensajería instantánea. Los alumnos de estos dos extremos corresponden casi todos ellos a la asignatura de máster y es por ello que no se ha incluido esta asignatura (15 alumnos en total) en el análisis de la correlación con el rendimiento de los equipos.

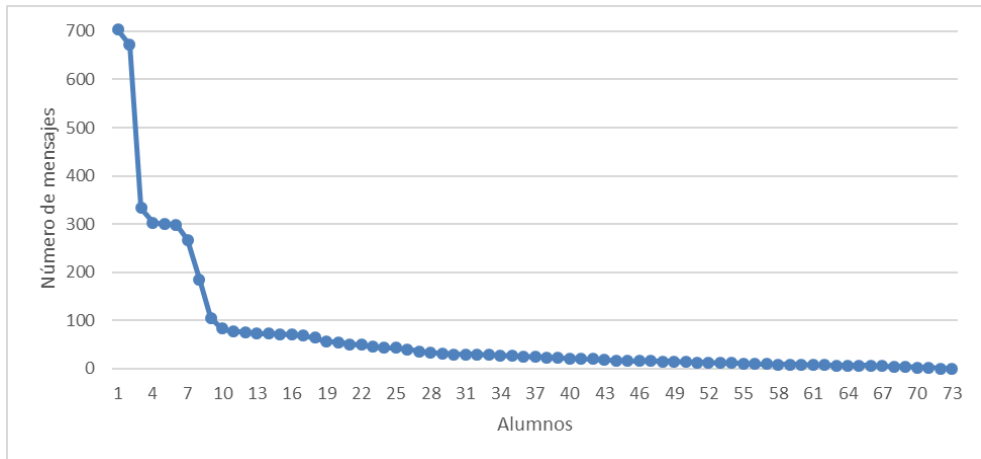


Figura 1. Valores de la métrica Chat a nivel individual

En cuanto a la métrica de comunicación oral solo fue posible su valoración a nivel de equipo por parte de los profesores, quedando pendiente como reto para un futuro la medición del nivel de comunicación oral de cada miembro del equipo. Además, estas métricas solo se han cuantificado para las dos asignaturas del grado, si bien representan el 80% de los alumnos.

En la figura 2 se muestran los valores de las métricas a nivel de equipo. En el caso de las métricas de Chat se observa una relación entre valores altos de la media y bajos de la desviación estándar y viceversa.

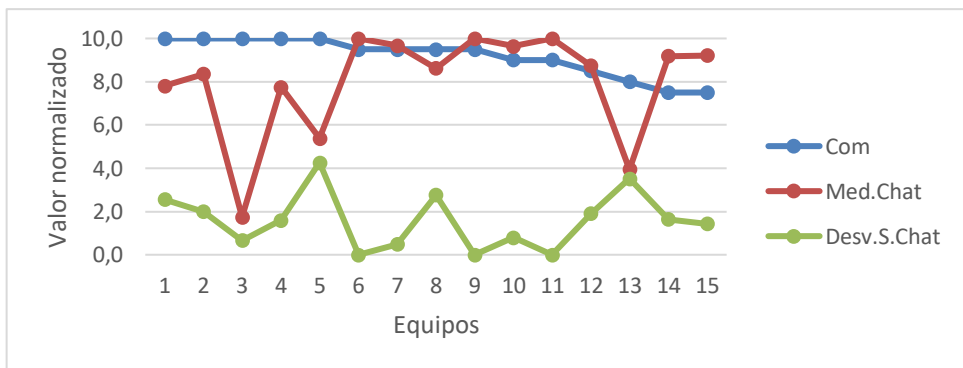


Figura 2. Valores de las métricas a nivel de equipo

**Objetivo 3:** Estimación del rendimiento de los equipos.

Este objetivo se ha orientado únicamente a las dos asignaturas de grado, con un total de 58 alumnos divididos en 15 grupos. El significativo menor número de alumnos (15) y equipos

(4) en la asignatura de máster, así como el hecho de no disponer de información sobre el nivel de comunicación oral en los equipos, descartaron finalmente su inclusión.

Una vez concluida la evaluación de las asignaturas y conocida la calificación de los trabajos en equipo, se analizó en profundidad su correlación con las métricas de cooperación obtenidas. La calificación obtenida por los alumnos en el trabajo en equipo consta de dos partes, una común a todos sus miembros y que depende de los resultados alcanzados, y otra individual que depende de la defensa del trabajo realizada por cada uno de ellos.

En primer lugar, y como estrategia prioritaria, se buscó la mejor estimación lineal posible de la parte común de la calificación del trabajo en equipo a partir de las métricas. La expresión encontrada por parte de la herramienta utilizada (Excel) fue la siguiente:

$$\text{Calificación estimada} = 0,484 * \text{Com} - 0,013 * \text{Med.Chat} - 0,069 * \text{Desv.S.Chat}$$

donde el valor de los coeficientes asociados a las métricas da idea de su peso relativo.

La estimación anterior da lugar a un error predicción (diferencia entre calificaciones reales y estimadas) de 0,281 (medio)  $\pm$  0,260 (desviación estándar) para el conjunto de 15 equipos en las dos asignaturas. Este error es un 6,4% inferior al obtenido utilizando solo la métrica *Com* en la predicción y un 33,4% inferior al obtenido utilizando solo las dos métricas de *Chat*. En la figura 3 se muestran las calificaciones reales en orden decreciente y las estimaciones correspondientes. El error de estimación es superior a 0,5 en solo 3 de los 15 equipos.

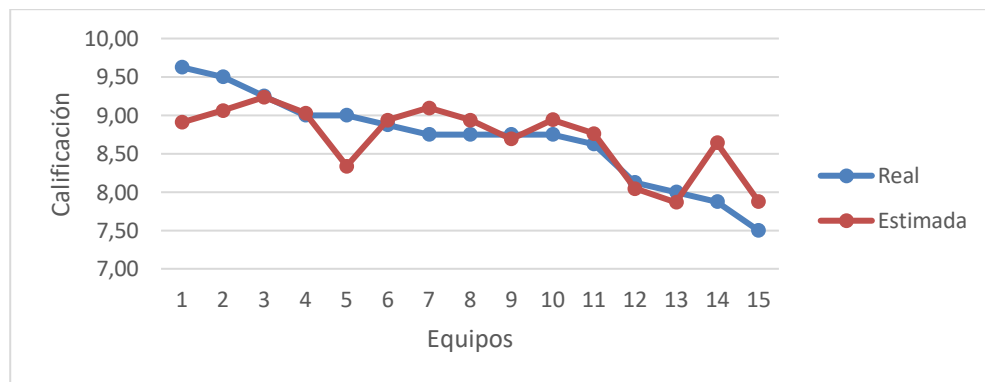


Figura 3. Estimación del rendimiento de los equipos

En segundo lugar, y aunque no planteado inicialmente en el trabajo, se buscó la mejor estimación lineal posible de la parte individual de la calificación del trabajo en equipo. La expresión encontrada fue la siguiente:

$$\text{Calificación estimada} = 0,388 * \text{Com} - 0,025 * \text{Med.Chat} - 0,040 * \text{Desv.S.Chat}$$



donde el valor de los coeficientes asociados a las métricas da idea de su peso relativo.

La estimación anterior da lugar a un error predicción de  $0,283 \pm 0,234$  para el conjunto de 58 alumnos en las dos asignaturas. Este error es un 5% inferior al obtenido utilizando solo la métrica *Com* en la predicción y un 30,4% inferior al obtenido utilizando solo las dos métricas de *Chat*. En la figura 4 se muestran las calificaciones reales en orden de equipos y las estimaciones correspondientes. El error de estimación es superior a 0,5 en solo en 9 alumnos (15,5%) pertenecientes a los mismos 3 equipos mencionados anteriormente.

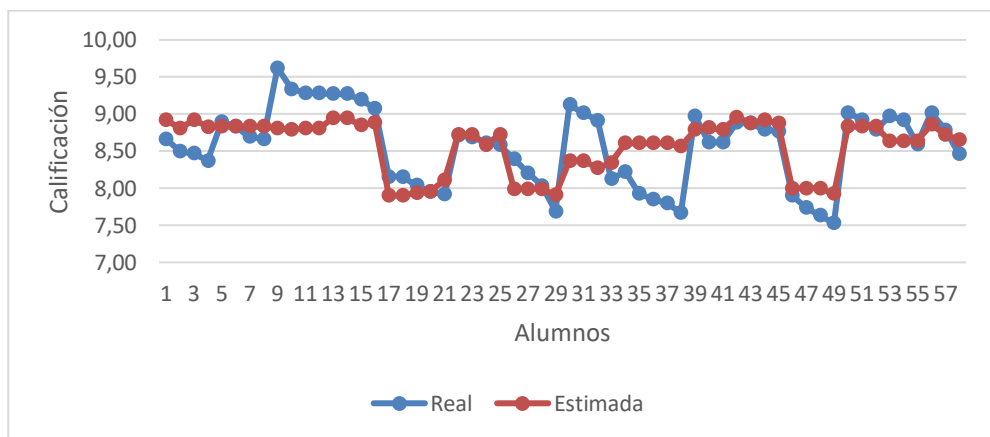


Figura 4. Estimación del rendimiento de los miembros de los equipos

## 5. Conclusiones

Como puntos fuertes del trabajo realizado destacamos la buena valoración de la herramienta de trabajo cooperativo, la definición de varias métricas para valorar la cooperación de equipos y miembros y la obtención de estimaciones del rendimiento tanto de equipos como de sus miembros a partir de las métricas de cooperación definidas. La estimación del rendimiento de equipos y alumnos habilita la monitorización en tiempo real de la cooperación, que podría ser útil a profesores y alumnos para la detección temprana de problemas de funcionamiento en los equipos. Con ese objetivo, se plantean las métricas relativas a comunicación oral y vía Chat frente a otras como las relativas a foros, wikis y repositorios de código.

Como aspecto vital de mejora, la monitorización en tiempo real de la cooperación debe pasar necesariamente por disponer de valores periódicos de las métricas. Disponer de datos de comunicación vía Chat de forma periódica (p.e. semanalmente) supondría conocer no solo el nivel sino también el patrón temporal de comunicación, lo que permitiría componer

métricas adicionales (p.e. a partir de la varianza) que aportarían sin duda mayor precisión a las estimaciones de rendimiento. Esperamos que una próxima actualización de la herramienta *Teams* permita resolver a corto plazo la limitación actual. En cuanto a la medición de la comunicación oral, automatizar dicha medición mediante micrófonos asociados a los alumnos en las sesiones presenciales de trabajo en equipo permitiría dar un gran salto de calidad en esta importante métrica. No solo la precisión de las medidas sería notablemente superior, sino que además se abriría la posibilidad de componer nuevas métricas que reflejen el patrón temporal de comunicación, al igual que ocurría con la comunicación vía Chat.

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## Los Objetivos de Desarrollo Sostenible en el plan de estudios del Grado en Ingeniería Civil de la Universitat Politècnica de València

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### Resumen

*En septiembre de 2015 la Asamblea General de la ONU adoptó la Agenda 2030 para el Desarrollo Sostenible, en la que se plantean 17 objetivos con 169 metas interdependientes sobre cuestiones económicas, ambientales y sociales. Es el acuerdo internacional más ambicioso hasta la fecha y es necesaria la colaboración de todos los actores de la sociedad para hacer frente a los desafíos que en ella se plantean.*

*La Universidad tiene que reflexionar acerca del servicio que presta a la sociedad y adaptarse a las nuevas necesidades del siglo XXI, permaneciendo en contacto con la ciudadanía y contribuyendo a la resolución de los problemas, desafíos y conflictos de nuestro tiempo. Por ello, adoptar el contenido de la Agenda 2030 como marco de trabajo, ayudará a integrar en los estudios universitarios los Objetivos de Desarrollo Sostenible (ODS).*

*La presente comunicación recoge el trabajo desarrollado en la Escuela Técnica Superior de Ingeniería de Caminos, Canales y Puertos de Valencia para adaptar el plan de estudios del Grado en Ingeniería Civil con objeto de integrar los ODS en los resultados del aprendizaje del título. Así, los estudiantes incorporarán a su formación la adquisición de habilidades y competencias que les permitan desarrollar en su desempeño profesional como ingenieros soluciones sostenibles.*

*Para ello se ha realizado un diagnóstico del plan de estudios y se han identificado las asignaturas que contribuyen a cada uno de los 17 ODS. Con esta información se han establecido los contenidos a incorporar para mejorar la formación de los ingenieros civiles para alcanzar las metas de la Agenda 2030.*



**Palabras claves:** ODS, Agenda 2030, Ingeniería Civil, Plan de Estudios.

## **1. Introducción**

### **1.1. La Agenda 2030 en España**

El 25 de septiembre de 2015 la asamblea general de la Organización de las Naciones Unidas (ONU, 2015) adoptó uno de los acuerdos globales más ambiciosos y trascendentes de nuestro tiempo: la Agenda 2030 para el Desarrollo Sostenible con el lema “transformando nuestro mundo”. Es un plan de acción a favor de las personas, el planeta y la prosperidad que también tiene la intención de fortalecer la paz universal y el acceso a la justicia.

La Agenda plantea 17 Objetivos de Desarrollo Sostenible (ODS) con 169 metas de carácter integrado e indivisible que pretende abordar los desafíos mundiales más acuciantes: acabar con la pobreza y promover la prosperidad económica, la inclusión social, la sostenibilidad medioambiental, la paz y el buen gobierno para todos los pueblos para el 2030.

En junio de 2018 el gobierno de España aprobó el “Plan de acción para la implementación de la Agenda 2030” (Gobierno de España, 2018) en la que se presenta el estado del país, analizando la situación de los ODS en España y se abordan las acciones a llevar a cabo para poner en marcha la Agenda. En este documento se menciona a la Universidad como actor imprescindible que debe comprometerse para la implementación de la Agenda y se indican explícitamente 7 contribuciones de las universidades españolas a la aplicación de la Agenda 2030. Entre ellas queremos destacar:

- a. (2) Un compromiso decidido con la inclusión de competencias relacionadas con un desarrollo sostenible e inclusivo, necesarias para la construcción de una ciudadanía global, en la formación de todo el estudiantado, el personal docente e investigador y el personal de administración y servicios.
- b. (3) La generación y la transferencia de un conocimiento comprometido con el desarrollo sostenible, incluyendo aquí también el conocimiento necesario para articular y dar seguimiento a la propia Agenda 2030.
- c. (7) Compromiso por parte de las universidades, a reportar informes acerca de sus impactos en términos de docencia, investigación y transferencia, alineándose a cada uno de los ODS.”

En este contexto, la Universitat Politècnica de València, a través del Vicerrectorado de Calidad y Acreditación, está llevando a cabo un programa de innovación docente para alinear el perfil competencial de sus egresados con los ODS, mediante su incorporación en

los resultados del aprendizaje. En primera instancia, la UPV exigirá a partir del curso 2019/2020 que el estudiante incorpore a su Trabajo de Fin de Título, una reflexión explícita que justifique en qué medida el trabajo se relaciona con determinados ODS. Además, se ofrecerá a los estudiantes formación on-line especializada y específica sobre cada uno de los ODS. En una segunda fase, se incentivará la incorporación de los ODS en las propias titulaciones, a todos los niveles. Es en este último contexto en el que se centra el trabajo que se presenta.

## 1.2. La profesión de la ingeniería civil y los ODS

En las sociedades actuales, la actividad profesional ocupa un lugar significativo teniendo una clara influencia en la estructuración y funcionamiento de la vida social. Por ello es de vital importancia para la cimentación de sociedades comprometidas con la Agenda 2030, que los profesionales conozcan y asuman los ODS en sus quehaceres diarios.

Asimismo, la profesión de la ingeniería civil tiene una gran responsabilidad como motor que transforma el medio, y desde la creación de la primera Institución de ingenieros civiles (ICE) en Reino Unido, se ha reflexionado sobre el trabajo que realizan. En 1828 Tredgold (Ashley, 2012) en el momento de la creación de la institución definió la ingeniería civil como “el arte de dirigir las grandes fuentes de poder de la Naturaleza para el uso y conveniencia del hombre, como medio de producción y de tráfico en los estados, tanto para el comercio exterior como para el interior, tal como se aplica en la construcción de carreteras, puentes, acueductos, canales, navegación fluvial y muelles, para el intercambio y el intercambio interno; y en la construcción de puertos, topos, rompeolas y faros, y en el arte del a navegación con energía artificial, para fines comerciales; y en la construcción y adaptación de maquinaria y en el desagüe de ciudades y pueblos”. Esta definición se ha ido transformando con el paso del tiempo y en el año 2007 esta institución la reformuló de la siguiente manera: “la ingeniería civil es un arte vital, que trabaja con las grandes fuentes de poder de la naturaleza para la riqueza y el bienestar de toda la sociedad”.

Las asociaciones de ingeniería civil de todo el mundo definen la profesión en términos similares y por ejemplo la *American Society of Civil Engineers* (ASCE) de Estados Unidos dice que “los ingenieros civiles diseñan, construyen y mantienen los cimientos de nuestras sociedades modernas – nuestras carreteras y puentes, el agua potable y los sistemas de energía, los puertos y los aeropuertos, y la infraestructura para un medio ambiente más limpio”.

Esta asociación a partir de La Cumbre sobre el Futuro de la Ingeniería Civil celebrada en junio de 2006, publicó el documento “La visión para la ingeniería civil en 2025” (ASCE, 2007), en el que se articula una visión global de esta profesión y se muestran las tareas a las

que deben aspirar los ingenieros del siglo XXI: “En 2025, los ingenieros civiles prestarán servicio de manera competente, colaborativa y ética como maestros:

- Planificadores, diseñadores, constructores y operarios del motor económico y social de la sociedad: el medio ambiente construido;
- custodios del medio ambiente natural y sus recursos;
- innovadores e integradores de ideas y tecnología en los sectores público, privado y académico;
- gestores de los riesgos y las incertidumbres causados por acontecimientos naturales, accidentales y otras amenazas; y
- líderes en debates y decisiones que conformarán la política pública ambiental y de infraestructuras”.

En general todas las asociaciones de ingenieros civiles del mundo toman estas definiciones como propias para explicar las tareas de la profesión y queda clara su trascendencia en la transformación del medio, en la construcción de redes de transporte, y en el abastecimiento de recursos, lo que conlleva una gran responsabilidad y una influencia directa en la consecución de la agenda 2030. Por todo ello es necesario que desde las escuelas de ingeniería civil se promueva y se instruya a los estudiantes para conseguir los ODS.

## **2. Cómo empezar**

### **2.1. Método**

Para estudiar cómo integrar los ODS en el curriculum de los ingenieros civiles se puede tomar como punto de partida los esfuerzos llevados a cabo en diversas universidades para introducir la sostenibilidad en sus planes de estudio (Holmberg et al. 2008, Lozano 2010 and Watson et al. 2013). En los trabajos mencionados se emplean diversas metodologías para abordar la tarea de analizar los planes de estudio. En este trabajo, para abordar la tarea de integrar los ODS en el curriculum de los ingenieros civiles se ha seguido una metodología basada en la herramienta STAUNCH (Lozano, 2010). Para ello será necesario identificar los contenidos relacionados que ya se están impartiendo, identificando a que ODS contribuyen, se señalarán las asignaturas que pueden contribuir y se indicarán nuevos contenidos que pueden introducirse en las actividades que se desarrollan en la Escuela para que los alumnos adquieran de manera holística las competencias y conocimientos que aborda la agenda 2030.

## 2.2. Diagnóstico

Una vez revisado el plan de estudios se ha comprobado que, como se intuía al iniciar la tarea, el curriculum que siguen los estudiantes para convertirse en ingenieros civiles tiene un gran potencial para integrar contenidos relacionados directamente con los ODS.

El análisis detallado de las guías docentes de las 59 asignaturas que conforman el plan de estudios ha puesto de manifiesto que actualmente solo hay 17 asignaturas que trabajen contenidos directamente relacionados con alguna de las 169 metas de los 17 ODS. Estas 17 asignaturas se concentran en 11 de los 17 ODS. Destacando principalmente los siguientes ODS:

- ODS #6 “Agua limpia y saneamiento”, trabajado en 6 asignaturas correspondientes a los cursos de 1º, 3º y 4º.
- ODS #9 “Industria, innovación e infraestructura”, trabajado en 4 asignaturas correspondientes a los cursos de 2º y 3º.
- ODS #11 “Ciudades y comunidades sostenibles”, trabajado en 5 asignaturas correspondientes a los cursos de 3º y 4º.
- ODS #13 “Acción por el clima”, trabajado en 3 asignaturas correspondientes a los cursos de 3º y 4º.

Sin embargo, este análisis ha puesto de manifiesto, por un lado, que las asignaturas que ya integran alguno de los ODS en sus contenidos, podrían integrar también otros ODS y, por otro lado, que hay 25 asignaturas que están relacionadas con los ODS y aunque no los trabajan en la actualidad, se podrían implementar de forma más o menos sencilla, ya que sus contenidos están vinculados a algunas de las metas definidas en los 17 ODS. Finalmente, solo existen 17 asignaturas de las 59 que integran el plan de estudios que no se han podido relacionar con ninguno de los ODS, las cuales fundamentalmente se corresponden con las materias de formación básica de matemáticas, física y dibujo.

A la vista de las metas relacionadas directamente con cada asignatura se ha demostrado que la ingeniería civil está esencialmente relacionada con 5 de los 17 ODS, los cuales se consideran los ODS más vinculados con la titulación y por tanto los que pueden ser trabajados en mayor número de asignaturas, estos son:

- ODS #6 Agua limpia y saneamiento: en 10 asignaturas.
- ODS #9 Industria, innovación e infraestructura: en 25 asignaturas
- ODS #11 Ciudades y comunidades sostenibles: en 15 asignaturas
- ODS #12 Producción y consumo responsables: en 16 asignaturas
- ODS #13 Acción por el clima: en 12 asignaturas

El resto de los ODS se pueden trabajar en distinto número de asignaturas (entre 1 y 9) con diferente profundidad y alcance según el caso. Además, todos los ODS se pueden trabajar



en otras actividades universitarias que dan lugar al reconocimiento de créditos contemplados en el RD1393/2007.

Las asignaturas con mayor potencial para trabajar los ODS, teniendo en cuenta el número de ODS que se trabajan o se pueden llegar a trabajar son las asignaturas siguientes:

- Transporte y territorio (2º curso): 5 ODS
- Hidráulica e hidrología (3er curso): 6 ODS
- Obras marítimas (3<sup>er</sup> curso): 6 ODS
- Gestión de empresas (4º curso): 5 ODS
- Infraestructuras hidráulicas (4º curso): 6 ODS
- Gestión de empresas consultoras y constructoras (4º curso): 5 ODS
- Ética en la ingeniería civil (4º curso): 8 ODS

La asignatura de 4º curso Ingeniería civil para la sociedad tiene una importancia relevante ya que es la única asignatura del plan de estudios vinculada con el ODS #16 Paz, justicia e instituciones solidarias. Del mismo modo, la asignatura Ética en la ingeniería civil, es la única asignatura que desarrolla el ODS #4.

En el siguiente apartado se va a realizar una propuesta con acciones concretas.

### **3. Propuesta**

#### **3.1. Acciones en tres niveles**

La incorporación de mejoras en una titulación en la Universitat Politècnica de València incluyen, atendiendo al Manual de Calidad de la institución, mejoras en dos esferas: mejoras en los procesos propios de la Universitat o de la Escuela y mejoras en el propio diseño del título.

Con este contexto, se plantean acciones en tres niveles diferentes para la incorporación de los ODS en los resultados del aprendizaje y perfil competencial de los egresados del Grado en Ingeniería Civil.

El primer nivel, de aplicación inmediata, consiste en introducir contenidos relacionados con la Agenda 2030 de manera transversal, para que todos los estudiantes conozcan su contenido. Para los autores, el modo más inmediato de conseguirlo es planteando una actividad formativa obligatoria para los alumnos de primer curso y que se puede impartir en el marco del Programa de Acción Tutorial (PATU) (Giménez-Carbó et al., 2017). Esta actividad estará orientada a explicar los objetivos perseguidos por la Agenda 2030, los 17

ODS y las 169 metas. Este nivel se corresponde con las mejoras en los procesos propios, en este caso, de la Escuela, mencionados anteriormente.

El segundo nivel planteará cambios a nivel asignatura. Una vez realizado el análisis explicado en el apartado 2, se tiene conocimiento de las asignaturas relacionadas con los ODS. Por lo que se propone mantener reuniones con los profesores responsables de dichas materias, junto con expertos en Agenda 2030, y abordar cambios para que, en los resultados del aprendizaje de los alumnos, estén presentes los ODS. Este nivel se corresponde con propuestas de mejora que no suponen una modificación de la memoria de verificación del título. En consecuencia, su implantación es relativamente sencilla y viable.

El tercer nivel se corresponde con propuestas de mejora que suponen una modificación de la memoria de verificación del título. El margen de acción y la inmediatez en la implantación de estas propuestas es muy reducido. No obstante, conviene plantear también acciones en este nivel pues son las que pueden dar lugar a cambios más integrados y articulados en todo el plan de estudios.

Todas las potencialidades detectadas en el diagnóstico se pueden abordar con actuaciones del segundo nivel, dado que simplemente pasarían por incorporar acciones específicas en las guías docentes de las asignaturas. Por otra parte, en futuras revisiones del plan de estudios que dieran lugar a modificaciones en la memoria de verificación podría plantearse a tenor del diagnóstico realizado, si asignaturas actualmente optativas que trabajan directamente os ODS, como Ingeniería civil para la sociedad o ética en la ingeniería civil no debieran pasar a formar parte del currículo obligatorio.

### **3.2. Validación de la eficacia de las acciones.**

Además de estudiar como introducir los ODS en el plan de estudios de los ingenieros civiles, también nos teníamos que plantear como verificar que los estudiantes alcanzaban estos resultados de aprendizaje. Todos los alumnos deben superar exámenes para certificar que han adquirido los conocimientos impartidos en cada materia, así que los contenidos relacionados con los ODS que se introducían en cada asignatura son relativamente fáciles de evaluar (por supuesto será necesario diseñar correctamente los actos de evaluación para que esta afirmación sea válida). Pero también es muy importante saber que la integración de estos contenidos en el currículo ha hecho que estén presentes en cada trabajo que los ingenieros civiles desarrollen en su vida profesional.

Será muy difícil llevar un seguimiento del trabajo de los egresados una vez abandonen la Escuela (en este momento será responsabilidad de los colegios profesionales), pero si se puede evaluar si están presentes en el trabajo fin de grado, el último acto que los estudiantes

realizan para conseguir la titulación y que en muchos casos es muy similar a los trabajos técnicos que realizaran durante su carrera profesional.

Por ello, se ha desarrollado una rúbrica, para analizar la capacidad de los estudiantes para incorporar los ODS en su trabajo. Esta rúbrica se ha diseñado teniendo en cuenta las 5 partes en que se agrupan los ODS y se han planteado 4 niveles (A, B, C, D) de consecución de integración del ODS, pero en dos alcances, potencial y asignado. La adaptación de la rúbrica a 4 niveles se ha realizado para mantener el mismo sistema de calificación que se lleva a cabo en el UPV para evaluar las competencias transversales presentes en todas sus titulaciones. Esta rúbrica también estará a disposición de los profesores de las asignaturas para que puedan evaluar la capacidad de implementación de los ODS en los trabajos entregados por los estudiantes en cada asignatura concreta.

#### **4. Conclusiones**

Una vez estudiado y analizado el plan de estudios del Grado en Ingeniería Civil se puede concluir:

- a. En el caso de la formación de los ingenieros civiles es imprescindible que los ODS estén presentes en su plan de estudios.
- b. Se ha mostrado una metodología sencilla en la que a partir de la revisión de las guías docentes de las asignaturas que conforman las distintas materias del plan de estudios, se han detectado la presencia y las potencialidades de incorporación de los ODS en la formación de los estudiantes.
- c. Se han expuesto acciones a tres niveles para incorporar los ODS en el currículo.
- d. Y por último se ha indicado como validar la adquisición de estos resultados de aprendizaje a nivel de asignatura y a nivel de Trabajo Fin de Grado, diseñando una rúbrica para facilitar la evaluación.

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## Docencia inversa en la asignatura Fundamentos Químicos para la Ciencia y Tecnología de los Alimentos

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### Resumen

*Dentro del Proyecto de Docencia Inversa de la Universitat Politècnica de València (UPV), esta metodología (DI) se ha incorporado a la asignatura Fundamentos Químicos para Ciencia y Tecnología de Alimentos, para el primer curso de dicho grado. Se ha aplicado a una unidad didáctica (UD) de química orgánica, con sus prácticas de laboratorio (PL), y a las PL de la UD de química física. La herramienta fundamental ha sido Lessons, diseñada para la creación y gestión de contenidos interactivos dentro de PoliformaT (plataforma educativa on-line de la UPV). Las principales características de la UD de química orgánica han sido: la atención a los conocimientos previos, el enfoque del contenido descriptivo como trabajo autónomo y el tratamiento presencial del que posee mayor demanda cognitiva. Se ha puesto además especial énfasis en la evaluación formativa. En cuanto a las PL, se ha utilizado Lessons y Exámenes de PoliformaT para la realización de actividades pre-laboratorio incluyendo un vídeo explicativo de cada práctica así como para la propuesta de actividades post-laboratorio. De este modo, la DI ha permitido optimizar las sesiones de prácticas, al prescindir de las introducciones teóricas, llegando el alumnado al laboratorio con una idea más clara de sus fundamentos teóricos y objetivos. En general, se han observado cambios positivos en el ambiente del aula, con una mayor autonomía, participación y responsabilidad del alumnado sobre su propio aprendizaje y una cierta mejora en los resultados académicos, debida probablemente a una mayor motivación.*

**Palabras clave:** Docencia inversa, Química, Prácticas de laboratorio, PoliformaT



## 1. Introducción

### 1.1. Características generales

La docencia inversa (DI) puede definirse como una estrategia educativa donde la clase presencial es un espacio de aprendizaje activo centrado en las tareas de mayor demanda cognitiva, en las que juega un papel esencial la interacción entre los estudiantes y entre estos y el profesorado (Tucker, 2012; Akçayir y Akçayir, 2018). Tradicionalmente, la docencia ha estado centrada en la transmisión de conocimientos en el aula y su revisión y aplicación práctica en tareas no presenciales. Por el contrario, en la DI, una determinada información conceptual y metodológica es proporcionada mediante objetos de aprendizaje diversos para que el alumno los trabaje de manera autónoma. Este aprendizaje proporciona el fundamento para las tareas presenciales, de mayor complejidad y demanda cognitiva. De este modo, el alumnado adquiere un mayor protagonismo en su formación.

En el diseño y aplicación de los materiales para el trabajo autónomo (no presencial) es importante utilizar la amplia gama de recursos tecnológicos actualmente disponibles para transmitir información: vídeos, *screencasts*, etc., así como diferentes herramientas interactivas: wikis, foros, etc., que hacen la clase más eficaz y amena, preparando emocionalmente al alumnado para estar más receptivos al aprendizaje. Ello es posible en el marco de plataformas de aprendizaje *on-line* como PoliformaT, utilizada en el Proyecto de Docencia Inversa de la Universitat Politècnica de València (UPV), (2019).

### 1.2. El papel del profesorado en la docencia inversa

Desde una perspectiva general, la DI puede situarse, de acuerdo con Akçayir y Akçayir (2018), en un enfoque del aprendizaje centrado en el estudiante y no en el profesorado. De esta manera, la organización y el contenido de las sesiones presenciales permiten una atención individualizada a los estudiantes y una mayor interacción entre ellos (Tucker, 2012), creando un espacio de aprendizaje colaborativo basado en el trabajo en pequeños grupos y en el papel del profesorado como facilitador del aprendizaje. Es posible así proporcionar un *feed-back* mucho más inmediato y llevar a cabo una evaluación formativa más eficaz. Abeysekera y Dawson (2015) añaden, como elemento esencial, la responsabilidad del estudiante en su propio aprendizaje, lo cual exige prestar una especial atención al desarrollo de la actividad metacognitiva del estudiante. Este factor, uno de los principales rasgos de identidad de la orientación constructivista del aprendizaje, es decisivo a la hora de implementar la DI, sobre todo en lo que concierne a las actividades no presenciales. También se refieren los citados autores al potencial que posee la preparación de los materiales de aprendizaje en cuanto al desarrollo profesional del docente, ya que le exigen un esfuerzo de

síntesis y clarificación que repercute positivamente en la calidad de su trabajo y en su propia formación.

### 1.3. La aplicación de la clase inversa: aspectos positivos y problemáticos

La evaluación de los resultados de la DI ha sido objeto de numerosas investigaciones basadas en estudios comparativos entre grupos control y experimentales, algunas de ellas relacionadas con el aprendizaje de la química (Ryan y Reid, 2015) y particularmente con la química orgánica (Cornier y Voisard, 2018) así como con las prácticas de laboratorio (Teo *et al.*, 2014). En general, en todas ellas se constata un efecto positivo en el rendimiento académico y sobre todo en la motivación e implicación de los estudiantes. En cualquier caso, como puntualizan Akçayir y Akçayir (2018), no debe olvidarse que la implementación de la DI no pretende exclusivamente el logro de mejores resultados académicos, sino también facilitar la atención individualizada y la posibilidad de crear más oportunidades para aplicar los conocimientos adquiridos. Una conclusión prácticamente general de las citadas investigaciones es que el vídeo es el recurso más eficaz para presentar la información (Jensen *et al.*, 2018), sobre todo cuando se trata de vídeos cortos para tratar conceptos concretos, tal como describen Cormier y Voisard (2018), en el contexto de la química orgánica. La eficacia de su aplicación didáctica puede explicarse partiendo de la teoría de la codificación dual (Clark y Paivio, 1991), que reconoce la efectividad de la combinación de los textos verbales y la imagen. La teoría motivacional de Keller (Galicia-Alarcón y Edel-Navarro, 2014) también explica el éxito del vídeo como material de aprendizaje, ya que es un recurso capaz de integrarse en la vida cotidiana del estudiante por tratarse de un formato que le resulta muy familiar por su amplio uso en las redes sociales. Los requisitos que deben cumplir estos vídeos han sido ampliamente descritos en la literatura y el impacto de su calidad en la aplicación de la docencia inversa es también ampliamente reconocido (Akçayir y Akçayir, 2018). Estos criterios de calidad concuerdan ampliamente con las características del denominado formato *Polimedia*, vídeos de corta duración elaborados como objetos de aprendizaje dentro del proyecto de Docencia en Red de la UPV (“¿Qué es Polimedia?”, 2019). De hecho, existe un elevado consenso acerca del papel positivo de la aparición de una persona transmitiendo la información, tanto por la motivación que genera como por el estímulo de la atención. Otra aportación interesante del vídeo es su capacidad para facilitar el repaso previo a las pruebas de evaluación, valoración constatada en anteriores estudios (Jensen *et al.*, 2018).

En general, puede apreciarse un cierto consenso acerca de la mejoría más acusada que la DI produce en los estudiantes con mayores dificultades iniciales (Jensen *et al.*, 2018). Asimismo, en cuanto a las competencias transversales, se considera que la DI promueve la autonomía y



el pensamiento crítico, tan importantes en el aprendizaje a lo largo de la vida y en el futuro desempeño profesional (O’Flaherty y Phillips, 2015).

En cuanto a las prácticas de laboratorio, la utilidad de la DI es afirmada por Teo *et al.* (2014), destacando la efectividad de su presentación mediante vídeos con un narrador, seguidos de cuestiones prelaboratorio. También se refieren dichos autores a una mejora en la comprensión de la fundamentación teórica y del objetivo de cada etapa experimental, así como al ahorro de tiempo que supone prescindir de la introducción teórica en el laboratorio, permitiendo la discusión final de los resultados obtenidos. Este modelo es, por otra parte, coincidente con el que los autores de este trabajo vienen aplicando habitualmente en la UPV.

Pese al balance generalmente positivo reflejado en la experimentación de la DI, diferentes retos, dificultades y dudas son también descritos en la literatura (Akçayir y Akçayir, 2018). En primer lugar, la necesidad de adaptación de los materiales didácticos, que supone un esfuerzo adicional al profesorado, sobre todo al comienzo de su implementación. Desde el punto de vista de los estudiantes, la literatura consultada coincide en señalar como el principal obstáculo el diferente grado de implicación de los estudiantes, manifestado en la falta de preparación del trabajo no presencial (Jensen *et al.*, 2018). También hay referencias específicas a las dificultades de adaptación a la DI del alumnado del primer curso de sus estudios universitarios (O’Flaherty y Phillips, 2015).

## **2. Desarrollo de la innovación**

La propuesta descrita a continuación ha sido implementada en la asignatura Fundamentos Químicos para Ciencia y Tecnología de Alimentos, en el primer curso de dicho grado. Esta asignatura es troncal, de 12 créditos, y está distribuida en tres unidades didácticas: UD1. Introducción a la Química orgánica, UD 2. Química física y UD 3. Cinética y Equilibrios. La DI fue aplicada globalmente a la UD1 y a las prácticas de laboratorio de la UD2 durante el curso 2018-19, en el marco del Proyecto de Docencia Inversa de la UPV. La iniciativa de incorporar la DI a esta asignatura surgió, en cuanto a las PL, por la necesidad de garantizar una adecuada comprensión de sus fundamentos y objetivos, así como de su contextualización en la secuencia de aprendizaje de la asignatura. Por otra parte, en la introducción a la química orgánica, la DI se consideró una alternativa potencialmente útil para conseguir sesiones presenciales más participativas y centradas en los contenidos de mayor exigencia cognitiva, desarrollando los de carácter descriptivo y los relacionados con la formulación y nomenclatura de modo preferentemente no presencial.

En cuanto al tratamiento de las CTs, esta asignatura es punto de control de: “Conocimiento de problemas contemporáneos”, donde se pone el acento en el enfoque agroalimentario de la

UD1 e “Instrumental específica”, a la que contribuye el aprendizaje del uso de software químico. Al mismo tiempo, el desarrollo de otras CTs como la organización y gestión del tiempo puede considerarse implícito en la aplicación de la DI.

La aplicación de la DI a las prácticas consistió en una actividad prelaboratorio basada en un vídeo o una actividad con la herramienta *Lessons*. Esta permite configurar secuencias de aprendizaje cuyos elementos se hallan incorporados o enlazados en un documento digital único, de modo que son fácilmente accesibles al alumnado. En algunos casos se incluyeron también artículos docentes de apoyo para la comprensión de los conceptos o para ampliar algunos de particular interés. En cualquier caso, sus objetivos fueron contextualizar la práctica en cuanto a su fundamentación teórica y en relación al ámbito agroalimentario, así como describir el proceso experimental atendiendo a los fundamentos físico-químicos de las operaciones de laboratorio y los posibles problemas de seguridad. Esta actividad prelaboratorio se complementó con una prueba *on-line* obligatoria a través de la herramienta “exámenes” de PoliformaT, contribuyendo a la nota final de la práctica. Asimismo, se plantearon actividades post-laboratorio de reflexión y consolidación, susceptibles de ser comentadas en las clases de teoría y preguntadas en el examen. Cabe precisar que las calificaciones de teoría y de las prácticas son independientes, contribuyendo estas últimas (diez en total, para las tres unidades didácticas) en un 25 % a la calificación final.

La UD1, dedicada a la química orgánica, se estructuró en 11 temas elaborados con la herramienta *Lessons* con la siguiente estructura: (1) Presentación con presentaciones y vídeos de los contenidos descriptivos de menor demanda cognitiva, referidos al contexto agroalimentario, integrando preguntas con *feed-back* inmediato. Algunos de los vídeos son interactivos, incluyendo ejercicios prácticos. (2) Actividades para la clase presencial, en forma de PDFs o presentaciones, donde se trata la relación estructura-propiedades, isomería, y reactividad, aspectos de mayor demanda cognitiva. En estas sesiones se utilizó ocasionalmente la herramienta *Socrative*<sup>TM</sup> para la evaluación formativa, junto a una autoevaluación *on-line* semanal. (3) Trabajo en grupos: elaboración de un *screencast* acerca de un aditivo alimentario, que se evaluó mediante una rúbrica específica. Paralelamente, al comienzo de curso, se propusieron actividades relacionadas con prerrequisitos y sobre el manejo del software *ChemSketch*<sup>®</sup>. También se plantearon durante este periodo inicial actividades no presenciales y presenciales sobre formulación y nomenclatura.

### 3. Resultados y discusión

Para conocer la opinión del alumnado acerca de la metodología implantada (DI), se realizó un sondeo con las siguientes cuestiones en *Google forms*, al que contestaron 39 estudiantes (44% del alumnado). Los resultados se muestran en la figura 1. En cuanto a la valoración



general del modo de abordar los contenidos. (Fig. 1a) puede aceptarse que la mayor parte del alumnado (59 %) valora positivamente la DI. La utilización del material audiovisual (Fig. 1b) registra también un grado de aceptación que avala la calidad del material empleado. Del mismo modo, la valoración de las actividades pre-laboratorio (Fig. 1c) apoya su aplicación generalizada. También es positivamente apreciada la utilidad de la herramienta *Lessons* (Fig. 1d). En cuanto al modo de introducir la formulación y nomenclatura (Fig. 1e) los resultados también aconsejan no modificar la metodología empleada. También parece apropiado desde la opinión del alumnado mantener la realización de autoevaluaciones (Fig. 1f). La preferencia del alumnado por la explicación presencial del profesorado de los contenidos descriptivos (Fig. 1g) puede explicarse, de acuerdo con Brewer y Movahedazarhouli (2018) por cierta sensación de desconcierto que diferentes modos de presentar la información pueden producir en el alumnado, sobre todo cuando se enfrenta a la DI al comenzar sus estudios universitarios. Por otra parte, cabría revisar si el diseño y aplicación del material audiovisual es adecuado en cuanto a su duración y densidad semántica. También es necesario garantizar que el alumnado lo utilice correctamente, por lo que puede ser conveniente un seguimiento más riguroso del trabajo no presencial, verificando el uso personal de los vídeos.

Con respecto a la organización general del curso y el seguimiento de los planes de trabajo (Fig. 1h) un 25% en desacuerdo aconseja la necesidad de revisar la estructura del curso. También cabe reflexionar acerca de la autopercepción que el alumnado tiene de su organización personal del tiempo (Fig. 1i). Aproximadamente el 54% está de acuerdo en que no se organiza bien, aunque un 25% piensa que ese no es el problema. Este resultado puede explicarse en parte por tratarse de alumnado de primer curso. La organización y gestión del tiempo (una de las competencias transversales en el proyecto de la UPV) es especialmente sensible a la madurez del alumnado y consecuentemente, a su capacidad de reflexión y autocrítica. Sin embargo, hay otro factor que puede considerarse decisivo: el hecho de que la DI se aplique solo puntualmente en ciertas materias. Es evidente el impacto que los actos de evaluación de otras asignaturas producen en la DI, principalmente en el trabajo no presencial.

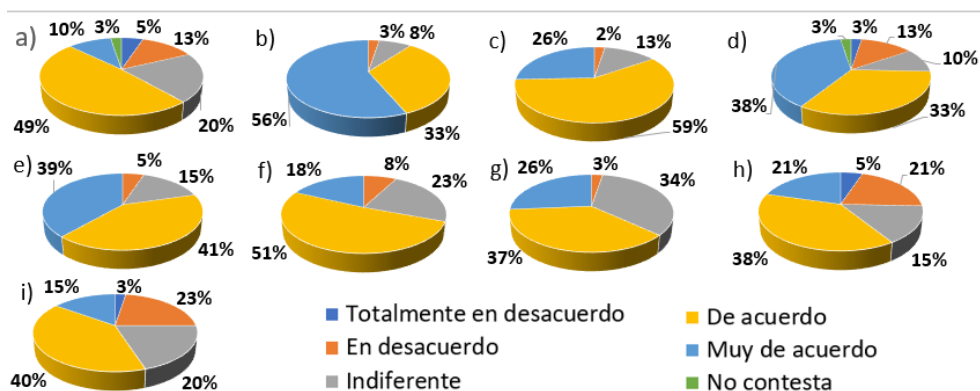


Fig.1. Opiniones de los estudiantes sobre la implantación de la DI en la asignatura. Se muestra en diagrama de sectores, representados por colores (nº; %), las opiniones sobre las cuestiones: a) En general, me parece apropiado el modo de abordar los contenidos. b) La utilización del material audiovisual (polimedias, principalmente) me ha resultado útil en el desarrollo de la asignatura. c) Las actividades pre-laboratorio contribuyen a mejorar las sesiones de prácticas y a comprender mejor su fundamento y objetivos. d) La herramienta de poliformaT "Lessons" la considero un importante avance a la hora de organizar los contenidos de la asignatura. e) El modo de introducir la formulación y nomenclatura (sesiones iniciales de introducción y ejercicios resueltos a lo largo de los temas) lo considerado adecuado. f) La realización de autoevaluaciones me ha resultado útil para comprender mejor los conceptos introducidos en la asignatura. g) En los contenidos descriptivos, como las aplicaciones agroalimentarias, he echado de menos la explicación en clase. h) La organización general del curso: exámenes, trabajos, etc., me impide ir al día, no realizando las tareas indicadas en los planes de trabajo. i) Una mejor organización personal del tiempo me ayudaría a llevar la asignatura al día, realizando en su momento las tareas indicadas en los planes de trabajo.

En cuanto a los resultados académicos, la Fig. 2 muestra de modo comparativo los resultados de cada uno de los bloques del examen y la calificación global de la UD1, (que integra el trabajo complementario y los resultados de la evaluación formativa), para el curso 2018-19 y 2017-18, en el que no se aplicó la DI. Excepto en reactividad, se observan pequeños incrementos que son significativos ( $P \leq 0.05$ , prueba "t" de Student), en los bloques de isomería (típicamente presencial) y formulación (desarrollado de modo no presencial). Sin embargo, donde el cambio de enfoque docente fue más drástico (aspectos descriptivos), totalmente no presencial, el rendimiento fue prácticamente idéntico. Una mejoría relativamente importante, aunque no llega a ser estadísticamente significativa, se ha observado en el apartado de propiedades físicas y estructura molecular. En cuanto a la calificación global, la DI muestra una media significativamente mayor ( $P = 0.05$ ). Comparando la calificación media de la UD1 del curso 2018-19 con las obtenidas en la UD2 (5.29) y UD3 (5.37) en las que no se aplicó la DI (en cuanto a contenidos teóricos), se observó una cierta mejoría que no llega a ser significativa para  $P \leq 0.05$  ( $P = 0.08$  en ambos casos).

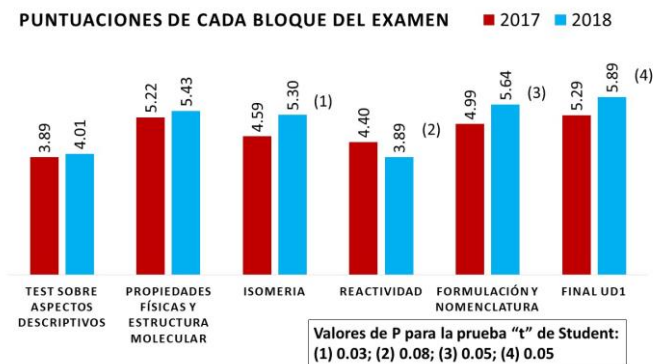


Fig.2. Calificaciones de los diferentes bloques del examen parcial de la UD1 y nota global de los cursos 2017 y 2018. Se muestran los valores de P para la prueba "t" de Student cuando pueden considerarse relevantes.

#### 4. Conclusiones

En general, la DI es positivamente valorada por el alumnado encuestado en cuanto a los recursos utilizados. Aspectos tales como el material audiovisual, empleo de la herramienta *Lessons* o la realización de autoevaluaciones han sido muy bien valorados, del mismo modo que la aplicación de la DI a las actividades pre-laboratorio. Estas han sido un recurso muy útil para la mejora de las prácticas teniendo en cuenta su contenido, número de estudiantes y duración. Todos estos resultados pueden considerarse satisfactorios tratándose del primer año de experimentación con alumnado de primer curso. Es la percepción global de la DI lo que parece más susceptible de mejora, siendo evidente la necesidad de explicar más detenidamente al alumnado esta metodología al principio del curso, así como de proporcionarles pautas y orientaciones para mejorar la organización y gestión del tiempo, competencia transversal que juzgamos clave en la implementación de la DI. Por último, debe constatar que, pese a haber constituido de una experiencia claramente positiva tanto para el profesorado y el alumnado, un impacto claramente positivo de la DI en el aprendizaje exige, si no su aplicación en todas las asignaturas de un curso, al menos una coordinación entre ellas que evite interferencias en el trabajo no presencial, aspecto clave de la DI.

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## Metodología docente para la enseñanza técnica online. La experiencia Cursosagua

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### Resumen

*La enseñanza online ha llegado para quedarse. Su éxito se debe a que ha eliminado la barrera temporal y espacial, facilitando el acceso de estudiantes de todo el mundo. Sin embargo, un curso online de calidad no puede tratarse de una adaptación de una clase presencial a una clase online. Es necesario adecuar la metodología docente a este medio. Este trabajo ilustra la metodología docente utilizada para la formación técnica online por CursosAgua, así como los resultados obtenidos.*

**Palabras clave:** *formación online, hidráulica, formación técnica, metodología docente.*

### 1. Introducción

La enseñanza online es un concepto que, desde la irrupción de las nuevas tecnologías, se ha ido normalizando en la sociedad. En 2007, con la creación del primer curso MOOC (Massive Open Online Courses - Cursos Online Masivos y Abiertos), el número de estudiantes online ha ido creciendo exponencialmente (Dumbauld, 2014).

La enseñanza online ha permitido la democratización de la enseñanza puesto que ha logrado eliminar la barrera geográfica y temporal. De este modo, pueden acceder a cursos especializados un mayor número de estudiantes, tanto profesionales que buscan ampliar sus conocimientos para progresar en su carrera profesional, como estudiantes que buscan especializarse para salir al mercado laboral.

La oferta de cursos online es muy amplia, sobre todo en lo que refiere a los MOOC. Sin embargo, aunque las plataformas educativas no dejan de publicar guías de buenas prácticas para crear cursos que motiven al alumnado y ofrezcan conocimiento de calidad (MiríadaX,





2016; Pineda, Valdivia, & Ciraso, 2015; Universidad Carlos III de Madrid, 2016), la realidad es que las tasas de finalización de la enseñanza online, y en particular, los MOOC, son muy bajas.

Un estudio llevado a cabo por la Escuela Europea de Dirección de Empresa (EUDE) en 2014 revela que la tasa de abandono de la formación online se encuentra sobre el 35% en másteres y posgrados, pero cuando hablamos de MOOC, el porcentaje asciende al 90% (Carrizosa, 2014). ¿A qué se deben estas cifras? Se podrían identificar tres aspectos relevantes: la metodología utilizada en la formación online, las tasas de abandono en los cursos y las expectativas del alumnado.

La metodología docente es uno de los aspectos clave para el éxito del curso. Un formato adaptado a la formación online y atractivo, que rompa con la monotonía que supone realizar un curso online a base de vídeos o documentos pdf descargados, aumentará las posibilidades de que el estudiante finalice la formación.

Por supuesto, no toda la culpa la tiene el formato de los cursos, también está el aspecto económico. De acuerdo con Confitegal (2017), frente a una tasa de abandono de los 90% de los cursos gratuitos (MOOC), los cursos de pago se sitúan en torno al 30%.

Finalmente, en cuanto a las expectativas de los alumnos, se debe salvar por un lado la dificultad de que muchos de los alumnos matriculados esperan que, por el hecho de ser online, la formación sea más fácil y les suponga menos tiempo y esfuerzo. Sin embargo, esto no suele ser así, y puede ocurrir que el estudiante no encuentre el tiempo suficiente para cumplir con los compromisos que se exigen en la formación. Por otro lado, la resolución de dudas de forma rápida y efectiva es un aspecto relevante.

CursosAgua es la marca de enseñanza online del Grupo ITA (DIHMA, Universitat Politècnica de València). Cuenta con más de 10 años de experiencia online, y actualmente imparte un máster online, 4 títulos de posgrado y más de 20 cursos online de pago sobre hidráulica urbana y modelación y gestión de abastecimientos urbanos.

Este artículo presenta una propuesta de metodología docente para la enseñanza online, aplicada a formación técnica, a través de la metodología utilizada por CursosAgua en sus cursos de hidráulica. Asimismo, se presentará la figura del tutor como un actor clave para la culminación exitosa del curso por parte del alumno.

## 2. Metodología docente para la enseñanza técnica online

### 2.1. Creación de materiales para enseñanza online en asignaturas técnicas

La creación de contenido educacional online debe de adaptarse al medio en el que será utilizado. En muchas ocasiones los cursos online son una versión en línea de contenidos presenciales. Así, es fácil, por ejemplo, encontrar cursos compuestos únicamente por largos vídeos que simulan clases presenciales o cursos formados por descargas de documentos extensos con los contenidos del temario. Es por ello que, pese a la gran oferta educativa online, no es sencillo encontrar cursos que realmente enganchen al alumno.

Uno de los factores clave para el éxito de un curso online es la pedagogía empleada y el diseño del curso (Johnson & Aragon, 2003). El modelo pedagógico tradicional en el que el instructor proporciona grandes cantidades de información al alumno y espera que éste la procese y asimile, ha demostrado no ser el más adecuado (Reigeluth, 2016). Se ha demostrado que la asimilación de conocimiento es mayor cuando al estudiante se le proporciona la información en pequeñas dosis y cuando los contenidos se aplican a casos prácticos que guardan similitud con el día a día del alumno. La motivación del estudiante es también un aspecto que debe cuidarse, tanto a nivel de contenidos como por parte del tutor (Johnson & Aragon, 2003).

Los contenidos de los cursos impartidos en CursosAgua tienen en cuenta todas estas consideraciones y están diseñados específicamente para impartirlos en un entorno online. El curso está formado por un camino principal, donde se encuentra todo el temario que se estima que el alumno debe poseer para alcanzar los objetivos de aprendizaje. Este camino está formado por cortos textos acompañados de imágenes y esquemas relacionadas con el contenido, que ayudan a los alumnos a una mejor comprensión del temario estudiado, tal y como muestra la Fig. 1.

La variación del desnivel geométrico de la impulsión modificará también el punto de funcionamiento. Por ejemplo, el vaciado del depósito de aspiración desplaza la curva resistente hacia arriba (aumenta  $H_g$ ), y al mismo tiempo se reduce el caudal impulsado aumentando la altura de bombeo

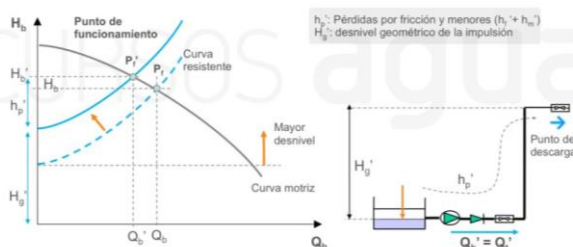


Fig. 1. Elemento del camino principal

El camino principal cuenta también con vídeos. La función principal de éstos es explicar aquellos conceptos que son más complejos y en los cuales los alumnos presentan mayores dificultades de comprensión. Se trata de vídeos cortos, de no más de 5 minutos, puesto que se ha demostrado que la atención del alumno disminuye cuando la longitud del video es mayor (Guo, Kim, & Rubin, 2014; Hsin, Cigas, & Science, 2013).

La tipología de vídeos utilizada varía en función del objetivo a cumplir. Para explicar el uso de software se utilizan screencast. Los conceptos técnicos más complejos se explican con vídeos donde aparece el profesor como protagonista, apoyado por transparencias que le permiten explicar con claridad los contenidos del vídeo. Por último, los objetivos del curso, la introducción de las unidades y los conceptos teóricos que no necesitan de explicación visual, se exponen empleando vídeos con el busto del profesor como protagonista, sin apoyo de diapositivas.

Además de los contenidos situados en el camino principal del curso, se cuenta con material adicional en forma de descarga o caminos alternativos. Las descargas pueden ser documentos de texto que proporcionen más información, enlaces a otros sitios web o casos prácticos que el alumno debe resolver. Los caminos alternativos son desvíos del camino principal que ofrecen contenido que el alumno puede elegir si desea visitar o no. Estos desvíos siguen el mismo formato que el camino principal.

Estos contenidos adicionales tienen dos objetivos. El primero de ellos es ofrecer información extra que puede ser de interés para el alumno, pero que no es necesaria para lograr los objetivos didácticos del curso. El segundo objetivo es ofrecer información sobre conceptos que son necesarios para comprender lo que se está explicando. Son conceptos que se dan por sabidos, pero que se ofrecen para ser repasados y recordados.

## **2.2. Desarrollo del curso**

En muchos cursos online el temario se va desbloqueando de forma temporal, por lo que cada cierto tiempo se habilita un nuevo tema. Esta filosofía tiene algunas ventajas, ya que, se garantiza que los alumnos visualicen el contenido secuencialmente, siendo más fácil comprobar que están siguiendo el calendario del curso. Sin embargo, el mayor inconveniente de este método es que los alumnos que avanzan más rápido quedan parados hasta la nueva fecha de apertura.

En el extremo opuesto se pueden encontrar los cursos cuyo temario está completamente abierto desde un principio. Se debe tener en cuenta, que los contenidos, sobretodo en asignaturas técnicas, está ordenado de forma que se empieza desde los conocimientos más básicos para ir construyendo una base sólida que ayude al alumno a comprender los conceptos

más complejos. En este caso, se corre el riesgo de que el alumno se salte alguna parte necesaria del temario para entender desarrollos futuros.

Los cursos ofertados por CursosAgua se encuentran disponibles en cualquier momento del año. Al tener alumnos que empiezan a lo largo de todo el año, es inviable ir abriendo los temas de acuerdo a fechas predefinidas. Para este caso, se estima más conveniente que sea el mismo alumno quien vaya avanzando a su ritmo, en función de su disponibilidad temporal, y siempre con el apoyo y seguimiento de los tutores. De este modo, los contenidos están bloqueados desde un inicio, y es el alumno quien los desbloquea conforme va desarrollando el temario.

Cabe resaltar que, aunque la formación online permite mucha flexibilidad en cuanto a horarios y fechas de realización de los cursos, es recomendable establecer una fecha de finalización para lograr que el alumno culmine con éxito la formación.

### **2.3. Evaluación**

La evaluación utilizada por Cursosagua está basada en 4 elementos de evaluación (Del Teso March, Estruch Juan, Gómez Sellés, & Soriano Olivares, 2018): puntos de control, test de las unidades, test final y entrega de ejercicios. La combinación de estos elementos conforma un sistema de evaluación continua en el que el alumno va superando pruebas en cada unidad didáctica. De esta forma, es inmediato conocer si está asimilando los conceptos correctamente y, si no es el caso, el tutor lo detecta rápidamente para remediar la situación.

Los puntos de control son el primer tipo de evaluación con la que se encuentran los alumnos. Se trata de preguntas prácticas, aplicadas a ejercicios a resolver o a conceptos teóricos clave visualizados. Se localizan a lo largo de las unidades didácticas. Los resultados obtenidos ayudan al alumno a saber si está comprendiendo el temario adecuadamente.

El test de unidades es una evaluación que se habilita una vez se ha finalizado una unidad. Su intención es evaluar si los conocimientos de la unidad se han adquirido correctamente y si los puntos de control han servido para aderezar las faltas de conocimiento.

Al finalizar cada curso el alumno debe realizar un test final en el que se evalúa si ha adquirido los objetivos de aprendizaje.

Finalmente, al tratarse de una formación técnica, la aplicación de los conceptos aprendidos a casos prácticos reales es la mejor forma de que los alumnos fijen los conocimientos adquiridos. A lo largo del curso los alumnos deben resolver ejercicios prácticos que han de enviar a los tutores para su evaluación. Una vez realizado y entregado, los tutores lo corrigen y proveen feedback en un plazo inferior a 24 horas. En el caso de que el caso no esté bien resuelto, indican al alumno en qué conceptos ha fallado para que pueda subsanarlos y volver

a enviarlo para su evaluación. No todos los cursos tienen ejercicios, siendo una característica de los más técnicos, donde este tipo de evaluación es clave para alcanzar los objetivos del curso.

#### **2.4. El tutor como elemento imprescindible de la formación online**

El tutor es un elemento crucial para garantizar el éxito de un curso online (Pineda et al., 2015) ya que debe garantizar una respuesta rápida a las consultas del alumno y de forma continua. La metodología CursosAgua está completamente alineada con esta filosofía, ya que el tutor es quien realizará un seguimiento al alumno para asegurarse que el desarrollo del curso es el adecuado para superar el curso y finalizarlo dentro del plazo previsto.

Entre sus tareas están contestar las dudas de los alumnos y guiarlos en cualquier consulta que puedan tener sobre el curso o su funcionamiento. Garantizando la respuesta en un breve plazo de tiempo. Por supuesto, en muchos casos, no es una contestación inmediata, ya que cerca del 40% de los alumnos provienen de Latinoamérica. Sin embargo, las preguntas se suelen contestar en un plazo inferior a 24 horas.

El tutor es también quien corrige los ejercicios entregados por los alumnos y les proporciona la retroalimentación acerca de la idoneidad de la solución propuesta. Al tratarse de una formación ingenieril y técnica, existen multitud de soluciones posibles para los casos prácticos y, por tanto, es imprescindible la revisión de la resolución de los ejercicios planteados por los tutores. Los tutores son accesibles a los alumnos por diversos medios como son el correo interno de la plataforma CursosAgua, correo electrónico, teléfono o videoconferencia. Siendo los dos primeros los más utilizados por los alumnos.

### **3. Resultados**

Los resultados obtenidos por dicha metodología docente son positivos. Las encuestas contestadas por los alumnos muestran que éstos están muy satisfechos con la formación. Las encuestas son realizadas por el Centro de Formación Permanente de la Universitat Politècnica de València, centro del que dependen los cursos ofrecidos por Cursosagua.

La Fig. 2 muestra los resultados de dicha encuesta en el Máster en Gestión Eficiente del Agua urbana. En particular, las preguntas I, J, N y O son las referidas a la metodología docente del curso, y muestran resultados excelentes, todas por encima de 9. Asimismo, las preguntas B, C y D también cuentan con buenos resultados. Estas preguntas están dirigidas a evaluar la relación del alumno con el tutor y la idoneidad de la respuesta del tutor ante las sobre cuestiones que les puedan surgir.



Fig. 2. Resultado de las encuestas del título propio de posgrado: Máster en gestión eficiente del agua urbana

Por otro lado, acerca del porcentaje de abandono, en la última edición 17/18 ésta fue de un 19% en cursos individuales. En cuanto a los 4 títulos de posgrado que se ofertaron, la tasa de abandono fue del 28%, llegando al 18% en el Máster en Gestión Eficiente del Agua Urbana. Estos resultados se consideran satisfactorios ya que los porcentajes se encuentran por debajo de la tasa de abandono de este tipo de formación (35%), aunque se está trabajando para seguir mejorando. Para ello, se están realizando mejoras en los vídeos y en el entorno educativo.

La tasa media de abandono se puede observar que es superior en los títulos de posgrado. Esto puede ser explicado por el hecho de que realizar un título de estas características, en el caso de CursosAgua, supone entre 210 y 660 horas de formación. Así, se trata de un tipo de formación que requiere más sacrificio y dedicación que realizar un único curso online. Los alumnos que realizan los posgrados de CursosAgua son en su mayoría profesionales del sector del agua, que compaginan sus estudios con sus labores profesionales. Es por ello, que no todos son capaces de dedicar todo el esfuerzo que se requiere y abandonan la formación o la posponen para finalizarla en ediciones posteriores.

## **4. Conclusión**

La metodología docente es uno de los factores clave para lograr una formación online exitosa y de calidad. Este trabajo muestra la experiencia de CursosAgua en la docencia online de formación técnica centrada en la hidráulica urbana y la gestión eficiente del agua urbana.

A lo largo del artículo se ha detallado la metodología docente utilizada, centrada en la creación de materiales adecuados para la docencia online, el formato del curso en cuanto a la visualización del temario, el método de evaluación utilizado así como el papel del tutor en la motivación y tutorización del alumno.

A continuación, se resumen los principales factores identificados como clave para garantizar una formación online de calidad y que motive al alumno. En primer lugar, se ha destacado la importancia de que los contenidos sean especialmente diseñados para ser impartidos en un medio online. Para ello, es importante que los contenidos estén presentes en distintos formatos (imagen, vídeo y texto) para romper la monotonía. Además, en un entorno online no se puede evaluar la atención del alumno. Es por ello que, para evitar distracciones y falta de atención, se propone presentar los contenidos de manera directa, clara, concisa e ilustrativa, en pequeñas dosis fácilmente digeribles por el alumno..

En segundo lugar, se recomienda que sea el alumno quien fije su ritmo de trabajo en función de su disponibilidad temporal. Sin embargo, los cursos deben tener definida una fecha de finalización para lograr que los alumnos culminen con éxito la formación.

En tercer lugar, se recomienda emplear una evaluación continua. Este tipo de evaluación ofrece grandes ventajas a la hora de detectar deficiencias en la consecución de los objetivos docentes del curso y solucionarlas rápidamente.

Finalmente, se ha destacado el papel del tutor, como elemento imprescindible en la formación online, siendo éste el encargado de fomentar la motivación de los alumnos y resolver cualquier duda o consulta que les pueda surgir. El tiempo de respuesta debe ser reducido para que los alumnos no queden parados esperando la resolución de una duda que les impide continuar con el desarrollo del curso.

Como consecuencia, los resultados obtenidos por dicha metodología docente son positivos, tal y como indican el grado de satisfacción del alumnado, así como la tasa de abandono, que se mantiene por debajo de los valores medios obtenidos por la formación online.

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## Desarrollo de competencias transversales mediante la creación de screencasts por los estudiantes

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### Resumen

*El desarrollo y evaluación de las competencias transversales (CTs) exige el diseño y evaluación de actividades de aprendizaje capaces de contribuir, en sucesivos grados de amplitud y complejidad, a su puesta en práctica. En este sentido, la incorporación de recursos tecnológicos como los screencasts puede ser de gran utilidad. En este se ha introducido un modelo de actividad en la asignatura Fundamentos Químicos para la Ciencia y Tecnología de Alimentos para la adquisición de las competencias transversales basado en la elaboración de screencasts por el propio alumnado, a lo largo de tres cursos académicos. En los dos primeros, su contenido fue el estudio de la composición química de un alimento, así como de sus características nutricionales y aspectos relacionados con la salud. En el tercero, la descripción de un aditivo alimentario en cuanto a su naturaleza química, aplicaciones y posibles efectos nocivos. En ambos cursos, se prestó especial atención al uso de aplicaciones informáticas para la representación de estructuras moleculares, a los criterios básicos de calidad de una presentación y al uso de una bibliografía adecuada. La actividad se evaluó mediante una rúbrica específica, cuyos resultados han permitido considerarla especialmente adecuada para el logro de los objetivos propuestos.*

**Palabras clave:** Competencias transversales, screencasts, Tecnología de Alimentos



## 1. Introducción

### 1.1. El desarrollo de las competencias transversales en el marco del Espacio Europeo de Educación Superior.

El aprendizaje basado en la adquisición de competencias puede considerarse el marco teórico en el que desarrolla la mayor parte de las innovaciones educativas dentro del Espacio Europeo de Educación Superior. Además de las competencias específicas, relacionadas con los conocimientos y habilidades necesarias en un ámbito disciplinar o profesional concreto, las transversales (CTs) pueden definirse como el conjunto de habilidades, actitudes y valores vinculados al desarrollo personal, que no están directamente relacionadas con un contexto temático o disciplinar concreto, sino que surgen en los distintos ámbitos de la actuación profesional y académica. La adquisición de estas competencias puede considerarse decisiva desde una concepción del aprendizaje a lo largo de la vida (Rué, 2008). Un ejemplo de esta tendencia es el *Proyecto de Competencias Transversales de la Universitat Politècnica de València* (UPV), (2015), cuyo objetivo principal es acreditar un conjunto de competencias transversales a sus egresados.

### 1.2. Algunos retos a los que se enfrenta la introducción de las CTs

Desde la práctica docente cotidiana pueden plantearse dos retos fundamentales que dan sentido a este trabajo. En primer lugar, las limitaciones temporales imponen una cuidadosa y adecuada selección de los contenidos y actividades. Es necesario diseñar secuencias de aprendizaje capaces de integrar las CTs de modo que éstas no constituyan un apéndice o extensión de las actividades ordinarias. En este sentido, el aprendizaje de la química posee ciertas características específicas que le confieren complejidad, principalmente porque el conocimiento químico se basa en una coordinación continua entre tres niveles de descripción de la materia y sus transformaciones: simbólico, atómico-molecular y macroscópico. Este hecho exige a los estudiantes la adquisición de competencias comunicativas adecuadas, tanto textuales como gráficas. Por otra parte, las relaciones química-sociedad son notablemente variadas, muy relevantes y a menudo controvertidas. La enseñanza de la química es por tanto un ámbito privilegiado para el tratamiento de determinadas dimensiones competenciales como la *responsabilidad ética y medioambiental* o el *conocimiento de problemas contemporáneos*, del mismo modo que la *aplicación y pensamiento práctico* o *planificación y gestión del tiempo*, si tenemos en cuenta las características específicas de la experimentación en el laboratorio de química.

En segundo lugar, debemos considerar el reto de la evaluación. Las CTs vienen relacionadas con aspectos ligados al desarrollo personal y social de los estudiantes muy

condicionados por el ambiente de aprendizaje. En la medida en que la evaluación se enriquece por la incorporación de prácticas tales como la evaluación formativa, la autoevaluación y la coevaluación, cada vez más extendidas y acreditadas, es posible disponer de más y mejores oportunidades para la evaluación de las CTs.

### 1.3. La utilización de recursos digitales por el alumnado

Una valiosa herramienta a la hora de afrontar los retos anteriormente citados es la incorporación de las TIC (Maceiras et al., 2010). Además de proporcionar recursos para el acceso a la información, contribuyen a dotar de una elevada fluidez y diversidad metodológica la interacción entre los propios estudiantes y entre estos y el profesorado. En este contexto, los recursos digitales generados por los estudiantes (conocidos por las siglas LGDM: *Learner-Generated Digital Media*), constituyen una prometedora línea de investigación e innovación educativa, tal como afirman Reyna y Meier (2018).

Dentro de recursos digitales, la creación de *screencasts* por los estudiantes puede considerarse con un gran potencial innovador, principalmente por su accesibilidad y facilidad de creación. Los *screencasts* consisten en vídeos elaborados a partir de la captura de pantalla de una secuencia de imágenes, acompañadas frecuentemente de la correspondiente grabación en audio, que puede ser creada, por ejemplo, a partir de una presentación de diapositivas.

Como recurso docente es una herramienta ampliamente utilizada, siendo de particular interés su utilización en la transformación de la clase tradicional en la clase inversa o *flipped teaching* (Seery, 2015). Es ampliamente utilizado en la enseñanza *on-line* y en la clase presencial como material de apoyo (Smith, 2014), existiendo una amplia literatura relacionada con su diseño y modo de aplicación (Mohorovičić, 2012). Sin embargo, existe muy escasa literatura, centrada fundamentalmente en el aprendizaje de la informática, acerca de su producción por los estudiantes (Reyna y Meier, 2018).

Desde la perspectiva de la relación coste/beneficio, el *screencast* posee ciertas ventajas que lo hacen particularmente aconsejable. En primer lugar, su capacidad para integrar procesos comunicativos diversos: imágenes y textos orales y escritos. También cabe destacar su gran versatilidad en cuanto a su función en el proceso de aprendizaje, destacando su potencialidad como instrumento de evaluación. El *screencast*, por último, puede crearse fácilmente mediante herramientas de acceso gratuito que proporcionan productos audiovisuales de razonable calidad sin necesidad de una gran experiencia previa en su uso.

## 2. Objetivos:

El objetivo fundamental de este trabajo es el diseño y aplicación de un modelo de actividad que favorezca de modo prioritario el logro de las siguientes competencias transversales: Comprensión e integración; planificación y gestión del tiempo, trabajo en equipo y liderazgo, responsabilidad ética, medioambiental y profesional, comunicación efectiva, pensamiento crítico, conocimiento de problemas contemporáneos e instrumental específica.

Este trabajo es una continuación de la experimentación desarrollada durante los cursos 2016-17 y 2017-18 (Cardona y Rubio-Granero, 2018; Llorens-Molina, 2018). En su aplicación durante 2018-19 se ha mantenido la estructura de la actividad y su metodología pero se ha cambiado su contenido. En los dos primeros cursos el tema fue el estudio de un alimento vegetal, en el último, de un aditivo alimentario. Esta modificación ha pretendido dar un enfoque más crítico y centrado en la responsabilidad ética y medioambiental.

Otro objetivo ha sido la propuesta y aplicación de una rúbrica específica para su evaluación. Esta fue utilizada en la evaluación por el profesorado y por alumnado (coevaluación) en los dos cursos anteriores (Cardona y Rubio-Granero, 2018; Llorens-Molina, 2018). Tras el análisis de los resultados obtenidos y considerando las condiciones en que se desarrolló la unidad en 2018/19 se optó por mantener exclusivamente la evaluación por el profesorado. Por último, se ha analizado también la percepción del alumnado acerca del tratamiento de los CTs a través de la actividad, comparando los resultados con los obtenidos en los dos cursos precedentes.

## 3. Desarrollo de la innovación

El presente trabajo ha sido realizado durante el primer trimestre del curso 2018-19 en la asignatura Fundamentos Químicos para la Ciencia y Tecnología de Alimentos, en el primer curso de dicho grado, en la Escuela Técnica Superior de Ingeniería Agronómica y del Medio Natural (ETSIAMN). El trabajo formaba parte de una unidad didáctica de 4 créditos dedicada a la química orgánica. Desde el punto de vista metodológico, dicha unidad formaba parte del proyecto de clase inversa de la UPV. En total, fueron producidos 35 vídeos por 24 equipos de tres estudiantes y once equipos de dos.

Los objetivos de esta actividad, tal como fueron propuestos al alumnado, fueron los siguientes: Dado un aditivo utilizado en la industria alimentaria, (1) Representar su estructura molecular mediante la fórmula de esqueleto y un modelo tridimensional, utilizando aplicaciones informáticas específicas (*ChemSketch*<sup>TM</sup>, por ejemplo), (2)



Especificar en dichas moléculas qué grupos funcionales estudiados en el curso aparecen, (3)  
Buscar información sobre dicho aditivo: para qué se utiliza, si presenta efectos potencialmente nocivos y si se existen alternativas basadas en productos naturales.

El trabajo fue realizado en grupos de tres personas (ocasionalmente en parejas). El aditivo fue asignado por el profesorado una vez fueron constituidos todos los grupos. Cada uno de ellos elaboró una presentación en *power-point* (5 o 6 diapositivas, incluyendo la inicial) según los objetivos anteriormente descritos y a partir de ella elaboraron el *screencast* de una duración no superior a cinco minutos. Aunque fue admitida cualquier aplicación para la producción de vídeos en formato MP4, se recomendó la aplicación: *Screen-o-matic*<sup>TM</sup>, gratuita y fácil de utilizar. En la grabación de voz se exigió la intervención de los 3 miembros del grupo. Del mismo modo fue preceptiva la inclusión en la última diapositiva de la bibliografía consultada, incluyendo las páginas *web* de dónde habían sido obtenidas las ilustraciones utilizadas. Es importante puntualizar que la duración del periodo de trabajo autónomo en grupos se amplió dos semanas con respecto a los dos cursos anteriores.

A partir de los resultados de la coevaluación obtenidos los cursos 2016/17 y 2017/18 (Cardona y Rubio-Granero, 2018; Llorens-Molina, 2018) se decidió restringir la evaluación a la realizada por el profesorado, sobre todo por motivos de organización docente (no interferir en el desarrollo de la Unidad 2) y por la elevada concordancia que se observó entre las calificaciones otorgadas por el profesorado y por los estudiantes. La rúbrica elaborada y aplicada a lo largo de los tres cursos se muestra en la Tabla 1.

#### 4. Resultados y discusión

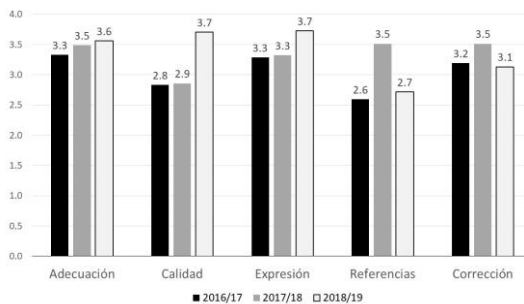
La figura 1 muestra los resultados de la evaluación del profesorado para cada uno de los ítems del *screencast*. En general, se aprecia una realización satisfactoria de acuerdo con los criterios establecidos en la rúbrica. Cabe destacar, no obstante, los incrementos observados en la calidad y en la expresión, en los que pudo influir la ampliación del tiempo asignado a la realización del trabajo. En cuanto a la búsqueda y selección de información, tras la mejoría observada el segundo año, se apreció una vuelta a la consulta masiva de *webs* generalistas y de divulgación. Es notable también la elevada corrección conceptual observada en el contenido de los *screencasts* si se compara con los errores manifestados en los exámenes. Este hecho puede interpretarse como una muestra de la eficacia de un ambiente de aprendizaje colaborativo, que favorezca el *feed-back*, permitiendo la corrección y reelaboración de los trabajos.

La figura 2 muestra la comparación, para cada ítem, entre la coevaluación, en los dos cursos en que se realizó, con la evaluación del profesorado. Lo primero que cabe destacar

es la ausencia de diferencias significativas, aunque cualitativamente se observa una cierta tendencia a una valoración ligeramente superior por el profesorado. La diferencia significativa observada el primer curso en cuanto a la adecuación a las normas puede explicarse teniendo en cuenta que posiblemente el alumnado entendió la normativa en un sentido más amplio que el profesorado. Éste aplicó estrictamente los requisitos expuestos en la propuesta del trabajo, asignando la máxima puntuación cuando la grabación presentada contenía todos los elementos descritos en las instrucciones iniciales. Esta diferencia ya no se observó en el curso siguiente, posiblemente por una mejor explicación al alumnado del uso de la rúbrica.

**Tabla 1. Rúbrica aplicada para evaluar los screencasts elaborados por el alumnado.**

CRITERIO (20 % cada criterio)	NIVELES			
	1 (0,5 puntos)	2 (1 punto)	3 (1,5 puntos)	4 (2 puntos)
<b>ADECUACIÓN AL CONTENIDO DEL TRABAJO</b>	Alguna de las partes del trabajo no se ha tratado.	Alguna de las partes del trabajo es tratada de manera superficial o deficiente	Todas las partes del trabajo se han tratado adecuadamente, con alguna pequeña carencia	Todas las partes del trabajo se han tratado de manera equilibrada y completa
<b>CALIDAD TÉCNICA Y ASPECTOS FORMALES. APLICACIÓN DEL SOFTWARE</b>	La grabación de video y audio es claramente deficiente, con exceso de texto en las diapositivas e imágenes de escasa calidad	Las diapositivas tienen el texto necesario y las imágenes son adecuadas, pero es deficiente la grabación de audio o video	Las diapositivas (texto e imágenes) son correctas, aunque no visualmente atractivas. Audio y video son correctos	La presentación es correcta y atractiva visualmente. El audio contribuye a captar la atención.
<b>EXPRESIÓN ORAL Y ESCRITA</b>	El texto escrito presenta importantes deficiencias en sintaxis y ortografía. El texto oral consiste en la lectura del texto de las diapositivas.	El texto escrito es correcto, aunque con algunas faltas de sintaxis y ortografía. Las diapositivas tienen demasiado texto que es leído tal cual	El texto escrito presenta deficiencias pero es esquemático, el texto oral lo explica y desarrolla pero no es su simple lectura.	El texto no presenta errores de sintaxis u ortografía. El texto oral, aunque basado en las diapositivas, es elaborado con autonomía.
<b>REFERENCIAS Y FUENTES DE INFORMACIÓN</b>	Apenas si se citan 1 o 2 referencias de tipo general y divulgativo, sin aplicar ningún tipo de normativa. No se citan las referencias de las imágenes.	Se citan varias referencias de tipo general y divulgativo, aunque no de manera completa o sin adecuarse a normativa.	Todo el contenido se apoya en referencias bibliográficas, cumpliendo la normativa. Incluyen algún manual universitario o web de instituciones universitarias y científicas.	Todo el contenido se apoya en referencias bibliográficas, cumpliendo la normativa. Predominan los textos especializados o webs de instituciones universitarias o científicas.
<b>CORRECCIÓN CONCEPTUAL Y VOCABULARIO CIENTÍFICO</b>	Hay errores importantes de carácter conceptual y escaso o erróneo empleo del vocabulario científico.	Algunos errores o confusiones de tipo conceptual. Vocabulario a veces inadecuado tomando como referencia los contenidos de la asignatura.	No hay errores significativos. En el vocabulario se utilizan expresiones cotidianas o imprecisas en lugar del vocabulario de la asignatura.	No hay errores conceptuales ni confusiones y el vocabulario utilizado corresponde a la terminología científica introducida en la asignatura.



*Fig. 1 Puntuaciones medias (1-4) correspondientes a cada ítem a lo largo de los cursos 2016/17, 2017/18 y 2018/19.*

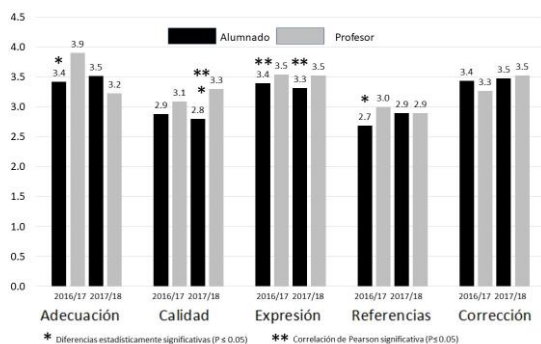


Fig. 2 Comparación entre las calificaciones otorgadas por el profesorado y a través de la coevaluación para cada uno de los ítems evaluados en los cursos 2016/17 y 2017/18.

Cabe destacar también la elevada correlación observada a la hora de valorar la expresión oral y escrita, así como la calidad formal durante el segundo curso. En este sentido, es importante determinar en qué aspectos la coevaluación es más convergente con la del profesorado, pudiendo distinguir así para futuras aplicaciones de esta actividad qué aspectos asignar exclusivamente a la coevaluación. Los ítems que reflejan la aplicación del software y la valoración de las fuentes de información, son los que registraron la calificación más baja. En cuanto a la corrección conceptual no se observan diferencias significativas en la valoración media, pero las correlaciones son bajas. Tal vez sea este el aspecto en el que la coevaluación puede no ser aconsejable en un primer curso, ya que la evaluación del profesorado es más sensible a errores que se consideran importantes en la asignatura: denominación de los grupos funcionales, definiciones confusas, etc.

La percepción de los estudiantes acerca del grado en que la producción del *screencast* favorece el desarrollo de las CTs se muestra en la figura 3, donde se representan los valores promedio al asignar valores de 1 a 5 a los grados de la escala Likert (1: Totalmente en desacuerdo, 5: Totalmente de acuerdo). Las valoraciones fueron generalmente elevadas, destacando el hecho de que algunas competencias que en principio no fueron consideradas objetivos prioritarios de la actividad, fueron las que los estudiantes sí percibieron como tales, como el trabajo en equipo y la planificación y gestión del tiempo. Una de las CTs de la que es punto de control la asignatura (Instrumental Específica) mostró una elevada valoración, explicable si se tiene en cuenta que la elaboración del *screencast* exigió de los estudiantes la utilización de software no habitual (*ChemSketch*<sup>TM</sup> y distintas aplicaciones para la creación de los vídeos). Sin embargo, también la asignatura es punto de control de la CT “conocimiento de problemas contemporáneos” y es junto a “responsabilidad ética, medioambiental y profesional” la que obtuvo los registros más bajos, (aunque en este último caso parece que el cambio de contenido de la actividad ha mejorado su percepción).



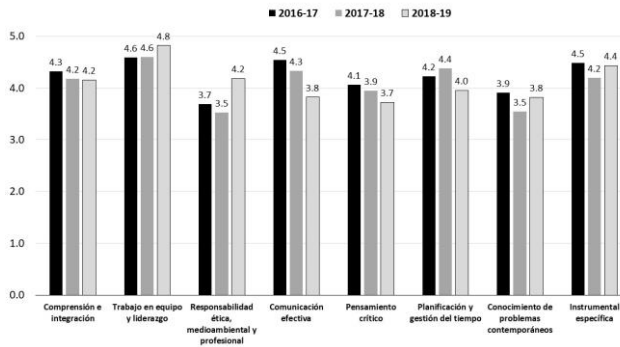


Figura 3. Percepción por los estudiantes del desarrollo de las CTs estudiadas.

## 5. Conclusiones

Este modelo de actividad es útil para desarrollar y evaluar varias CTs de una manera sencilla y con una relación coste/beneficio muy elevada para los estudiantes, lo que la convierte en un recurso muy recomendable para esta finalidad.

La rúbrica experimentada a lo largo de tres cursos consecutivos sigue conteniendo ítems que necesitan ser revisados, dándoles un carácter más operativo que mejore su objetividad.

Algunos resultados concretos apuntan a la necesidad de incidir en la búsqueda y uso de la información. Es necesario reivindicar la importancia de los manuales clásicos como fuentes de información por su fiabilidad y estructura, además de proporcionar orientaciones generales para el análisis y selección de la información procedente de la web. Con respecto al tratamiento de las CTs, los resultados muestran que la hora de orientar la actividad y presentarla a los estudiantes debe prestarse una mayor atención a las implicaciones sociales y éticas del tema propuesto. En este sentido, parece acertado centrar el trabajo en los aditivos alimentarios, o en general en aspectos relacionados con la vida cotidiana.

Los resultados muestran la importancia de la metacognición para el desarrollo de las CTs. Es necesaria una convergencia entre lo que el alumnado elabora de modo consciente y lo que el profesorado propone, para lo que puede ser necesaria alguna actividad de orientación y discusión en el aula, y no su realización exclusivamente no presencial.

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## Aprendizaje y divulgación de las técnicas antiguas en la industria creativa de las fallas. Aproximación a la falla conmemorativa del València C.F. de 1925

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### Resumen

*Coincidiendo con el centenario del Valencia Club de Fútbol, la comisión de la plaza de la Reina se unió a esta celebración con la reproducción de la falla conmemorativa que en 1925 se levantó a las puertas de la sede de la institución deportiva.*

*A través del Instituto de Restauración del Patrimonio (IRP-UPV) esta falla vuelve a erigirse en el mismo entorno después de un estudio documental para determinar sus características técnicas originales y concretar una versión imitativa por medio de los procedimientos de la época.*

*La recuperación de las antiguas técnicas y materiales del oficio de artista fallero concurre como objetivo didáctico fundamental, así como la utilización de métodos y rituales tradicionales durante la plantà de la falla y su posterior traslado por el barrio.*

*La utilización de procesos tradicionales, como la creación de ninots de acuerdo con la articulación de miembros de cera, con estructuras internas de madera, cartón, paja y tela; la reproducción seriada de elementos decorativos en cartón-piedra; o el modelado directo de motivos con cartones y pastas celulósicas, otorga la oportunidad de rescatar los viejos procedimientos por medio del Aprendizaje Basado en Proyectos (ABP). De este modo, se ha generado un grupo de trabajo diversificado, compuesto por investigadores del IRP, miembros de la comisión fallera y alumnos del Grado de Conservación y Restauración de Bienes Culturales. El modelo de enseñanza ABP ha posibilitado el desarrollo de un proyecto cimentado en la cooperación en grupo, envolvente y de gran motivación.*

*El plan de acción contempló el desarrollo de estrategias de difusión que posibilitaron visibilizar los resultados de esta experiencia, con la producción*



*de un breve documental institucional, el diseño de paneles divulgativos en el entorno de la falla y otras acciones que consideran los valores culturales de la fiesta en toda su magnitud patrimonial.*

**Palabras Claves:** Valencia Club de Fútbol, cartón-piedra, cera, Aprendizaje Basado en Proyectos (ABP), conservación, fallas

## 1. Introducción

Pocos años después de su fundación en 1919, el Valencia Football Club se había convertido en la institución deportiva más destacada de la ciudad y una de las más importantes del país, con sus diferentes secciones de fútbol, atletismo, hockey y esgrima, entre otras.

Los socios y aficionados, cada vez más numerosos y entusiastas, impulsaron en 1924 la creación de nuevos símbolos que acompañarían al equipo en sus primeros años, como una bandera institucional y un himno. Y tampoco desaprovecharían el paroxismo para homenajear al club levantando una falla apologética el día de San José de 1925 a las puertas de la sede institucional, en la antigua plaza de Canalejas.



*Fig. 1 “El Lleó de Mestalla”, falla plantada por los socios del Valencia FC en la plaza de Canalejas en 1925 y réplica realizada por el Instituto de Restauración del Patrimonio (IRP-UPV).*

La obra, que entonces fue realizada por el reconocido escultor Arturo Boix, reaparece en 2019 con motivo del centenario del Valencia CF, de la mano de la comisión de la falla de la

plaza de la Reina como heredera de la actividad festiva desarrollada en el entorno urbano donde se fundó el club.

Su reproducción facsímil ha posibilitado una aproximación real a las características tecnológicas de la época, acordes con el diseño original y con los materiales combustibles más tradicionales. Este acercamiento ha ofrecido la oportunidad a todo el equipo de trabajo de inmiscuirse en un proyecto de aprendizaje único, basado en el trabajo colaborativo.

## **2. Objetivos**

Con la reproducción de la primera falla dedicada al Valencia CF se consigue la recuperación y puesta en valor de la memoria histórica de la institución deportiva, precisamente coincidiendo con la celebración de su centenario. Con esto, no solo se pretende poner el foco de atención en su etapa fundacional, acompañada de fulgurantes éxitos deportivos, sino también acentuar su impacto dentro de la sociedad civil valenciana y su inmediato reflejo en las fallas, considerada ya por entonces como la fiesta grande de la ciudad. De esta manera, se reivindican también sus raíces y el entorno urbano donde nació, reforzando los lazos de identidad entre la comunidad y el club.

Junto a esta intención inicial se persigue el objetivo fundamental de rescatar las técnicas tradicionales para la construcción de fallas y que, en la actualidad, se encuentran en desuso o han sido desplazadas por los procedimientos y materiales contemporáneos. La recuperación de los procesos de la época, además de representar un guiño al oficio del artista fallero en sus orígenes, acude a soluciones constructivas respetuosas y sostenibles. A esto debe sumarse la rememoración de antiguos rituales festivos durante los momentos del montaje de la falla y su traslado por las calles del barrio, restituyendo así la vieja tradición de pasear la falla por la demarcación que tanto éxito tubo durante el primer tercio del siglo XX.

## **3. Características constructivas y materiales**

La falla levantada por los socios del Valencia Football Club en 1925 respondía a una disposición típica de la época, marcadamente simétrica y con un elevado pedestal a modo de escenario teatral, con cuatro ninots que representaban las secciones deportivas del club y una fallera. Sobre este elemento prismático se acomodaba el cuerpo central, formado por



una gran copa coronada por un esbelto león. Esta figura de remate le daba título a la falla y funcionaba como alegoría del orgullo y la tenacidad del equipo valencianista.

Las dimensiones aproximadas de la obra eran de unos 6 metros de altura, con una base de 4,5 x 4,5 metros. Sus características técnicas se especificaron de acuerdo con un primer estudio documental que ha tenido en cuenta la fotografía de la falla original, su boceto y explicación, pero también otras fuentes que han determinado los procedimientos artísticos de la época para la construcción de ninots y la reproducción de decoraciones iterativas en cartón.



*Fig. 2 Trabajos de carpintería artística y recubrimientos de cartón, con decoraciones metálicas y policromías.*

### **3.1. Carpintería artística y recubrimientos ornamentales**

La falla se establece a partir de una estructura de madera, realizada por el taller de carpintería creativa del artista Manolo García. Es importante referir el trabajo llevado a cabo en la copa que sirve de cuerpo central, cuya morfología parte de un primer entramado de dogas y costillas, que se ensamblan y cubren de chapa para determinar el perfil final.

Los recubrimientos decorativos, así como la figura del león y el resto de los ninots, fueron realizados por el Instituto de Restauración del Patrimonio de la Universitat Politècnica de València, bajo la dirección de los investigadores José Luis Regidor i Antoni Colomina.

Estos ornamentos recurren a la producción de motivos seriados, que se repiten en todas las caras de la falla. De este modo, colgaduras, ángeles tenantes, medallones, hojarascas y molduras, entre otras decoraciones, se acoplan sobre las estructuras de madera para conformar una visión proporcionada y armónica. En unos casos, estos módulos realizados en cartón se han extraído después de un primer modelado en barro y la obtención de moldes

de yeso; otras veces, papeles, cartones y masillas celulósicas se han adaptado directamente sobre ligeras estructuras acopladas a la madera para conformar estas decoraciones.



*Fig. 3 Rostros de cera policromada al óleo.*

Conforme a los procesos tradicionales, una vez montados los elementos decorativos en cartón, todo el conjunto ha sido cubierto con una preparación de cola de conejo y carbonato cálcico para uniformar la superficie. El lijado y la impermeabilización, finalmente, dieron paso al acabado pictórico a la chamberga y decoración con pan de oro.

### **3.2. El ninot como elemento escénico**

La metodología para la elaboración de las figuras protagonistas de la escena fallera ha variado constantemente a lo largo de la historia (Colomina, 2006: 25-54). En contraposición a los ninots moldeados íntegramente con cartón o los tallados actualmente con poliestireno expandido, las esculturas efímeras más antiguas se articulaban de acuerdo con un esqueleto de madera, henchido con otros materiales combustibles como paja, tela o papel. Otras veces, estos volúmenes internos incluían bultos de cartón que, en cualquier caso, se cubrían con ropas y complementos para buscar la veracidad teatral de la representación.

Las cabezas y las manos se realizaban con cera, policromada con ligeras veladuras de colores al óleo; se acoplaban finalmente al conjunto con la intención mimética de aproximación a la realidad. Sus rasgos, en esta época, ofrecían pocas deformaciones o perfiles grotescos o hiperbólicos, aunque se aproximaban, como ocurre en el caso de los

ninots de “El Lleó de Mestalla”, a los perfiles propios de los movimientos imperantes a principios del siglo XX, como el *Art Déco*.

#### **4. El Aprendizaje Basado en Proyectos**

La reproducción de la falla de 1925 se ha planteado, desde el punto de vista docente, como una oportunidad para componer un equipo de trabajo que actuara de acuerdo con una metodología de Aprendizaje Basada en Proyectos (ABP). La implicación de profesores y alumnos, a través de prácticas de empresa UPV, y la participación de otros agentes relacionados con el ámbito de la creación fallera, como los artistas profesionales y los miembros de la comisión involucrada, ha supuesto la creación de un grupo de cooperación diverso y enriquecedor. El APS ha concretado, pues, un modelo de aprendizaje efectivo en el que los estudiantes, pero también el resto de los actores implicados, han evaluado y ejecutado diversas actividades comunes ligadas a la realidad profesional (Blank and Harwell, 1997).

##### **4.1. Aspectos relevantes y beneficios del APS**

Uno de los aspectos más significativos del proyecto ha sido la relación de los alumnos con otros perfiles diversos para concertar un plan de trabajo común y real. Para organizar las diversas actividades se ha establecido un cronograma que ha abarcado cuatro intensos meses de trabajo y se ha concretado un diseño instruccional definido, con una determinación muy precisa de roles en el momento de repartir competencias y tareas interrelacionadas.



*Fig. 4 Aprendizaje basado en proyectos y por medio del trabajo colaborativo. Realización de motivos ornamentales con cartón piedra y masillas celulósicas.*



El APS ha posibilitado la integración y aplicación práctica de diferentes aspectos artísticos estudiados durante los primeros años del Grado de Conservación y Restauración de Bienes Culturales, reforzando la visión de conjunto de todos estos conocimientos para un fin común y organizando actividades que habilitan para el desarrollo de la creatividad, el juicio crítico y la responsabilidad como individuo perteneciente a un grupo (Maldonado, 2008: 160-161).

Esta fórmula, que conecta fehacientemente con la realidad profesional, redundará en un aumento de la motivación y disposición para la realización de los diferentes cometidos. Entre sus beneficios destaca la adquisición de destrezas y habilidades de orden superior, conforme a un aprendizaje de tipo constructivista (Jonassen, 2000), en el que el alumno asienta sus nuevas adquisiciones sobre conocimientos previos que ha fortalecido en etapas anteriores y que desarrolla con este tipo de proyectos estimulantes y colaborativos.

Aunque para la ejecución de la falla existían una serie de instrucciones previas, el APS ha fomentado la flexibilización y adaptación de estas pautas iniciales en aras a favorecer el intercambio de ideas y convenir soluciones consensuadas. Esta reciprocidad e intercambio de saberes, que además aumenta las habilidades sociales y comunicativas como fruto de la interacción de los integrantes del equipo, posibilita un aprendizaje cualitativo y cuantitativamente mayor que el que pudiera desarrollar un alumno de manera individual (Guitert y Jiménez, 2000)

#### **4.2. Grupos de trabajo colaborativos. Elementos básicos para su articulación**

En definitiva, la reproducción de la falla de 1925 a través de este método ha supuesto la configuración de un grupo de colaboración que, frente al aprendizaje basado en la competencia o el individualismo, se ha establecido con una interdependencia positiva para lograr objetivos compartidos (Johnson et al., 1999: 3-6).

Por otro lado, se ha potenciado la interacción promotora de los participantes, que han resuelto problemas mediante actos de comunicación verbal y momentos de discusión y debate. Otros componentes docentes que se han esgrimido para que la cooperación funcionase han sido la responsabilidad individual, el desarrollo de habilidades sociales para trabajar cómodamente en equipo y el procesamiento grupal, que ha dado la posibilidad de evaluar cuales han ido siendo los progresos, los logros alcanzados y las dificultades encontradas.

## 5. Acciones de divulgación

La singularidad del proyecto radica igualmente en su vertiente divulgativa, por lo que se llevaron a cabo diferentes estrategias de difusión para dar a conocer los objetivos del trabajo y sus características significativas y formales.

Desde el Instituto Universitario de Restauración del Patrimonio (IRP-UPV), como acción incluida en su programa de divulgación, se editó un documental institucional que recogió secuencialmente los diferentes momentos creativos de la construcción e instalación de la falla. El facsímil escultórico, instalado definitivamente en la concurrida plaza de la Reina, también contó con diversos paneles explicativos, dotados de numerosos registros visuales, que ayudaron a transmitir al público visitante la experiencia.

La repercusión mediática del proyecto, sin duda reforzada por el apoyo y colaboración del Valencia CF, además de la comunicación académica que se está llevando a cabo en diferentes congresos, seminarios y foros especializados que consideran los valores culturales de la fiesta en toda su magnitud patrimonial, representan un conjunto nutrido de acciones de divulgación educativa.

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## Intereses y tendencias de la educación musical hoy: un estudio a partir de sus revistas científicas

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### **Resumen**

*La difusión de la educación musical es el lugar público de encuentro de la innovación y la investigación, y por ello su mejor escaparate científico y una síntesis de sus aspiraciones, aportaciones y tendencias, sin embargo, se encuentran pocos trabajos que la estudien. Este artículo se interesa por la especificidad de la educación musical, sus relaciones con la interdisciplinariedad y también sus diferentes aproximaciones metodológicas como elemento determinante. El objetivo es analizar sus intereses en revistas científicas especializadas y artículos publicados en una muestra. Para ello se han estudiado las palabras clave de los artículos seleccionados y líneas editoriales de las revistas a que pertenecen. Se han realizado 3 análisis de contenido a 7 revistas nacionales e internacionales de Educación musical y analizando 148 artículos para conocer sus dominios, tendencias, especificidad y aproximaciones metodológicas. Los resultados dan cuenta de los temas de interés destacados de las revistas y también de sus autores, mostrando así sus cuatro grandes áreas temáticas: Investigación, Formación, Contenidos y Práctica Musical como elementos centrales de sus intereses. El artículo termina mostrando, un estudio de dispersión y líneas de tendencias señalando la posición tanto de los autores como de las revistas en este juego de fuerzas que cobran visibilidad y sentido al establecer comparaciones entre ellas.*

**Palabras Clave:** : Intereses, revistas, palabras clave, líneas editoriales

### **1. Introducción**

La difusión de la educación musical es el lugar público de encuentro de la innovación y la investigación, y por ello su mejor escaparate científico. Este espacio supone, igualmente, una síntesis de las aspiraciones de los trabajos realizados, proyectos y tendencias, y la razón



de que haya sido elegido como base de este trabajo. Desde el ámbito no formal e informal, la educación musical toma su sentido e impulso de la importancia que la sociedad concede a la música en la vida diaria y erudita, cultural, patrimonial, industrial y comunicativa, de las que siempre es un reflejo (Porta, 2017). Su carácter identitario crea manifestaciones de muy diferente índole en las colectividades, así como conexiones con diferentes áreas de conocimiento, y, como manifestación de la vida diaria, su presencia es incuestionable en la sociedad y el hábitat. Sin embargo, encontramos pocos trabajos que aborden su difusión como espacio de visibilidad, aspiraciones y tendencias en investigación e innovación, tanto del campo como en sus relaciones y conexiones con el resto de la comunidad científica. Y este hecho conviene tenerlo en cuenta porque dificulta la valoración de sus necesidades y aspiraciones dentro del espacio nacional, europeo y mundial de la Educación. El sistema por competencias de la educación supone el primer filtro con una apuesta clara de la Música en los niveles obligatorios por la interdisciplinariedad, que tiene como asignatura pendiente a día de hoy, una revisión en profundidad de las relaciones entre contenidos interdisciplinares y singularidades de la Música. Esta falta de definición del propio campo crea controversia entre los términos especificidad e interdisciplinariedad en ocasiones, debido a las dos competencias generales implicadas: la competencia lingüística y la competencia artística, cultural y expresiva (Porta, 2016). Los elementos de máxima especificidad de la música son su propio lenguaje (Sloboda, 1985; Porta, 2007) y los componentes técnicos de la interpretación musical en los niveles profesionales que requieren de métodos mixtos para poder ser visibilizados en sus foros, divulgados en sus espacios públicos y comprendidos como campo científico

El objetivo de este trabajo es analizar los intereses de la educación musical a partir de una muestra de revistas científicas de Educación Musical y sus artículos publicados en 2015 y 2016.

## **2. Revisión de la literatura**

### **2.1. Palabras clave**

Las palabras clave (a partir de ahora PC) surgen como un producto de internet como indexadores y motores de búsqueda. Sin embargo, además de estos usos, existen otros de índole académico que afectan a la selección de contenidos y preferencias. Desde la óptica de la difusión científica, las palabras clave son a modo de descriptores que no llegan a tener un vocabulario controlado como los Thesaurus -entre los que destaca en nuestro campo el de la UNESCO- que presentan una lista estructurada de términos para el estudio temático y

búsqueda de documentos en múltiples campos (Tesauro de la Unesco, 1984). E igualmente, otro elemento de interés en nuestro estudio como sistema clasificatorio es la norma ISO (International Organization for Standardization) (Dextre Clarke & Zeng, 2012; ISO 2788, 1986), en la que se define un indicador como «una expresión (numérica, simbólica o verbal) utilizada para caracterizar actividades (sucesos, objetos, personas) en términos cuantitativos y cualitativos, con el propósito de evaluar el valor de las actividades caracterizadas y el método asociado» (Martínez Tamayo, 2011, p. 32).

## 2.2. Las revistas y las líneas editoriales

Para el estudio de las revistas de educación musical se ha buscado una muestra significativa de las publicaciones. Se han revisado revistas que figuran en el Arts & Humanities Citation Index; el Social Sciences Citation Index y Scopus, 39 que figuran en el Catálogo de Latindex y Scielo y, finalmente, 18 que poseen referato pero no aparecen en los índices anteriores. A partir de la revisión inicial se recopilieron 86 revistas que no lo agotan y revisado 29 para, finalmente, centrarnos en 7 de ellas que pudieran ser comparables. Todas ellas disponen y hacen públicas sus líneas editoriales (a partir de ahora LE), tienen intereses centrados en la educación musical tanto de ámbito internacional como españolas, están clasificadas como de alto y medio impacto y disponen de comités de selección y referees que requieren de dos votos favorables de tres posibles para la publicación de los artículos.

## 3. Método

### 3.1. Instrumentos utilizados y diseño de la investigación

Se ha utilizado una metodología mixta que ha tenido como principal instrumento el análisis de contenido mediante nubes de palabras y análisis de texto con soporte informático con los programas MxQda y Atlas.ti. En esta investigación se estudiaron los artículos, PC y LE de siete revistas de los años 2015 y 2016. De ellas, cuatro aparecen en la base de datos de la Web of Science (ISI) estando tres en el JCR y una en Scopus, mientras, el resto, todas las españolas, en el periodo indicado no estaban incluidas en ellas. Se realizaron tres análisis de contenido a todos los artículos y revistas seleccionadas para estudiar las PC, las LE y su comparaciones en dominios, especificidad así como aproximaciones analíticas y metodológicas. Nuestro foco se centra en conocer qué es lo que interesa actualmente saber



y explorar en la educación musical, y de que manera estos artículos se aproximan a sus temáticas e interrogantes.

### 3.2. Las palabras clave y las líneas editoriales

El procedimiento general ha sido la selección de las palabras, su posterior codificación y creación de categorías por el sistema inductivo basado en los datos de la Grounded Theory (Strauss & Corbin, 1990). Se han seleccionado las correspondientes a 148 artículos obteniendo 424 códigos que fueron agrupados de manera progresiva hasta obtener las categorías, códigos y subcódigos que presentamos para conocer la presencia de lo específico, interdisciplinar y sus formas de aproximación analítica y metodológica.

## 4. Resultados

### 4.1. Palabras clave

Los resultados obtenidos provienen de una selección inicial de la que hemos obtenido una serie de mapas, mostrando uno de ellos (Figura 1). El primer mapa, de máxima generalidad, muestra los elementos más nombrados, que hacen referencia a un perfil docente basado en la disciplina de la música como materia de contenido, así como diferentes géneros musicales, aspectos de la formación, el aprendizaje y la evaluación de música, quedando las temáticas más sistemáticas y estructurales de la música en un plano menos visible.



Fig. 1 Nube de palabras

Font: propia

#### 4.1.1. *Lo específico*

Los resultados destacados han sido: Música Popular y Jazz (7%), Formación de Profesores de Música (5%), Etapas y niveles de la educación musical (3%), Música Instrumental (3%) y Lenguaje Musical (2%). La Música Popular abarca desde la música rock hasta distintas formas populares del s. XX, las tradicionales y el jazz. En cuanto a la Educación Musical, supone un gran conjunto que incluye temáticas específicas de todos los niveles de la educación formal e interesándose también por la no formal e informal.

#### 4.1.2. *Lo interdisciplinar*

Este apartado requiere un análisis detallado. La interdisciplinariedad es una de las grandes apuestas del sistema por competencias que, según la OCDE (2005), responden a demandas complejas, utilizando y movilizand recursos psicosociales en un contexto particular. Si hablamos de la presencia de la música en la vida de las personas, su presencia multidisciplinar es uno de los grandes indicadores del valor de la música en lo social, descriptor de intereses y vehículo de acciones educativas para el desarrollo de múltiples aprendizajes y sus aproximaciones. Igualmente evidencia cómo la música amplía su radio de acción a otros espacios educativos y perfiles de lectores que las descubren desde otras disciplinas.

#### 4.1.3. *Metodología y análisis científico por categorías*

Los resultados por categorías en referencia a totales y de la propia categoría han sido: Aproximaciones (3%, 43%; técnicas, instrumentos y medidas (1%, 11%); Instrumentos (11%); Análisis cuantitativo (1%, 18%); Análisis cualitativo (1%, 14%); Metodologías mixtas (0%, 4%). Su distribución por categorías es la siguiente: 1) Aproximaciones analíticas (21%): referencia a diferentes metodologías (14%), estudio de caso (7%); 2) Técnicas, instrumentos y medidas (21%): a pesar de la gran dispersión destacan con un (4%) Medición, Clasificación y Observación.; 3) Análisis cuantitativo (18%): ocupan los lugares más destacados: validación de instrumentos, análisis factorial, quasi- experimento, registro todos con (4%); 4) Análisis cualitativo (18%): lo ocupan por igual con (4 %) análisis visual, narrativo, autoetnografía y etnografía. Y 5) Metodologías mixtas: (1%): análisis de contenido y análisis del discurso



## 4.2. Líneas editoriales

Los apartados de las web de las revistas son indicadores de calidad y, como tales, pueden dividirse en indicadores de estructura, focalizados en la normalización editorial, y los de procesos, parámetros de gestión, visibilidad y revisión por pares. Entre los indicadores de resultados aparecen el número de acceso, artículos descargados y número de citas bibliográficas de los artículos entre otros. En cuanto a temáticas, todas tienen en común por definición pertenecer al campo de la Educación Musical. Para conocerlas con detalle hemos seleccionado los sustantivos obteniendo 337 palabras y 189 códigos. El mapa mental muestra en la Figura 2 sus temáticas destacadas.



Fig. 2: Temáticas de las líneas editoriales

Font: Propia

## 4.3. Agrupaciones y comparaciones

### 4.3.1. Agrupaciones temáticas

Agrupando los resultados de códigos y categorías en niveles de máxima generalidad obtenemos cuatro grandes temáticas, aproximándonos así a nuestro objetivo final. Se trata de Formación, Práctica Educativa, Reflexión, Investigación y Difusión como indicadores comparables para la verificación de nuestra hipótesis. Así hemos llegado al tercer análisis de contenido que ha sido el que nos ha conducido a la meta. Las comparaciones entre LE y PC nos han dado el índice de intereses y tendencias en nuestro campo. Se han estudiado sus coincidencias y ausencias

#### 4.3.2. Coincidencias.

Los resultados más destacados corresponden a la educación musical multicultural y artística, a los que siguen la educación de adultos, profesores de música, valores, educación auditiva, formal, inclusiva y jazzística.

#### 4.3.3. Intereses

Agrupando los temas llegamos a cuatro intereses de la Educación Musical en Líneas Editoriales, Palabras Clave y revistas: Investigación y difusión, Educación, Didáctica y Formación, Contenidos Musicales y Práctica Musical (Figura 3)

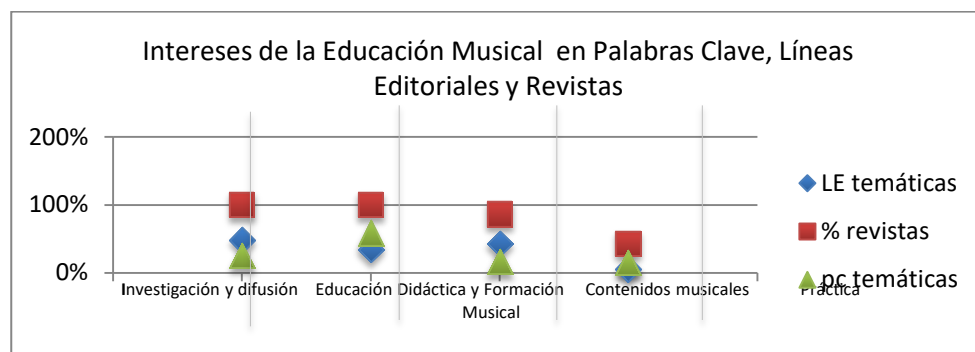


Fig. 3: Intereses de la Educación Musical en revistas y artículos

Font: Propia

#### 4.3.4. Tendencias

El estudio de tendencias, mostrado en sus líneas de LE, PC y R ofrece los siguientes resultados

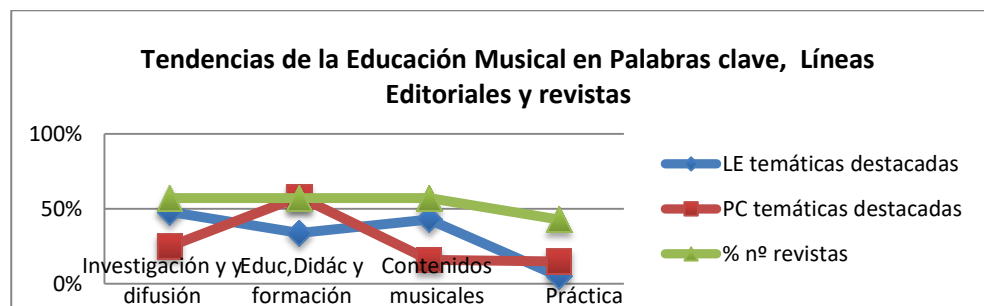


Fig. 4: Tendencias

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## 5. Conclusiones y discusión

El estudio de los artículos y revistas de Educación Musical, por medio del análisis de contenido, nos ha permitido conocer cuáles son los intereses y tendencias del campo. La selección de las PC de los artículos y las LE de las revistas seleccionadas ha sido valiosas como indicadores de los intereses de autores y editores de la Educación Musical. El estudio de las palabras ha dado cuenta de qué es y cómo se estudia lo específico, interdisciplinar y metodológico. Las Líneas Editoriales marcan los límites, pero los autores crean los contenidos. Las coincidencias, discrepancias y ausencias en cada una y entre ellas proporcionan datos de mucho interés para la Educación Musical actual, y lo que es más importante, van anticipando su futuro mediante las tendencias que se van dibujando desde el aquí y ahora.

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## Buscando respuestas a los tres grandes hitos de la Música en los últimos 70 años en una asignatura de master

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### **Resumen**

*Tres son los grandes hitos de la música desde el ámbito educativo conseguidos en los últimos 70 años. El primero, la importancia y significatividad del contexto, el segundo es la importancia comunicativa de la música y el tercero, la naturaleza mediadora de los signos poseedores de significado y sentido social. A partir de estos tres parámetros nos preguntamos de qué música hablamos, dónde está situada qué significa, a quien o qué representa y qué efectos produce? Los resultados muestran las percepciones de la música de los participantes en diferentes contextos. Todo ello considerado desde su posición en la docencia como espacio de innovación e investigación educativa en educación superior.*

**Palabras clave:** Educación musical, Análisis de contenido, Didáctica, Métodos mixtos

### **1. Introducción**

La educación musical ha ido evolucionando a lo largo del tiempo y actualmente nos movemos, como el resto de áreas de conocimiento, en un espacio sujeto a cambios constantes. Uno de los máximos hallazgos de la educación del S. XX fue colocar al sujeto en el contexto dando así un paso más a los grandes avances logrados con la Escuela Nueva (Giroux & Mur Ubasart, 1998; Wertsch, Ramírez Garrido, Zanón, & Cortés, 1988)). Esta posición del sujeto que aprende inmerso en el contexto, no tiene un tratamiento sencillo, de hecho estamos de manera permanente tratando de encontrar formas de dialogo.

El objetivo de este trabajo es analizar la percepción de siete contextos musicales por estudiantes de postgrado especializado en estudios de master a través de dos objetivos específicos:



1. Explorar y analizar diferentes entornos musicales por medio de visionados
2. Realizar un análisis de contenido y sus comparaciones con los resultados obtenidos sobre el debate generado.

Todo ello realizado individualmente, en grupos de trabajo y como resultados de síntesis finales de la acción en nivel de master

### **1.1. Marco Teórico**

Los cambios acontecidos en el último siglo obligan a un movimiento hacia adelante en la acción didáctica del siglo XXI. Esta necesidad de avance sustantivo, con unos cambios sin precedentes en la Historia de la Música, requiere conocer cuales son sus espacios y contenidos vivos en la acción educativa. Así, hablamos del contexto social, académico, digital, mediático, de la producción musical, la recepción y la audiencia, el espacio de la música tradicional y culta, sus poblaciones, impulsores, la industria y otros muchos. Este escenario hace necesario observar la música como un gran territorio, utilizado y generado desde distintos dominios, miradas y acciones. La aproximación a este mundo complejo y multifacético no es sencilla, necesita, para que sea veraz y eficaz, responder a la sociedad de la que surge. Para ello se hace necesario utilizar una metodología que, partiendo del contacto directo, proporcione una serie de indicadores con los que operar de manera representativa para definirla y analizarla. A lo largo de nuestra trayectoria hemos estudiado las distintas formas de aproximación desde la Música, la Sociología, la Psicología Cognitiva y la Semiótica. En este caso nos acercaremos a través del análisis de contenido de los diferentes sectores contextuales que queremos analizar (Porta, 2007, 2014, 2016)]

#### *1.1.1. Aproximación metodológica*

La forma de aproximación requiere repensar, no tanto el concepto de música como los espacios que le dan soporte y vida, creando redes y enjambres que muestran por donde la música circula y se instala en la práctica totalidad de los espacios culturales. De esta forma el escenario se amplía a la práctica totalidad de las actividades humanas. Por esa razón, los entorno sonoros también lo son de aprendizaje, y la Didáctica de la Música necesita ampliar su cobertura para explorar sus territorios. Todo ello hace necesaria una triangulación metodológica cuyos grandes pilares son el Lenguaje de la Música porque la música habla desde ella, la Sociología porque se dirige a los espacios sociales, masivos en muchas ocasiones, y, finalmente, la Semiótica porque tiene significación para cada uno (Porta, 2007, 2014)

### 1.1.2. El contexto y la Didáctica de la Música

El sujeto y su contexto han sido dos ejes de transformación de la educación en el S. XX en el aprendizaje significativo ha tenido u (Ausubel, 1976) así como con el estudio y significado del aprendizaje escolar Coll (1988). Por todo ello, nuestra línea investigadora se interesa por posición del sujeto en el discurso disciplinar, académico, social, patrimonial de la Didáctica de la Música. Y en ella se considera

*El sujeto:* aquel al que va dirigido o sufre sus efectos

*El discurso:* el conglomerado de signos (Talens, Romera & Tordera, 1978)

*El sentido:* la posición del sujeto en su hábitat sonoro.

Finalmente, destacamos como último elemento de nuestra fundamentación teórica, la naturaleza mediadora de los signos poseedores de significado y el carácter social de la conciencia (Vigotsky, Carrasco Iriarte & Ausín, 2008). A partir de estos presupuestos y mirando los espacios profesionales, elementales y obligatorios de la música desde la formación de su profesorado nos preguntamos en nuestra acción formativa de la Música en la Educación Superior.

¿De qué música hablamos? ¿Dónde está situada? ¿Qué significa? ¿A quien o qué representa? ¿Qué efectos produce?

Para poder contestarlas, necesitamos del análisis e interpretación de la música desde una posición ampliada requiere para su comprensión de: 1) Análisis de contenido, 2) Análisis del discurso y 3) la aplicación de procesos inductivos basados en la Teoría Fundamentada.

## 2. Metodología

### 2.1. Finalidad

Para dar respuesta al objetivo, 24 estudiantes de master con titulación superior de conservatorio estudiaron y debatieron a partir de secuencias musicales visionadas en Mp4. Se grabó el contenido de la sesión en cuya discusión se les invitó a hablar de música desde distintas vertientes: la propia música, el público, el escenario, la preparación y la difusión. Una vez transcrito dicho debate, se aplicó el análisis de contenido siendo sus resultados tratados de forma estadística y como análisis de texto con soporte informático.



## **2.2. Muestra**

Los 30 estudiantes participantes tenían entre 24 y 55 años con un 65,2 % de hombres y 34,8 65 mujeres. Fue realizado en una asignatura de master universitario de educación musical. Las secuencias fueron visionadas colectivamente y analizadas inicialmente de manera individual, posteriormente en grupo y finalmente se recogieron los resultados finales. La actividad se desarrolló precedida de una presentación teórica sobre la aproximación al tema “Dando visibilidad a los contextos en los estudios de la música” en la asignatura “Lecturas del Habitat sonoro”

## **2.3. Procedimiento**

Se desarrollaron cuatro tareas en cuatro sesiones de dos horas de trabajo cada una :

*Tarea 1.* Búsqueda de elementos musicales en diferentes audiovisuales, codificación de elementos y creación de categorías a través de procesos inductivos basados en la Teoría Fundamentada (Strauss, A., & Corbin, J. M. (1990).

*Tarea 2.* Visionado y análisis individual de siete contextos musicales y análisis de cinco categorías: Música, escenario, publico, preparación y difusión.

*Tarea 3.* Creación de mapas colectivos por grupos de trabajo

*Tarea 4.* Análisis de grupos, contextos y categorías

La tarea 1 tuvo carácter preliminar. En ella se realizó una exploración introductoria en la que los estudiantes tenían que clasificar en códigos y subcódigos los indicadores o conceptos seleccionados previamente, a partir del visionado de escenas musicales en diferentes audiovisuales.

## **2.4. Preguntas y cuestiones clave**

¿Qué ves y escuchas? En la música, en el escenario, en el público

¿Qué piensas sobre la preparación de lo que acabas de ver: personas, estudios necesarios, medios económicos y humanos, impacto social,...La difusión y cobertura

2.4.1. *Tabla 1.*

Se muestra la Plantilla para la clasificación completa con palabras que indiquen aspectos sustanciales o características (Tabla 1)

Tabla 1.

	<i>mc 1</i>	<i>mc 2</i>	<i>mc 3</i>	<i>mc 4</i>	<i>mc 5</i>	<i>mc 6</i>	<i>mc 7</i>
Música							
Escenario							
Público							
Preparación							
Difusión							
Otros							

*Tabla 1 Plantilla para la clasificación completa con palabras que indiquen aspectos sustanciales o características*

*Font: Elaboración propia*

### 3. Resultados

El análisis de contenido queda plasmado en una serie de mapas y gráficas que muestran cada una de las categorías así como el análisis de su presencia ponderada en cada uno de ellos. Los resultados revelan la presencia de elementos de la música y sus entornos que pueden utilizarse en la docencia, la innovación y la investigación educativa como indicadores. Estos elementos destacados no aparecen normalmente en las acciones formativas en los ámbitos universitarios. Este primer trabajo sobre los elementos destacados del debate prepara las acciones necesarias para establecer estudios comparados que pongan en relación la vida social y curricular o académica de la música.

### 3.1. Resultados individuales por nubes de palabras

Para realizarlo se ha utilizado la aplicación Word Cloud Generator

#### 3.1.1. Música

La percepción del concepto música por los estudiantes, todos ellos titulados superiores de Conservatorio fue la de mayor número de aportaciones. Destacan la tímbrica representada por familias: cuerda, viento, voz, elementos estilísticos y objetos con significación muy específica de la música como es el caso de la batuta. En la nube de palabras, destacan los instrumentos acústicos; en los géneros y tipologías musicales aparecen la música tradicional, clásica y el pop y, finalmente, como elementos específicos del siglo XX, la grabación y el altavoz. En resumen los mapas mentales construidos por el conjunto de los estudiantes de música, por individualidades a partir del visionado de las cinco obras en sus contextos muestran una percepción, al menos docente, claramente inclinada hacia los elementos acústicos de la música y las familias instrumentales reconocidas, sin referencias al lenguaje musical ni a los elementos o estructuras musicales, y apareciendo la música de los siglos XX y XXI con menor énfasis. (Figura 1).



Fig. 1 Música

Font: Propia

#### 3.1.2. Escenario

El escenario percibido incluye elementos más modernos en líneas generales como son: imágenes, pantallas, enchufes, cables así como referencias a tamaños y condiciones de iluminación (Figura 2)



Fig. 2 Escenario

Font: Propia

### 3.1.3. El público

En relación al público la nube de palabras grupal destaca una mayor referencia a los sectores populares que a los entornos académicos y cultos de la música como pudieran ser respetuoso, silencioso, arreglado, butacas, pelo blanco, en oposición a multitudinario, joven, agitado, informal, agitado, saltando.

### 3.1.4. Preparación

Aparecen con una presencia similar los grandes polos referidos al tiempo de preparación de los conciertos clásicos con respecto a las grandes producciones y entornos del pop-rock.

### 3.1.5. Difusión

Finalmente la difusión percibida indica los grandes medios de comunicación social con una representación alta, y en un grado mucho más bajo las menciones a los sistemas utilizados tradicionalmente por la música y otras manifestaciones hasta la mitad del siglo XX como son los programas, carteles, con la familia, revistas y periódicos, el boca a boca y una mayor presencia de los grandes medios como son radio TV (Figura 3)



Fig. 3 Difusión  
Font: Propia

### 3.2. Resultados obtenidos por grupos y categorías

Table 2. Resultados por grupos y categorías

Muestra	Música	Escenario	Público	Preparación	Difusión
G1	6,6	10	0	42,4	9
G2	0	27,27	0	33,3	0
G 3	14,28	8,33	0	37,5	12,5
G 4	6,6	7,14	0	60	0
G 5	6,25	8,33	0	50	0
G 6	17,6	15,38	0	75	10

Fuente: Propia

## 4. Conclusiones

La mirada de la Psicología Cognitiva, la Pedagogía Crítica, la Sociología de la Música y la Semiótica han sido las disciplinas de las que nos hemos nutrido para este acercamiento que, finalmente, ha dado lugar al recorrido que presentamos.

A través de todo ello nos hemos aproximado al perfil del estudiante de postgrado en Música y comprobado cómo lo que más actúa en él a la hora de analizar la música es lo que conoce de ella. Por ello es necesario realizar aproximaciones analíticas a los contextos de la música como espacios de reflexión y aprendizaje con objeto de ampliar el foco de la Didáctica de la Música.

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## ¿La metodología Flipped Classroom contribuye a crear un aprendizaje significativo?

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### Resumen

*En las últimas décadas se ha tratado de impulsar un cambio metodológico en la enseñanza universitaria desde una enseñanza centrada en la actividad del profesorado a otra orientada al aprendizaje del estudiantado. Así, en nuestra labor como docentes debemos ser capaces de seleccionar correctamente las acciones que emprendemos en el contexto de la asignatura, con la intención de que el estudiantado logre un aprendizaje profundo y comprensivo, y no tan sólo el procesamiento superficial de la información. Para ello es esencial fomentar actividades de aprendizaje que promuevan el papel activo del estudiantado, en las cuales “no se pueda escapar de aprender”. En este sentido se han llevado a cabo experiencias en el aula teniendo en cuenta la denominada “clase al revés” (Flipped Classroom), la cual precisamente pretende fomentar el aprendizaje activo, colaborativo y la resolución de problemas. El propósito de este trabajo es valorar en qué grado los estudiantes perciben que han conseguido un aprendizaje significativo en el contexto de una asignatura en la que se ha seguido la metodología de la Flipped Classroom, así como valorar su satisfacción con la asignatura. Los resultados obtenidos proporcionan orientación al docente sobre la efectividad de las nuevas metodologías docentes en el proceso de aprendizaje.*

**Palabras clave:** *Flipped Classroom, aprendizaje significativo, satisfacción del estudiantado*





## 1. Introducción

El nuevo sistema de créditos ECTS promovido desde el Espacio Europeo de Educación Superior pretendía cambiar el modo de orientar la enseñanza, dirigiendo la mirada al estudiantado e impulsando el uso de nuevas metodologías docentes más enfocadas al desarrollo de competencias (Vidal, 2012). Así, el proceso de enseñanza-aprendizaje en este nuevo sistema debería estar enfocado en el aprendizaje del estudiantado más que en la docencia del profesorado.

Cruz Tomé (2002) define la enseñanza como el conjunto de decisiones, actividades y medios que se organizan sistemáticamente para facilitar el aprendizaje del alumno (la adquisición de conocimientos, habilidades, valores y actitudes), poniendo por tanto el énfasis en que la enseñanza debe realizarse de acuerdo con un método al servicio de un fin u objetivo que, en última instancia, es el aprendizaje. De acuerdo con Marqués et al. (2017), la docencia de cualquier asignatura debe proponer metodologías que promuevan un aprendizaje efectivo, y las sesiones meramente expositivas parecen no ser la mejor alternativa para lograrlo. La clase al revés o *flipped classroom* se presenta como una metodología docente alternativa a la clase magistral, que favorece la consecución de un aprendizaje significativo y al mismo tiempo contribuye a la satisfacción del estudiantado. A pesar del valor que puede tener esta metodología para mejorar el aprendizaje, como señala Prashar (2015), es necesario analizar la perspectiva del estudiantado en relación con el valor pedagógico que tiene la *flipped classroom*.

En este contexto, el presente trabajo trata de abordar la percepción del estudiantado sobre la *flipped classroom*. Más concretamente, el objetivo del estudio es analizar las opiniones del estudiantado, en una asignatura sobre gestión de la calidad en la que se ha utilizado la *flipped classroom*, en relación con el aprendizaje conseguido, el apoyo obtenido por el profesorado y sus compañeros, las exigencias de la asignatura, así como su satisfacción global con la misma.

## 2. Marco conceptual

De acuerdo con el marco conceptual que proporciona el constructivismo, el aprendiz es un procesador activo de la información y el profesorado es el facilitador de un aprendizaje significativo, el cual se concibe como un cambio estable en lo que sabe, hace y piensa el aprendiz. El término “aprendizaje significativo” fue acuñado por Ausubel (1982) a principios de los años 60, como oposición al aprendizaje repetitivo-memorístico, en el que

no se relaciona, o se relaciona de forma arbitraria, lo que ha de ser aprendido con los conocimientos que el alumno posee. Esta relación inexistente o arbitraria hace que los conocimientos adquiridos de forma memorística no perduren.

Adoptamos, asimismo, el marco conceptual que ofrecen Biggs y Tang (2011) en su libro “Teaching for Quality Learning at University”. Este enfoque parte de la premisa de que el aprendizaje tiene lugar a través del comportamiento activo del alumno. Citando a Tyler (1949) “*Learning takes place through the active behavior of the student: it is what he does that he learns, not what the teacher does*”. Biggs y Tang (2011) proponen siete características que debe poseer un buen entorno de aprendizaje, las cuales son resumidas por Marqués et al. (2017) según se presenta en la Tabla 1.

Esta concepción del proceso de enseñanza-aprendizaje convierte la ocupación del docente en una tarea compleja y retadora, puesto que en el desempeño de su actividad debe seleccionar correctamente las acciones que emprende con la intención de que el estudiantado logre un aprendizaje profundo y comprensivo, y no tan sólo el procesamiento superficial de la información (Lloret y Mir, 2007).

**Tabla 1. Características de un buen entorno de aprendizaje para la adquisición de competencias.**

Característica	Definición
<b>Aprendizaje reflexivo</b>	Un buen entorno de aprendizaje debe dar al alumno oportunidades para reflexionar: ¿cómo me va? ¿estoy cometiendo errores? ¿hay algún patrón en mis errores? ¿cómo puedo evitar dichos errores? ¿hay alguna forma mejor de hacerlo?
<b>Estar activos</b>	Aprendemos activando los sentidos y cuantos más sentidos se activan, más efectivo es el aprendizaje ya que los sentidos se refuerzan. Si el aprendizaje se hace haciendo tareas, aunque sea un aprendizaje de tipo declarativo, es más fácil recordar lo aprendido.
<b>Feedback formativo</b>	Se proporciona durante el proceso de aprendizaje y le sirve al alumno para saber cómo va y qué ha de hacer para lograr los resultados de aprendizaje. Se trata de utilizar los posibles errores cometidos de forma constructiva. Es necesario crear un clima en el que el alumnado no se sienta juzgado.
<b>Motivación</b>	Según la teoría valor-expectativa, hay dos factores que hacen que alguien quiera aprender algo: tiene que ser importante, debe tener valor para el aprendiz (debe estar relacionado con los resultados de aprendizaje), y el aprendiz necesita sentir que va a conseguirlo, que tendrá éxito (para lo cual es importante conocer los criterios mediante los cuales saber si han tenido éxito).
<b>Conocimiento base interconectado</b>	Según la teoría del constructivismo, al aprender se reestructura lo que se sabe para conectarlo con lo nuevo. Para facilitar que los alumnos hagan dichas conexiones, el profesorado debe construir sobre lo conocido haciendo conexiones de manera explícita, poniendo ejemplos que resulten familiares, pidiendo a los alumnos que expliquen sus experiencias, haciendo paralelismos, conectando con otras materias, temas, etc.
<b>Aprendizaje social</b>	Es fundamental promover situaciones donde los alumnos aprendan unos de otros. Trabajar con otros permite ampliar la visión del tema, ayuda a observar que otros iguales ven las cosas de otra manera.
<b>Enseñanza de calidad</b>	Hay que usar variedad de métodos. Las sesiones de clase han de estar bien estructuradas y deben seguir un ritmo adecuado.

Fuente: adaptado de Biggs y Tang (2011) y Marqués et al. (2017).

De acuerdo con Biggs y Tang (2011), las actividades deben ser diseñadas de modo que el estudiante no pueda pasar por ellas sin aprender. Más concretamente, Bain (2006) concluye que los mejores profesores son los que preparan sus clases a partir de lo que quieren que sus estudiantes hagan y plantea 4 preguntas que los buenos profesores se cuestionan: “¿qué deberían hacer intelectual, física y/o emocionalmente mis alumnos?, ¿cómo puedo ayudarles? ¿cómo podemos mis alumnos y yo entender mejor el aprendizaje efectuado? ¿cómo puedo evaluar mis intentos de fomentar ese aprendizaje?

Por su parte el profesor Finkel (2008), en su libro “Dar clase con la boca cerrada”, inspirado en la máxima de que “ninguna idea puede transmitirse de una persona a otra” (Dewey, 1916), propone la utilización de métodos que puedan complementar o sustituir la pura transmisión oral de conocimientos y técnicas, y fomentar el papel activo del estudiantado, partiendo del supuesto de que lo aprendido tiene valor si nos enfrentamos a problemas e intentamos resolverlos. Este autor propone la lectura de textos relevantes seleccionados por el profesorado, invitar a la discusión o promover la indagación como método de aprendizaje a través, por ejemplo, de talleres conceptuales.

A partir de estos referentes, la clase al revés o *flipped classroom* se erige como una metodología que puede fomentar el aprendizaje significativo. La clase al revés se concibe como una alternativa a las sesiones expositivas, y pretende fomentar el aprendizaje activo, colaborativo y la resolución de problemas (Abeysekera y Dawson, 2015). La metodología docente basada en la *flipped classroom* consiste en que el alumnado trabaja contenidos antes de la sesión de clase, de forma no presencial, y una vez en el aula se proponen actividades de aprendizaje para trabajar niveles cognitivos más altos de acuerdo con la taxonomía de Bloom (p.e. analizar, aplicar, evaluar, crear) (Marqués et al., 2017). Antes de la clase se proporcionan materiales en forma de artículos de prensa o académicos, vídeos, y se les proponen actividades previas para trabajarlos. Además, es habitual que estas actividades previas se apoyen en la presencia de las nuevas tecnologías. En la sesión del aula se realizan actividades de aprendizaje para profundizar, se detectan y analizan errores, se aclaran dudas, etc. De este modo, se convierte el tiempo de clase presencial en un espacio en que los alumnos están activos trabajando juntos y con el apoyo del profesorado. En este contexto, la labor del profesorado pasa de la elaboración de presentaciones a la preparación de actividades para que el estudiantado trabaje tanto previamente a la sesión de clase como en la sesión presencial en el aula, de modo que se pueda profundizar en el aprendizaje y éste pueda ser retenido (Roehl et al., 2013).

De acuerdo con Perdomo (2016), en esta metodología, la autorreflexión del estudiantado a partir de las actividades previas a la sesión de clase es clave y le permitirá hacerse las preguntas oportunas para que en la sesión de clase pueda aprovechar las actividades propuestas y el profesorado pueda guiarle en su proceso de aprendizaje. En la misma línea argumental, Prashar (2015) señala que la *flipped classroom* favorece que el alumnado

“pruebe” o constate por él mismo el contenido a aprender, así como que se sientan más abiertos a la asociación de contenidos y materias. De este modo, la *flipped classroom* puede contribuir a un aprendizaje significativo por parte del estudiantado al permitirle construir nuevo conocimiento y habilidades que tienen un sentido a partir de sus conocimientos previos, y al incrementar, al mismo tiempo, su percepción de responsabilidad para con su aprendizaje debido al protagonismo que se les otorga (Barreiro y Novo, 2018). Así lo confirman los estudios realizados por varios profesores universitarios de diferentes ámbitos y territorios (e.g. Asef-Vaziri, 2015; Prashar, 2015; Perdomo et al., 2016; Esteban, 2018).

En definitiva, las principales ventajas que se desprenden de esta metodología pueden resumirse en que: el alumnado puede progresar en su casa a su propio ritmo, el tiempo en el aula es invertido de un modo más creativo y efectivo, el estudiantado se involucra en mayor grado en su propio proceso de aprendizaje, el docente obtiene una mejor comprensión de las dificultades y los diferentes estilos de aprendizaje del estudiantado al hacer las actividades de clase y, por último, aunque no menos importante, al estudiantado le gusta y disfruta con esta metodología (Fulton, 2012; Herreid y Schiller, 2013).

### 3. Metodología

Con el propósito de conocer la percepción del estudiantado sobre la *flipped classroom*, en el curso 2017-18 se realizó una encuesta al alumnado matriculado en la asignatura Gestión de la calidad y recursos humanos, impartida en el cuarto curso del Grado en Relaciones Laborales y Recursos Humanos de la Universitat Jaume I, en Castellón (España). Esta asignatura se planificó de manera que el alumnado tenía que realizar una serie de actividades previas a las diferentes sesiones de clase para trabajar algunos de los resultados de aprendizaje. Por ejemplo, en la actividad que se trabaja el concepto de calidad, los alumnos debían visualizar dos vídeos cortos y leer una nota técnica, a partir de los cuales debían responder a unas preguntas, incluidas en un formulario de Google, sobre los diferentes enfoques para comprender el concepto de calidad. Asimismo, en el formulario podían plantear las dudas que les habían surgido, para poder comentarlas en clase. Con posterioridad, en la sesión de clase, se comentan las dudas y se profundiza con el desarrollo de otras actividades realizadas en equipo y con la tutorización de la profesora. Se consiguió una muestra de 28 alumnos, sobre los 30 matriculados, lo cual nos permite contar con una muestra representativa.

El cuestionario incluía una cuestión para que el estudiantado valorara si el aprendizaje conseguido en la clase al revés había sido mejor, igual o peor que el obtenido en el caso de

la clase expositiva. Asimismo, para valorar el aprendizaje significativo se incluyeron 6 ítems elaborados a partir de la escala utilizada por Guirao et al. (2007). Dado que la clase al revés requiere la realización de actividades en el aula que requieren el apoyo del profesorado y de los compañeros, se incluyeron cuestiones dirigidas a valorar el apoyo por parte de la profesora así como de sus compañeros, o sobre la carga de trabajo percibida, los cuales se seleccionaron a partir de investigaciones como las de van Yperen y Hagedoorn (2003) y van Wanrooy et al. (2013). Finalmente, se incluyó un ítem para valorar la satisfacción general con la asignatura, y una variable de clasificación sobre la asistencia regular a las sesiones presenciales. En todos los ítems en los que se pedía la valoración del estudiantado se utilizó una escala Likert de 10 puntos.

Para el análisis de los datos se ha utilizado el programa estadístico SPSS y, en concreto, se ha realizado un análisis descriptivo de medias, desviaciones típicas y análisis de frecuencias, así como análisis de correlaciones.

#### 4. Resultados

El 89% del estudiantado percibe que la realización de las actividades con antelación a la clase, les ha permitido aprender mejor que si se hubiese seguido la metodología de la clase magistral. Únicamente un 11% considera que igual, y ningún alumno considera que peor. Algunas opiniones sobre la clase al revés manifestadas en el cuestionario afirman que “se aprende mejor porque desarrollas conocimientos por ti mismo, y luego los refuerzas en clase”, “pienso que ayuda a entender mejor la materia y es una forma de motivar ya que dichas actividades puntúan” o “toda enseñanza que requiera el proceso de pensar por uno mismo es positiva, en lugar de escuchar o creer todo lo que se nos dice sin cuestionar nada”.

En relación con el aprendizaje significativo, la tabla 2 muestra las valoraciones medias referidas a los 6 ítems recogidos en el cuestionario, así como el promedio de los mismos.

**Tabla 2. Aprendizaje significativo (N=28)**

	Media	Mediana	Dev. típ.	% punt. 1-3	% punt. 8-10
1. La metodología utilizada me ha permitido ir desarrollando mi aprendizaje de forma paulatina	8.50	9.00	1.774	3.6	85.7
2. La profesora consideró mi conocimiento previo y sus observaciones me ayudaron a mejorar mi conocimiento	8.28	8.00	1.429	0	72
3. Los contenidos trabajados de forma autónoma me han permitido desarrollar mi conocimiento	8.74	9.00	1.318	0	85.2
4. El nuevo conocimiento presentado se conectó con el conocimiento previo que tenía	7.23	7.50	2.215	7.7	50
5. La metodología de aprendizaje utilizada me permite conseguir los objetivos planteados en la materia	8.59	9.00	1.421	0	81.5
6. El aprendizaje que voy adquiriendo es más perdurable que el aprendizaje memorístico	8.96	9.00	1.105	0	89.3
<b>Media aprendizaje significativo</b>	<b>8.38</b>	<b>8.33</b>	<b>1.01</b>	<b>0</b>	<b>64.3</b>

Como se observa en la tabla 2, la percepción de la metodología *flipped classroom* como medio para desarrollar el aprendizaje de forma paulatina presenta una media alta, recibiendo un 85.7% de las respuestas puntuaciones entre 8 y 10. El aprendizaje adquirido es considerado más perdurable que el aprendizaje memorístico, siendo este el ítem que presenta la valoración más alta (8.96). Por otra parte, la media más baja corresponde a la percepción de los estudiantes sobre la conexión del nuevo conocimiento con el conocimiento previo que se tenía. Se observa que el porcentaje de las puntuaciones entre 1 y 3 son inferiores al 7.7% en todos los ítems del aprendizaje significativo.

Respecto a la percepción sobre el apoyo por parte de la profesora y de los compañeros y la carga de trabajo que perciben en la asignatura, la tabla 3 muestra que el alumnado percibe un elevado apoyo por parte de la profesora (valoración media de 9.47), destacando el trato justo percibido o el cumplimiento de las promesas por parte de la profesora, ítems en el que el 100% de los encuestados sitúan su valoración por encima de 8. En cuanto al apoyo de los compañeros, igual que al apoyo de la profesora, ningún estudiante ha puntuado por debajo de 3 su respuesta, y la valoración media (8.23) se puede considerar alta, aunque inferior al apoyo percibido por la profesora. Por otra parte, el estudiantado no percibe que exista una elevada carga de trabajo en la asignatura (media de 5.05).

**Tabla 3. Apoyo y carga percibidas por los estudiantes (N=28)**

	Media	Mediana	Desv. típ.	% punt. 1-3	% punt. 8-10
<b>APOYO PROFESORA</b>					
1. Se puede confiar en que cumplirá sus promesas	9.61	10.00	0.629	0	100
2. Es sincera al intentar entender el punto de vista de los estudiantes	9.39	10.00	1.031	0	92.9
3. Tratan a los estudiantes honestamente	9.57	10.00	0.836	0	92.9
4. Entiende que los estudiantes tengan que atender otras tareas además de las de la asignatura	9.07	10.00	1.412	0	88.09
5. Trata a los estudiantes justamente	9.71	10.00	0.535	0	100
Media apoyo profesora	9.47	9.60	0.73	0	92.9
<b>APOYO COMPAÑEROS</b>					
1. Puedo confiar en mis compañeros/as cuando las cosas se ponen difíciles	7.78	8.00	1.968	0	70,4
2. Si es necesario, puedo pedir ayuda a mis compañeros/as	8.64	9.00	1.471	0	75.00
Media apoyo compañeros	8.23	9.00	1.63	0	71.4
<b>CARGA DE TRABAJO</b>					
1. Esta asignatura requiere que trabaje muy duro	6.50	7.00	1.753	7.1	32.1
2. Parece que nunca tengo tiempo suficiente para hacer el trabajo que requiere esta asignatura	3.61	3.00	2.183	57.1	3.6
Media carga de trabajo	5.05	5.00	1.46	10.7	0

La tabla 4 presenta la satisfacción general con la asignatura, la cual alcanza una media de 8.68, reflejando una valoración alta por parte del estudiantado.

**Tabla 4. Satisfacción general con la asignatura (N=28)**

	Media	Mediana	Desv. típ.	% punt. 1-3	% punt. 8-10
Satisfacción general con la asignatura	8.68	9	1.15	0	82.1

Finalmente, la tabla 5 presenta las valoraciones medias de la variable aprendizaje significativo, apoyo de la profesora, apoyo de los compañeros, carga de trabajo y la satisfacción general con la asignatura, así como las correlaciones entre estas variables.

**Tabla 5. Descriptivos y correlaciones (N=28)**

	Media	Desv. típ.	1	2	3	4	5
1. Aprendizaje significativo	8.38	1.01	1				
2. Apoyo profesora	9.47	0.73	0.531**	1			
3. Apoyo compañeros	8.23	1.63	0.291	0.249	1		
4. Carga trabajo	5.05	1.46	-0.351	-0.352	-0.318	1	
5. Satisfacción	8.68	1.15	0.742**	0.703**	0.423*	-0.371	1

. \* p < 0.05; \*\* p < 0.01

Como se observa, el nivel de satisfacción con la asignatura es elevado, y está relacionado significativamente con el aprendizaje significativo y el apoyo recibido por parte de la profesora y los compañeros. También se aprecia cómo la percepción de haber obtenido un aprendizaje significativo está relacionado positivamente con un mayor apoyo por parte de la profesora. Finalmente, se observa que no hay diferencias significativas en las variables analizadas en función de la asistencia o no a clase de una forma regular, evidenciándose que un 60% de los estudiantes asisten regularmente a clase (a más del 80% de las sesiones).

## 5. Conclusiones

Los resultados de la experiencia docente presentada nos permiten responder afirmativamente acerca de la contribución de la *flipped classroom* como metodología para alcanzar un aprendizaje significativo. Asimismo, este aprendizaje se consigue con unos niveles altos de satisfacción por parte del estudiantado. Estos resultados siguen la línea de trabajos previos que señalan la buena percepción que los estudiantes muestran con esta metodología (e.g. Asef-Vaziri, 2015; Prashar, 2015; Perdomo, 2016) y que se puede entender vinculada con un aprendizaje significativo. Además, los estudiantes no han percibido una alta carga de trabajo a pesar de ser una metodología activa en la que se requiere una mayor participación e implicación del estudiante en el proceso de enseñanza-aprendizaje.

La satisfacción general con la asignatura se considera elevada y relacionada con el aprendizaje significativo y con el apoyo de la profesora. Este resultado apunta a la importancia que tiene la labor docente tanto de planificación como de implementación de la metodología, para lograr que los estudiantes sientan que el profesor les acompaña activamente durante su proceso de aprendizaje. En este sentido, Marqués (2016) señala que dar la vuelta a la clase no es sencillo y requiere de una mayor planificación de las sesiones, facilitando a los estudiantes los materiales que han de utilizar para exponerse a los contenidos así como las actividades de aprendizaje adecuadas para hacer dentro y fuera de clase. En el caso de esta asignatura el esfuerzo realizado por el docente es bien percibido por parte del estudiantado. Sin embargo, el cambio de metodología docente y la preparación que requiere la *flipped classroom* nos lleva a considerar la necesidad de replantear el cálculo de la carga docente del profesorado, que no debería reflejar sólo las horas de docencia presenciales y las tutorías, dado que el profesorado tiene que invertir más tiempo en la preparación de actividades y en la atención personalizada al estudiantado (Asef-Vaziri, 2015). También resulta un apoyo para el profesorado compartir experiencias docentes sobre la aplicación de esta metodología, de modo que se pueda contar con referentes y recomendaciones que hagan más efectiva la utilización de la *flipped classroom*.

## Agradecimientos

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## Influencia del orden de matrícula en la elección de grupo, en los resultados académicos y la encuesta de valoración del profesorado

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### Resumen

*Al inicio del primer curso universitario los alumnos escogen grupo por orden de matrícula, y este orden viene condicionado por la nota obtenida en la Prueba de Acceso a la Universidad. Los profesores observan en general una clara influencia de la nota de este prueba en la capacidad de aprendizaje del alumnado, al menos comparando entre grados con notas de corte considerablemente distintas. En este sentido, la prueba parece ser un buen indicador de esta capacidad de aprendizaje. También se ha observado que, en general, los alumnos con mejores notas en las pruebas de acceso (y preferencia en el orden de matrícula) tienden a escoger el grupo A, y dentro del mismo el subgrupo A1 antes que el A2, independientemente de otros factores como pueden ser el horario o el profesorado que imparte la docencia de cada grupo. Por este motivo, los grupos se completan en el orden alfabético-numérico lógico: primero A1, después el A2, luego el B1, y por último el B2.*

*En el presente trabajo se analizan las calificaciones por grupos de la Unidad Didáctica 2 (Química Física) de la asignatura Fundamentos Químicos en Ciencia y Tecnología de los Alimentos, de primer curso del Grado en Ciencia y Tecnología de los Alimentos de la Univeristat Politècnica de València. Los resultados demuestran la influencia del orden de matrícula (reflejada como grupo de matrícula) en las calificaciones obtenidas, siendo sustancialmente mejores en el grupo A, incluso en las prácticas de laboratorio, y teniendo en cuenta que es el mismo profesor el que imparte los dos grupos de teoría, y otro profesor el que imparte los dos grupo de prácticas. Además, se ve una clara influencia en la valoración que los alumnos de cada grupo hacen de la asignatura y del profesor, como muestran los resultados de las encuestas de opinión del alumnado, que se realizan después de calificarse la primera convocatoria de la unidad didáctica.*



**Palabras clave:** *Orden de matrícula, capacidad de aprendizaje del alumnado, calificaciones, encuestas de opinión del alumnado.*

## **1. Introducción**

En el primer curso universitario los estudiantes escogen grupo por orden de matrícula, lo que a su vez es establecido por la nota obtenida en las Prueba de Acceso a la Universidad (PAU). También se ha observado que, en general, los estudiantes que se matriculan primero tienen tendencia a escoger el grupo A, y dentro del mismo el subgrupo A1 antes que el A2, independientemente de otros factores como pueden ser el horario o el profesorado que imparte la docencia de cada grupo. Por este motivo, los grupos se completan en el orden alfabético-numérico lógico: primero A1, después A2, luego el B1, y por último el B2, en el caso de que haya cuatro subgrupos. Por otro lado, el profesorado observa una clara influencia de la nota del PAU en la capacidad de aprendizaje, al menos comparando entre grados con notas de corte considerablemente distintas. En este sentido, la prueba del PAU parece ser un buen indicador de las capacidades de los estudiantes.

Se ha observado en algunos casos la influencia del grupo de matrícula en los resultados académicos a favor de los grupos ordenados por orden alfabético (Campo-Cabal, 2012), aunque la diferencia no resultara estadísticamente significativa con los tests aplicados, o bien fuera debida a las diferencias entre el profesorado o los métodos de evaluación.

En lo que respecta a la evaluación de los docentes universitarios, el artículo 108 de los Estatutos de la Universitat Politècnica de València (UPV) establece que el Consejo de Gobierno establecerá los criterios de evaluación de la actividad y dedicación docente, de gestión e investigadora y la contribución al desarrollo científico, tecnológico o artístico del personal docente e investigador, que serán relevantes para determinar su eficiencia en el desarrollo de su actividad. A este respecto en el Manual de Evaluación de la Actividad Docente del Profesorado (Índice de Actividad Docente) se regula la actual encuesta de opinión del alumnado, siendo competencia del Instituto de Ciencias de la Educación la lectura de las encuestas y posterior tratamiento de datos, así como la elaboración de los informes personales, los de cada Estructura Responsable de Título, Departamento y Rectorado. De este artículo y su aplicación se desprende que la principal, aunque no la única, herramienta de evaluación del profesorado universitario de la UPV son las encuestas de opinión del alumnado.

La objetividad y validez de estas encuestas ha sido cuestionada en repetidas ocasiones (Silva-Montes, 2009), incluso dentro de la UPV (Verdeguer et al, 2013), o bien se ha concluido que solo es válida para evaluar algunos aspectos de la docencia (Zambrano et al,

2015). También se ha postulado que la evaluación del profesorado depende del rendimiento académico de los estudiantes (La Serna Studzinski, 2014), del interés previo por el tema de estudio (Marsh, 1987), o las calificaciones esperadas o recibidas, por lo que se plantea en numerosas ocasiones si deberían realizarse antes de que el alumno sea evaluado (Aleamoni y Hexner, 1980; Aparicio et al, 1982; De Salvador, 1996; revisado en Marsh, 2007).

En este trabajo se estudia la influencia del grupo de matrícula en el rendimiento académico de una asignatura de prier curso, así como la influencia de las calificaciones obtenidas en la evaluación del profesorado. Los resultados obtenidos apuntan a que la nota obtenida en el PAU, reflejada en el grupo de matrícula, afecta a las capacidades académicas de los estudiantes, y ésta a su vez a la opinión que tienen del profesorado y de la asignatura.

## 2. Contexto

El presente trabajo analiza la influencia del grupo en los resultados académicos y en la encuesta de opinión del alumnado, tanto en la parte de teoría (TA, impartida por el mismo profesor en ambos grupos) como en prácticas de laboratorio (PL, impartida en los cuatro grupos por la misma profesora). El contexto es la unidad didáctica 2 de la asignatura Fundamentos Químicos para la Ciencia y Tecnología de los Alimentos, del primer curso del correspondiente grado.

Para evaluar los resultados académicos se utilizaron las calificaciones de los alumnos de teoría y prácticas. Para la opinión de los alumnos sobre el profesor se utilizaron las evaluaciones del profesor de teoría, ya que eran las únicas disponibles.

## 3. Resultados y discusión

### 3.1. Influencia del grupo de matrícula en los resultados académicos

El análisis de los resultados académicos por grupos, muestra que las calificaciones obtenidas por el grupo A son significativamente más altas que las del B (Fig. 1), tanto en el caso de TA (Fig. 1a, t-student  $p = 0,038$ ) como para la parte de PL (Fig. 1b, t-student  $p = 0,0048$ ). Cabe destacar que en ambos casos el profesor es el mismo para los dos grupo, y distinto para TA y PL, por lo que queda descartada la influencia del profesor en los resultados.

Al separar las calificaciones obtenidas en TA en el examen de teoría (EXTA) y el de problemas (EXPR), se observa que la diferencia es debida principalmente a las

calificaciones obtenidas en la parte de problemas (Fig. 1a). Separar las notas por tramos (5-6, 7-8, 9-10), no permite atribuir la diferencia a ningún tramo concreto, si no que la disminución ocurre significativamente en todos ellos (datos no mostrados).

En el caso de las PL, la diferencia se debe a su realización en el laboratorio (PL, t-student  $p = 0,035$ ), y no al examen de prácticas (EXPL, t-student  $p = 0,129$ ) (Fig. 1b). Sin embargo, no se encontraron diferencias significativas para los diferentes subgrupos de prácticas (A1 respecto A2, B1 respecto B2, datos no mostrados).

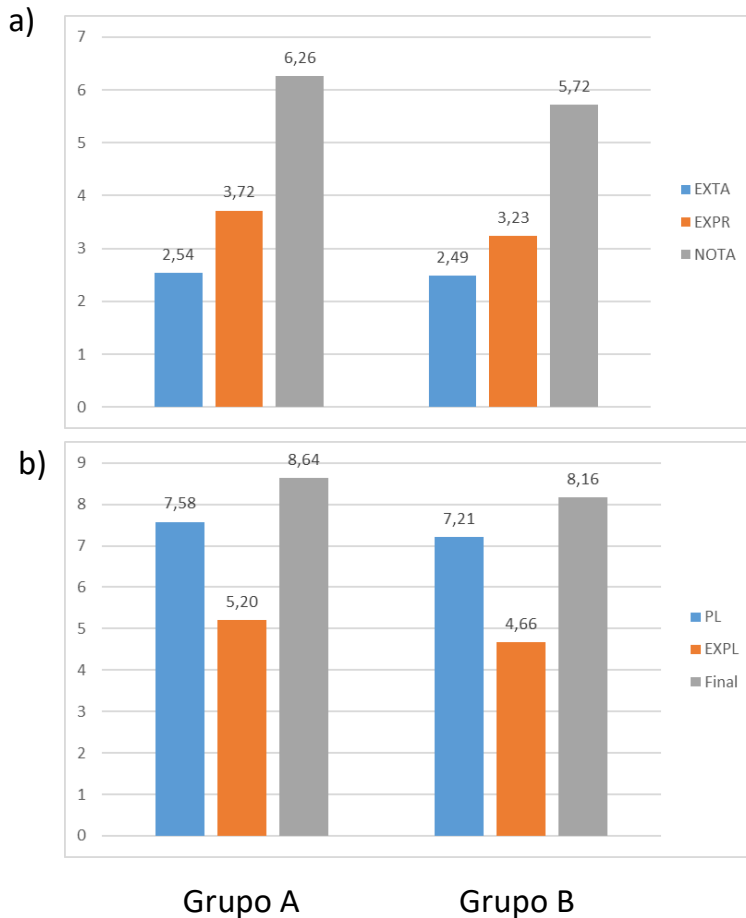


Fig. 1. Comparativa entre grupos de las resultados obtenidos en teoría (a) y prácticas (b). Se muestra sobre la barra del histograma la media de las calificaciones. Fuente: elaboración propia.

### 3.2. Influencia de los resultados académicos en los resultados de opinión del alumnado

Al analizar los resultados de las encuestas de opinión del alumnado por grupos (es como se le proporcionan al profesor), se observa también que los resultados son diferentes según el grupo considerado, siendo bastante peor la opinión del grupo que ha obtenido peores calificaciones (Fig. 2). Separando los resultados de la encuesta en los diferentes apartados en los que se proporciona, se observa que las diferencias son comunes a todos, y por lo tanto no dependen de la parte que se considere.

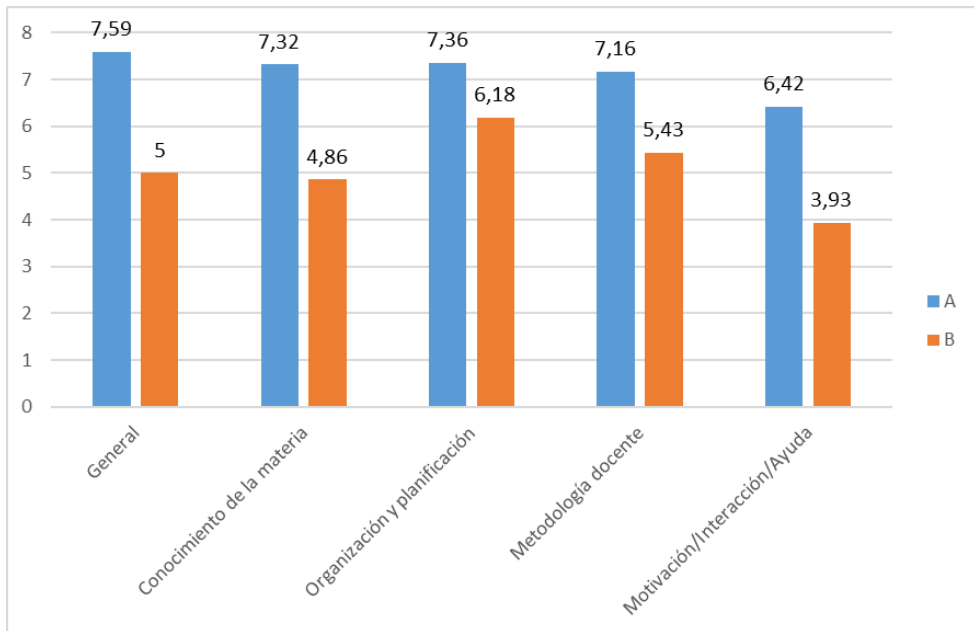


Fig. 2. Comparativa entre grupos de los resultados de las encuestas de opinión del alumnado para el profesor de teoría. Se muestra sobre la barra del histograma la media de las calificaciones. Fuente: elaboración propia.

## 4. Conclusiones

- 4.1. El grupo de matrícula de los estudiantes afecta a los estudiantes de esta asignatura en este curso académico, siendo mejores los resultados del grupo A que los del grupo B.
- 4.2. Los resultados académicos obtenidos en la asignatura afectan a la opinión que los estudiantes tienen sobre el profesor y la asignatura, al menos en esta asignatura y curso académico.
- 4.3. Es necesario un seguimiento en cursos posteriores con diferentes promociones de alumnos para corroborar los resultados obtenidos. En caso de confirmarse, sería necesario replantearse el protocolo de matrícula y de evaluación del profesorado.



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## Docencia inversa en prácticas de laboratorio. Desarrollo y autoevaluación de competencias transversales

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### Resumen

*Durante el curso 2018/2019 se ha introducido la docencia inversa en las prácticas de laboratorio de la Unidad Didáctica 2 (química física) de la asignatura Fundamentos Químicos para la Ciencia y Tecnología de los Alimentos, que se imparte durante el primer curso del grado correspondiente. Además, las cuestiones previas y el examen de prácticas se han realizado on-line, ya que en cursos anteriores se comprobó que los alumnos preferían ese formato frente al formato clásico en papel.*

*Se ha podido constatar que el alumnado sigue prefiriendo hacer las cuestiones y el examen on-line frente a hacerlo en papel, pero prefiere el método tradicional frente a la docencia inversa, probablemente debido a que esta última metodología le supone mayor esfuerzo. Aproximadamente la cuarta parte prefiere la docencia inversa, más del 40% la tradicional, y al resto le es indiferente una u otra. Sin embargo, se observa una mejora significativa de las calificaciones obtenidas, lo que apunta a que la metodología mejora el rendimiento académico. Queda por comprobar en cursos posteriores si se mantiene esta proporción, y por lo tanto cuestionarse si realmente vale la pena implantar la docencia inversa, que normalmente aumenta la carga de trabajo del profesorado, al menos el primer año de implementación.*

*En cuanto a la auto-evaluación de competencias transversales, en general los alumnos piensan que estas prácticas de laboratorio son útiles para desarrollar las competencias de “Comprensión e integración”, “Trabajo en equipo y liderazgo” e “Instrumental específica”, coincidiendo con la opinión del profesor.*



**Palabras clave:** *Docencia inversa, prácticas de laboratorio, cuestionarios on-line, valoración del alumnado, auto-evaluación de competencias transversales*

## 1. Introducción

La Universitat Politècnica de València (UPV) está inmersa en el proyecto de implantación de la Docencia Inversa (DI) (<http://docenciainversa.blogs.upv.es/el-proyecto/proyecto-clase-inversa-upv/>), formando, fomentando e incentivando al profesorado. La DI es un modo de trabajo basado en los resultados de aprendizaje, por el cual, aquellos resultados más sencillos, simples y concretos pueden ser trabajados de modo autónomo por los estudiantes (generalmente en casa), mientras que los resultados más complejos, y de mayor nivel cognitivo serán trabajados con la guía y apoyo del profesor (normalmente en clase). A su vez es una metodología en la que el alumno debe trabajar activamente, favoreciendo el trabajo grupal en la medida de lo posible y estableciendo distintos modos y tiempos de trabajo en el aula. El objetivo del proyecto de la UPV es la implantación progresiva de la metodología, con el fin de basar el aprendizaje en el alumno como centro del proceso en torno al que gira toda la programación, consiguiendo además un aprendizaje personalizado, activo y significativo, pero sin olvidar la cooperación y la colaboración en el trabajo presencial o en grupo fuera del aula.

La metodología de DI es actualmente tan popular como controvertida en cuanto a su efectividad, y se piensa que es a lo que debe tender la educación superior, al menos a medio-largo plazo (Bergman y Sams, 2012). Este método ha demostrado dar mejores resultados académicos en cuanto a calificaciones y asistencia a clase (O'Flaherty y Phillips, 2015). Sin embargo, los resultados obtenidos dependen en gran medida de la motivación del estudiante (Chen et al, 2014) y, relacionado con esto último, del tiempo que el alumno dedica a preparar los contenidos fuera del aula de forma autónoma. Así pues, el método fracasa si el estudiante no lleva los contenidos preparados a las clases presenciales, lo que supone un esfuerzo adicional frente a la metodología tradicional de lección magistral, provocando el rechazo de los estudiantes menos motivados (Sengel, 2016).

El uso de computadoras y dispositivos digitales en el aula se ha relacionado con una mejora en la motivación, si bien no siempre se refleja en una mejora del proceso de enseñanza-aprendizaje para todas las competencias; por ejemplo se ha relacionado con el empeoramiento de las habilidades de escritura, y en el aprendizaje de cuestiones teóricas cuando se evalúan mediante respuesta larga (Wakefield et al, 2005; Wollscheid et al, 2016), Sin embargo, los exámenes y cuestionarios *on-line* han demostrado disminuir la ansiedad y



estrés del estudiante, lo que lleva a una evaluación del aprendizaje más apropiada (Veenman et al, 2014). Además, puede proporcionar un *feedback* inmediato, lo que resulta en una mejora de la evaluación formativa (Epstein et al, 2002).

En lo referente a Competencias Transversales (CTs), también la UPV está inmersa en proyecto de implantación de las mismas (<http://www.upv.es/contenidos/COMPTRAN/>). El proyecto pretende incorporar a los títulos de grado y posgrado de manera explícita la formación de los estudiantes en estas competencias, evaluar sistemáticamente su nivel de logro y acreditar la adquisición de las mismas, dentro de un proyecto estratégico de estas universidades, marcado por la adaptación al Espacio Europeo de Educación Superior. Por la tanto, es importante planificar su desarrollo y evaluación en las asignaturas de los planes de estudio. En este sentido las prácticas de laboratorio (PL) se han postulado como una metodología eficaz desarrolladora de competencias transversales o genéricas (Aróztegui et al, 2012), por lo que parece apropiado usarlas, además de para el aprendizaje activo de materias experimentales, para el desarrollo y evaluación de CTs dentro del proyecto institucional. Las CT definidas por la UPV son: 1. Comprensión e integración. 2. Aplicación y pensamiento práctico. 3. Análisis y resolución de problemas. 4. Innovación, creatividad y emprendimiento. 5. Diseño y proyecto. 6. Trabajo en equipo y liderazgo. 7. Responsabilidad ética, medioambiental y profesional. 8. Comunicación efectiva. 9. Pensamiento crítico. 10. Conocimiento de problemas contemporáneos. 11. Aprendizaje permanente. 12. Planificación y gestión del tiempo. 13. Instrumental específica. Como puede observarse, varias de ellas son potencialmente desarrollables en las PL.

Por todo ello, en el presente proyecto se pretender implementar la metodología parcialmente en las prácticas de laboratorio de la asignatura, a modo de ensayo piloto para posteriormente abordar la implantación total.

## 2. Desarrollo

La metodología de DI descrita a continuación ha sido aplicada a las prácticas de laboratorio de una unidad didáctica (química física) de un primer curso del Grado de Ciencia y Tecnología de los Alimentos, en la UPV, durante el curso 2018-19, en el marco del Proyecto de DI desarrollado por dicha universidad. El proceso consiste en:

- Actividad prelaboratorio, basada en un video o una actividad con la herramienta Lessons, incorporada a la plataforma PoliformaT de la UPV. En algunos casos se anexa también artículos docentes de apoyo para la comprensión de los conceptos, o bien para ampliar los conceptos estudiados en caso de interés particular en los mismos. En cualquier caso los objetivos son:



-Contextualizar el trabajo experimental en la asignatura, tanto en cuanto a su fundamentación teórica como en relación a cuestiones prácticas relacionadas con el ámbito agroalimentario.

-Describir el proceso experimental atendiendo a los fundamentos físico-químicos de las distintas operaciones de laboratorio.

-Indicar los posibles problemas de seguridad y relativos al manejo de los equipos e instrumentos de laboratorio.

- Las actividades prelaboratorio se complementan con una prueba de respuesta corta o de realizar cálculos numéricos *on-line* de realización obligatoria y que puntúa determinado el 30% de la nota final de la práctica. Esta actividad incide principalmente en la comprensión del fundamento y sentido de cada una de las operaciones implicadas.
- Tras la realización de la actividad experimental en el laboratorio, se plantean, además de entregar el correspondiente informe, actividades post-laboratorio de reflexión y consolidación, que pueden ser comentadas posteriormente en las clases de teoría o preguntadas en el examen de la asignatura.

Tras finalizar las prácticas, se paso un sondeo a los estudiantes, que fue contestado por 39 personas (44%).

### 3. Resultados y discusión

#### 3.1. Comparativa de los resultados académicos entre el curso anterior y el actual

Con el objetivo de que conocer si la metodología implantada mejora los resultados académicos, se compararon las notas obtenidas (test t-student con varianzas desiguales) y las medias de la asignatura (diagrama de cajas y bigotes, Fig.1). Los resultados muestran que la nota media aumenta (9,3 frente a 8,4) al implantar la metodología de la DI de manera significativa ( $p\text{-valor}=1,85 \cdot 10^{-11}$ ).

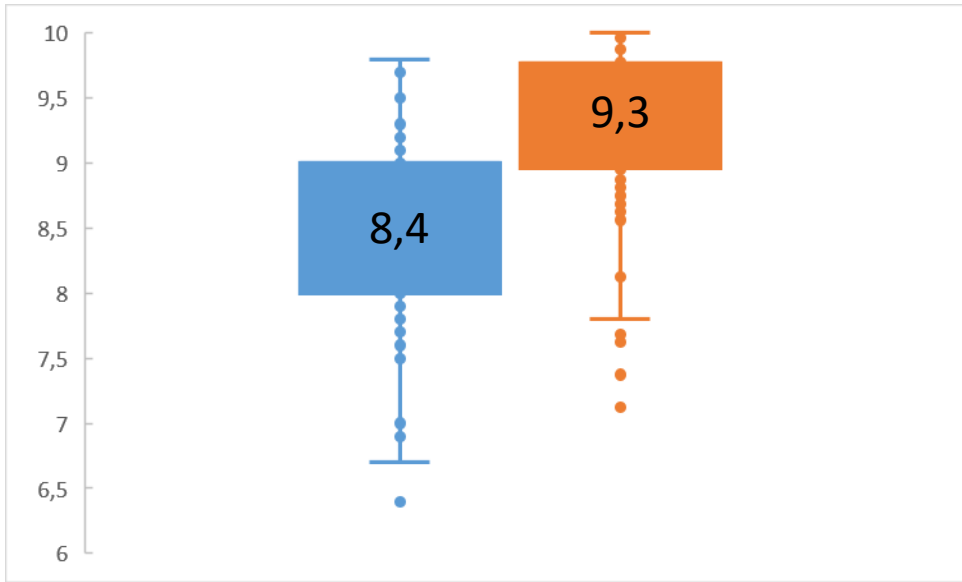


Fig. 1 Comparativa de las calificaciones obtenidas en las PL de la asignatura durante los cursos 2017-18 (azul) y 2018-19 (naranja). Se muestra la nota media en la caja correspondiente. Fuente: elaboración propia

### 3.2. Preferencia de los estudiantes por las diferentes metodologías de enseñanza-aprendizaje. DI frente al método tradicional.

Los resultados del sondeo a los estudiantes (39 repuestas, 44% de los estudiantes) muestran que solo el 23,1% prefiere la DI, mientras que el 43,6% prefiere la metodología tradicional (Fig. 2a). EL profesorado atribuye los resultados a que la DI supone mayor esfuerzo para los estudiantes, al tener que preparar la práctica de manera autónoma.

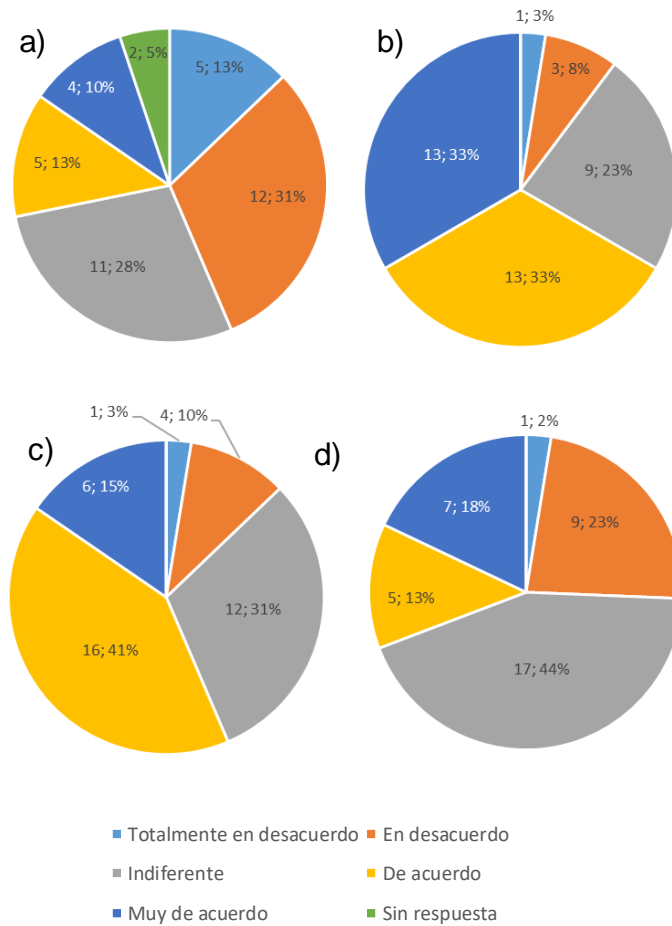


Fig. 2. Resultados del sondeo en diagramas de sectores en lo referente a la DI ya los cuestionarios on-line. Se muestra el número de respuestas ey el porcentaje para cada categoría (n°; %). Preguntas: a) En general, me parece más apropiada la metodología de docencia inversa, frente a la metodología clásica utilizada en otras prácticas de laboratorio b) La realización de las cuestiones previas on-line y las cuestiones posteriores a la realización de la práctica, me han resultado útiles para comprender mejor los conceptos introducidos en la asignatura c) La realización del examen de prácticas y las cuestiones previas on-line me parece más apropiada que hacerlo escrito (en papel) d) Me hubiera gustado que el informe de laboratorio y las cuestiones posteriores a la realización de la práctica se entregaran también a través de poliformaT. Fuente: elaboración propia.

### 3.3. Realización on-line de las cuestiones previas y el examen de prácticas

Los resultados obtenidos muestran que los estudiantes prefieren en general realizar las cuestiones previas (Fig. 2b) y el examen on-line (Fig. 2c). El 66% prefiere hacer las cuestiones de esta dforma, frente a un 11% que esta en desacuerdo o muy en desacuerdo. En cuanto al examen, el 56% prefiere hacerlo on-line, frente al 13% que prefiere realizarlo

en papel. Al resto de estudiantes les es indiferente un modo u otro de examinarse. Además, un 57% preferiría entregar también *on-line* las cuestiones que se realizan después de la práctica y el informe correspondiente a los resultados obtenidos en el laboratorio (Fig. 2d).

### 3.4. Autoevaluación de CTs

En la encuesta los estudiantes indicaron también el grado de desarrollo de algunas CTs que pensaban que habían alcanzado con las prácticas. En cuanto a la CT “Comprensión e integración” el 69% indicó que había alcanzado un grado de desarrollo adecuado o excelente (Fig. 3a), y solo una persona se autoevaluó como “no alcanzado” ningún nivel de desarrollo. En cuanto a la CT “Trabajo en equipo y liderazgo” los resultados del sondeo indican que el 87% piensa que ha alcanzado un nivel adecuado o excelente la la competencia, y ninguno que no haya alcanzado ningún nivel de desarrollo (Fig. 3b). Respecto de la CT “Instrumental específica”, el 75% piensa que tiene un nivel adecuado o superior, y el 25% la percibe como “en desarrollo” (Fig. 3c).

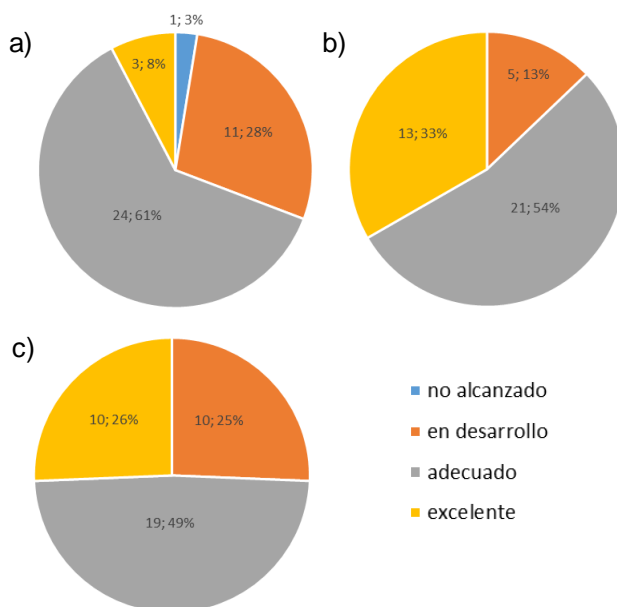


Fig. 3. Resultados del sondeo en diagramas de sectores en lo referente a la auto-evaluación de las CTs. Se muestra el número de respuestas y el porcentaje para cada CT (n°; %). Preguntas: a) Comprensión e integración b) Trabajo en equipo y liderazgo c) Instrumental específica. Fuente: elaboración propia.



## 4. Conclusiones

- 4.1. El rendimiento académico de los estudiantes mejora al aplicar la metodología de la DI, aunque ellos prefieren la metodología tradicional, probablemente debido a que requiere menor esfuerzo autónomo
- 4.2. Los estudiantes prefieren realizar las cuestiones previas, el informe de laboratorio y el examen *on-line* frente a hacerlo en papel
- 4.3. Las prácticas de laboratorio se perciben útiles por profesores y estudiantes para desarrollar las CTs “Comprensión e integración”, “Trabajo en equipo y liderazgo” e “Instrumental específica”.

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## Identificación de factores influyentes en el proceso de aprendizaje en estudios de máster

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### Resumen

*La puesta en marcha de los postgrados ha supuesto, en muchos casos, la incorporación de metodologías más apropiadas a este nivel educativo. En el trabajo que se presenta se estudia la repercusión de una metodología, que combina el modelo tradicional y el design thinking, en el rendimiento académico de los estudiantes de un máster ofertado por la Universitat de València y enmarcado dentro de la rama de ciencias sociales y jurídicas. El estudio hace énfasis en si el resultado obtenido aplicando dicha metodología muestra diferencias atendiendo a factores del alumnado de tipo académico y personal (estudios universitarios previos, situación laboral, ...). Si dichas disparidades se confirmaran, el docente dispondría de información que, en principio, le facilitaría adecuar el modelo educativo al perfil del alumnado, con la finalidad de optimizar el aprendizaje y, por ende, el rendimiento académico. Los primeros resultados permiten detectar diferencias y la obtención de mejores resultados en el caso de estudiantes provenientes de ingenierías.*

**Palabras clave:** factores, rendimiento académico, postgrado, design thinking.

### 1. Introducción

La incorporación de metodologías apropiadas a los estudios de postgrado debe ir acompañada de una evaluación de su puesta en marcha, con la finalidad de detectar sus puntos débiles y fuertes, para minimizar los primeros y potenciar los segundos. En este trabajo se analizan los resultados obtenidos al aplicar, en una asignatura cuantitativa del



máster de Gestión de la Calidad (UV), una metodología en la que se han combinado el modelo tradicional y el Design Thinking (Brown, 2008; Romero, 2012; Castillo-Vergara, et al. 2014). Al primero se ha incorporado el uso de los Clickers, que generalmente ha dado muy buenos resultados (Caballer Tarazona, et al. 2014; Calvo Roselló, et al. 2017, 2018; Derek Bruff, 2009; López Rodríguez, et al. 2015). El impacto más directo del Design Thinking, en el caso objeto de estudio, se da en el trabajo en grupo que deben desarrollar los alumnos a lo largo de las diferentes sesiones presenciales de la asignatura y de las reuniones de equipo. Por otra parte, la evaluación de la asignatura se basa en pruebas de carácter individual y en la presentación y defensa del trabajo grupal, de modo que cada estudiante dispone de una calificación individual y de una grupal. Estos dos ítems, junto con el porcentaje medio de aciertos en los sondeos con los Clickers, son los que se han considerado como indicadores del rendimiento académico. En ellos se basará el análisis de la efectividad de la metodología propuesta.

## **2. Metodología**

La metodología utilizada es la propia de un análisis exploratorio. Se obtendrán las medidas de posición más relevantes en este tipo de análisis (medidas de posición, dispersión, ...) junto con el diagrama de Box-Wiskher, que permitirá además de corroborar gráficamente la información aportada por las medidas obtenidas, la detección, en su caso, de datos anómalos.

## **3. Resultados**

Los resultados se expondrán siguiendo el siguiente esquema: tras la obtención de las medidas de reducción y gráficos correspondientes a todos los alumnos de la promoción (resultados globales), se replicará el análisis con los datos desagregados según los niveles de los factores considerados. La finalidad de dicha estructura expositiva es estudiar si la metodología utilizada ha proporcionado buenos resultados y si, atendiendo a factores de tipo personal (por ejemplo, género) o académico (por ejemplo, estudios universitarios previos), se detectan diferencias en los resultados obtenidos a nivel del rendimiento académico.

### **3.1. Globales**



La tabla 1 recoge las medidas de reducción de cada ítem analizado (calificación individual, grupal y porcentaje medio de aciertos obtenido en los sondeos realizados con Clickers).

**Tabla 1. Medidas de reducción para calificación individual, grupal y % aciertos Clickers**

Parámetros	Calificación individual	Calificación grupal	% medio aciertos sondeo Clickers
Media	7,99	8,71	70,27%
Desviación típica	1,60	0,19	17,08%
C. de variación de Pearson	0,20	0,02	0,24
Mínimo	4,51	8,30	34,11%
Máximo	10	9,00	100%

De su observación se deduce que el resultado obtenido en todos los casos es más que favorable, con mejor resultado en la nota correspondiente al trabajo en equipo frente al individual, ya que además de presentar una media superior, lo hace con menor variabilidad, atendiendo al valor del coeficiente de variación de Pearson. Además, el diagrama de Box-Whisker (Fig.1) permite descartar la existencia de datos anómalos en los tres casos.

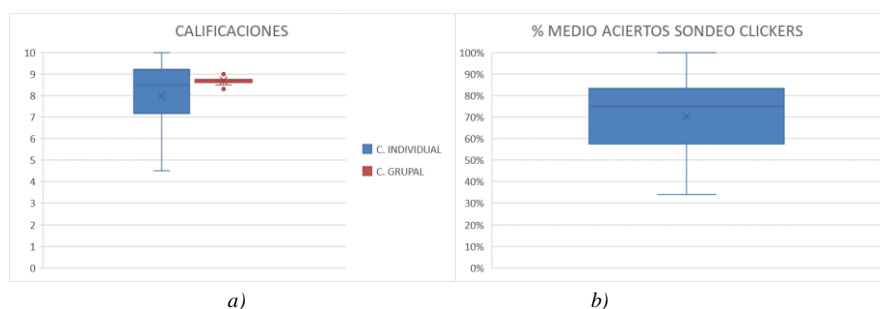


Fig. 1 Diagrama de Box-Whisker para: a) calificaciones, b) % medio aciertos sondeo Clickers

Buscando detectar algún tipo de relación entre las características consideradas, relativas al rendimiento académico del alumnado, se ha obtenido la matriz de correlación (tabla 2)

**Tabla 2. Matriz de correlación entre calificaciones y % medio de aciertos Clickers**

	Calificación individual	Calificación grupal	% medio aciertos sondeo Clickers
Calificación individual	1	0,19	0,16
Calificación grupal	0,19	1	0,06
% medio aciertos sondeo Clickers	0,16	0,06	1

Pudiendo deducirse que no hay apenas relación entre ellas, esto es, por término medio el que un estudiante obtenga un buen resultado en alguno de los tres ítems considerados no permite concluir que también lo obtenga bueno (o malo) en los otros dos.

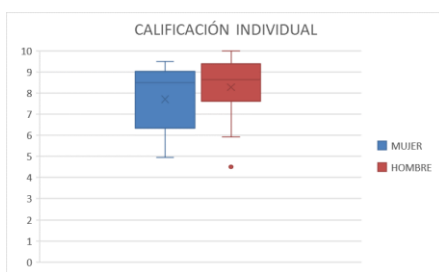
### 3.2. Atendiendo al género

Replicando la misma estructura que en el epígrafe anterior, las tablas 3 y 4 contienen las medidas de reducción y correlación de los datos obtenidos desagregados por género, y la figura 2 los diagramas de Box-Whisker atendiendo a los niveles del factor considerado

A partir de los parámetros de la tabla 3 se deduce que la nota media individual es superior en alumnos que en alumnas, con menor variabilidad en aquellos. La situación se invierte si se considera tanto la calificación obtenida en el trabajo en equipo, como el porcentaje de aciertos en sondeos de Clickers, pues son las alumnas las que muestran resultados mejores.

**Tabla 3. Medidas de reducción (factor: género)**

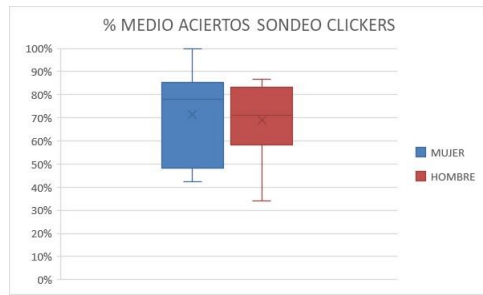
Parámetros	Calificación individual		Calificación grupal		% medio aciertos sondeo Clickers	
	Mujer	Hombre	Mujer	Hombre	Mujer	Hombre
Media	7,71	8,28	8,73	8,69	71,36%	69,11%
Desviación típica	1,56	1,52	0,24	0,10	18,84%	14,17%
C. de variación de						
Pearson	0,20	0,18	0,03	0,01	0,26	0,20
Mínimo	4,96	4,51	8,30	8,50	42,32%	34,11%
Máximo	9,50	10	9,00	8,75	100%	86,67%



a)



b)



c)

Fig. 2 Diagrama de Box-Whisker (factor: género) para: a) calificación individual, b) calificación grupal, c) % medio aciertos sondeo Clickers

**Tabla 4. Matriz de correlación entre calificaciones y % medio de aciertos Clickers (género: mujer/hombre)**

	Calificación individual	Calificación grupal	% medio aciertos sondeo Clickers
Calificación individual	1	0,48 / -0,41	-0,27 / 0,83
Calificación grupal	0,48 / -0,41	1	0,2 / -0,44
% medio aciertos sondeo Clickers	-0,27 / 0,83	0,2 / -0,44	1

Por otra parte, la observación de la figura 2 permite detectar la existencia de un dato anómalo que corresponde a la calificación individual de un alumno que está bastante por debajo de lo que cabía esperar (obsérvese que esta situación pasaba desapercibida en el análisis global de los datos).

En cuanto al análisis bidimensional, centrado en la teoría de la correlación, se da la circunstancia de que al desagregar los datos por género las conclusiones obtenidas difieren notablemente del caso global. En efecto, los coeficientes de correlación son, en valor absoluto, más elevados y permiten deducir que, mientras que en el caso de los alumnos: hay relación lineal negativa entre la calificación grupal y la individual (-0,41), así como entre aquella y el porcentaje de aciertos en el sondeo con Clickers (-0,44), siendo la relación muy alta y positiva (0,83) entre la individual y los aciertos en los sondeos. Cuando se considera el cluster de alumnas, las conclusiones son totalmente opuestas, pues siguiendo el mismo orden, los coeficientes de correlación toman los valores 0,48, 0,2 y -0,27; esto es, la relación es la contraria y con una intensidad bastante inferior.



### 3.3. Atendiendo a los estudios universitarios previos

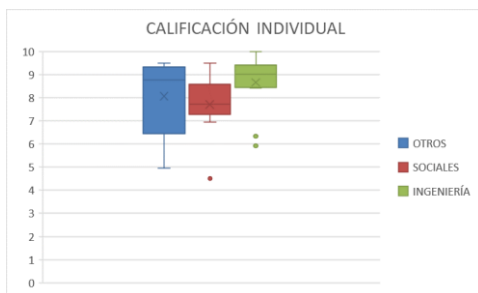
Las tablas 5 y 6 contienen las medidas de reducción y correlación de los datos obtenidos desagregados según los estudios universitarios previos, y la figura 3 los diagramas de Box-Whisker según los niveles del factor.

**Tabla 5. Medidas de reducción (factor: estudios universitarios previos)**

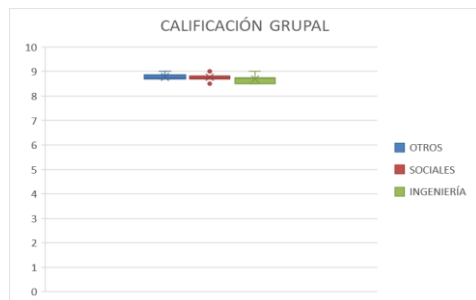
Parámetros	Calificación individual			Calificación grupal			% medio aciertos sondeo Clickers		
	Soc.	Ing.	Otros	Soc.	Ing.	Otros	Soc.	Ing.	Otros
Media	7,71	8,67	5	8,77	8,70	8,78	67,57%	68,20%	72,75%
Desviación típica	1,29	1,23	8,07	0,14	0,17	0,11	17,63%	16,70%	10,80%
C. de variación de Pearson	0,17	0,14	1,64	0,02	0,02	0,01	0,26	0,25	0,15
Mínimo	6,95	8,50	0,20	8,70	8,50	8,70	48,21%	44,11%	55,89%
Máximo	9,50	9,45	4,96	9,00	9,00	9,00	88,57%	85,18%	85,00%

De los parámetros contenidos en la tabla 5, se deduce que la calificación individual es superior en alumnos procedentes de Ingenierías, ocupando la última posición los procedentes del campo de Sociales. Respecto a la calificación del trabajo en grupo, esta es muy similar en los 3 casos, con una dispersión relativa muy parecida y en ningún caso superior al 1,3%. En cuanto al porcentaje de aciertos en sondeos clickers, este es inferior en el cluster de alumnos procedentes de Sociales.

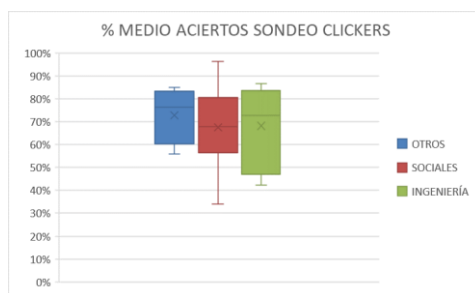
La figura 3 refleja la existencia de 2 datos anómalos (correspondientes a Sociales) en la calificación grupal y de 3 en la individual (1 de Sociales y 2 de Ingeniería). Cabe aquí la misma observación que en el factor género, esto es, dichas situaciones pasaron desapercibidas en el análisis global de los datos.



a)



b)



c)

Fig. 3 Diagrama de Box-Whisker (factor: estudios universitarios previos) para: a) calificación individual, b) calificación grupal, c) % medio aciertos sondeo Clickers

**Tabla 6. Matriz de correlación entre calificaciones y porcentaje medio de aciertos Clickers (estudios universitarios previos: Soc/Ing/Otros)**

	Calificación individual	Calificación grupal	% medio aciertos sondeo Clickers
Calificación individual	1	-0,12 / -0,22 / 0,27	0,37 / 0,42 / 0,63
Calificación grupal	-0,12 / -0,22 / 0,27	1	0,59 / 0,15 / 0,47
% medio aciertos sondeo Clickers	0,37 / 0,42 / 0,63	0,59 / 0,15 / 0,47	1

Respecto al análisis bidimensional, se produce una circunstancia similar al factor género, pues las conclusiones obtenidas difieren del caso global, al tomar los coeficientes de correlación valores más elevados, en términos absolutos, aunque mostrando diferencias tanto de sentido (positivo o negativo) como de intensidad entre los tres grupos. Así, mientras que el comportamiento, en cuanto a sentido, coincide para los alumnos procedentes de Ingeniería y Sociales (correlación negativa entre calificación grupal e individual y positiva entre las otras dos características) la intensidad difiere sobre todo cuando se estudia la relación entre la calificación grupal y el porcentaje de aciertos en los sondeos, con coeficientes de correlación de 0,59 para Sociales frente al 0,15 para Ingenierías.

#### 4. Conclusiones

El uso de una metodología que combina el método tradicional (con apoyo de sondeos con Clickers) y el Design Thinking ha resultado más que favorable. En efecto, implantando dicha metodología en una asignatura de carácter cuantitativo del máster de Gestión de la

Calidad (UV) los resultados obtenidos reflejan que el rendimiento académico del alumnado, medido a través de su calificación individual, grupal y del porcentaje de aciertos, en los sondeos llevados a cabo con los Clickers, son muy buenos, al obtenerse una calificación media individual de 8 y una grupal cercana al 9 (escala de 0 a 10), al tiempo que el porcentaje medio de aciertos en los sondeos supera el 70%.

Por otra parte, la utilización de dicha metodología muestra diferencias atendiendo a factores del alumnado de tipo académico (estudios previos universitarios) y personal (género). Con los datos disponibles su impacto es mejor en la calificación individual para los alumnos y en la grupal para las alumnas. Así mismo, los alumnos procedentes de Ingenierías obtienen mejores resultados a nivel individual; en cuanto al trabajo en grupo, los resultados son similares sea cual sea el área de procedencia del alumnado (Ingeniería, Sociales u Otros).

Por último, analizadas las relaciones entre las tres características consideradas como indicadores del rendimiento académico (calificación individual, grupal y porcentaje de acierto en sondeos), cabe indicar que, por término medio y para ambos factores, la relación más alta se da entre la calificación individual y el porcentaje de aciertos en los sondeos llevados a cabo con los Clickers. Este resultado podría reforzar la hipótesis de que el uso de estos repercute en mayor medida en la parte individual de la calificación del estudiante.

En cuanto a la metodología Design Thinking, parecen más que probados sus beneficios sobre el rendimiento académico del alumnado, pues aquella tenía un impacto directo sobre la nota del trabajo en grupo y en todos los análisis llevados a cabo (agregados y desagregados según niveles de los factores) la calificación grupal ha superado el 8 y ha resultado bastante superior a la individual.

Por último, y con la finalidad de analizar la significatividad de los resultados obtenidos, se proponen como futuras líneas de investigación el uso de herramientas inferenciales (t de Student, ANOVA, ...) que permitan constatar o no dicha significatividad.

## **Reconocimientos**

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## **Análisis bibliométrico de la evolución de los estudios en Educación Superior**

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### **Resumen**

*El objetivo de este estudio es establecer y presentar la evolución académica que ha habido en el ámbito de estudio de la educación superior. Para ello, esta investigación analiza las revistas más influyentes en este ámbito, así como los autores y las instituciones más productivos. Entre los resultados obtenidos, destaca que, de los 10 artículos más citados en el ámbito de la educación superior, 9 hacen referencia al uso de las redes sociales. Además, tanto Reino Unido como España se encuentran en el top 3 del ranking de países más productivos e influyentes en este ámbito de estudio. Son países que tienen un gran número de publicaciones y, además, un número relativamente elevado de citas.*

**Palabras clave:** *bibliometría, educación superior, Web of Science.*

### **1. Introducción**

Con la entrada en el siglo XXI, las universidades públicas comenzaron a cambiar. Así, el énfasis pasó de los temas relacionados con la atención a las demandas sociales, el crecimiento, la descentralización o la planificación, a la preocupación por temas como la evaluación y acreditación, el uso y la gestión de la contratación financiera y los recursos extrapresupuestarios basados en la competitividad.

Con respecto a los cambios producidos en los últimos tiempos, estudiantes y sindicatos han sido menos activos con respecto a las reformas universitarias (concentrándose en las demandas de interés propio), y las autoridades académicas han alcanzado un mayor interés y dinamismo como actores de cambio, definiendo cambios internos y externos en estas instituciones.



Con respecto a la asignación de recursos, los esquemas tradicionales también han ido cambiando en los últimos tiempos. Así, las políticas de diversificación han introducido una mayor competencia entre las instituciones, y han surgido universidades privadas que se han ido construyendo una gran reputación, incluso en comparación con las instituciones públicas.

La cooperación en educación superior ha experimentado un aumento notable. Así, existen diversos programas y proyectos de cooperación, movilidad universitaria, homologaciones de certificados y títulos, programas conjuntos en diferentes áreas y niveles, uso extensivo de nuevas tecnologías, programas de grado compartidos, etc.

El estudio de la educación superior tiene una relevancia superior, pues no solo se refiere a la educación superior en sí, sino también a sus relaciones con la ciencia y las políticas públicas.

Este estudio se centra en las investigaciones académicas que se han hecho hasta el momento en el ámbito de la educación superior (o 'higher education'), ya que, como se ha visto, es un ámbito que está en constante evolución. Además, como veremos, se trata de un ámbito de estudio que recoge cada vez mayor interés por parte de los académicos. Para ello, se utiliza un análisis bibliométrico realizado con la base de datos de la Web of Science (WoS).

La estructura que se sigue es la siguiente: en la siguiente sección se hace una breve revisión de la literatura sobre la bibliometría, como metodología clave en este estudio, y se establecen los principales resultados. En la tercera sección se destacan las conclusiones obtenidas, así como las limitaciones y las futuras líneas de investigación.

## **2. Metodología**

La bibliometría es un ámbito que estudia de manera cuantitativa el material bibliográfico existente en un ámbito de estudio. En este caso se analizan los estudios existentes (article, review, letter y note) hasta el momento que se encuentran en la base de datos de la WoS. Los indicadores más interesantes que se analizan a nivel bibliométrico son el número total de publicaciones, el número total de citas y el índice h (Cancino, Merigo, Torres, Diaz, 2018).

Desde el año 1996, 1417 artículos han sido publicados en el ámbito de la educación superior. La tabla 1 muestra la evolución del total de publicaciones y el total de citas que se ha producido en los artículos a lo largo de los años. Con carácter general, el ámbito de estudio de los 'estudios superiores' o 'higher education' ha crecido considerablemente en

comparación con otros ámbitos. La estructura de citas muestra que desde el año 2008 ha comenzado a aumentar el número de artículos publicados, pasando de 4 artículos publicados en 2007 a más de 20 artículos publicados en 2008. Sin embargo, en los dos últimos años, esta cifra ha aumentado exponencialmente, publicándose en los últimos años más de 200 artículos al año.

### 3. Results

Las citas, de acuerdo con la tabla 1, demuestran que se trata de un tema de estudio candente. Así, desde 2008, las citas anuales son superiores a 1000. En los dos últimos años analizados (2017 y 2018), esta cifra es ligeramente inferior, pero ello es debido a que se trata de artículos publicados muy recientemente y no ha existido tiempo físico para que la comunidad académica los estudie. Además, llama la atención que 9 de los artículos tienen más de 200 citas, de nuevo estos artículos son posteriores a 2008. De estos artículos más citados, como se verá en la tabla 3, 5 de ellos tiene más de 300 citas.

Tabla 1. Estructura de citas anual

Y	TP	TC	>200	>100	>50	>25	>10	>5	>=1
1996	1	62			1	1	1	1	1
1997	2	5							2
1999	1	9						1	1
2000	2	304		2	2	2	2	2	2
2001	1	49				1	1	1	1
2003	5	275		1	1	3	4	5	5
2004	3	141		1	1	1	2	3	3
2005	2	29				1	1	1	1
2006	8	135		1	1	1	2	3	7
2007	4	86				2	2	3	4
2008	22	1117	1	4	6	11	16	18	19
2009	21	353				6	14	14	19
2010	50	1569	2	3	9	13	23	33	38
2011	76	1565	2	3	4	13	26	38	66
2012	80	2384	2	6	12	22	37	49	71
2013	136	1753	2	2	4	20	45	63	108
2014	132	1180			4	14	40	58	99
2015	193	1175			2	8	34	83	152
2016	202	920				6	24	53	152
2017	249	520				1	7	37	152
2018	227	103					1	4	54

Nota: Y: año, TP: publicaciones totales, TC: citas totales, >: más de X citas, el número de publicaciones es >=



Con respecto a los artículos más citados, se puede observar en la tabla 2 que los cinco primeros artículos tienen más de 300 citas. El artículo más citado se titula ‘Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites’ (Roblyer, McDaniel, Webb, Herman y Witty, 2010) y fue publicado en 2010. Como se puede observar, este artículo se centra en la educación superior desde el punto de vista de las redes sociales (en este caso Facebook). Sin embargo, llama la atención que, de los 10 artículos más citados en el ámbito de la educación superior, 9 hacen referencia al uso de las redes sociales. En concreto, 4 de ellos se centran en el uso de Facebook y uno de ellos en los efectos que tiene Twitter sobre los estudiantes de educación superior.

**Tabla 2. Los 25 documentos más citados**

<b>R</b>	<b>TC</b>	<b>Title</b>	<b>Author/s</b>	<b>Year</b>	<b>C/Y</b>
1	433	Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites	Roblyer, M. D.; McDaniel, M.; Webb, M.; Herman, J.; Witty, J	2010	43,3
2	411	Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning	Dabbagh, N.; Kitsantas, A	2012	51,38
3	376	The effect of Twitter on college student engagement and grades	Junco, R.; Heiberger, G.; Loken, E.	2011	41,78
4	365	Tastes, ties, and time: A new social network dataset using Facebook.com	Lewis, K.; Kaufman, J.; Gonzalez, M.; Wimmer, A.; Christakis, N	2008	30,42
5	343	The relationship between frequency of Facebook use, participation in Facebook activities, and student engagement	Junco, R	2012	42,88
6	265	Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media	Gikas, J.; Grant, M	2013	37,86
7	260	Are digital natives a myth or reality? University students' use of digital technologies	Margaryan, A.; Littlejohn, A.; Vojt, G.	2011	28,89
8	222	The role of social media in higher education classes (real and virtual) - A literature review	Tess, P	2013	31,71
9	204	Facebook: An online environment for learning of English in institutions of higher education?	Kabilan, M.; Ahmad, N.; Abidin, M	2010	20,4
10	189	Reframing the migration question: An analysis of men, women, and gender in Mexico	Kanaiaupuni, SM	2000	9,45
11	187	Combining qualitative evaluation and social network analysis for the study of classroom social interactions	Martinez, A.; Dimitriadis, Y.; Rubia, B.; Gomez, E.; de la Fuente, P	2003	11

R	TC	Title	Author/s	Year	C/Y
12	185	Web-Based Recruiting for Health Research Using a Social Networking Site: An Exploratory Study	Fenner, Y.; Garland, S.; Moore, E.; Jayasinghe, Y.; Fletcher, A.; Tabrizi, S.; Gunasekaran, B.; Wark, John D.	2012	23,13
13	145	Peer Effects in Education: How Might They Work, How Big Are They and How Much Do We Know Thus Far?	Sacerdote, B	2011	16,11
14	140	Leadership in the Plural	Denis, J.; Langley, A.; Sergi, V	2012	17,5
15	123	From racial democracy to affirmative action: Changing state policy on race in Brazil	Htun, M	2004	7,69
16	122	Implementing Web 2.0 technologies in higher education: A collective case study	Bennett, S.; Bishop, A.; Dalgarno, B.; Waycott, J.; Kennedy, G	2012	15,25
17	117	The Performance of Policy Networks: The Relation between Network Structure and Network Performance	Sandstrom, A.; Carlsson, L	2008	9,75
18	115	Ties that bind - A social network approach to understanding student integration and persistence	Thomas, SL	2000	5,75
19	114	Educational use of social networking technology in higher education	Hung, H.; Yuen, S	2010	11,4
20	112	Sieve, incubator, temple, hub: Empirical and theoretical advances in the sociology of higher education	Stevens, M.; Armstrong, E.; Arum, R	2008	9,33
21	111	Interaction and cognitive engagement: An analysis of four asynchronous online discussions	Zhu, E	2006	7,93
22	109	The old boy (and girl) network: Social network formation on university campuses	Mayer, A.; Puller, S	2008	9,08
23	105	Higher education scholars' participation and practices on Twitter	Veletsianos, G	2012	13,13
24	98	Migrant networks and foreign direct investment	Javorcik, B.; Oezden, C.; Spatareanu, M.; Neagu, C	2011	10,89
25	92	The Use of Alternative Social Networking Sites in Higher Educational Settings	Brady, K.; Holcomb, L.; Smith, B	2010	9,2



**Tabla 3. Top 20 – autores con mayor productividad**

R	Full Name	University	Country	TC	TP	H	TC/TP
1	George Veletsianos	Royal Rd U	Canada	370	12	7	30,83
2	Bart Rienties	Open U	United Kingdom	184	10	6	18,40
3	Royce Kimmons	Brigham Young U	USA	254	8	6	31,75
4	Bogdan Patrut	Alexandru Ioan Cuza U	Romania	12	7	2	1,71
5	Monica Patrut	U of Bacau	Romania	12	7	2	1,71
6	Shane Dawson	University of South Australia	Australia	116	6	4	19,33
7	Tomayess Issa	Curtin U	Australia	4	5	1	0,80
8	Narelle Lemon	La Trobe U	Australia	19	5	3	3,80
9	Stefania Manca	National Research Council	Italy	131	5	5	26,20
10	Victoria I. Marin	U of the Balearic Islands	Spain	18	5	3	3,60
11	Maria Ranieri	U of Florence	Italy	131	5	5	26,20
12	Gemma Tur	U of the Balearic Islands	Spain	19	5	3	3,80
13	Jenny Waycott	U of Melbourne	Australia	213	5	4	42,60
14	Isidro F. Aguillo	Spanish National Research Council	Spain	57	4	2	14,25
15	Vladlena Benson	Kingston U	United Kingdom	31	4	2	7,75
16	Rachel Brooks	U of Surrey	United Kingdom	78	4	4	19,50
17	Jeff Cain	U of Kentucky	USA	77	4	4	19,25
18	Camelia Cmeciu	U of Bucharest	Romania	4	4	1	1,00
19	Thomas Cochrane	Auckland University of Technology	New Zealand	12	4	3	3,00
20	Vanessa P. Dennen	Florida State U	USA	2	4	1	0,50

Nota: TP: publicaciones totales, TC: citas totales, H: índice h

En lo referente a los autores con mayor número de publicaciones en el ámbito de los estudios superiores, esto es, los autores más productivos, el primero de ellos George Veletsianos, tiene 12 artículos y estos suman 370 citas, lo que supone una ratio de citas por publicaciones de 30.83. El tercer autor con más artículos, Royce Kimmons, tiene una ratio de 31.75, lo que quiere decir que, pese a tener un menor número de artículos, estos están teniendo buena acogida por la academia.

Con carácter general, en lo que se refiere al top 20 de autores más productivos, cuatro son de Australia, tres de ellos son de UK, tres de Rumanía, tres de España y tres de Estados Unidos.

**Tabla 4. Top 25 de universidades más productivas e influyentes**

R	Organization	Country	TP	TC	TC/TP	H	ARWU	QS
1	Open U UK	UK	21	261	12,43	8	601-700	/
2	U of Sevilla	Spain	21	106	5,05	5	501-600	601-650
3	University of Malaya	Malaysia	16	125	7,81	5	301-400	114
4	U of Surrey	UK	14	267	19,07	8	301-400	264
5	Monash U	Australia	13	54	4,15	5	91	60
6	U of Hong Kong	China-Hong Kong	13	102	7,85	6	101-150	26
7	U of North Carolina	USA	13	68	5,23	5	30	80
8	U of Extremadura	Spain	12	22	1,83	2	/	/
9	National Distance Education University (UNED)	Spain	12	98	8,17	5	/	/
10	U of Melbourne	Australia	12	463	38,58	7	38	41
11	Curtin U	Australia	11	62	5,64	3	151-200	262
12	U of Malaga	Spain	10	26	2,60	3	801-900	/
13	Macquarie U	Australia	9	46	5,11	3	201-300	240
14	Queensland U of Technology Qut	Australia	9	57	6,33	5	201-300	247
15	U of Basque Country	Spain	9	115	12,78	5	301-400	/
16	U of South Australia	Australia	9	45	5,00	4	601-700	279
17	Maastricht U	Netherlands	8	99	12,38	5	201-300	200
18	U of British Columbia	Canada	8	61	7,63	4	43	51
19	U of Minnesota Twin Cities	USA	8	252	31,50	4	37	163
20	U of South Africa	South Africa	8	23	2,88	3	701-800	/
21	U of Texas Austin	USA	8	231	28,88	6	40	67
22	Autonomous U of Barcelona	Spain	7	18	2,57	2	301-400	195
23	Bournemouth U	UK	7	25	3,57	3	/	701-750
24	Brunel U	UK	7	88	12,57	5	401-500	346
25	Charles Sturt U	Australia	7	142	20,29	3	901-1000	801-1000

Nota: TP: publicaciones totales, TC: citas totales, H: indice h.

Con respecto a las universidades, la Open University de Reino Unido es tanto la universidad más productiva (con un total de 21 artículos) como la más influyente, ya que ha obtenido más de 260 citas por estos 21 artículos. La segunda universidad más productivo es la Universidad de Sevilla (España) con el mismo número de artículos, pero con un número significativamente inferior de citas. Así, la ratio de citas por artículo de la Open University es de 12.43, mientras que el de la Universidad de Sevilla es de 5.05, el más bajo de este top 50.

Doce de las universidades más productivas en el ámbito de los estudios en educación superior son universidades de Australia, once de España, diez de los Estados Unidos y ocho son del reino unido.

Las universidades que más están siendo citadas, en términos de número de artículos (es decir, la que mayores ratios de citas por artículo tienen) son: University of Melbourne (38.58), University of Wollongong (34.29), University of Minnesota Twin Cities (31.50),

University of Texas Austin (28.88) y University of Michigan (27.29). Estas son universidades que, pese a tener menor número de artículos, éstos están teniendo muy buena acogida por la comunidad y están recibiendo un elevado número de citas.

**Tabla 6. Países más productivos e influyentes**

R	Country	TP	TC	TC/TP	H	Population	TP/POP	TC/POP
1	USA	365	6362	17,43	35	325.719.178	1,12	19,53
2	United Kingdom	218	2363	10,84	25	66.022.273	3,30	35,79
3	Spain	174	1042	5,99	14	46.572.028	3,74	22,37
4	Australia	135	1263	9,36	16	24.598.933	5,49	51,34
5	Canada	52	433	8,33	12	36.708.083	1,42	11,80
6	Malaysia	49	393	8,02	8	31.624.264	1,55	12,43
7	China	48	212	4,42	9	1.386.000.000	0,03	0,15
8	Turkey	40	115	2,88	6	80.745.020	0,50	1,42
9	South Africa	35	86	2,46	5	56.717.156	0,62	1,52
10	Germany	31	268	8,65	8	82.695.000	0,37	3,24
11	Netherlands	31	319	10,29	9	17.132.854	1,81	18,62
12	Brazil	23	16	0,70	2	209.288.278	0,11	0,08
13	India	23	60	2,61	4	1.339.000.000	0,02	0,04
14	Finland	22	219	9,95	8	5.511.303	3,99	39,74
15	Portugal	21	60	2,86	4	10.293.718	2,04	5,83
16	Sweden	21	311	14,81	7	10.067.744	2,09	30,89
17	Mexico	18	20	1,11	3	129.163.276	0,14	0,15
18	Italy	17	173	10,18	6	60.551.416	0,28	2,86
19	Taiwan	17	174	10,24	5	23.571.000	0,72	7,38
20	Russia	16	10	0,63	2	144.495.044	0,11	0,07
21	New Zealand	14	118	8,43	5	4.793.900	2,92	24,61
22	Saudi Arabia	13	63	4,85	2	32.938.213	0,39	1,91
23	Norway	12	90	7,50	5	5.282.223	2,27	17,04
24	South Korea	12	35	2,92	3	51.466.201	0,23	0,68
25	France	11	104	9,45	6	67.118.648	0,16	1,55

Nota: TP: publicaciones totales, TC: citas totales, H: índice h

El país con mayor número de artículos es Estados Unidos, pero esto se debe más a un tema de dimensión que a la influencia que tiene en el ámbito de estudio de la educación superior. Así, como se puede observar, también es uno de los países de la tabla que mayor población tiene, por lo que sus ratios de citas por población son relativamente bajos. En el caso contrario nos encontramos con países como Estonia que, pese a estar en el número 37 del ranking tiene una ratio de citas en función de la población de 42,57.

Tanto Reino Unido como España se encuentran en el top 3 del ranking. Son países que tienen un gran número de publicaciones y, además, un número relativamente elevado de citas.

## **4. Conclusiones**

El objetivo de este estudio ha sido observar la evolución de la investigación entemas de educación superior, a través de un análisis bibliométrico con los datos de la WoS.

Llama la atención que los artículos más citados en este ámbito versen sobre el uso de redes sociales en la educación superior.

Ciencia e investigación y política deben ir de la mano. Ciertos temas puestos en relieve por la investigación científica tienen implicaciones en forma de políticas públicas. A su vez, estas implicaciones, una vez se incorporan a la agenda política, se traducen en acciones concretas a través de la aplicación de políticas específicas. Y los resultados de estas políticas públicas pueden a su vez llamar la atención sobre las lagunas en el conocimiento que deben investigarse. Ciencia y política deben, de esta manera, mantener una relación saludable de interdependencia y retroalimentación (Guimaraes et al., 2006).

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# Una librería gráfica para la enseñanza de la Programación en primeros cursos universitarios

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## Resumen

*En la enseñanza de la Programación en primer curso universitario, viene siendo habitual utilizar lenguajes orientados a objetos, como Java, C++ o Python. Desafortunadamente, suelen contar con una interfaz gráfica relativamente compleja que precisa el uso de elementos avanzados de la Programación Orientada a Objetos (herencia, genericidad, ...). Por ello presentamos una herramienta orientada a la Programación en Java que simplifica la realización de gráficos, abstrayéndola de elementos irrelevantes desde el punto de vista de la enseñanza básica de la Programación. Así, podemos plantear la resolución de problemas habituales en estos primeros cursos de una forma más cercana a un alumnado habituado a interactuar gráficamente con los dispositivos que usa cotidianamente.*

**Palabras clave:** Enseñanza básica de Programación. Java. Librería gráfica.

## 1. Introducción

En las asignaturas de Programación de primer curso del Grado en Ingeniería Informática de la Universitat Politècnica de València, hemos detectado la necesidad de conjugar la realización de prácticas y ejercicios abarcables en primer curso, con la obtención de aplicaciones que despierten interés. Estas asignaturas, *Introducción a la Informática y a la Programación y Programación*, se imparten en dos cuatrimestres consecutivos, y cubren los tópicos desarrollados en el libro de texto (Prieto, Casanova, Marqués, Llorens, Galiano, Gómez, González, Martínez-Hinarejos, Moltó, y Piris, 2016). La matrícula es del orden de 500 alumnos, de nivel heterógeno, y en gran parte con relativamente bajos conocimientos de Programación; en cambio, como usuarios están habituados a interfaces sofisticadas.

La herramienta que presentamos<sup>1</sup> se ha desarrollado, en forma de librería, para ser usada fundamentalmente en la realización de prácticas de Programación en Java, lenguaje que se

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usa en la impartición de estas asignaturas. Además de aprovechar las ventajas docentes que aporta el uso de esta librería, no es menos importante el atractivo del resultado obtenido, lo que nos consta que puede estimular el trabajo de nuestros alumnos.

## 2. La librería gráfica

### 2.1. Objetivos y características

Está comúnmente aceptado que el uso de gráficos puede ser útil para la enseñanza básica de la Programación. En términos de representaciones gráficas se pueden plantear problemas cuya resolución exige conocimientos y destrezas propios de los cursos iniciales de esta materia. Además, con su uso, dichos problemas pueden presentarse de forma más clara y atractiva que con una mera representación textual (por ejemplo, ver Fig. 1).

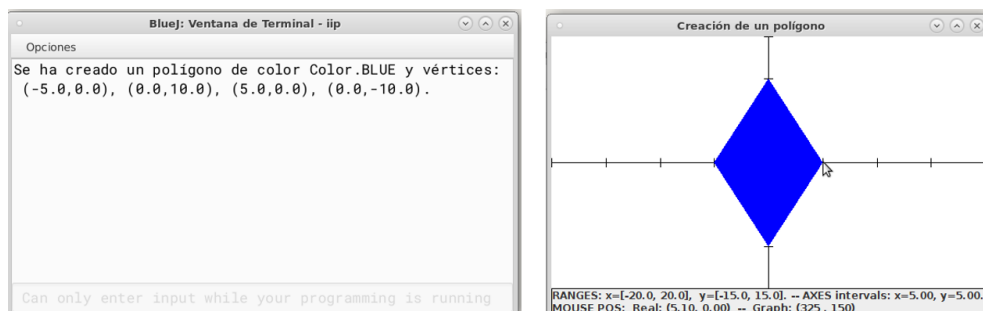


Fig. 1. Salida de texto de un dato de un programa y salida gráfica del mismo dato del programa.

En el aprendizaje de la Programación en Java resulta difícil el uso de representaciones gráficas, particularmente para los alumnos primerizos. Ello se debe a que es preciso conocer aspectos avanzados de la Programación Orientada a Objetos (herencia, genericidad) y de la gestión de eventos, que no se estudian en los cursos de introducción. El entorno de programación *BlueJ* que usamos en prácticas, disponible en [www.bluej.org](http://www.bluej.org) y ampliamente difundido en la enseñanza de la Programación en Java, facilita una entrada de datos amigable; pero, a menos que se usen ciertas librerías de Java (AWT y Swing) difíciles de dominar para un principiante, el alumno debe limitarse a mostrar el resultado de sus programas en la salida de texto estándar, como en el ejemplo de la Fig.1 izquierda.

Además, el modelo de imagen 2D propio de Java (Arnold y Gosling, 2005), obliga a tener en cuenta aspectos de transformación de espacios de representación (espacio cartesiano de representación del problema frente a espacio gráfico real de la pantalla, basado en píxeles) al tiempo que no facilita el uso de persistencia, dificultando una representación tipo “Geometría de Tortuga” como la que ofrece el lenguaje Logo (Abelson y diSessa, 1986).

Con todo ello, los principales objetivos que guiaron la realización de la librería gráfica presentada son los siguientes:

- Evitarle a los alumnos principiantes en Java la complicación del uso prematuro de librerías tales como `java.awt` y como `javax.swing`.
- Abstracter los problemas de transformación de espacios asociados a la representación gráfica, de forma que no se tenga que pensar en términos de espacios de píxeles, sino en representaciones cartesianas en el espacio dominio del problema a resolver.
- Permitir la interacción con el espacio gráfico mediante operaciones puramente cartesianas (por ejemplo, para trazar un segmento de recta es necesario proporcionar las coordenadas de sus extremos) o tipo plóter, en las que se tiene en cuenta el estado interno de la representación y para el trazado de una recta basta con indicar cuánto hay que avanzar o girar, desde la posición y ángulo anterior.
- Desarrollar algunos métodos, de funcionamiento sencillo, para ser capaces de interactuar algo con un ratón sin tener que manejar un modelo de eventos.
- Facilitar una interfaz de usuario de la librería lo más similar posible al de las librerías gráficas 2D estándar del lenguaje. Procurando así que la transición en el uso de una a otra, caso de producirse más adelante, sea sencilla para el alumno.
- Proporcionar una documentación exhaustiva de la librería, siguiendo los estándares de Java. El relativamente reducido número de clases de la librería simplifica dicha documentación, lo que promueve su uso.

## 2.2. Descripción de la librería

La librería gráfica consiste en un paquete Java, formado por un grupo de definiciones y clases. Toda la interacción del programador con la librería se produce a través de dos clases: la clase `Graph2D`, orientada a una representación cartesiana habitual (en la que se describen las posiciones de los elementos a ser dibujados), y la clase `Plotter`, derivada de la anterior, pero con la inclusión de un estado que representa la existencia (posición y ángulo) de un elemento de dibujo similar a un plóter. Adicionalmente, es posible configurar diversos parámetros de la representación tales como el grosor o color de las líneas, la existencia o no de ejes cartesianos y la información asociada a la posición del ratón.

Mediante los métodos de la librería es posible crear ventanas en las que se pueden dibujar elementos gráficos planos, tales como puntos, rectas, poligonales, arcos y óvalos. Los elementos pueden mostrarse con colores diferentes (los de un espacio RGB), varios grosores de línea y pueden ir o no rellenos (pintados). Adicionalmente, permite el dibujo de cadenas de caracteres `String` (de diferentes tipos, tamaños y colores).



Uno de los aspectos fundamentales de la librería es que abstrae el espacio de representación sobre el que se desea dibujar, de la proyección concreta que se tiene que realizar para trazar un gráfico en la pantalla del ordenador. En todo momento se trabaja sobre un espacio cartesiano definido por el programador (alumno), sin tener que realizar traslaciones al espacio de píxeles dado por los componentes gráficos del lenguaje. Las dimensiones de la representación se definen por el usuario en el momento de la creación del objeto ventana de dibujo. Esta estrategia facilita mucho la representación de los problemas ya que se obvian las transformaciones al espacio de píxeles subyacentes. Además, la librería está diseñada para que las ventanas sean reescalables sin tener que calcular explícitamente el programador las transformaciones afines asociadas, ya que se calculan automáticamente.

Cabe indicar que estas dos características, junto con la posibilidad de interactuar de manera simple con el ratón, la diferencian de otras librerías, de propósito docente similar, usadas en otras universidades como Princenton (Sedgewick y Kevin, 2008) y Stanford (Roberts, Picard y Fredricsson, 1998).

En resumen, el usuario de la librería se limita a definir y configurar la ventana de dibujo con muy pocas líneas de código, para a continuación trazar en ella los gráficos que desee.

En el siguiente ejemplo se dibuja un cuadrado centrado en (0,0) con el color por defecto (azul), y mostrando sus diagonales en color rojo. La ventana se ha creado con las dimensiones y sistema de coordenadas por defecto (ver el resultado en la Fig. 2 izquierda). Aunque algo abreviado, puede comprobarse la simplicidad del código utilizado:

```
Graph2D gd = new Graph2D();
// Draw a rectangle:
gd.drawRect(-0.5, 0.5, 1.0, 1.0);
// Change the drawing color:
gd.setForegroundColor(Color.RED);
// Draw the diagonals:
gd.drawLine(-0.5, -0.5, 0.5, 0.5);
gd.drawLine(-0.5, 0.5, 0.5, -0.5);
```

En la Fig. 2 derecha se muestra otro ejemplo más elaborado, en el que se ha usado el método `drawLine` para dibujar una espiral nautilus mediante sucesivos segmentos de recta de longitud creciente.

La clase `Plotter` de la librería facilita la realización de gráficos como la *Figura de Koch*, *Snowflake* o *Copo de nieve*, de la Fig. 3. La realización de esta figura puede efectuarse, de forma bastante rebuscada, calculando sus vértices en el plano cartesiano. Pero resulta mucho más simple si se realiza en términos similares a los de un plóter, mediante los métodos de la clase que realizan el avance y rotación de la pluma.

El siguiente código traza un lado de la figura de orden  $n$ , e ilustra el uso de estos métodos:

```

static void side(Plotter p, int n, double l) {
    if (n == 0) { p.forward(l); }
    else {
        double l3 = l / 3;
        side(p, n - 1, l3);
        p.rotate(60); side(p, n - 1, l3);
        p.rotate(-120); side(p, n - 1, l3);
        p.rotate(60); side(p, n - 1, l3);
    }
}

```

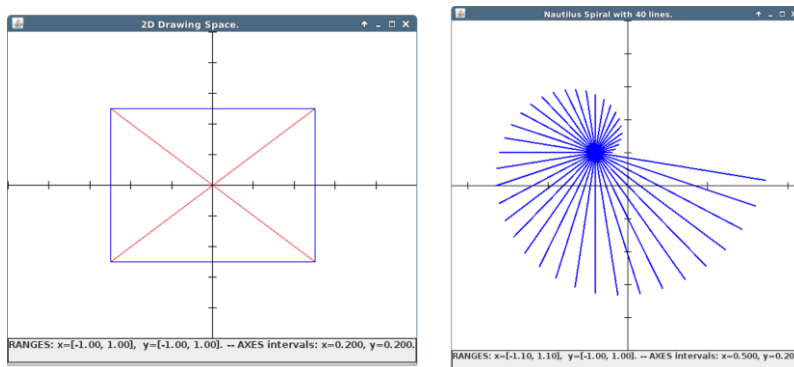


Fig. 2 Un cuadrado y sus diagonales. Una espiral nautilus dibujada con segmentos de recta.

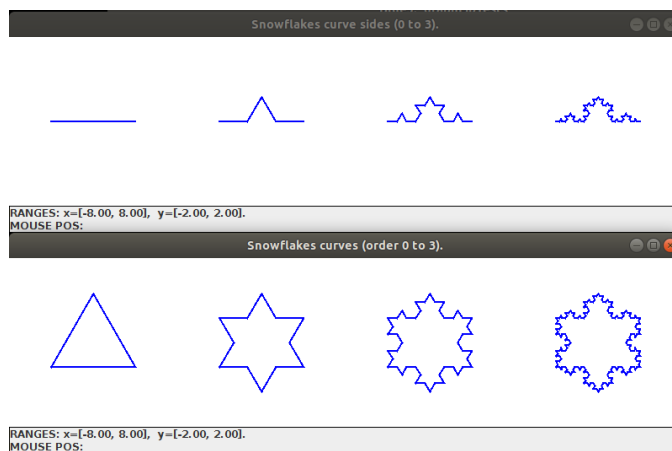


Fig. 3. Lados de una figura SnowFlake de orden 0 a 3 dibujados con el método side, y las correspondientes figuras completas de los mismos órdenes, obtenidas por yuxtaposición de tres lados convenientemente girados.

Finalmente, cabe destacar el funcionamiento del método de captura de clics de ratón definida en la librería. Este método actúa de forma análoga a la captura de la entrada de texto de teclado por métodos predefinidos de Java, y abstrae al alumno de la gestión de eventos: el método espera a que se pulse sobre la ventana gráfica, obteniendo la abscisa y la ordenada del clic. El siguiente ejemplo muestra la simplicidad de su uso:

```
System.out.println("Please, click on the image.");  
double[] coord = gd.nextMousePressed(); // Cartesian coordinates of the click
```

### **2.3. Instalación y uso de la librería**

La librería se proporciona como un único fichero comprimido que el alumno puede descargarse libremente junto con la documentación `html`. El fichero puede residir donde desee el usuario (puede ser de acceso común para los alumnos, o cada usuario puede utilizarlo de forma independiente en su equipo particular). Para su uso, basta con dejar indicada la ruta del fichero, de la forma habitual en el entorno de programación que se use.

La librería se ha construido utilizando solamente Java estándar, por lo que puede ser usada inmediatamente en cualquier sistema: Windows, MacOSX y, especialmente, Linux, en el que se efectúan nuestras prácticas. Incluso puede usarse en las Raspberry PI.

## **3. Aplicación en las asignaturas de primer curso**

La simplicidad de uso de la librería presentada nos ha permitido utilizarla, estos últimos años, en las prácticas de laboratorio de primer curso y en la realización de entregables, pudiendo experimentar sus ventajas docentes sin el coste de tener que introducir temas avanzados.

Además de que el uso de gráficos mejora la presentación de resultados y facilita su interpretación, por sí mismo proporciona un conjunto de problemas y metodologías con interés propio, y que caen dentro de los tópicos que se cubren en las prácticas. Estos son principalmente: la iteración, la recursión y el uso de arrays en estructuras de datos.

Un ejemplo de problema en un curso inicial de Programación consiste en implementar el cálculo de funciones mediante métodos iterativos, como recurrencias y desarrollos en serie; a continuación se comprueba su corrección tabulando las funciones, respetando ciertas reglas de formato del listado asociado. La representación gráfica de los resultados proporciona una variación interesante de la presentación tabulada, y puede efectuarse dibujando puntos sucesivos, o bien mediante segmentos conectados entre sí.

Así, en una práctica de iteración se proponía la implementación de las funciones raíz cuadrada y logaritmo. Una vez obtenidas (y comparadas con las del propio lenguaje), los alumnos pasaban a graficarlas, usando nuestra librería para dibujar segmentos de unión entre puntos consecutivos de la tabulación. El resultado se puede ver en la Fig. 4.

En las prácticas asociadas al tema de recursión, se plantearon unos primeros problemas de recursión lineal sobre datos numéricos y sobre cadenas de caracteres. Sin embargo, no es fácil encontrar problemas de recursión múltiple indicados para un nivel de primer curso. No obstante, si se considera el dibujo de fractales, es posible encontrar abundancia de figuras en las que se da un patrón recursivo múltiple, y al mismo tiempo fácil de descubrir y programar.

Por ejemplo, en el capítulo 2.3 de (Sedgewick y Kevin, 2008) se propone como ejercicio la realización del fractal de la Fig. 5., en sus dos variaciones de recursión no final y final. Este problema se abordó en una práctica de laboratorio usando nuestra librería, dibujando como motivo básico de la figura un cuadrado sólido, perfilado con un cuadrado de otro color.

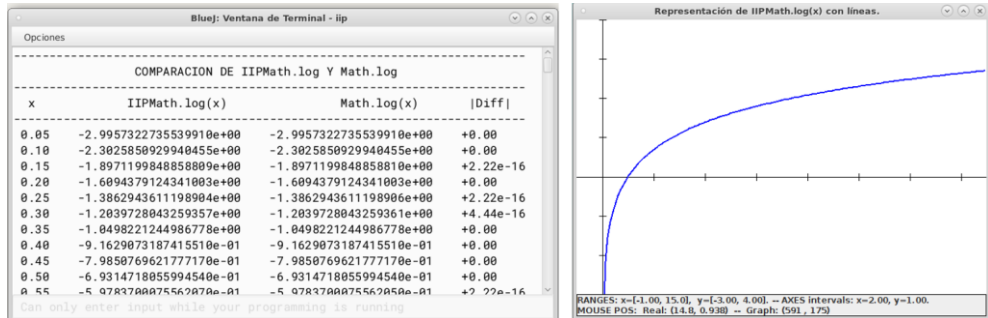


Fig. 4. Tabulación del logaritmo natural y representación gráfica de los valores de la tabla, unidos con líneas.

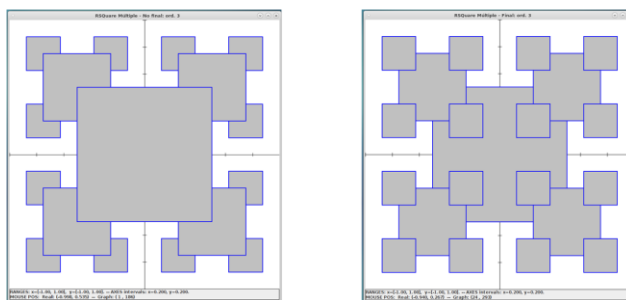


Fig. 5. Figuras fractales obtenidas mediante recursión múltiple, no final y final.

Está ampliamente reconocida en la comunidad docente la necesidad de hacer trazas de los algoritmos recursivos, tanto en clase de teoría como en el laboratorio (Tucker, 1991;

Hazzan, Lapidot y Ragoni, 2011). El depurador del lenguaje es una herramienta excelente para seguir la traza de una recursión lineal, pero su uso es menos efectivo para capturar el funcionamiento de la recursión múltiple. Para subsanarlo, en la práctica del fractal se sacaba partido de la posibilidad de animar la figura: cada vez que se dibuja un cuadrado, se usa un método que produce un retraso de décimas de segundo. Así, el ojo humano puede percibir el orden en que se van construyendo recursivamente las subfiguras del dibujo.

Finalmente, otro de los objetivos primordiales de nuestras asignaturas consiste en dominar los algoritmos básicos de manipulación de arrays, y su aplicación a la estructuración de tipos de datos sencillos; para su mejor comprensión, en el laboratorio desarrollamos ejemplos concretos de cierto interés práctico. Aunque el entorno *BlueJ* proporciona herramientas para examinar los datos de estos tipos y ver cómo afectan los métodos a su estado, casi siempre es conveniente desarrollar algún programa de aplicación, más o menos costoso de elaborar, y para el que no siempre la salida estándar muestra con eficacia su comportamiento.

El ejemplo de la Fig. 6 corresponde a una práctica en la que se manejaba mediante un array un grupo de polígonos, elementos que se pueden dibujar en una ventana de la librería, superpuestos por su orden en el array. En un ejemplo como este, realizar una aplicación completa excede las limitaciones en cuanto a objetivos y tiempo de una asignatura de primer curso; no obstante, el uso de la librería gráfica permite escribir un sencillo programa de prueba en el que, creado un grupo, se visualice su estado antes y después de aplicarle las operaciones implementadas, comprobando así sus posibilidades y correcto funcionamiento.

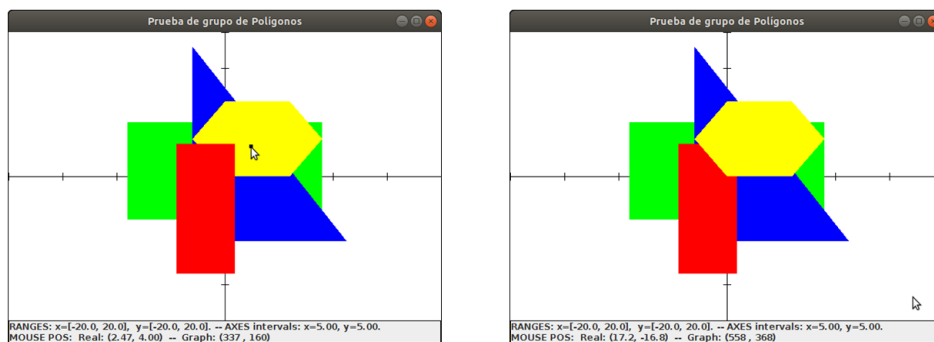


Fig. 6. Prueba en un grupo de polígonos de la ejecución de traer al frente un polígono. A la izquierda: selección mediante un clic del polígono a mover. A la derecha: estado resultante.

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## Desarrollo de una herramienta para el cálculo de ciclos de refrigeración con Excel y Coolprop

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### Resumen

*El estudio de ciclos de refrigeración es un tema que aparece en diversas asignaturas tanto de grado como de máster: Termodinámica, Climatización, Refrigeración, Producción de frío, etc. El artículo presenta una herramienta desarrollada sobre la aplicación Excel para el análisis de ciclos de refrigeración. El objetivo del trabajo es disponer de una aplicación docente que permita facilitar las sesiones teóricas y realizar ejercicios para sesiones prácticas de las asignaturas con este contenido. El uso de Excel, que es una aplicación ampliamente conocida, permite facilitar la interacción con el alumno, de manera que la explicación de su funcionamiento no requiere un gran empleo de tiempo. La aplicación permite al usuario interactuar con las variables que definen cada ciclo y poder centrar el esfuerzo en el análisis de los resultados. La herramienta permite obtener como resultados tanto los diferentes puntos del ciclo termodinámico, numéricamente y gráficamente, como los valores de potencias, flujos de refrigerante y rendimiento del mismo. Las propiedades de los refrigerantes se obtienen con la herramienta Coolprop, que es de acceso libre y se conecta con Excel mediante el uso de un complemento.*

**Palabras clave:** Refrigeración, TIC, Coolprop, Excel, Ciclos refrigeración.

### 1. Introducción

El cálculo de los ciclos de refrigeración es un tema común en diferentes asignaturas impartidas en grados y másteres. En el caso de la Universitat Politècnica de València se explica en las asignaturas de grado de Termodinámica, Refrigeración, Diseño de instalaciones de climatización y calefacción, etc. En el caso de máster se incluye en Calor, Frío y Climatización y en Generación e instalaciones de frío. Según los conocimientos previos del alumno la complejidad de los ciclos que se estudian es mayor o menor. En los



primeros cursos suele analizarse solamente el ciclo simple de refrigeración, mientras que en asignaturas de final de grado o máster ya se introducen los ciclos de doble compresión.

Existen diferentes aplicaciones para el cálculo de ciclos frigoríficos, aunque a nivel docente es más difícil encontrar alguna que pueda ayudar en la elaboración de prácticas o en la explicación de la asignatura. En (Sarabia et al., 2018) se describe el desarrollo de una aplicación docente que permite a los alumnos realizar cálculos sobre diferentes configuraciones de ciclos de refrigeración. La aplicación se llama FRIO\_V2 y puede descargarse de manera gratuita desde una plataforma de software de la Asociación Técnica Española de Climatización y Refrigeración (Atecyr, 2016). Esta aplicación está registrada como Software de la Universitat Politècnica de València y permite obtener los cálculos de cualquiera de las configuraciones de forma rápida y analizar los resultados, pero no permite a los alumnos configurar y calcular un ciclo diferente de los que ya hay programados. Otra aplicación que también puede utilizarse de forma didáctica es CYCLE\_D-HX (NIST, 2017), desarrollada por el National Institute of Standards and Technology de EEUU. La aplicación permite seleccionar un total de cuatro ciclos de refrigeración y definir en otra pantalla los parámetros necesarios para el cálculo del ciclo termodinámico. Es una aplicación bastante intuitiva, como la anterior, pero está más limitada en cuanto al número de sistemas que permite elegir.

## 2. Objetivo

El objetivo del trabajo es doble, por un lado el desarrollo de una aplicación de carácter docente para su uso en prácticas; por otro, el diseño de una sesión práctica que permita al alumno consolidar los conocimientos de la materia a través de unos ejercicios que intenten adaptarse a la resolución de casos reales.

## 3. Descripción de la herramienta

La herramienta que se ha diseñado consiste en un archivo Excel con diferentes hojas de cálculo para la resolución de diferentes problemas. La hoja Excel utiliza un complemento llamado CoolProp (Bell et al., 2014) que permite a través de unas funciones determinar el valor de las variables termodinámicas de un refrigerante.

Las primeras hojas contienen una serie de ciclos ya parametrizados. En función de los valores que se indican en la entrada de datos (celdas de color gris), la hoja está programada

para indicar las propiedades de cada punto termodinámico que describe el ciclo y una serie de datos de referencia: potencia del condensador, EER de la instalación, potencia eléctrica consumida, etc. Además, los puntos quedan representados en una grafica, diagrama presión-entalpía, en el que se reflejan de forma más visual los diferentes puntos del ciclo (Fig. 1).

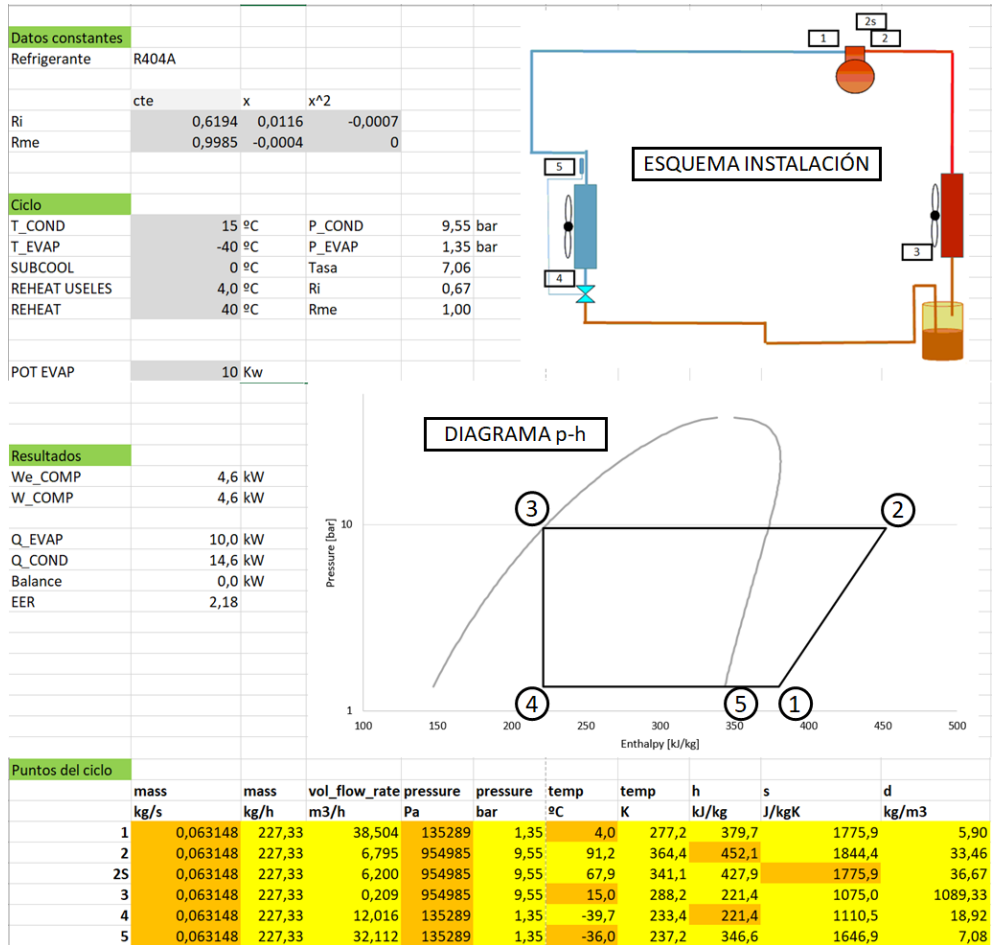


Fig. 1 Vista de las partes que componen la hoja de cálculo del ciclo simple: propiedades, esquema del ciclo, diagrama p-h y descripción de los puntos del ciclo.

La hoja que se presenta en la Fig. 1 pertenece a la parametrización de un ciclo simple de refrigeración. Las celdas de fondo gris representan datos que el alumno debe de introducir para definir el sistema, el resto de celdas son resultados de la aplicación. En la parte superior derecha de la Fig. 1 se muestra el esquema de la instalación y los puntos más significativos de la misma:

- Punto 1: aspiración del compresor
- Punto 2: descarga del compresor
- Punto 2s: es un punto ideal de descarga del compresor teniendo en cuenta que la compresión es isentrópica (no aparece en la gráfica porque el punto de salida descarga real es el Punto 2)
- Punto 3: salida del condensador
- Punto 4: salida de la valvula de expansión
- Punto 5: salida del evaporador

En el cálculo de los puntos del ciclo hay algunas variables cuyas celdas tienen un color naranja y otras amarillo. Este código de colores es para facilitar la comprensión de cómo realizar el ciclo a los alumnos. En cada punto, se representan de color naranja las variables que se han tomado de referencia para el cálculo del resto. Por ejemplo, en el punto 1 se conocen la presión y la temperatura, y con estas variables se calculan el resto. El caso de la masa también está de color naranja porque el cálculo se realiza en función de datos que introduce el usuario. Por tanto, las celdas de color amarillo son las que utilizan la llamada al complemento Coolprop para el cálculo de sus valores.

Actualmente la aplicación Excel está formada por las hojas que se nombran a continuación:

- **PRESENTACIÓN:** Contiene la página de presentación de la aplicación y los autores para contacto.
- **SIMPLE:** Esta hoja tiene parametrizado un ciclo simple de refrigeración. El alumno deberá completar los datos que aparecen en celdas de fondo gris para poder ver los resultados que se presentan en forma numérica y gráfica. (Ver Fig. 1)
- **SIMPLE REC:** Esta hoja contiene definido un ciclo simple con un recuperador de recalentamiento-subenfriamiento. Es muy similar a la anterior a diferencia de este nuevo equipo.
- **DOBLE\_TOTAL:** En esta hoja se define un ciclo doble de inyección total. La definición del mismo requiere de algunos datos más que el ciclo anterior, pero el modo de trabajar en la hoja es idéntico.
- **DOBLE\_TOTAL REC:** Esta hoja tiene definido un ciclo como el anterior, pero con un intercambiador adicional que el alumno deberá definir y podrá observar su influencia sobre los resultados.
- **DOBLE\_INY\_PARCIAL:** Esta hoja tiene parametrizado un ciclo doble con inyección parcial de refrigerante y con un recuperador. Al igual que en los casos anteriores, el alumno deberá completar las celdas indicadas en fondo gris.
- **EJERCICIO 1:** Esta hoja contiene un ejercicio propuesto para que el alumno complete. Observando el funcionamiento y el modelizado de los ciclos en las hojas

anteriores, el alumno deberá realizar un modelo del ciclo que se describe en la figura que contiene la hoja (Ver Fig.2).

- EJERCICIO 2: Al igual que la anterior, esta hoja contiene un esquema de instalación diferente para que el alumno lo pueda parametrizar (Ver Fig.2).
- Syntax: Esta hoja contiene un ejemplo de cómo utilizar las funciones en Excel para el cálculo de propiedades termodinámicas de refrigerantes aplicando el complemento Coolprop.
- Lists: Esta hoja contiene un listado de los posibles refrigerantes con los que puede trabajar el programa.

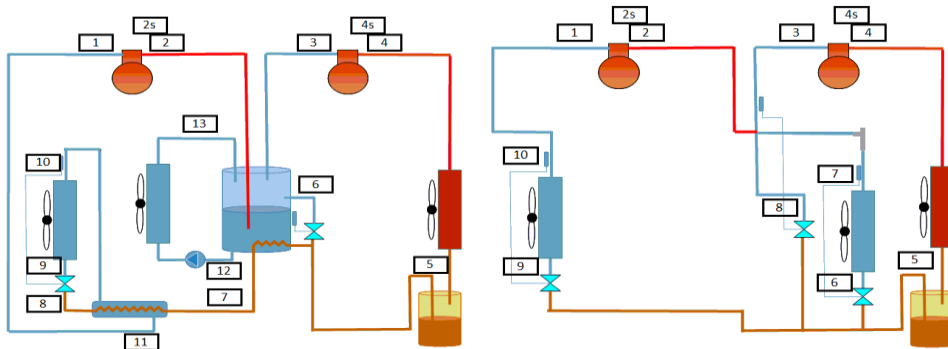


Fig. 2 Esquemas de instalaciones que se proponen para modelizar en el Ejercicio 1 (izquierda) y Ejercicio 2 (derecha)

La idea es poder completar la herramienta con más tipologías diferentes de ciclos, aunque los ya definidos son los más habituales.

Las últimas dos hojas de la aplicación son dos ejercicios propuestos en los que se indica el ciclo que se debe modelizar, nombrando los diferentes puntos en el esquema correspondiente y se indican también las propiedades de la instalación, a modo de enunciado de problema. En estos casos los alumnos deberán definir cada uno de los puntos de la instalación estableciendo para ello las relaciones entre ellos y realizando los balances de masa y energía necesarios. Una vez definidos los puntos, de forma sencilla se podrá visualizar en el diagrama ph para comprobar de forma visual que el modelo es correcto. Como ejemplo para trabajar con el ejercicio el alumno ya dispone de las otras hojas con ciclos definidos. El cálculo de las propiedades de los refrigerantes se realizará con llamadas al complemento Coolprop. Para ello se emplea la llamada “=PropsSI(v1,v2,v3,v4,v5,v6)”, donde:

- v1 representa la variable que se quiere conocer del fluido
- v2 y v4 las variables que se conocen del punto termodinámico
- v3 y v5 el valor que tienen las variables v2 y v4 respectivamente
- v6 el nombre del fluido refrigerante

Empleando esta función se pueden calcular todos los puntos que conforman el ciclo de refrigeración y que están definidos en la figura que se adjunta en la hoja (Fig. 2). Una vez conocidos los datos de todos los puntos del ciclo se pueden calcular valores como la potencia del mismo, la potencia de los compresores, caudal volumétrico en los mismo, etc.

#### 4. Descripción de la práctica diseñada

En este apartado se describe, a modo de ejemplo, cómo trabajar con la herramienta de cálculo de ciclos. La práctica que se describe a continuación tiene una duración de 3 horas y consta de dos tareas claramente diferenciadas, como se muestra en la Tabla 1. En el caso de disponer de más o menos tiempo, la segunda de las tareas se puede flexibilizar con más o menos ejercicios.

La primera parte de la sesión se dedica a una explicación básica del funcionamiento del programa y de los ejercicios de la práctica. Este apartado no requiere de una duración muy extensa ya que el programa se ha desarrollado sobre Excel y los alumnos de todos los niveles tienen un conocimiento suficiente de la aplicación. En este caso, hay explicar en mayor detalle es la conexión de Excel con el complemento de CoolProp, que es el que permite obtener las propiedades de los fluidos refrigerantes. En primer lugar, asegurar la instalación del complemento en Excel y posteriormente indicar cómo se realizan las llamadas a la función que permite el cálculo de las propiedades del refrigerante, tal y como se ha explicado en el apartado anterior.

La primera tarea consiste en obtener y analizar unos resultados utilizando los ciclos ya modelizados en la aplicación.

El enunciado de la tarea plantea una situación en la que se conoce:

- la potencia de refrigeración necesaria,
- recalentamiento útil y no útil,
- el subenfriamiento,
- eficiencia del intercambiador (si existe)
- la temperatura del evaporador y
- la temperatura exterior.

Con todo ello se plantea que el alumno:

- calcule la potencia requerida por la instalación utilizando diferentes refrigerantes
- el rendimiento EER en función del uso del intercambiador y el refrigerante
- caudal volumétrico de los compresores

La segunda tarea consiste en la modelización de dos ciclos dobles planteados con uno o varios evaporadores. Para la elaboración del modelo, la hoja está preparada con los datos de entrada necesarios con los que se debe realizar el modelo. El modelizado de la instalación consiste básicamente en definir las variables termodinámicas de cada uno de los puntos que se indican para cada ciclo. Para ello el alumno deberá conocer la relación existente entre las variables de cada punto de la instalación y utilizar el complemento de CoolProp para determinar el valor de las propiedades para completar el modelo. Esta tarea puede flexibilizarse y adaptarse al nivel del alumnado. La aplicación desarrollada, en su versión actual, está adaptada para alumnos de 1º de máster, son alumnos que ya tienen conocimientos de ciclos en asignaturas anteriores de grado (Termodinámica) y que por tanto entienden bien el manejo de ciclos de compresión multietapa (dobles). En el caso de cursos de iniciación (alumnos de grado), los ciclos a modelizar deberían adecuarse a los estudiados en la parte de teoría. En este caso el manejo de la herramienta y los casos propuestos deberían estar relacionados con ciclos de compresión simple y diferentes variantes, por ejemplo, casos de diferentes presiones de evaporación en un ciclo simple. En estos cursos de iniciación la herramienta sirve también para aplicar que los alumnos vean cómo se pueden aplicar los conocimientos que parecen más teóricos al diseño de equipos e instalaciones. Por lo que respecta al tiempo disponible de práctica, esta segunda tarea puede adaptarse con más o menos ciclos a modelizar.

**Tabla 1. Esquema de práctica informática con la aplicación**

<b>Tareas</b>	<b>Duración</b>
Caso presencial: Explicación del funcionamiento del programa.	
Caso online: Visualización videos tutoriales del manjo de la aplicación	0.5 hora
Tarea 1. Resolución de un caso planteado utilizando los ciclos definidos	0.5 hora
Tarea 2. Modelizar dos ciclos propuestos	2 horas

La propuesta de evaluación de la práctica se muestra en la Tabla 2. En ella se recoge una valoración menor para la tarea uno debido a la menor dificultad de la misma y menor



tiempo requerido para su resolución. La tarea 2 presenta un valor del 70% del total de la práctica y se puede repartir entre los ejercicios que se planteen. En el caso de la aplicación actual son dos de igual valor cada uno.

**Tabla 2. Evaluación de la práctica**

<b>Tareas</b>	<b>Actividad</b>	<b>Valor</b>
Tarea 1. Análisis de ciclos de refrigeración ya definidos	Resolución caso	30%
Tarea 2. Diseño de dos ciclos de refrigeración propuestos	Diseño del ciclo 1	35%
	Diseño del ciclo 2	35%

Como bibliografía para el diseño de la instalación se recomiendan los apuntes de la asignatura y los manuales de refrigeración (Pinazo, 1996) y (Fernández Seara et al., 2016).

Estas tareas permiten que los alumnos puedan aplicar los conocimientos adquiridos a la resolución de problemas más cercanos a la realidad, lo cual les motiva y ayuda al proceso de aprendizaje (Cabreró,2006).

## 5. Conclusiones

El artículo describe las características esenciales de una aplicación informática de uso docente desarrollada sobre una hoja Excel para el cálculo de ciclos de refrigeración. La aplicación presenta características de fácil interoperabilidad con el usuario y adaptación para la elaboración de prácticas informáticas sobre la materia.

El trabajo también describe una práctica informática sobre modelización de ciclos de refrigeración. Esta práctica permite al alumno consolidar los conocimientos adquiridos en las sesiones teóricas y ponerlos en práctica con el fin de analizar las repercusiones de diferentes variables del problema.

La herramienta permite adaptarse al nivel de alumnado, ya que la temática es común en diferentes niveles de estudiantes, desde primeros cursos de grado (Termodinámica) hasta último curso de Máster (Generación de frío). De esta manera, los ejercicios de diseño de la instalación deberán adaptarse al tipo de instalación que se está estudiando, instalaciones

más simples en el caso de iniciación y ciclos de doble etapa en el caso de estudiantes de mayor nivel, aunque el formato de la práctica se mantiene.

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## Innovación a través del arte en la Escuela

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### **Resumen**

*El arte en la educación es muy importante. Muchas veces, y a pesar de estar siempre presente en las aulas, pasa a formar parte de alguna asignatura secundaria, en ocasiones, pasando desapercibido, y solo se recurre a él cuando se le necesita; ya sea para un proyecto, un regalo... Nosotros, como docentes, rara vez nos damos cuenta de lo esencial que puede llegar a ser, pues permite a su vez adquirir competencias que son imprescindibles para el desarrollo de los alumnos.*

*Las escuelas de hoy en día se esfuerzan por llevar un aprendizaje basado en proyectos, en la que se les pide a los alumnos la capacidad de trasladar sus conocimientos al mundo real; y este aprendizaje basado en proyectos, lleva implícito el arte, la necesidad de crear. Y hablando de proyectos y de la importancia de dar rienda suelta a la imaginación, ¿Es posible recurrir al arte como elemento esencial para trabajar este tipo de educación? ¿Podría la animación ser capaz de transmitir los conocimientos adquiridos y trabajar de la mano de la creatividad?*

*Pues bien, en este proyecto, se hace uso de la animación, en concreto, de la técnica del Stop motion, para que los alumnos puedan traspasar sus conocimientos adquiridos en las distintas materias, sin dejar de lado su creatividad. Pues con ella, se puede llevar a cabo este tipo de proyectos que relacionan las distintas áreas y de los que tan centrados están las escuelas de hoy en día. Por su atractivo y fácil uso en el aula, se convierte en una herramienta idónea para trabajarla en clase. Dando lugar a proyectos más cercanos y creativos capaces de plasmar el aprendizaje adquirido y sin dejar de lado a la creatividad, que tan importante es.*

*Como educadores, es nuestro deber tener siempre presente el arte en nuestras clases, pues es tan importante saber desarrollar los conocimientos adquiridos y plasmarlos en el mundo real, como desarrollarlos a través de proyectos que den rienda suelta a esa creatividad.*

**Palabras clave:** Arte, educación, creatividad, animación, Stop motion, imaginación, proyectos.



## **1. Introducción**

Nos encontramos en una sociedad llena de cambios, donde el lugar que en antaño ocupaban las palabras, ahora es la imagen la que va ganando el terreno. A pesar de que con la revolución tecnológica, esto haya incrementado, lo cierto es que desde bien conocida la imagen, ésta siempre ha sido capaz de expresar lo que con palabras a veces nos es difícil de explicar.

Por ello, en este proyecto se hace hincapié en la imagen, en el arte, en la creatividad. Porque a pesar de que esté muy poco valorada en los centros educativos, no se le suele dar la importancia que debería. Hoy en día, nos centramos en llevar a cabo una educación basada en proyectos y en muchas ocasiones los docentes se enfrentan al reto de como conseguir llevar a cabo este tipo de aprendizaje, de enseñanza. Pues bien, ahí debería entrar la imagen, para poder expresar a través de ella nociones aprendidas en distintas materias.

A través de la imagen, los alumnos son capaces de transmitir cosas, son capaces de proyectar lo aprendido sin la necesidad de hacer un recital. Son capaces de llevar a cabo esa metodología basada en proyectos, en la que la imagen debería estar siempre presente. Usar un medio audiovisual como puede ser la animación, es una herramienta muy útil que muchos centros educativos ya han puesto en práctica hoy en día, pues es usada en muchas ocasiones para enseñar nuevos conceptos. Continuamente acudimos a videos para aclarar a nuestros alumnos un concepto que no ha quedado claro, o simplemente para enseñarles una idea. Por ello, nuestros alumnos, no solo deberían saber captar la información de estos medios, sino que se hace esencial que sepan hacer uso de ellos y ser capaces de transmitir sus propios conocimientos a través de medios audiovisuales.

Ahora bien, se nos hace casi imposible entender como niños de 7 años pueden ser capaces de hacer un buen uso de esta técnica y saber transmitir los conocimientos aprendidos en las diferentes materias a través de ella. Bien, precisamente por eso hacemos uso de la animación. Concretamente, de la técnica del Stop motion, que no solo destaca por su fácil acceso al aula, al ser económica y no necesitar de muchos medios, sino que además es capaz de captar la atención de cualquier público espectador, y eso, en una edad tan temprana en la que cada niño es único, se le debe enseñar a desarrollar esa parte creativa que tan importante es. Otra ventaja que se puede decir es que nuestros alumnos, podrían aprender jugando. Y a través del juego, se expresan, comparten, aprenden, sociabilizan e intercambian roles; y esto último es muy importante a tener en cuenta en el aprendizaje basado en proyectos, y por eso hoy en día está cobrando importancia. Este cambio o asignación de roles consiste en asignar a cada niño un rol que tendrá que representar hasta nueva orden o cambio de rol. Así, los niños tímidos, por ejemplo, deben ser capaces de hacer de portavoces, y así, sucesivamente.

La técnica del stop motion es ideal para trabajar con nuestros alumnos, tengan la edad que tengan. No ayuda solo a desarrollar la creatividad de nuestros pequeños, sino a captar la atención incluso de aquellos alumnos que puedan no sentirse identificados con la metodología empleada en clase.

## 2. Objetivos

Dado que hacemos referencia a unidades basadas en proyectos, y nos centramos en una forma distinta de enseñar, prestando atención al desarrollo de la creatividad y teniendo en cuenta que partimos de la base de una educación individualizada, donde cada alumno es diferente, único y especial, y por tanto, el profesor ha de ser flexible a la hora de enseñar en clase diferentes conceptos, y ha de ser capaz de explicarlos de distintas formas, los objetivos serán los siguientes:

- A través de un lenguaje visual se pretende desarrollar la creatividad.
- Haciendo uso de proyectos globales y multidisciplinares, hacer buen uso de los conocimientos y saber integrarlos adecuadamente.
- Usar el arte como medio de expresión para representar una idea o fijar conocimientos.
- Hacer un buen uso del lenguaje audiovisual, así como comprender su complejidad y beneficios.
- Mejorar la búsqueda de información a través del Aprendizaje Basado en Proyectos.
- Mejorar las habilidades sociales al trabajar en equipo.

## 3. Metodología empleada

Si témenos en cuenta que pudimos poner en práctica este tipo de proyecto en una clase donde las edades de los niños circulan alrededor de 6 años, es importante en primer lugar haber seguido a lo largo del curso una dinámica que favorezca esa enseñanza-aprendizaje basado en proyectos. Posteriormente, se ha de buscar la unidad y asignatura o asignaturas con las que usaremos este tipo de metodología y proyecto y se les explicará a los alumnos en que consiste la técnica del Stop Motion. Esta técnica suele agradales mucho y les

motiva a empezar bien el proyecto, pues ¿Quién no ha soñado alguna vez poder dar vida a un objeto? Pues algo similar ocurre con esta técnica de animación, en la que los alumnos han de crear su propia historia haciendo uso de todo tipo de materiales, ya sean, lápices, goma eva, pizarra, números, dibujos, pinturas, palabras...

Así pues, una de las metodologías a utilizar en este proyecto está basada y centrada más en el aprendizaje basado en proyectos, en el cual nuestros alumnos aprenden mediante estos proyectos a enlazar contenidos y dar respuesta a problemas en el día a día.

Como al fin y al cabo son niños, es conveniente dejarles claro el tema a tratar. Pues no es lo mismo hablar de sentimientos, que de plantas. Es importante que el tema sea atractivo, con el fin de motivarles y sacar lo mejor de ellos.

Para este tipo de actividad, sería conveniente crear grupos, y hablando de grupos, ¿qué mejor que adjudicar roles a cada miembro? Esto es importante que si no hemos usado esta dinámica de los roles en clase hasta ahora, seamos capaces de explicárselo bien y hacer que realmente se sientan conectados con su rol a representar. En esta actividad, los roles serían, coordinador, fotógrafo, motivador, representante o portavoz, diseñador y escenógrafo, por ejemplo.

Llega el momento de explicarles el tema a tratar, y esto es importante que no dure mucho tiempo, pues se presupone que lo habrán dado simultáneamente en otra de las asignaturas y lo tienen bien aprendido. En este caso, el tema a tratar fue el de las plantas, muy sencillito, pero lo suficiente para captar su atención.

Pero como es importante saber llegar a nuestros alumnos, y esto se consigue siendo flexible, ésta no ha sido la única metodología a utilizar. Entre otras, destacamos la metodología de investigación, al haber tenido conocimiento previo del tema a raíz de estudiarlo anteriormente e investigar un poco sobre ello. Por su parte, el profesor también se anticipó a aquellas preguntas que pudieran demandar en un futuro sus alumnos, y a esto se le llamaría metodología proactiva. Y por último, no hay que olvidarnos del trabajo cooperativo, que tan importante es hoy en día para el desarrollo personal, cognitivo y social de nuestros alumnos.

Así pues, se lleva a cabo el audiovisual, en el que al contar con poca edad, el profesor supervisa y ayuda, así como lleva a cabo el posterior montaje de los fotogramas.

## **4. Resultados**

Cuando le ponemos empeño a la educación y nos involucramos al máximo, nos damos cuenta de lo importante que es enseñar de diversas formas, y no aferrarse a una sola. Es

sorprendente como incluso con niños tan pequeños, se puede apreciar ese empujón de motivación que les crea este tipo de actividades, de aprendizaje. En cuestión de segundos, conseguimos captar su atención y colaboramos a ese aprendizaje en el que jugando, adquieren conocimientos y habilidades.

Mis alumnos se aferraron bien a su posición de roles y llevaron su papel más allá de su imaginación. Es una buena forma de comenzar motivándoles para una actividad grupal, cooperativa.

Como en este caso tratamos el tema de las plantas, dejaré aquí abajo algún que otro fotograma en el que se aprecie su evolución y desarrollo. En este ejercicio concreto, usamos, acrílico, goma-eva, y lápices de colores. Pero cualquier material habría servido. Es importante tener en cuenta que en eso consiste la creatividad, el arte, en dejarles ser libres, pues hay mil maneras de llegar a una misma conclusión. La imagen, como vemos, cobra vida.

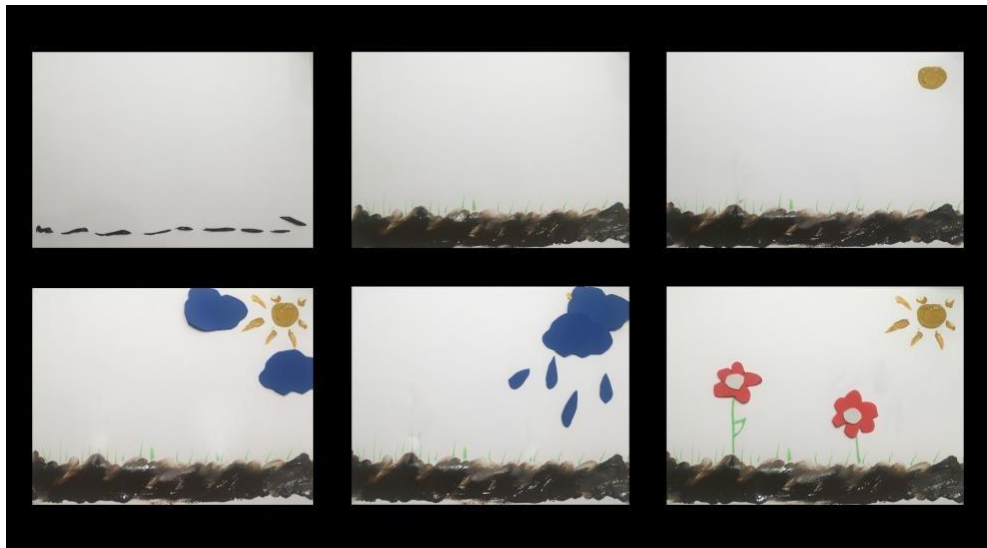


Fig. 1 Stop motion, la vida de una planta  
Font: Edwards, B (2005)

## 5. Conclusiones

Como profesores, hemos de ser conscientes del cambio que se está produciendo en nuestra sociedad, y por ello, hemos de ser conscientes de que no existe una única y clásica vía de enseñar a nuestros alumnos. Hemos de esforzarnos por una educación más individualizada,



y ser capaces de aceptar esa flexibilidad, para que en momentos que necesitemos, podamos hacer uso de ella y seamos capaces de llegar a los alumnos que por alguna razón, están desmotivados en el aula.

Actividades y proyectos como este suelen captar la atención de casi todos nuestros alumnos y son verdaderamente útiles para enseñarles distintas vías de adquirir conocimientos y habilidades, así como de aprender a trabajar en equipo.

Seamos flexibles, seamos creativos y aprendamos jugando.

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## Nuevas herramientas para la docencia de la historia del arte

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### Resumen

*La propuesta que se presenta en esta comunicación surge de la observación, de las consultas -tanto las más habituales como las más llamativas- de los estudiantes de historia del arte y de algunos vacíos y errores recurrentes detectados tras la evaluación.*

*Teniendo en cuenta tanto los contenidos curriculares como las competencias reales de los alumnos, hemos ideado un espacio colaborativo on-line en el que los estudiantes puedan compartir recursos e ir elaborando, de manera supervisada, su material de apoyo para el estudio (imágenes, esquemas, fichas, apuntes y etiquetas web), superando algunos tópicos y errores que suelen acumularse tras la búsqueda indiscriminada en internet.*

*Este modo de trabajar permitirá que los alumnos cuenten con materiales de estudio de buena calidad, al tiempo que se fomentan otras destrezas y capacidades necesarias cuando se trabaja con un volumen de imágenes tan elevado, tales como el adecuado manejo de bases de datos y de herramientas básicas de diseño y de tratamiento de imágenes.*

*En esta comunicación presentamos el desarrollo de esta propuesta (plantillas, reparto de tareas, métodos de evaluación y supervisión, entre otros aspectos), así como los buenos resultados obtenidos de otras experiencias y prácticas previas que, en cierto modo, nos han animado a diseñarla.*

**Palabras clave:** *innovación docente, historia del arte, trabajo colaborativo, nuevas herramientas*

### 1. Introducción

No resulta difícil detectar que cada vez más alumnos recurren a internet como fuente para buscar sus imágenes, completar sus apuntes o incluso suplir sus faltas a clase. Tampoco es



extraño, dada la inmediatez y comodidad que supone la búsqueda y descarga de información en la web. Y no sería reprochable si no relizasen esas consultas de manera superficial y descuidada, acumulando algunos errores y obviando algunas valiosas opciones que ofrecen.

Proponemos un ejercicio que puede ayudarles a elaborar unos apuntes completos y bien organizados, al tiempo que les muestra cómo aprovechar adecuadamente las nuevas tecnologías para facilitar el estudio y la investigación. Compartiendo el esfuerzo y los recursos construirán entre todos, de manera supervisada, el material de estudio complementario de la asignatura.

Puede parecer que con esta propuesta, en cierto modo, estamos fomentando un sustituto a los libros, dado que algunos alumnos, muy probablemente, recurrirán a la biblioteca sólo para completar el trabajo que les haya sido asignado, pero no para consultar otras obras, considerando posiblemente que con los materiales compartidos tienen información suficiente. Sin embargo, esperamos que se produzca el efecto contrario; al compartir su trabajo con el resto de los compañeros, contarán con más referencias y fuentes fiables y accesibles -búsquedas y organizadas por ellos- a las que recurrir, promoviendo su consulta actual y futura. Las herramientas que proponemos para su elaboración les permitirán además conocer otras maneras de gestionar sus datos que podrían serles útiles.

## **2. Apuntes compartidos: base de datos colaborativa**

### **2.1. Objetivos**

-Elaborar, de manera cooperativa, materiales complementarios de estudio o consulta de buena calidad, supervisados por la docente.

-Fomentar destrezas básicas para la investigación, así como otras destrezas a nuestro entender necesarias cuando se trabaja con un elevado volumen de imágenes, tales como el adecuado manejo de bases de datos y de herramientas básicas de diseño y de tratamiento de imágenes.

-Fomentar el trabajo colaborativo, la interacción entre alumnos y el desarrollo de otras habilidades.



## 2.2. Desarrollo de la propuesta

Basándonos en los contenidos curriculares de la asignatura “Historia del arte precolombino” incluidos en la guía docente<sup>1</sup> y teniendo en cuenta que se trata de una asignatura -en la Universidad de Valencia- optativa cuatrimestral de cuarto curso, ofertada para un máximo de 40 alumnos, proponemos la elaboración conjunta de los materiales de estudio complementarios a los apuntes de clase a través de un espacio compartido on-line que, finalizado el trabajo, contendrá una base de datos con las fichas e imágenes de las obras más destacadas de la asignatura, una carpeta de bibliografía organizada por temas con artículos, vídeos y referencias bibliográficas de calidad contrastada, así como la carpeta con los materiales de apoyo que ya se les facilitan en la actualidad.

Se propone como una actividad obligatoria y evaluable, con un peso del 10% en la nota final. Cada alumno deberá elaborar, cumpliendo los requisitos requeridos, al menos la ficha de una obra que seleccionará de un listado (Tabla 1.1) el primer día de clase. Cada una de ellas constituirá una entrada de la base de datos conjunta. Facilitaremos asimismo un listado alternativo para aquellos alumnos que, de manera voluntaria, decidan realizar más de una entrada de la base de datos colectiva.

Deberán completar de manera adecuada los siguientes campos: identificación de la obra, localización geográfica y temporal, cultura, análisis formal (soporte, descripción formal -materiales y procedimiento técnico), aproximación al significado (análisis iconográfico e interpretación iconográfica), bibliografía, enlaces (referencias, artículos, vídeos...), palabras clave e imágenes o referencias/enlaces a las imágenes.

En los apartados de cultura, análisis formal y aproximación al significado se requerirán textos de 8.000 caracteres como mínimo. Aunque las obras habrán sido explicadas en clase, deben incluir, además de la bibliografía citada en el texto, al menos cinco referencias bibliográficas y dos enlaces externos relacionados con la obra trabajada o con la cultura a la que pertenece. Las imágenes incluidas, adecuadamente referenciadas, deberán tener calidad suficiente para ser manipuladas por el alumno, que habrá de ser capaz de modificarlas al menos mínimamente (recortar o ampliar detalles de la imagen, iluminar o destacar algunas zonas, colorear motivos, calcar, incluir texto o marcas...).

Inicialmente, los alumnos rellenarán los datos en una plantilla de excel<sup>2</sup> (Tabla 1.2) y subirán sus imágenes a una carpeta asociada a su entrada, en una tarea individual creada en la plataforma Aula Virtual de la Universidad de Valencia. Una vez corregida la tarea, cada

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<sup>1</sup> Elaborada por la Dra. Cristina Vidal: <https://webges.uv.es/uvGuiaDocenteWeb/guia>

<sup>2</sup> Los datos pueden exportarse fácilmente y permite organizar la información por campos; en caso de que no se disponga del programa adecuado para la elaboración de bases de datos, es una buena manera de organizar la información.

alumno deberá rellenar la entrada correspondiente en la base de datos colectiva (Img. 1) y cargar los artículos y enlaces pertinentes; esos materiales serán validados por las docentes tras una segunda revisión para garantizar la buena calidad de las entradas.

La base de datos se alojaría en el Aula Virtual de la Universidad de Valencia. Aunque el entorno del Aula Virtual permite pocas modificaciones, principalmente en lo referido al diseño, ofrece a los alumnos un primer contacto con bases de datos. Al requerirse imágenes modificadas e incluir la carpeta de “Bibliografía y referencias”, organizada por temas, se pretende que los alumnos se familiaricen también con programas de gestión y modificación de imágenes, al tiempo que aprenden a organizar sus materiales sin duplicarlos.

Además se propone impartir dos clases de asistencia voluntaria en horario de actividad complementaria para facilitar la labor a los alumnos menos familiarizados con estas herramientas. La primera de ellas, acerca del manejo básico de programas y aplicaciones de diseño y tratamiento de imágenes; la segunda, sobre el manejo básico de bases de datos y bancos de imágenes; tanto en lo que se refiere a su creación, como en adquirir familiaridad con su consulta, dado que cada vez son más las instituciones que digitalizan y comparten sus datos de este modo.

Somos conscientes de que se trata solo de una propuesta y de que no podemos aportar todavía resultados relevantes. Es muy posible que, una vez implementada, tengamos que ir ajustándola, adaptándonos a los recursos disponibles y a su recepción por parte de los alumnos pero creemos que puede ser una herramienta útil, con posibilidades de enriquecimiento posterior.

### 2.2.1. Plantillas

**Tabla 1.1. Asignación de entradas**

Culturas ceramistas del Preclásico y Olmecas	Cabeza colossal	<a href="#">Alumn@ 1</a>
	Ofrenda 4 de La Venta	<a href="#">Alumn@ 2</a>
	Altar 4 de La Venta	<a href="#">Alumn@ 3</a>
	Pretty Ladies de Tlatilco	<a href="#">Alumn@ 4</a>
	Tumbas de tiro de Nayarit	<a href="#">Alumn@ 5</a>
	Señor de las Limas	<a href="#">Alumn@ 6</a>
	El epiclásico y el ciclo de la vida en Xochitécatl	<a href="#">Alumn@ 7</a>
Teotihuacan	Plano	<a href="#">Alumn@ 8</a>
	Templo de Quetzalcoatl	<a href="#">Alumn@ 9</a>
	Incensario	<a href="#">Alumn@ 10</a>
	Máscara	<a href="#">Alumn@ 11</a>
	Tetitla, Pórtico 11, Mural 2. Detalle	<a href="#">Alumn@ 12</a>
	Tepantitla, Tlalocán y Tamoanchán	<a href="#">Alumn@ 13</a>

Mayas	Murales de Bonampak	<a href="#">Alumn@ 14</a>
	Templo I de Tikal	<a href="#">Alumn@ 15</a>
	Lápida de Pacal	<a href="#">Alumn@ 16</a>
	Dinteles Yaxchilán	<a href="#">Alumn@ 17</a>
	K1728	<a href="#">Alumn@ 18</a>
	Templo de las Inscripciones	<a href="#">Alumn@ 19</a>
	Estela x de Copán?	<a href="#">Alumn@ 20</a>
	Códice Dresden	<a href="#">Alumn@ 21</a>
Aztecas	Códice Boturini	<a href="#">Alumn@ 22</a>
	Grabado de Tenochtitlan	<a href="#">Alumn@ 23</a>
	Piedra del Sol	<a href="#">Alumn@ 24</a>
	Coatlicue	<a href="#">Alumn@ 25</a>
Chavín, Paracas	Plano	<a href="#">Alumn@ 26</a>
	Lanzón	<a href="#">Alumn@ 27</a>
	Momia Paracas	<a href="#">Alumn@ 28</a>
	Estela Raimondi	<a href="#">Alumn@ 29</a>
	Textiles Karwa	<a href="#">Alumn@ 30</a>
Moche, Nazca, Chimú y Lambayeque	Estela Raimondi	<a href="#">Alumn@ 31</a>
	Tumbas del Señor de Sipán	<a href="#">Alumn@ 32</a>
	Vasija-estribo ritual funerario	<a href="#">Alumn@ 33</a>
	Tumi	<a href="#">Alumn@ 34</a>
	Cerámica Pampa Grande, taller de soldado	<a href="#">Alumn@ 35</a>
Incas	Esquema cancha	<a href="#">Alumn@ 36</a>
	Plano Cuzco	<a href="#">Alumn@ 37</a>
	Sacsahuyaman?	<a href="#">Alumn@ 38</a>
	Macchu Picchu	<a href="#">Alumn@ 39</a>
	Estereotomía	<a href="#">Alumn@ 40</a>

**Tabla 1.2. Plantilla de Excel que debe rellenarse en la primera fase**

LOCALIZACIÓN				ANÁLISIS FORMAL		APROXIMACIÓN AL SIGNIFICADO	REFERENCIAS			IMÁGENES
Id. obra	Loc. geográfica	Cronol.	Cultura	Soporte	Descripción formal (mats, procedimiento técnico)	Aproximación al significado (análisis iconográfico e interpretación iconográfica)	Bibliografía	Palabras clave	Enlaces (referencias, artículos, videos...)	Imágenes

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## Las Tecnologías de Información y Comunicaciones en la formación del ingeniero industrial

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### Resumen

*La dinámica actual de las Tecnologías de Información y Comunicaciones (TIC) ha sumergido a organizaciones y sociedad en general en un entorno cambiante en donde la facilidad de acceso a la tecnología impone retos importantes, creación de nuevas formas de gestionar los recursos y procesos de negocio, aumentar su eficiencia y efectividad, dinamizar los procesos de toma de decisiones, actuar con mayor rapidez ante las exigencias del mercado y acercar a empresas, competidores y consumidores en un nuevo entorno virtual.*

*El objetivo del trabajo es presentar un marco conceptual y contextual de la importancia de la inclusión de contenidos asociados a las TIC en la formación profesional del ingeniero industrial, que sirva de base al proceso de transformación curricular en que se encuentran el programa de grado en la Universidad Pontificia Bolivariana seccional Bucaramanga (UPB BGA).*

*Con el fin de comprender las tendencias en relación a las TIC, e Internet en especial, tanto en los negocios como en diversos aspectos de la vida de las personas, se realizó un análisis del contexto y una búsqueda refinada de publicaciones de los últimos 8 años en la base de datos SCOPUS que evidencia un abanico cada vez más amplio en temas de investigación asociados con las TIC.*

*De la revisión realizada se identifica un amplio espectro de áreas de trabajo para el programa de Ingeniería Industrial de la UPB BGA, no solo en lo que respecta al contexto regional local que enfrenta retos bien importantes de cara al futuro, sino en el contexto mundial en una industria con tecnologías disruptivas, cambios en los modelos de negocio y de paradigmas, en donde las TIC se constituyen en una condición evidente. Estos cambios implican*

*una transformación para la cual el profesional del futuro debe estar preparado.*

**Palabras claves:** *TIC, tecnologías emergentes, currículo, formación profesional, Ingeniería Industrial.*

## **1. Introducción**

Las Instituciones de Educación Superior en Colombia -IES, han venido afrontando una serie de cambios asociados con la transformación digital, que se caracterizan por la facilidad de acceso a la información y comunicación de una sociedad interconectada. Esta situación viene inquietando a las IES, cuyo rol les exige repensar sus procesos formativos y adecuarlos a las necesidades del entorno laboral y social, entorno en el que la tecnología juega un papel relevante

La Universidad Pontificia Bolivariana Seccional Bucaramanga (en adelante UPB BGA), es una entidad educativa con acreditación de Alta Calidad Multicampus (Ministerio de Educación Nacional, 2018), que cuenta con una Sede Central en Medellín y con seccionales en Bucaramanga, Montería y Palmira. Como Institución le apuesta a la calidad de su oferta académica, ofreciendo carreras profesionales y de postgrado competitivas a nivel regional, nacional e internacional. Esta apuesta implica procesos de mejoramiento continuo que incluyen la revisión constante de sus currículos y la transformación enfocada a ofrecer programas pertinentes y de calidad desde la perspectiva académica, científica y con carácter ético y moral propios de su sello Pontificio (Universidad Pontificia Bolivariana, 2016, 2019b).

Uno de los programas que ofrece la UPB BGA es el programa de grado de Ingeniería Industrial<sup>1</sup>, que consta de 10 semestres académicos conformados por cuatro ciclos de formación: Ciclo básico disciplinar, Ciclo de formación humanística, Ciclo profesional (asignaturas troncales obligatorias) y Ciclo de Integración (Asignaturas optativas de profundización), siendo los dos últimos sobre los que recae la formación en la disciplina y que a su vez comprende las líneas de formación en Métodos cuantitativos, Métodos cuantitativos aplicados, Sistemas de gestión y de información. Esta última línea intenta, con dos asignaturas troncales, abordar los elementos del uso de las Tecnologías de Información y Comunicaciones (TIC) en la empresa, pero se enfoca desde conceptos tradicionales que

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<sup>1</sup> El Programa de grado de Ingeniería Industrial en Colombia se puede asimilar al programa de Ingeniería en Organización Industrial de España

pierden vigencia rápidamente dada la dinámica tecnológica (Universidad Pontificia Bolivariana, 2019a).

En el marco del proceso de autoevaluación del programa (Ingeniería Industrial UPB Bucaramanga, 2018), y atendiendo los requerimientos del entorno, se realiza un análisis preliminar que permite conocer la expectativa de empresarios y egresados, en relación al perfil profesional esperado del Ingeniero Industrial. Este análisis permite identificar oportunidades de mejora, tales como la importancia de contar con profesionales con competencias para la resolución de problemas en entornos complejos con múltiples variables y en entornos cambiantes y capaces de integrar conceptos adquiridos a lo largo de la carrera en la solución de problemas reales. Igualmente se evidencia la importancia del pensamiento prospectivo y estratégico para proyectar la organización, mayor capacidad de visualizar tendencias en los sectores de tal forma que, a las empresas, se les proporcione nuevos horizontes para desarrollarse en ese sentido, destacando la importancia de fortalecer la apropiación de conocimiento sobre uso de software especializado para soportar la toma de decisiones, modelos de aprendizaje computacional (inteligencia artificial) y minería de datos.

Dadas las oportunidades de mejora, y partiendo del perfil de egreso del profesional, que contempla la formación en competencias para *“concebir, diseñar, implementar y mejorar procesos organizacionales desde una perspectiva sistémica y con criterios tecnológicos y de sostenibilidad, capaz de tomar decisiones con criterios éticos fundamentados en el Humanismo Cristiano, que contemplen a la persona como centro de toda organización y con responsabilidad social y respeto al medio ambiente”* (Universidad Pontificia Bolivariana, 2019a), el programa de grado de Ingeniería Industrial ha iniciado un proceso de transformación curricular a partir de un análisis interno y externo en busca de mejorar y enriquecer la oferta académica e incorporar los ajustes necesarios que permitan al futuro profesional ser competente ante la dinámica global en la que se encuentra inmerso. Parte de este trabajo corresponde a la revisión conceptual y contextual de la carrera de Ingeniería Industrial desde la perspectiva internacional, nacional y local en las diferentes áreas del saber, razón por la cual en este documento se pretende realizar un análisis de una de las áreas de interés, el área de las Tecnologías de Información y Comunicaciones, y para ello se presenta un marco conceptual y contextual de la importancia de la inclusión de contenidos asociados a las TIC en la formación profesional del ingeniero industrial, que sirva de base al proceso de transformación curricular en que se encuentran el programa de grado en la UPB BGA.

## **2. Revisión de literatura**

Las Tecnologías de Información y Comunicaciones se pueden definir como el conjunto de elementos hardware, software, datos, telecomunicaciones, incluido Internet (Laudon & Laudon, 2007), que emplean las organizaciones para la gestión de la información, de modo que los Sistemas de información comprenden las tecnologías, datos y personas involucradas en la gestión de información y servicios de comunicación (Davis, 2000). En otras palabras, los sistemas de información son los fines y las tecnologías de información son los medios (Pérez González, 2005).

La robustez creciente de las tecnologías y el crecimiento exponencial de la información en el universo digital abre posibilidades en un espectro muy amplio para las organizaciones y ya desde hace más de una década, Carr en su libro “IT Doesn’t Matter” argumentaba que las TIC habían llegado a ser un simple factor de producción: un elemento en el proceso de producción, que es necesario para la competitividad pero no suficiente para obtener ventajas (Carr, 2004). La dinámica actual de las Tecnologías de Información y Comunicaciones ha sumergido a organizaciones y sociedad en general en un entorno cambiante en donde la facilidad de acceso a la tecnología impone retos importantes, creación de nuevas formas de gestionar los recursos y procesos de negocio, aumentar su eficiencia y efectividad, dinamizar los procesos de toma de decisiones, actuar con mayor rapidez ante las exigencias del mercado y acercar a empresas, competidores y consumidores en un nuevo entorno virtual (Aguilar-Jimenez, 2010).

Por lo anterior, y en función de dar cumplimiento a este perfil, parece importante estudiar las tendencias en relación a las TIC, e Internet en especial, tanto en los negocios como en diversos aspectos de la vida de las personas. Para ello se inició con una búsqueda refinada de publicaciones de los últimos 8 años en la base de datos SCOPUS, lo que evidencia un abanico cada vez más amplio en temas de investigación asociados con las TIC, y para el caso que nos ocupa, para las TIC en los procesos de negocio en las organizaciones. De este proceso se pudo identificar que la mayoría de los estudios (38,6%) se encuentran en las áreas de negocios y gestión seguido por un 18% en economía y afines y 17% en áreas de ingeniería y se resalta una tendencia creciente de estudios (10,5% en 8 años) que publican en Ciencia de las Decisiones basadas en las TIC.

Adicionalmente se resalta que los países que más están publicando en esta área son en su orden Estados Unidos, España y Reino Unido pero la filiación que predomina en los autores es de la Universidad Tecnológica de Malasia seguida por dos universidades importantes de Valencia como son las Universidades Politécnica de Valencia y la Universidad de Valencia.

Ahora bien, haciendo un análisis de las áreas de interés de las publicaciones entre 2010 y 2018 de temas de TIC para áreas de gestión y negocios, se identifican temáticas clásicas como es el uso de TIC para la gestión estratégica, la cadena de suministro, la innovación, el modelado, el desarrollo industrial de empresas de todos los tamaños, el emprendimiento o la industria de servicios y aparecen tendencias emergentes como la gestión de comunidades virtuales, gestión del conocimiento, toma de decisiones basadas en el análisis de datos, negocio electrónico, los agro-negocios y el almacenamiento en la nube como se puede apreciar en el diagrama de burbujas que aparece en la Fig. 1.



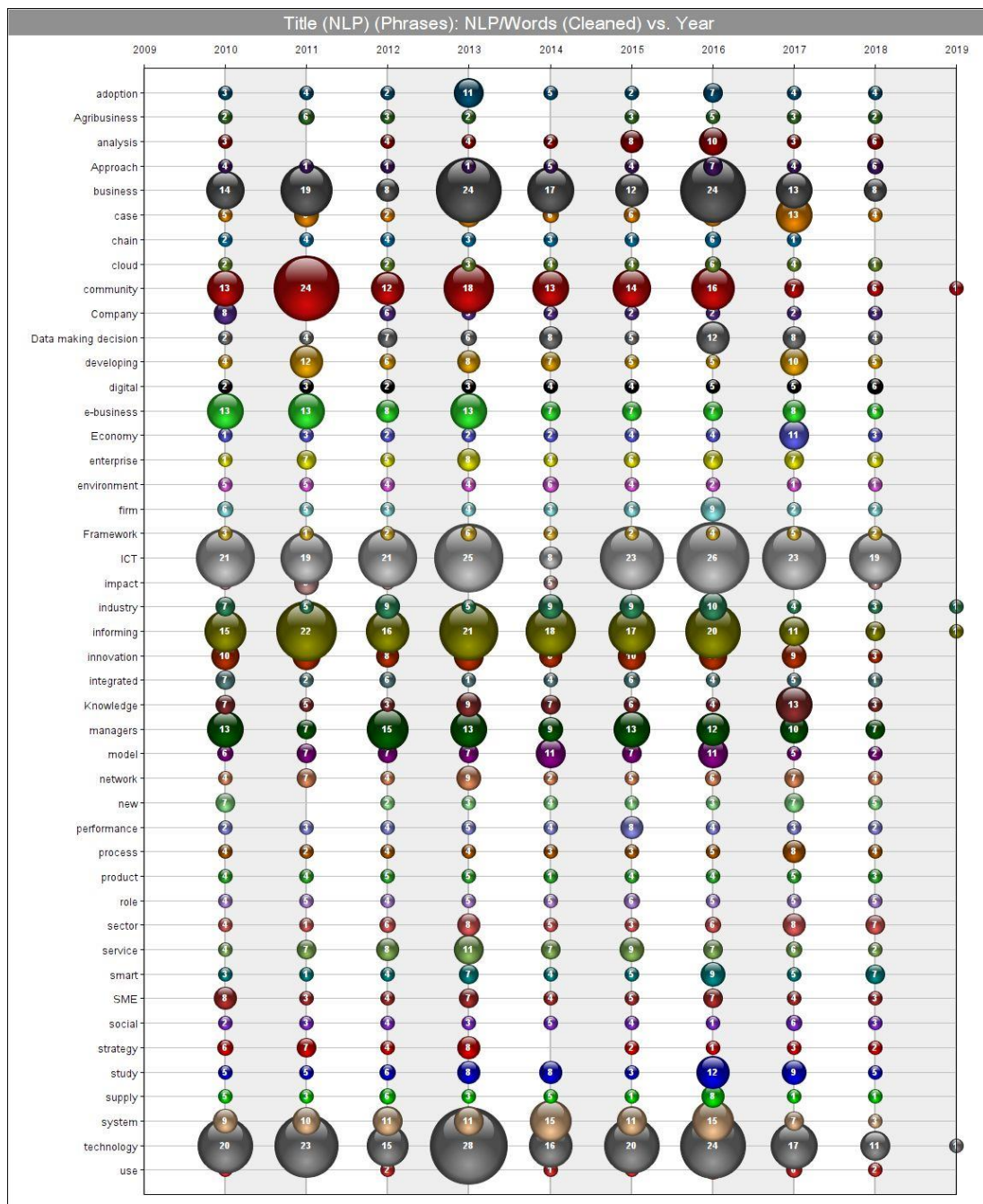


Fig. 1 Gráfico de burbujas por temáticas publicadas

Fuente: Elaborada en Vantagepoint con información de SCOPUS (SCOPUS, 2018)



Adicionalmente, si se analizan las palabras que más se repiten en las publicaciones se evidencia información interesante como la que muestra el gráfico de aduna, Fig. 2., en donde los círculos de mayor tamaño representan las palabras que más se repiten y la relación de cada término con otro en las publicaciones. Este gráfico además permite encontrar la tendencia que tienen ciertas temáticas a asociarse con otras.

Los bloques de palabras más relevantes son tecnología, seguida por negocios y sistemas que básicamente son los términos que definen la temática de estudio. Los siguientes términos de mayor frecuencia son adopción, análisis, desempeño, estrategia, lo que claramente marca una tendencia que resalta la importancia que sigue teniendo en la literatura científica, el estudio de los procesos de negocio soportados por SI/TI y su relación con las estrategias y el desempeño organizacional, más aún cuando estos términos muestran no solo una fuerte relación entre ellos sino también una relación importante con otros términos como decisiones, éxito, ventajas y perspectivas.

En otro bloque de relaciones encontramos un grupo de palabras como aprendizaje, enseñanza, educación, inteligencia que marca otra clara tendencia en estudios enfocados al uso de TIC en educación.

Otro hallazgo importante que se puede resaltar son las industrias en las que se evidencia aplicación y encontramos la industria de la salud, defensa, educación, agronegocios y bancos, lo que nos lleva a pensar que son los sectores en donde las TIC están siendo un soporte importante en los procesos de análisis y toma de decisiones en este tipo de industrias.

Finalmente resaltar la aparición de temáticas como 4.0, nube, relación hombre-máquina, abierto, automatización, ciudades, móviles, cuidado, salud, crowdsourcing, criptomonedas, mujeres o jóvenes que muestran otras tendencias de trabajos científicos en temáticas diversas, algunas de ellas clásicas, otras emergentes.



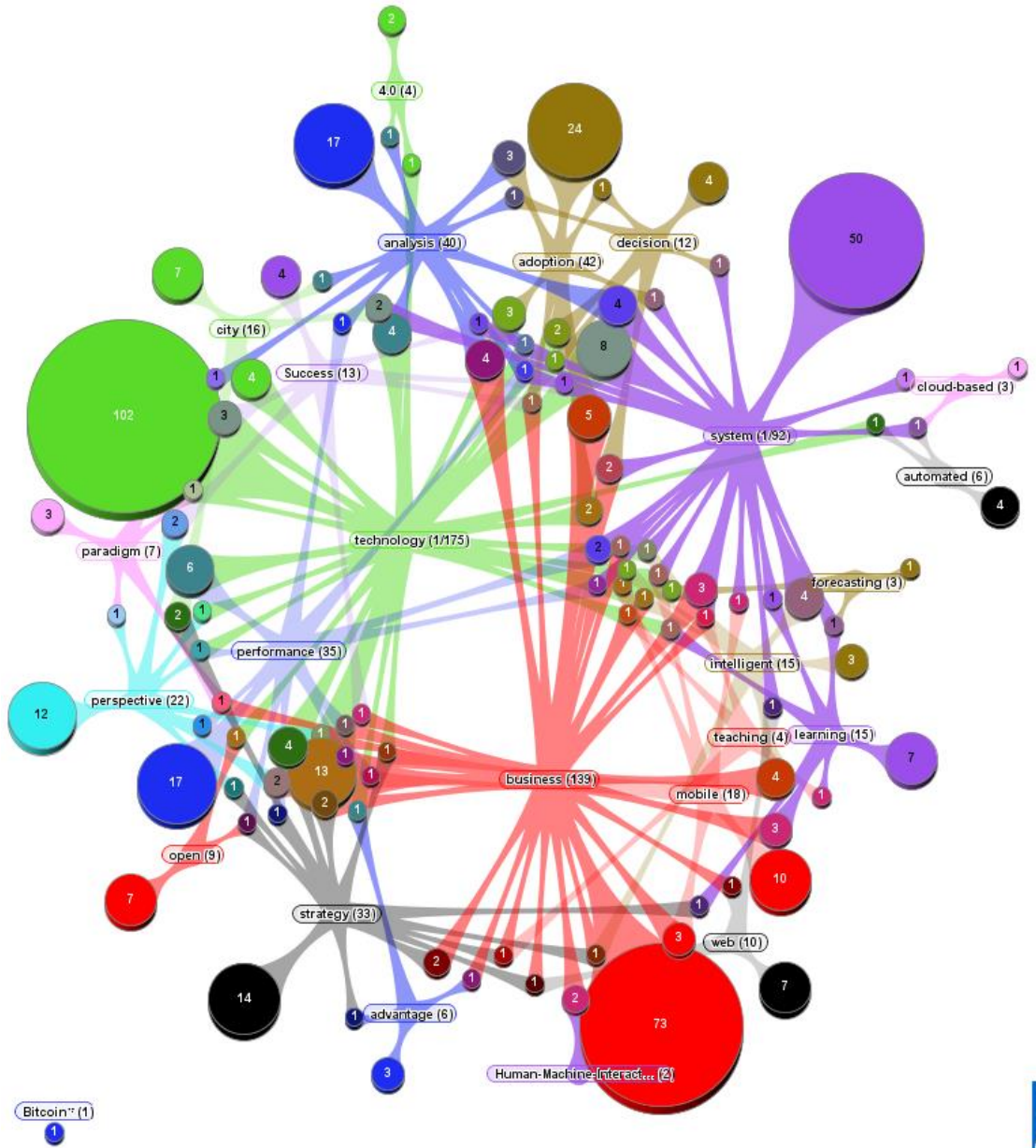


Fig. 2 Gráfico Aduna por términos recurrentes en publicaciones  
Fuente: Elaborada en Vantagepoint con información de SCOPUS (SCOPUS, 2018)

### 3. Análisis del contexto

#### 3.1 Análisis externo

A nivel internacional se destaca el estudio presentado por la Consultora Gartner en el Symposium/ITxpo 2017 en Orlando, Florida, las principales tendencias tecnológicas estratégicas que tendrán mayor impacto y afectarán en la mayoría de las empresas en 2018 son (Gartner, 2017):

- Inteligencia artificial para tomar decisiones incluyendo modelos de «aprendizaje automático» o «machine learning»
- Aplicaciones y análisis inteligentes y sistemas de aprendizaje automático.
- Internet de las Cosas
- La aparición de un gemelo digital que se refiere a la representación digital de una entidad o sistema del mundo real.
- Una «nube» transversal o «*edge computing*», que es un modelo interconectado que se basa en el procesamiento de información y recopilación de contenido para acercarse en mayor medida con las fuentes de esta información.
- Servicios conversacionales que supondrán un importante cambio de paradigma en cómo los seres humanos interactúan con el mundo digital.
- Una mayor experiencia inmersiva en lo que tiene que ver con realidad virtual (VR) y la realidad aumentada (AR) con potencial beneficio comercial que permitirá a las empresas revisar escenarios específicos de la vida real en los que se pueden aplicar y hacer que los empleados sean más productivos.
- «*Blockchain*» o «cadena de bloques» integrado en el negocio, que es una tecnología utilizada para la creación de monedas virtuales como el Bitcoin, que además de suponer un cambio de paradigma del sector financiero mundial, puede convertirse en una alternativa disruptiva de los actuales mecanismos centralizados de transacción y mantenimiento de registros, y con ello servir como base de negocios digitales.

De otra parte, de acuerdo al Informe del Foro Económico Mundial titulado “El futuro de los trabajos” se presentan las tendencias y estrategias de la fuerza laboral para Cuarta Revolución Industrial. Este informe indica que entre el rango de roles que experimentarán una demanda creciente en el periodo hasta el año 2022, se encuentran roles como: Analista de datos y científicos, Desarrolladores de software y aplicaciones, y Especialistas en Comercio electrónico y redes sociales que se basan y mejoran significativamente con el uso de la tecnología (World Economic Forum, 2018). Adicionalmente, se espera, según este informe, se evidencia la aceleración de la demanda de una variedad de roles de especialistas relacionados con la comprensión y aprovechamientos de las últimas tecnologías emergentes, estos roles son: especialista en inteligencia artificial y aprendizaje automático, especialista en Big Data, expertos en automatización de procesos, analistas de seguridad de

la información, experiencia del usuario y Diseñadores de interacción humano-máquina, Ingeniería Robótica y especialistas Blockchain (World Economic Forum, 2018).

Desde un enfoque nacional, se puede destacar el último informe sobre el panorama TIC, elaborado por el Ministerio de Tecnologías de Información y las Comunicaciones (MinTic), que presenta un análisis de la cadena valor de sector TIC en Colombia. Según este informe, teniendo en cuenta el componente de la industria de las plataformas digitales que emerge de la economía digital, la cadena de valor del sector TIC está compuesta por 5 dimensiones: (1) la infraestructura que soporta la utilización de los productos y servicios, (2) la fabricación y/o venta de bienes TIC, (3) la producción de servicios de telecomunicaciones, donde el servicio de Internet comienza a ser el punto de surgimiento de una nueva industria, (4) la industrial de las plataformas digitales; y transversalmente (5) la investigación, desarrollo e innovación necesarias para la continua evolución del sector (PanoramaTIC, 2015). Todos estos elementos de alguna manera impactan las diferentes industrias, razón por la cual deben formar considerarse dentro de las posibilidades de desempeño del futuro profesional.

En este orden de ideas, en el departamento de Santander, en relación al temas de desarrollo económico y su articulación otros instrumentos de desarrollo se plantean estrategias en tema de transporte e infraestructura; tecnologías de la información y las comunicaciones; temas de desarrollo, ciencia e innovación; competitividad y productividad; fomento del desarrollo y empleo; fortalecimiento empresarial e industrial; estrategias de desarrollo turismo; minería e hidrocarburos; gas y energía eléctrica; energía sostenible y alternativa para el desarrollo; cooperación internacional; desarrollo regional; y desarrollo agropecuario y desarrollo rural, entre otros (Gobernación de Santander, 2016). Estas estrategias de han diseñado, teniendo como base, los 17 Objetivos de Desarrollo Sostenible (ODS) y el enfoque de crecimiento verde de la Organización para la Cooperación y el Desarrollo Económico (OCDE) como referente estratégico; y alineado a los objetivos consignados en el Plan Nacional de Desarrollo 2014-2018 (Departamento Nacional de Planeación, 2014).

En lo que tiene que ver con la modernización tecnológica y administrativa se priorizan sectores como Confección, Calzado, Agro-alimentos, Agro-industria y comercio lo que evidencia necesidades regionales que se convierten en oportunidades para el futuro ingeniero industrial, quien va a requerir contar con elementos que le permitan analizar información para apoyar las decisiones de empresas de cualquier sector y optimizar procesos y modelos de negocio (Gobernación de Santander, 2016).

Dentro del Plan de Desarrollo Nacional el objetivo 6 propone el Desarrollo de Infraestructura vial y de transporte e inclusión coherente en las tecnologías de la información y las comunicaciones, así como el acceso a energías sostenibles, en la perspectiva cerrar de brechas productivas. Dentro de sus estrategias se encuentra el reducir

brechas en acceso a las tecnologías de la información y las comunicaciones en los sitios alejados geográficamente, y garantizar el uso efectivo de las TIC, a través de la conectividad al 100% de cabeceras municipales que sean centros de influencia indígena (Departamento Nacional de Planeación, 2014).

Por su parte, y en relación a sistemas de información públicos se describe que en materia de tecnologías de la información y las comunicaciones, se impulsará el fortalecimiento y la integración de los sistemas de información con acciones encaminadas a implementar sistemas de planificación financiera, desarrollar la estrategia de datos abiertos –*Open Data*–, la carpeta ciudadana digital, la estrategia de –*Big Data*– y la consolidación de la figura de director de Tecnologías y Sistemas de información –Chief Information Officer (CIO)- para las entidades estatales de orden nacional y territorial.

Al mencionar aspectos como acceso a tecnologías y las comunicaciones, y estrategias de datos abiertos, así como estrategias de *Big Data*, se hace necesario involucrar el concepto de explotación de la información. Esto por esto, que el Consejo Nacional de Política Económica y Social (CONPES<sup>2</sup>) desarrolla el documento Conpes 3920, el cual se establece como una política de explotación de datos (Big Data). Este documento tiene por objetivo aumentar el aprovechamiento de datos, mediante el desarrollo de las condiciones para que sean gestionados como activos para generar valor social y económico (CONPES, 2018). Adicionalmente, para materializar este potencial, el documento propone la definición de un marco jurídico e institucional que maximice la obtención de beneficios del aprovechamiento de datos, permita la cooperación entre los sectores público y privado y, al mismo tiempo, refuerce la protección de los derechos de los ciudadanos en el contexto de la creciente transformación de la vida diaria en datos digitales cuantificables y procesables (llamada datificación) (CONPES, 2018).

### 3.2 Análisis Institucional

A nivel Institucional es importante resaltar que la UPB, ha definido 5 focos estratégicos a saber: Energía, TIC, Agua, Alimentación y Territorio, Salud y en central, Humanización y Cultura. Los Focos estratégicos dan cuenta de las principales fortalezas y capacidades internas a nivel de investigación y transferencia, y definen las prioridades temáticas de la universidad, enmarcados en los valores operativos de la institución.

Las líneas orientadoras propuestas por el Foco TIC son (Comité Científico del Foco TIC, 2017): a) Ciencia de datos, b) Ciudades inteligentes, c) Contenidos Digitales, d) Economía

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<sup>2</sup> El Consejo Nacional de Política Económica y Social CONPES es la máxima autoridad nacional de planeación y se desempeña como organismo asesor del Gobierno en todos los aspectos relacionados con el desarrollo económico y social de Colombia.

Digital, e) Infraestructura y conexión, f) Legislación y Regulación, g) Política - Gobierno y ciudadanía en línea, h) Seguridad informática, i) Transformaciones sociales, j) Uso y Apropiación Social de las TIC

Al revisar los focos estratégicos planteados en la UPB para orientar no solo la investigación y transferencia sino también los procesos de docencia y proyección social, se hace evidente los resultados de la revisión de la literatura científica con las líneas definidas por el Foco TIC. Esto sumado a la orientación del plan de Desarrollo de Santander “Santander nos une” (2016 – 2019) ofrece un amplio espectro de posibilidades de acción de la ingeniería industrial desde la perspectiva de las TIC, dado que este Plan de Desarrollo plantea dentro de los temas estratégicos; el desarrollo competitividad y productividad de las empresas de la región usando, entre otras, herramientas tecnológicas de información e infraestructura; que permitan ser un departamento competitivo, frente a la globalización económica (Gobernación de Santander, 2016).

#### **4. Conclusiones**

A manera de síntesis, se puede identificar un amplio espectro de áreas de trabajo para el programa de Ingeniería Industrial de la UPB BGA, no solo en lo que respecta al contexto regional local que enfrenta retos bien importantes de cara al futuro, sino en el contexto mundial en una industria con tecnologías disruptivas, cambios en los modelos de negocio y de paradigmas.

El estudio permitió identificar competencias emergentes en el ejercicio profesional de los egresados, por lo que el ingeniero industrial del futuro debe estar preparado para desempeñarse en la industria del futuro (en el futuro inmediato se puede hablar de industria 4.0) con nuevos modelos de negocio, en donde uno de los aportes más evidentes se vislumbra en el análisis de grandes cantidades de datos para la toma de decisiones estratégicas y para la gestión de procesos automatizados incluida la inteligencia artificial. Estas tendencias son tan variadas como amplias y si bien podrían abordarse desde las asignaturas optativas, estas solo corresponden a un 5% de los créditos totales lo que podría ser poco ante la exigencia actual.

Otro cuestionamiento importante que surge al identificar estas tendencias, es la reorientación que está tomando el perfil profesional del ingeniero industrial a la luz de la evolución tecnológica, que de alguna manera exige competencias que no solo entran a complementar otras disciplinas, sino que incluso pueden llegar a solaparse con ellas, lo que invita a repensar de manera radical el programa de ingeniería industrial o incluso a crear nuevos programas académicos más flexibles. Sin embargo, estas decisiones están sujetas a

contar con infraestructura moderna y docentes formados, recursos con los que el programa actualmente no cuenta ni probablemente podrá contar en el corto plazo.

Finalmente, la invitación es a abordar un análisis mucho más profundo del programa que supera los límites de una transformación curricular tradicional.

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## El estudio de aplicaciones de los sistemas de ecuaciones diferenciales ordinarias a través de artículos científicos

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### Resumen

*En el estudio de las Ecuaciones Diferenciales Ordinarias, y sistemas de estas, es importante la aplicación a casos reales a través de la modelización matemática. En la bibliografía existen muchas referencias a diversas aplicaciones clásicas: desintegración radiactiva, modelos de población depredador-presa, poblaciones de Lotka-Volterra o epidemias modelos SIR. En este trabajo mostramos cómo se ha ampliado el estudio de estas aplicaciones a través del manejo de artículos científicos disponibles en la red, en una asignatura optativa del Grado en Ingeniería de Sistemas de Telecomunicación, Sonido e Imagen en la EPSG, en una de sus unidades didácticas referida al estudio de las ecuaciones y sistemas de ecuaciones diferenciales. Nuestro alumnado ha trabajado con artículos científicos explorando otras aplicaciones o generalizaciones de las analizadas en clase: modelos matemáticos sobre las consecuencias de la vacunación, modelización y simulación del comportamiento epidemiológico de la gripe, una invasión zombi, modelado de la propagación de malware en redes de sensores inalámbricos, de ordenadores o en teléfonos móviles. Describiremos la metodología seguida, el trabajo realizado por el alumnado y su opinión.*

**Palabras clave:** Artículos científicos, ecuaciones diferenciales, simulación.

### 1. Introducción

En este trabajo mostramos la experiencia realizada en la asignatura optativa del Grado en Ingeniería de Sistemas de Telecomunicación Sonido e Imagen (GISTSI), Herramientas Matemáticas Aplicadas a las Telecomunicaciones (HMAT), en cuanto a la utilización de





artículos científicos para explorar otras aplicaciones o generalizaciones de las ecuaciones diferenciales ordinarias, distintas a las aplicaciones clásicas que suelen explicarse en clase. Describimos la metodología seguida durante varios cursos, así como el trabajo realizado por el alumnado y su opinión acerca de la metodología utilizada. Esta asignatura se oferta en el segundo semestre del segundo curso del GISTSI en la EPSG, con un total de 4,5 ECTS y su objetivo es utilizar el cálculo numérico para la modelización y resolución de problemas esenciales para los estudiantes de ingeniería con el apoyo de Matlab, permitiendo simular y resolver procesos del mundo real. Consta de las siguientes Unidades Didácticas: modelización de sistemas aplicados con Matlab; estudio de la propagación de errores; resolución numérica de ecuaciones y de sistemas lineales.

Describiremos la experiencia realizada en la citada asignatura durante este curso 2018-2019, en el que 20 estudiantes han cursado dicha asignatura. Nos centraremos en la unidad sobre modelización de sistemas aplicados con Matlab, unidad que se imparte durante el mes de febrero, con dos sesiones semanales, una de dos horas y otra de hora y tres cuartos (aproximadamente 1,5 ECTS), estructurándose en dos temas: Ecuaciones y sistemas de ecuaciones diferenciales. Resolución y representación gráfica de resultados; Modelización y simulación de sistemas: poblaciones, virus informáticos.

En la asignatura Matemáticas 2, del primer año del GISTSI, y como una de las aplicaciones del cálculo de primitivas, se realiza una introducción de las ecuaciones diferenciales, estudiando las de variables separables y algunas de sus aplicaciones: modelo de crecimiento de Malthus, la desintegración de un elemento radioactivo, estudio de los circuitos en serie formados por una resistencia y una bobina o la variación de temperatura según la ley de Newton. En la asignatura HMAT se amplía el estudio a otras ecuaciones diferenciales y sistemas de ellas, su resolución, analítica o numérica, y la representación gráfica de sus soluciones, así como la modelización y simulación de sistemas.

## **2. Modelización con Ecuaciones Diferenciales Ordinarias**

Las ecuaciones diferenciales ordinarias aparecen al modelizar problemas químicos, biológicos, económicos y de ingeniería en general. Muchos procesos complejos pueden descomponerse en varias etapas, pudiendo modelar todo el sistema al describir las interacciones entre las distintas etapas. Tales sistemas se denominan sistemas por compartimentos (Nagle, Saff y Snider, 2001) y de forma gráfica se representan como diagramas de bloque. El sistema básico de un compartimento representado en la Figura 1 consta de una función  $x(t)$  que representa la cantidad de una sustancia en el

compartimento y en el instante  $t$ , una razón, tasa de entrada o velocidad con la que la sustancia entra en el compartimento, y una razón, tasa de salida o velocidad con la que la sustancia sale del compartimento.

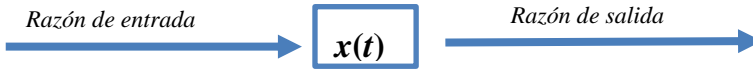


Fig. 1 Sistema básico compartimental

La derivada de  $x$  con respecto de  $t$  se puede interpretar como la tasa de cambio de la sustancia en el compartimento, luego para este sistema se verifica

$$\frac{dx}{dt} = \text{Razón de entrada} - \text{Razón de salida} \quad (1)$$

Como ejemplo clásico de aplicación de este modelo compartimental, surge el estudio de la dinámica de poblaciones, en particular el modelo básico de Malthus en el que si la tasa de nacimientos viene dada por  $aP(t)$  y  $bP(t)$  representa la de muertes, la ecuación diferencial

correspondiente  $\frac{dP}{dt} = aP - bP = (a - b)P = kP$ . Este modelo también es aplicable a la

desintegración de un elemento radioactivo, para  $k < 0$ . Además se puede generalizar a más compartimentos, como sucede en la descripción básica de la evolución de una epidemia SIR (Amelkin, 1987), que puede ser estudiada a través de modelos continuos (con ecuaciones diferenciales), discretos e IBM (Individual Based Model) (Vidal, Boigues y Estruch, 2015). Sistemas no lineales similares, con más o menos ecuaciones, aparecen como ejemplos clásicos en el estudio de estos sistemas de ecuaciones diferenciales. En los textos utilizados en la asignatura, (Hueso, Roca y Torregrosa, 1992; Blanchar, 1999; Nagle, 2001; Zill, 2002), pueden encontrarse muchas referencias a aplicaciones clásicas: desintegración radiactiva en serie; modelos de población depredador-presa; modelos de población de Lotka-Volterra; la primera ley de Lanchester sobre la dinámica de conflictos bélicos o epidemias modelos SIR. La aplicación de las matemáticas a la epidemiología aparece en 1760 cuando Daniel Bernoulli publica un pequeño tratado sobre la epidemia de peste europea. Desde entonces han surgido muchos modelos matemáticos para el estudio de este fenómeno. Vamos a describir un modelo muy básico (Amelkin, 1987). Supongamos que se detecta una enfermedad o plaga que puede inmunizar contra la misma al individuo que la ha sufrido. En cualquier instante  $t$ , la población se divide en tres grupos: los individuos sanos pero que son susceptibles a la enfermedad,  $S(t)$ , los individuos infectados,  $I(t)$ , y el grupo formado por individuos sanos con inmunidad o resistentes a la enfermedad,  $R(t)$ . Si el sistema es cerrado, es decir, si no hay nacimientos ni muertes la población se mantiene siempre constante, por tanto en cualquier instante  $t$  se cumple  $S(t) + I(t) + R(t) = N$ . El diagrama de bloques que nos relaciona cada una de las variables aparece en la Figura 2.

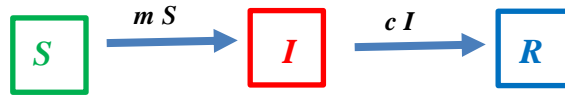


Fig. 2 Sistema del modelo de una epidemia SIR

La constante  $m$  es una medida de la rapidez de transmisión de la enfermedad de una persona infectada a la población susceptible. La  $c$  representa la razón con la que sana la población infectada haciéndose resistente a la enfermedad, es decir, inmune. Este diagrama da lugar al siguiente sistema lineal de ecuaciones diferenciales, que puede ser resuelto analíticamente:

$$\frac{dS}{dt} = -mS, \quad \frac{dI}{dt} = mS - cI, \quad \frac{dR}{dt} = cI \quad (2)$$

Un modelo más general surge al considerar que la infección se debe a los encuentros entre los susceptibles y los infectados, modelo formulado en 1927 por Kermack y McKendrick para describir la epidemia de peste de la India en 1906, con el sistema no lineal:

$$\frac{dS}{dt} = -mSI, \quad \frac{dI}{dt} = mSI - cI, \quad \frac{dR}{dt} = cI \quad (3)$$

El modelo SIR se aplica también en biomedicina al estudiar la competición entre las células cancerígenas,  $x(t)$ , y las del sistema inmune,  $y(t)$  (Chrobak y Herrero, 2011):

$$\frac{dx}{dt} = a x - b xy - c x^2, \quad \frac{dy}{dt} = d y - e xy - f y^2 \quad (4)$$

También se aplica en el campo de la informática y de las telecomunicaciones ya que la propagación de gusanos o malware en internet es muy similar a la de la propagación de enfermedades, de ahí que el modelo SIR sea esencial estudiarlo en nuestra asignatura. El proceso de propagación de malware ha sido ampliamente estudiado siguiendo el modelo epidemiológico (Frauenthal, 1981; Yang et al. 2005; Zou et al. 2007).

### 3. Material y metodología

La impartición de esta asignatura se hace en aula informática en la que cada estudiante dispone de un ordenador. Se alternan explicaciones teóricas con la resolución de ejemplos con Matlab. Se estudia la resolución analítica tanto de ecuaciones diferenciales como de sistemas a partir de condiciones iniciales, con el comando Matlab *dsolve*. La parte de

modelización a través de compartimentos permite la descripción de modelos como los descritos anteriormente. Para la resolución de ecuaciones o sistemas no lineales se recurre a métodos numéricos: método de Euler, método del trapecio de Euler (o Euler mejorado o de Heun) y métodos de Runge-Kutta. Este último está asociado con el comando Matlab *ode45*, que es el que utilizaremos mayoritariamente. Para la evaluación de esta unidad didáctica se consideran, a partes iguales, la realización de actividades durante la sesión presencial, un examen y la realización de un proyecto en grupo. Para el proyecto nuestro alumnado trabaja con artículos científicos o TFG, con el fin de explorar otras aplicaciones, basadas sobre todo en generalizaciones del modelo SIR. Este material se ha conseguido desde plataformas como ResearchGate, Google Scholar, Semantic Scholar, repositorios o revistas científicas de libre acceso. Durante este curso 2018-2109 los proyectos han estado relacionados con el modelado de la propagación de malware en redes de sensores inalámbricos, en redes de ordenadores o en teléfonos móviles a través de sms, modelos matemáticos sobre las consecuencias de introducir una campaña de vacunación como base de los estudios de evaluación económica, la modelización, simulación del comportamiento epidemiológico de la gripe en la ciudad de Barcelona, modelos SIR sin demografía y con demografía o un escenario post apocalíptico por una invasión zombi. Los sistemas de ecuaciones diferenciales que aparecen en estos trabajos no son lineales y el número de ecuaciones que comportan son tres, cuatro o muchas más ecuaciones, estudiándose el comportamiento o evolución de poblaciones de individuos susceptibles, infectados, recuperados, pero también de expuestos o afectados (infectados que no transmiten), resistentes fallecidos, infectados latentes,... Los artículos asignados tienen una estructura similar, siguiendo el canon de cualquier artículo científico dentro de este campo: introducción, formulación matemática del modelo, resolución numérica a través de simulaciones junto con representaciones gráficas y conclusiones. No adjuntan el código de la simulación realizada, así que es un buen material para que lo trabajen nuestros estudiantes. Siguiendo una estructura similar a la de estos artículos, para la memoria que debía presentar cada uno de los grupos de trabajo, se exigían 4 apartados: introducción del proyecto; sistemas de Ecuaciones diferenciales a estudiar y descripción de funciones y parámetros; planteamiento de los sistemas de ecuaciones diferenciales a resolver y las condiciones iniciales de partida; resolución con Matlab del sistema o sistemas con el método de Runge-Kutta de cuarto orden y conclusiones, aportando el código Matlab y las gráficas correspondientes.

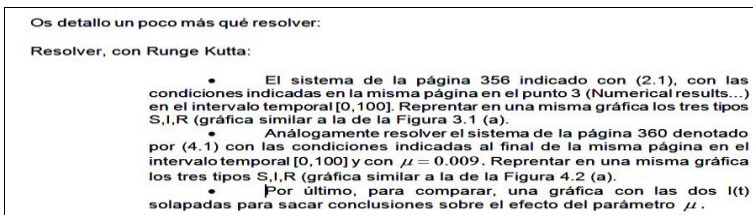
A mitad de febrero, analizada la modelización de sistemas, a cada grupo se le proporciona un artículo, previamente buscado y analizado por el profesor. En una de las sesiones presenciales cada uno de los grupos expone a sus compañeros, durante 5 minutos, los tres primeros puntos de la memoria a presentar (Figura 3), a través de dos o tres transparencias. El objeto de esta presentación conjunta es que todo el alumnado conozca no solo su aplicación sino todas las de sus compañeros y compañeras. Por otro lado, a cada uno de los grupos se les mandó por correo interno de PoliformaT un mail personalizado, detallándoles



exactamente qué debían reproducir del artículo, puesto que alguno incluía apartados como el análisis de la estabilidad de los puntos de equilibrio o incluso ajuste de parámetros, conceptos no estudiados en la asignatura. En la Figura 4 puede observarse uno de estos mails. En todos los casos se exigió la resolución numérica con el método de cuarto orden de Runge-Kutta, aportando las gráficas correspondientes y similares a las del artículo y se programó una Tarea desde PoliformaT con cierre el 31 de marzo.



*Fig. 3 Exposición introductoria del proyecto a mitad de febrero*



*Fig.4 Ejemplo de correos personalizados a cada uno de los grupos a través de PoliformaT*

#### 4. Resultados y conclusiones

La media de las notas del proyecto ha sido de 8 puntos. Respecto a la resolución de los sistemas y representación gráfica de las soluciones, en la Figura 5, izquierda, se observa la correspondientes al estudio numérico del modelo de epidemia SIR sin demografía y con demografía del artículo original y en la parte derecha las realizadas por los estudiantes. Análogamente, en la Figura 6 se contrastan las gráficas del artículo original (superiores)

junto con las reproducidas por la estudiante, en el caso de la influencia de la vacunación antigripal, utilizando modelos dinámicos basados en ecuaciones diferenciales.

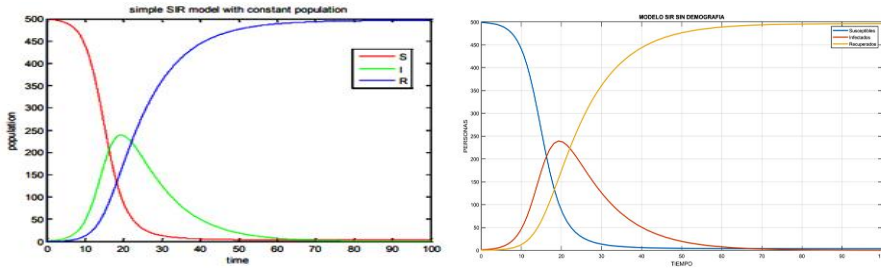


Fig. 5. Evolución modelo de epidemia SIR sin demografía. Derecha, artículo original, izquierda de los estudiantes

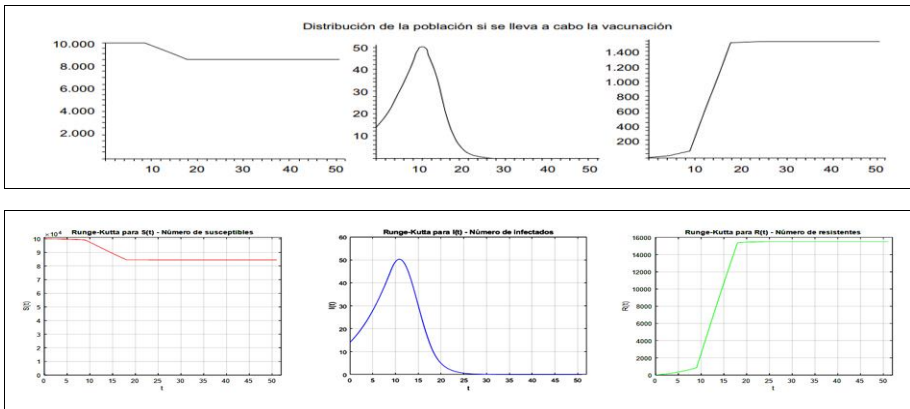


Fig.6. Influencia de la vacunación antigripal. Superior artículo original, inferior de la estudiante

Con una encuesta individual recogimos la opinión de los estudiantes acerca del proyecto y de la metodología seguida en clase. Las afirmaciones de las cuestiones se valoraron de 0 a 10 y los resultados aparecen en la Figura 7. Se añadió un campo de comentarios en el que valoran el trabajar con aplicaciones reales y que aprenden mejor a trabajar con ecuaciones diferenciales, sugiriendo alguno un seguimiento más continuado del trabajo o poder realizarlo durante las sesiones presenciales. En general tienen una opinión muy positiva sobre la materia estudiada y el trabajo realizado, además de valorar el trabajo realizado por la docente. La introducción de esta actividad en la asignatura ha sido muy satisfactoria, tanto para los estudiantes como para la docente, a pesar de la cantidad de trabajo que ha supuesto para esta última. y favorece la adquisición de competencias transversales de la UPV: aplicación y pensamiento práctico; análisis y resolución de problemas; trabajo en equipo y liderazgo; comunicación efectiva; conocimiento de problemas contemporáneos; aprendizaje permanente y planificación y gestión del tiempo. Por último remarcar que esta actividad ha sido posible realizarla gracias a los repositorios abiertos, redes sociales

colaborativas y a publicaciones de acceso abierto (open acces) a través de los cuales ha sido posible conseguir el material de trabajo para los estudiantes.

Criterios	Valoración cuantitativa (de 0 a 10)	Criterios	Valoración cuantitativa (de 0 a 10)
El proyecto que se te ha asignado te ha resultado interesante	Promedio= 8.53 Moda= 8 P <sub>25</sub> = 8	Piensas que dedicar una clase a la presentación de todos los proyectos vale la pena	Promedio=8.53 Moda=10 P <sub>25</sub> =8
La metodología utilizada y las actividades realizadas en las clases te han ayudado a poder resolver el proyecto	Promedio=8.88 Moda= 10 P <sub>25</sub> = 8	La realización del proyecto ha valido la pena en cuanto al conocimiento de las aplicaciones de las Ecuaciones Diferenciales	Promedio=9.06 Moda= 10 P <sub>25</sub> =8
El material proporcionado y las instrucciones personalizadas para cada grupo han sido de utilidad para la resolución del proyecto	Promedio=9.24 Moda= 10 P <sub>25</sub> =9	El proyecto ha conseguido motivarte en cuanto a la utilidad de las Ecuaciones Diferenciales	Promedio=8.53 Moda= 9 y 10 P <sub>25</sub> =8
El trabajo del proyecto ha sido adecuado en cuanto al tiempo que has dedicado y nivel teórico exigido	Promedio=8.94 Moda= 10 P <sub>25</sub> =8	Trabajar con un artículo científico, TFG o similares, para la realización del proyecto, ha sido interesante	Promedio=8.59 Moda= 10 P <sub>25</sub> =8
La clase dedicada a la presentación de todos los proyectos te resultó interesante	Promedio=8.68 Moda= 8 y 10 P <sub>25</sub> =8	La dedicación de la profesora en la preparación y puesta en marcha del proyecto ha sido adecuada	Promedio=9.47 Moda= 10 P <sub>25</sub> =9

*Fig. 7. Resultados de la encuesta*

## Agradecimientos

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## Uso de la gamificación para trabajar paradojas estadísticas y mejorar el espíritu crítico de los estudiantes

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### Resumen

*Una de las mayores dificultades encontradas por los estudiantes en asignaturas de tipo cuantitativo en diversas asignaturas a nivel universitario parece ser la asimilación y aplicación de conceptos matemáticos, así como el análisis crítico de los resultados obtenidos.*

*Con objeto de mejorar la adquisición de este tipo de competencias esenciales para los estudiantes (correcta definición de un problema planteado, identificación y aplicación de las herramientas matemáticas apropiadas para su resolución, y análisis crítico de los resultados), en este trabajo se presenta una propuesta de planificación de actividades para una sesión práctica. Dichas actividades se programan para tener lugar tanto dentro como fuera del aula, previas, durante, y posteriores a la sesión presencial.*

*A modo de actividad previa se plantea el visionado de material audiovisual que aborda dos paradojas estadísticas (de Simpson o de Yule- Simpson, y de Ellsberg) y el problema de Monty Hall, que servirán como preparación para las actividades posteriores y como preámbulo a una actividad de debate abierto dentro del aula (actividades de inicio y de desarrollo).*

*Además, en las actividades de desarrollo durante la sesión presencial, y haciendo uso de la gamificación, en grupo de 3 o 4 estudiantes y, con ayuda de dados y cartas, los estudiantes se familiarizan de forma directa con los conceptos vistos y discutidos anteriormente, cuyos resultados se presentarán y discutirán en un debate posterior que se hace extensivo a todo al aula.*

**Palabras clave:** *resultados de aprendizaje, paradojas estadísticas, innovación docente.*



## **1. Introducción**

Es un hecho aceptado de forma casi generalizada que uno de los escollos con los que tanto el profesorado como el alumnado universitario se encuentran, en asignaturas de carácter cuantitativo, es la dificultad de asimilación y aplicación de conceptos matemáticos por parte del estudiantado. A esta dificultad, se suele añadir el problema derivado de una correcta interpretación de los resultados obtenidos. Una de las posibles consecuencias de este problema es el incremento de las tasas de abandono (Cabrera, 2015). En los últimos años, con la finalidad de solventar en la medida posible esta problemática se ha incorporado, al proceso de enseñanza-aprendizaje, el uso de Tecnologías de la Información y la Comunicación (TIC) así como de material multimedia que ha dado muy buenos resultados (Casasús, Ivars y López, 2018). También se ha incorporado, de manera más que efectiva, la denominada gamificación en el aula, esto es, el uso de actividades de tipo lúdico cuyo objetivo es optimizar el proceso de aprendizaje (Agudo Garzón, et al.2014; Authors, 2014). En esta línea, en el trabajo que se presenta, se proponen una serie de actividades a aplicar en una unidad didáctica correspondiente a una asignatura de corte cuantitativo (Estadística) del grado de Ingeniería Química, ofertado por la Universitat Politècnica de València (UPV). El objetivo de las mismas es paliar las deficiencias relacionadas con las competencias ligadas a la definición de los problemas planteados, así como la identificación y aplicación de las herramientas matemáticas apropiadas para su resolución, y el análisis crítico de los resultados. Las actividades propuestas deberían desarrollarse, de manera coordinada, antes, durante y después de la sesión presencial. Cabe indicar que la asignatura, correspondiente al primer curso de Ingeniería Química, consta de 4 unidades didácticas (U.1: Introducción, U.2.: Estadística Descriptiva, U.3: Probabilidad y U.4: Inferencia Estadística), le corresponde una carga lectiva de 6 ECTS y es impartida por el Departamento de Estadística e Investigación Operativa Aplicadas y Calidad (DEIOAC). Otras cuestiones de interés se corresponden con: a) El tamaño del grupo: es de entre 50 y 60 alumnos en las sesiones de teoría y de entre 18 y 24 alumnos en las sesiones de práctica y b) Las competencias y resultados del aprendizaje que, de acuerdo con la guía docente de la propia asignatura y para la titulación en la que se enmarca se encuentran en la Tabla 1.

**Tabla 1. Competencias y resultados de aprendizaje**

- <u>Competencia específica:</u> CE01 - Resolver problemas matemáticos que puedan plantearse en la ingeniería. Aplicar los conocimientos sobre álgebra lineal, geometría, geometría diferencial, cálculo diferencial e integral, ecuaciones diferenciales y en derivadas parciales, métodos numéricos, algorítmica numérica, estadística y optimización.
- <u>Competencias generales:</u> CG28 - Desarrollar la creatividad. CG27- Tomar decisiones y razonar de forma crítica.
- <u>Competencias transversales:</u> CT01 - Comprensión e integración: <i>La adquisición de esta competencia tendría lugar mediante la resolución de preguntas de comprensión integradas en los ejercicios a llevar a cabo durante el curso, y su evaluación se efectuaría mediante preguntas de control y/o rúbricas.</i> CT03 - Análisis y resolución de problemas: <i>La adquisición de esta competencia tendría lugar mediante la resolución de los distintos problemas asociados a cada una de las unidades temáticas, y su evaluación se efectuaría mediante la revisión de los problemas resueltos por los alumnos a través de PoliformaT.</i>

Fuente: Elaboración Propia

Tomando como base esta información y la propuesta de contenidos de Romero y Zúñica (2008), la planificación que se propone para la impartición de la asignatura, atendiendo a las 4 unidades didácticas, se encuentra en la Tabla 2, teniendo en cuenta que se distingue las actividades que se llevarán a cabo en dos tipos: ‘teóricas’ y ‘prácticas’:

**Tabla 2. Unidades didácticas: composición y tiempo estimado**

UNIDAD DIDÁCTICA	TEMAS	TIEMPO ESTIMADO	
		Teoría	Práctica
U.1.	Tema 0	0'5 horas	-
U.2.	Temas 1 y 2	5'5 horas	5 horas
U.3.	Temas 3 a 7	11 horas	15'5 horas
U.4.	Temas 8 a 12	13 horas	9'5 horas

Fuente: Elaboración Propia

Donde, la información acerca del contenido de los temas que las constituyen, así como la estimación del tiempo necesario para su impartición se recoge en la Tabla 3.

Tabla 3. Desglose de contenidos y tiempos/unidades didácticas

U.D.	TEMAS	TIEMPO ESTIMADO	
		Teoría	Práctica
U.1.	<b>Tema 0: Introducción</b>	0'5 hora	0 horas
<b>TOTAL</b>		<b>0'5 horas</b>	<b>0 horas</b>
U.2.	<b>Tema 1: Estadística descriptiva unidimensional</b>	2 horas	2'5 horas
	<b>Tema 2: Estadística descriptiva bidimensional</b>	3'5 horas	2'5 horas
<b>TOTAL</b>		<b>5'5 horas</b>	<b>5 horas</b>
U.3.	<b>Tema 3.- Conceptos básicos de cálculo de probabilidades</b>	2'5 horas	5 horas
U.3.	<b>Tema 4.- Distribuciones de Probabilidad</b>	2 horas	3'5 horas
	<b>Tema 5.- Modelos específicos univariantes discretos</b>	2'5 horas	3'5 horas
	<b>Tema 6.- Modelos específicos univariantes continuos</b>	3 horas	3'5 horas
	<b>Tema 7.- Modelos específicos bivariantes</b>	1 hora	0 horas
<b>TOTAL</b>		<b>11 horas</b>	<b>15'5 horas</b>
U.4.	<b>Tema 8.- Introducción a la Inferencia</b>	1'5 horas	0 horas
	<b>Tema 9.- Estimación por intervalos</b>	2 horas	1'75 horas
	<b>Tema 10.- Contrastación de hipótesis</b>	3'5 horas	3'25 horas
	<b>Tema 11.- Análisis de la Varianza</b>	3'5 horas	3 horas
	<b>Tema 12.- Modelos de regresión lineal</b>	2'5 horas	1'5 horas
<b>TOTAL</b>		<b>13 horas</b>	<b>9'5 horas</b>

Fuente: Elaboración Propia

Así, la sesión seleccionada para la planificación de las actividades es una sesión práctica de hora y media dedicada a aplicación y análisis crítico de los conceptos/teoremas correspondientes al tema 3, sombreado en la Tabla 3 (se prevé que el número de alumnos con los que se trabaje sea de entre 18 y 24 alumnos). Se seleccionó este tema por considerarse el más adecuado para la implementación de actividades en las que se puede fomentar el espíritu crítico de los estudiantes, especialmente frente a la existencia de paradojas estadísticas que podrían llevar al equívoco si no se comprenden bien y a falta de buenas capacidades de análisis crítico. Esto es posible, además, a partir únicamente de los conocimientos adquiridos hasta este tema, sin añadir la complejidad (innecesaria para este objetivo) de temas posteriores.

Las competencias a trabajar en esta sesión serían las siguientes: a) Definir correctamente sucesos condicionados y no condicionados; b) Calcular correcta y eficientemente la probabilidad de que ocurra un suceso; c) Aplicar el teorema del producto y de Bayes y d) Analizar de forma crítica las implicaciones prácticas de las probabilidades de sucesos condicionados y sin condicionar (paradoja de Simpson o de Yule-Simpson), y de no conocer “cómo funcionan las probabilidades” (paradoja de Ellsberg + Problema de Monty

Hall). Y para trabajar estas competencias se proponen una serie de actividades, dentro y fuera del aula, previas a la sesión presencial, durante ésta y tras la misma. Dichas actividades, aparecen detalladas en el siguiente epígrafe.

## 2. Propuesta

Como se ha indicado anteriormente, en el presente epígrafe se indican los 3 tipos de actividades (previa, de inicio y de desarrollo), así como los resultados de aprendizaje que se espera obtener, los recursos necesarios y el método de evaluación empleado en cada caso.

### 2.1. Actividad previa

En esta actividad se plantea el visionado de material audiovisual que aborda dos paradojas estadísticas (de Simpson o de Yule- Simpson, y de Ellsberg) y el problema de Monty Hall, que servirán como preparación para las actividades posteriores y como preámbulo a una actividad de debate abierto dentro del aula (actividades de inicio y de desarrollo). Los datos identificativos de dicha actividad (título, tiempo estimado necesario para su puesta en marcha, materiales, instrucciones, ...) se recogen en la Tabla 4.

**Tabla 4. Diseño de la actividad previa**

<b>ACTIVIDAD PREVIA</b>
<b>Nombre:</b> ‘El problema de Monty Hall: ¿quieres la cabra o el coche?’
<b>Duración estimada:</b> 45 minutos
<b>Materiales</b> (disponibles en el apartado ‘Tareas’ o ‘Exámenes’ de <i>PoliformaT</i> ): - Problemas cortos correspondientes al Tema 3 (respuesta cerrada o numérica). - Formulario de la asignatura. - Enlace vídeo: <a href="https://www.youtube.com/watch?v=BzAhrFrnpGM">https://www.youtube.com/watch?v=BzAhrFrnpGM</a> - Cuestionario con 2-3 preguntas sobre el vídeo (archivo .pdf/.doc/.docx).
<b>Instrucciones:</b> - Los estudiantes deben realizar los problemas cortos del Tema 3 en el apartado ‘Exámenes’ de <i>PoliformaT</i> , sin tiempo límite y pudiendo usar el formulario de la asignatura. Una vez enviado, puede ver los resultados (pero no las respuestas correctas, que puede consultar al profesor en el aula si tiene dudas). Este ejercicio no pesa sobre la nota final de la asignatura, pero facilita el seguimiento al profesor y la preparación de los alumnos para la sesión presencial. - Seguidamente, deben visualizar el vídeo y explicar por qué “cambio de variable” no es la expresión adecuada, y que justifiquen matemáticamente el resultado mostrado en el vídeo. La resolución de este ejercicio se debe subir mediante la aplicación de <i>PoliformaT</i> en el apartado ‘Tareas’, y se valorará positivamente su correcta resolución en la nota final de la asignatura.

*Fuente: Elaboración Propia*



## 2.2. Actividad de inicio

Con la finalidad de comprobar que han realizado correctamente la actividad previa, al comienzo de la clase, se realizará una actividad que permita tener un feedback más o menos inmediato del alumnado. La actividad consistirá en cumplimentar un cuestionario que versará sobre los dos ejes que constituyen la actividad previa (repaso de conceptos previos y visualización y comprensión del vídeo). La información detallada se recoge en la Tabla 5.

Tabla 5. Diseño de la actividad de inicio

ACTIVIDAD DE INICIO
<b>Nombre:</b> ‘Cuestionario 3/3 – Probabilidad condicionada’
<b>Duración estimada:</b> 15 minutos
<b>Materiales:</b> <ul style="list-style-type: none"><li>- Test “Problema de Monty Hall” en ‘Exámenes’ de <i>PoliformaT</i>.</li><li>- Formulario de la asignatura (impreso o en .pdf).</li></ul>
<b>Instrucciones:</b> <p>Cada estudiante, o pareja según número de alumnos y ordenadores disponibles, debe responder el test ubicado en el apartado ‘Exámenes’ de <i>PoliformaT</i>. El tiempo límite para responder al test es de 10 minutos. En caso de ir por parejas, ambos miembros de la pareja responden el mismo test: primero uno, y luego el otro con su usuario. Con un tiempo límite total de 15 minutos. Las preguntas son cuestiones con respuesta cerrada o numérica, y cada estudiante debe guardar y enviar para calificar su cuestionario con su usuario personal.</p> <p>Se recomienda avisar de antemano a los alumnos para que no se retrasen, y bloquear el acceso a los tests (varios modelos) con usuario y contraseña que se les proporcionará al inicio de la sesión, y que cambiará de una sesión a otra.</p>
<b>Evaluación:</b> <ul style="list-style-type: none"><li>- La evaluación en este caso se lleva a cabo de la forma tradicional con tests de respuesta cerrada o numérica, admitiendo un pequeño margen de error por posibles aproximaciones para las preguntas de respuesta numérica.</li><li>- Los resultados y respuestas correctas de este cuestionario no se harán públicos hasta que todos los grupos hayan completado esta sesión de aula (si hay más de un grupo). No obstante, el profesor dispondrá de los resultados de forma inmediata para saber en qué cuestiones incidir más o menos en la fase de desarrollo.</li></ul>

Fuente: Elaboración Propia

Los resultados de aprendizaje que se pretenden evaluar con esta actividad son: a) Aplicar el teorema del producto correctamente; b) Aplicar correctamente el teorema de Bayes; c) Calcular probabilidades de sucesos condicionados y/o sin condicionar.

## 2.3. Actividad de desarrollo

La finalidad de la actividad de desarrollo es la de profundizar en los aspectos más prácticos de los conceptos impartidos en la sesión teórica previa y su aplicación, y como

continuación de lo visto por los alumnos en la actividad previa. En dicha actividad, que se llevaría a cabo durante la sesión presencial, y haciendo uso de la gamificación, los alumnos se organizarían en grupo de 3 o 4 estudiantes y, con ayuda de dados y cartas, se familiarizan de forma directa con los conceptos visualizados y discutidos anteriormente. Concretamente, y al igual en las actividades anteriores, una tabla (6) recoge de forma pormenorizada todo lo relativo a la actividad de desarrollo. Dado que la definición de gamificación y los criterios que permiten identificar qué constituye o no un ejemplo de gamificación son variados (Seaborn y Fels, 2015), conviene aclarar el uso en este caso del concepto de “gamificación” en el sentido del uso de juegos de azar conocidos, y en especial sus reglas y los fundamentos (estadísticos) en que se basan, como base para establecer estrategias de victoria (o minimización de la probabilidad de derrota), y para comprender cómo el “mal uso” de la estadística puede servir para ocultar trampas implementadas en los propios elementos de los juegos de azar (e.g. dados cargados y la paradoja de Yule-Simpson).

**Tabla 6. Diseño de la actividad de desarrollo**

<b>ACTIVIDAD DE DESARROLLO</b>
<b>Nombre:</b> ‘La probabilidad, los juegos de azar y la obsolescencia programada’
<b>Duración estimada:</b> 45 minutos
<p><b>Materiales:</b></p> <ul style="list-style-type: none"> <li>- Enunciado de la sesión práctica.</li> <li>- 1 baraja de cartas (de cualquier tipo).</li> <li>- 30-40 dados de seis caras, 10 de ellos cargados/trucados para que salgan más números de un lado, otros 10 para que salgan del lado opuesto, y 20 sin cargar/trucar.</li> <li>- Formulario de la asignatura (impreso o en .pdf).</li> <li>- Plantilla Excel preparada para cálculos con tiradas de dados (en la carpeta ‘Recursos’ de <i>PoliformaT</i>).</li> <li>- Enlaces a vídeos/artículos sobre: <ul style="list-style-type: none"> <li>→ Paradoja de Simpson/Yule-Simpson: <ul style="list-style-type: none"> <li>- <a href="https://www.youtube.com/watch?v=ZDinnCwP3dg">https://www.youtube.com/watch?v=ZDinnCwP3dg</a></li> <li>- <a href="https://www.youtube.com/watch?v=ebEkn-BiW5k">https://www.youtube.com/watch?v=ebEkn-BiW5k</a></li> </ul> </li> <li>→ Paradoja de Ellsberg: <ul style="list-style-type: none"> <li>- <a href="http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095748291">http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095748291</a></li> <li>- <a href="https://es.wikipedia.org/wiki/Paradoja_de_Ellsberg">https://es.wikipedia.org/wiki/Paradoja_de_Ellsberg</a></li> </ul> </li> </ul> </li> </ul>
<p><b>Instrucciones:</b></p> <p>Los estudiantes se organizan en parejas o grupos de tres para llevar a cabo esta actividad, que consta de varias etapas:</p> <ul style="list-style-type: none"> <li>- <i>Comprobación empírica del problema de Monty Hall</i>: Para esta etapa cada pareja/trío usará tres cartas, una de las cuales hace de “coche”, y las otras dos de “cabra”. Por turnos, uno de los jugadores hace de “presentador” y otro de “concurante”, y repiten la actividad del vídeo, anotando en una tabla si el “concurante” cambió o no de “puerta” (carta), y si se llevó el “coche” o una “cabra”, hasta haber simulado esta situación del “concurso” 20 veces. Entonces calculan las probabilidades de acertar “si cambian de puerta” y “si no cambian de puerta”, y las comparan con el resultado teórico. Se discute entre toda la clase los resultados obtenidos</li> </ul>



### ACTIVIDAD DE DESARROLLO

por cada equipo, y se agrupan todos los datos para hacer un cálculo más preciso. Esta etapa no debe durar más de 10 minutos en la recogida de datos, y 5 en la discusión posterior.

- **Paradoja de Ellsberg:** esta etapa se preguntará a mano alzada qué estudiantes habrían cambiado o no de puerta en el caso anterior, y se les presentará un problema asociado con la “paradoja de Ellsberg” y se preguntará también qué opción de dos ofrecidas escogería cada uno (a mano alzada de nuevo). Luego se discute la paradoja de Ellsberg y su relación con las dos preguntas planteadas. Esta etapa no debe durar más de 10 minutos.
- **Paradoja de Simpson/Yule-Simpson:** en esta etapa, cada grupo tendrá 3-4 dados. Los dados se reparten, además, de manera que algunos grupos tengan dados cargados en un sentido, otros sólo en un sentido, y otros no tengan ningún dado cargado. El profesor deberá saber qué dados están cargados y cuáles no, pero no se proporcionará esta información a los estudiantes, a priori. Los alumnos hacen 10-15 tiradas con cada dado, y anotan en el documento de *Excel* proporcionado los resultados de las tiradas para cada uno de los dados. La plantilla hará los cálculos por ellos. Es recomendable que el profesor lleve a cabo la actividad por su cuenta antes de la práctica y disponga de su propia hoja con resultados con todos los dados de antemano en el momento de realizar la actividad y posterior discusión, para agilizar la presentación de resultados si fuera necesario. Se analizan en grupo los resultados y se explica la paradoja de Simpson/Yule-Simpson. Esta etapa no debe durar más de 20 minutos.

#### Evaluación:

- La evaluación en este caso se lleva a cabo mediante el debate tras cada ejercicio. Dado que es posible que no todo el mundo quiera participar en igual medida, se recomienda o bien dar poco peso, o ninguno, en la nota final a esta actividad, y usarla simplemente como seguimiento, o bien “forzar” a todo el mundo a participar preguntando “a dedo” a cada grupo, eligiendo cada vez a un representante, si esto no consume demasiado tiempo (es decir, si el grupo es más reducido).

*Fuente: Elaboración Propia*

Los resultados de aprendizaje que se pretenden evaluar con esta actividad son: a) Calcular probabilidades de sucesos condicionados y sin condicionar y b) Analizar las implicaciones prácticas de calcular correctamente probabilidades y de saber interpretarlas.

### 3. Conclusiones

En el trabajo se proponen una serie de actividades a aplicar en una unidad didáctica correspondiente a la asignatura de Estadística del grado de Ingeniería Química, ofertado por la UPV, con la finalidad de paliar deficiencias como: definir los problemas planteados, identificar y aplicar las herramientas matemáticas para su resolución y el análisis crítico de los resultados. Dichas actividades (previa, de inicio y desarrollo) se realizan antes y durante la sesión presencial, basándose tanto en material que el alumnado tiene disponible en PoliformaT como en el visionado de vídeos relacionados con ciertas paradojas estadísticas. Como futuras líneas de investigación se proponen evaluar el resultado de su implantación, tanto de manera global como desagregando por factores de tipo personal o académico del alumnado (estudios previos, situación laboral, etc.).



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## Evaluación y autoevaluación de los estudiantes mediante la gamificación y el uso de recursos tecnológicos

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### Resumen

*La reestructuración de los contenidos impartidos en las asignaturas que forman los actuales planes de estudio ha dificultado, en buena medida, la forma en que debería enfocarse el proceso de enseñanza-aprendizaje. A esto se suma el hecho de que muchos alumnos acceden a la universidad con un nivel de conocimientos inadecuado para el nivel requerido en diversas asignaturas.*

*El uso de herramientas eficientes para la evaluación de los conocimientos adquiridos por los estudiantes es, por tanto, de gran relevancia, ya que permite adaptar el nivel o el ritmo al que se imparte cada asignatura para mejorar la asimilación de la materia.*

*En esta línea se propone, mediante la gamificación, una actividad por equipos de no más de 8 alumnos en la que, haciendo uso de “Plickers”, el profesorado adquiere información sobre el aprendizaje de los estudiantes a la vez que éstos puedan ‘autoevaluarse’ en tiempo real. También se plantea una actividad voluntaria, de carácter individual, evaluable tanto por el profesorado como por los compañeros de aula, cuya finalidad es analizar si se han adquirido las competencias básicas.*

*De este modo se propicia el trabajo equipo y el individual, posibilitando que tanto el profesor como los estudiantes revisan los conceptos trabajados y evalúan los resultados de aprendizaje adquiridos.*

**Palabras clave:** resultados de aprendizaje, actividad grupal, plickers.



## **1. Introducción**

La metodología utilizada en el proceso de enseñanza-aprendizaje, en la Educación Superior, ha “sufrido” cambios constantes con la finalidad de paliar los efectos derivados de los cambios en los planes de estudio, que han hecho que en muchos casos los créditos asignados a las diferentes asignaturas sean insuficientes o, al menos, no de acorde al amplio temario de las mismas. A este hecho se ha sumado que la ubicación temporal de la materia y el nivel de conocimientos del alumnado no fueran de la mano. Aunque estos puntos débiles tienen un impacto a lo largo de todo el proceso, el trabajo que se presenta se centra en la evaluación del alumnado, en tanto en cuanto se entiende que se habrá alcanzado la optimización del proceso de enseñanza-aprendizaje si se ha conseguido que el alumnado asimile correctamente los contenidos de la materia y haya adquirido las competencias requeridas. La correcta y eficiente evaluación de dicha asimilación resulta, por tanto, indispensable. Para ello se propone hacer uso de la gamificación y de las Tecnología de la Información y Comunicación (TIC) en una actividad de carácter grupal, complementada con otra individual que requiere la implicación del resto de compañeros del aula, para poder evaluar si los objetivos perseguidos se han alcanzado.

La elección del uso de la gamificación y las TIC, para la primera actividad se sustenta en los buenos resultados que ha proporcionado tanto la primera (Bezanilla et al.,2014; Autor 1, Autor 2, y López, 2019) como por la segunda (Calvo, López, y Ruiz, 2017; Fuertes et al. 2016; López, Autor1, Autor 2,2015; Navarro y Olmo, 2014; Pintor et al. 2014). Por otra parte, la propuesta de la segunda actividad surge como una variante de la revisión por pares que tan buena acogida ha tenido en las metodologías utilizadas a lo largo de los últimos años (Monllor-Satoca et al., 2012) así como de los resultados más que positivos que se han obtenido al integrar al alumno en la evaluación (Morell et al. 2004).

Por otra parte, la asignatura donde se propone su uso es una de carácter cuantitativo (Estadística) del grado de Ingeniería Química, ofertado por la Universitat Politècnica de València (UPV). Más concretamente en el Tema 3, correspondiente al estudio de los conceptos básicos de cálculo de probabilidades.

## **2. Propuesta**

En el presente epígrafe se expondrán las actividades mencionadas anteriormente, esto es la actividad de cierre (de carácter grupal) y la actividad posterior (de carácter individual).



## 2.1. Actividad de cierre

La actividad de cierre tiene como objetivos fundamentales:

- a) Propiciar el trabajo en grupo
- b) Ser una herramienta de revisión y evaluación de los conceptos trabajados y los resultados de aprendizaje deseados, y para detectar puntos débiles que merezcan especial atención tanto por parte del profesorado como del alumnado de cara a futuras sesiones de aula, ya sea de teoría o de práctica, tutorías, etc.

Esta actividad requiere la formación de 3 equipos de 8 alumnos (partiendo de que el grupo está formado por 24 alumnos) que deberán “competir” entre ellos para obtener la mayor puntuación posible. Para ello se formulará a los alumnos una batería de preguntas sobre la materia impartida en la sesión teórica anterior y sobre los conceptos trabajados en las actividades previas durante la propia sesión. La actividad exige además el uso de la aplicación “Plickers”, que se enmarca dentro de las denominadas Herramientas de Respuesta de Audiencia (HRA), pues se trata de un sistema de votación interactivo con múltiples utilidades, entre las que cabe destacar la realización del seguimiento de la asistencia al aula, evaluación de los conocimientos adquiridos en clases anteriores, y obtención de feedback inmediato a lo largo de las distintas sesiones. Además, el software necesario es gratuito, y no requiere que el alumno disponga de mandos, ordenador, móviles, ni ningún otro tipo de dispositivo para poder contestar a las cuestiones planteadas por el profesor.

Algunas **recomendaciones** de cara a la preparación previa de esta tarea son:

- a) El docente debería organizar a los estudiantes en distintos grupos, y no permitir que sean los propios alumnos los que se organicen, ya que:
  - Al elaborar dicha composición sería conveniente que los equipos fuesen lo más heterogéneos posibles para “romper” círculos cerrados que pudieran haberse formado a lo largo del primer semestre, y propiciar que éstos se “expandan”.
  - La composición de los grupos no debería hacerse pública hasta el comienzo de la actividad para evitar reparto de roles, intentos de cambios de componentes de un equipo por otros, etc.
- b) Por las mismas razones que el punto anterior, tampoco debería hacerse público en qué consistirá la actividad hasta su comienzo; lo único que los estudiantes deberían saber es que deberán colaborar unos con otros y tener claros los conceptos trabajados durante la sesión, y que quizás ello influya en su nota más adelante...

Una vez formados los equipos, la actividad de cierre se llevará a cabo teniendo en cuenta el siguiente procedimiento:



**1º:** Cada equipo, compuesto por 8 alumnos, se distribuiría en 4 parejas que se sentarían una detrás de otra, tal y como se observa en la Figura 1 (para el caso particular en el que se consideran 3 equipos):

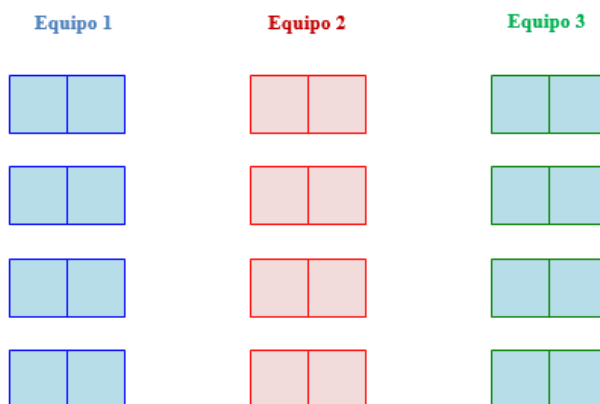


Fig. 1 Disposición integrantes equipos

**2º:** Se formularán un total de 12 o 24 preguntas (según tiempo disponible) de respuesta cerrada a todos los estudiantes, con tantas opciones de respuesta como parejas hay en cada grupo más una, al menos, por lo que el profesor deberá llevar las preguntas preparadas de antemano. Dichas preguntas se mostrarán en una presentación que se proyectará para que puedan leerlas todos los estudiantes sin problemas, además de escucharlas del propio docente. Tras cada pregunta (y sus correspondientes respuestas), se indicará también cuál era la respuesta correcta, a fin de que todo el mundo pueda llevar la cuenta del progreso de su equipo. Tanto la proyección de las preguntas como la recogida de las respuestas se llevaría a cabo mediante la aplicación “plickers”.

**3º:** Para asignar la puntuación a los equipos (se evalúa a todos los grupos de forma simultánea) se procederá de la siguiente manera:

**3.1.-** Una vez efectuada la **1ª pregunta**, si la primera pareja de un determinado equipo la ha respondido correctamente, dicho equipo conseguirá 10 puntos; en caso contrario, si sí que lo ha hecho la segunda pareja, entonces el equipo conseguirá 8 puntos; si la primera pareja en contestar bien a la pregunta ha sido la tercera, el equipo anotará 6 puntos; y si ha sido la cuarta, entonces recibirán 4 puntos. Si ninguna pareja del equipo ha acertado la respuesta correcta, no recibirán ningún punto.

**3.2.-** Para la segunda pregunta el procedimiento es el mismo que antes, pero ahora la asignación de puntos sigue el siguiente esquema: si la segunda pareja ha respondido correctamente, su equipo anota 10 puntos; si ésta ha fallado, pero la tercera ha

acertado, anotan 8 puntos; si no ha acertado ninguna de estas dos parejas, pero sí la cuarta, entonces su equipo suma 6 puntos; si sólo ha acertado la primera pareja, les corresponderán 4 puntos.

**3.4.-** A partir de este punto el procedimiento es equivalente, pero con cada pregunta la pareja que da más puntos es la siguiente a la que daba el máximo número de puntos con la pregunta anterior, y la que antes daba 10 puntos ahora daría el mínimo, siguiendo el mismo orden hasta terminar las 12 o 24 preguntas que se harán en total a todo el grupo.

La Figura 2 muestra lo indicado para el caso particular en que se efectuaran 5 preguntas y se consideraran 3 equipos

<b>1ª Pregunta</b>	<b>2ª Pregunta</b>	<b>...</b>	<b>5ª Pregunta</b>
<b>10 puntos</b>	<b>4 puntos</b>		<b>10 puntos</b>
<b>8 puntos</b>	<b>10 puntos</b>		<b>8 puntos</b>
<b>6 puntos</b>	<b>8 puntos</b>		<b>6 puntos</b>
<b>4 puntos</b>	<b>6 puntos</b>		<b>4 puntos</b>

*Fig. 2 Distribución de las puntuaciones*

Por simplicidad es importante tener en cuenta que el número de respuestas posibles a cada pregunta debe ser superior al número de parejas en cada equipo, para evitar que cada pareja seleccione una opción y garantice así al menos 4 puntos cada vez. La comunicación entre parejas de cada equipo, durante el tiempo que tienen para contestar a cada pregunta (un minuto aproximadamente) está prohibida. Por otra parte, los datos identificativos de dicha actividad (título, tiempo estimado necesario para su puesta en marcha, materiales, instrucciones, ...) se recogen en la tabla 1.



Tabla 1. Diseño de la actividad de cierre

ACTIVIDAD DE CIERRE
<b>Nombre:</b> ‘Cesta y puntos, todos a la vez’
<b>Duración estimada:</b> 30 minutos
<b>Materiales:</b> <ul style="list-style-type: none"><li>- Tarjeta de “Plickers”</li><li>- Plantilla de anotaciones y puntuaciones (en ‘Recursos’, en <i>PoliformaT</i>)</li><li>- Formulario de la asignatura (impreso o en .pdf)</li></ul>
<b>Instrucciones:</b> <p>Además de la explicación de la actividad, proporcionada antes de esta tabla:</p> <ul style="list-style-type: none"><li>- Cada estudiante debe responder a las cuestiones propuestas por el profesor haciendo uso de su tarjeta de “plickers” en el tiempo establecido.</li><li>- Los alumnos pueden hacer anotaciones en la plantilla de anotaciones que se les proporcionará antes de comenzar la actividad, o en el propio ordenador, descargada de la carpeta de ‘Recursos’ de <i>PoliformaT</i>. Puede usar esta plantilla para llevar la cuenta de las puntuaciones de cada equipo también.</li><li>- Los estudiantes pueden hacer uso a lo largo de esta actividad del formulario de la asignatura, impreso o descargado desde <i>PoliformaT</i>.</li></ul>
<b>Evaluación:</b> <ul style="list-style-type: none"><li>- La evaluación en este caso se lleva a cabo en tiempo real durante la propia actividad, recibiendo todos los estudiantes feedback inmediato de las respuestas correctas tras cada pregunta (y la explicación, si conviene). Además, el profesor puede guardar las respuestas de todos los alumnos (por parejas) a todas las preguntas planteadas, y usar esta información para saber en qué cuestiones convendría incidir más o menos en futuras sesiones.</li><li>- En cuanto al posible impacto de esta actividad en la nota final de los estudiantes, se puede ofrecer como incentivo a los estudiantes una mejora en la nota de su asignatura proporcional a la puntuación obtenida por su equipo con respecto a la máxima posible, siempre que superen una determinada puntuación.</li></ul>

Al tratarse de una actividad de cierre que cubre todos los conceptos impartidos relativos al Tema 3, los resultados de aprendizaje que se pretenden evaluar con esta actividad son todos los asociados a las competencias correspondientes (Autor1, Autor 2, 2019), además del trabajo en equipo y la gestión del tiempo (dado que deben responder “rápido” a las preguntas).

## 2.2. Actividad posterior

Tras la sesión de aula se propondrá a los estudiantes hacer una pequeña actividad de repaso voluntaria, con la finalidad de revisar los conceptos vistos en el aula, en la que el alumnado

deberá plantear, en sus propias palabras, ejemplos similares a los vistos en cuanto a casuística que presentan. Los datos identificativos de dicha actividad se recogen en tabla 2

**Tabla 2. Diseño de la actividad posterior**

<b>ACTIVIDAD POSTERIOR</b>
<b>Nombre:</b> ‘Crea tu paradoja personal’ – Trabajo voluntario
<b>Duración estimada:</b> 45 minutos
<b>Materiales:</b> - Todos/cualquiera de los materiales usados o elaborados durante la sesión práctica - Enunciado de la actividad posterior “Crea tu propia paradoja”, en el apartado de ‘Tareas’ de <i>PoliformaT</i>
<b>Instrucciones:</b> Los estudiantes deben llevar a cabo esta tarea de manera individual. Se les pedirá: <ul style="list-style-type: none"> <li>- <u>Resumen de los problemas y paradojas presentados en clase</u>: este ejercicio consistiría en la presentación lo más concisa posible, pero precisa, del problema de Monty Hall (<a href="https://www.youtube.com/watch?v=BzAhrFrmpGM">https://www.youtube.com/watch?v=BzAhrFrmpGM</a>) y las paradojas explicadas en la sesión práctica, y su relación con los contenidos del Tema 3.</li> <li>- <u>Paradojas personales</u>: el alumno tendría que buscar <b>un</b> ejemplo que se le ocurra, o que haya leído en un libro o periódico, o visto en algún medio, etc. en que se dé la paradoja de Simpson/Yule-Simpson (<a href="https://www.youtube.com/watch?v=ZDinnCwP3dg">https://www.youtube.com/watch?v=ZDinnCwP3dg</a>), y a ser posible la de Ellsberg (<a href="https://es.wikipedia.org/wiki/Paradoja_de_Ellsberg">https://es.wikipedia.org/wiki/Paradoja_de_Ellsberg</a>), y justificar su presencia en cada caso. A continuación, deberá preparar una presentación breve (menos de 5 diapositivas de PowerPoint, por ejemplo) de dicho/s ejemplo/s para presentar a la clase.</li> </ul>
<b>Evaluación:</b> - La evaluación en este caso se lleva a cabo mediante la corrección por parte del profesor de los trabajos voluntarios presentados. Aquellos alumnos que hayan decidido realizarlos dispondrán a su vez de dicha corrección. - Además, el alumno o alumnos cuyo ejemplo mostrado en clase reciba la mejor valoración por parte de sus compañeros tendrá una bonificación a la nota final (a discreción del profesor).

Los resultados de aprendizaje que se pretenden evaluar con esta actividad son:

- Sintetizar los conceptos aprendidos durante la sesión práctica relativa al Tema 3
- Analizar las consecuencias de las paradojas de Simpson/Yule-Simpson y su interpretación
- Definir o identificar casos en que se den las paradojas mencionadas, ya sea ficticios/imaginados o reales/observados.

### **3. Conclusiones**

La optimización del proceso de enseñanza-aprendizaje, en la Educación Superior, requiere una correcta asimilación, por parte del alumnado, de los contenidos de las diferentes materias que componen los planes de estudio. Así, en el trabajo que se presenta, se proponen dos actividades (de cierre y posterior) a desarrollar en la asignatura de Estadística del grado de Ingeniería Química, ofertado por la UPV, con la finalidad de evaluar si los estudiantes han alcanzado los objetivos propuestos. Aunque una de las actividades es grupal y la otra individual, la primera se desarrolla por completo dentro del aula y requiere del uso de la denominada gamificación y TIC, mientras que los resultados de la segunda se presentarán dentro del aula, y ambas actividades permiten tanto la evaluación por parte del profesor como la autoevaluación de los estudiantes. En trabajos posteriores se pretende evaluar el resultado de su implantación, así como la percepción que el alumnado ha tenido de las mismas.

### **Agradecimientos**

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## Una biografía tecnológica de la industria

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### Resumen

*La presente investigación tiene por objetivo analizar el historial de aprendizaje de los líderes empresariales del sector productivo, denominada biografía tecnológica. La intención de la biografía tecnológica es el construir una ruta de aprendizaje sobre herramientas innovadoras de comunicación y colaboración de quienes están al frente de la industria.*

*La metodología de evaluación se define con un enfoque cuantitativo, orientado a la etnografía digital. Se realiza una intervención aplicando un instrumento de medición en base a la autopercepción de los líderes participantes. En el análisis se profundiza sobre las habilidades y la intensidad de uso de herramientas tecnológicas, mismas que se distinguen por brindar soluciones a las empresas, eficientando sus procesos internos y externos.*

*El caso de estudio se enfoca en la industria de las energías renovables, seleccionada debido al impacto del sector a nivel mundial y por considerarse uno de los principales gremios de desarrollo en México. Se estudian las pequeñas y medianas empresas en el estado de Baja California, ubicado en el límite territorial del norte de México, uno de los estados con mayor potencial para la generación de energía renovable en el país, debido a sus condiciones geográficas y naturales, con proyectos de energía solar, eólica, geotérmica, mareomotriz y de biomasa.*

*Los resultados de la biografía tecnológica dan evidencias positivas, debido a que exponen competencias tecnológicas a un nivel alto de los líderes respecto a la interacción con dispositivos y aplicaciones. Los líderes evaluados proyectan un grupo de empresarios con claridad en el autoaprendizaje constante.*



**Palabras claves:** *Tecnologías en la industria, competencias tecnológicas, aprendizaje tecnológico, apropiación tecnológica.*

## 1. Introducción

La industria en la actualidad se enfrenta al desarrollo tecnológico, a la innovación empresarial y a la revolución 4.0, dichas temáticas representan un desafío para establecer una visión de crecimiento en las organizaciones, sobre todo en países en vías de desarrollo (Carrillo & Hualde, 2000; Carrillo & Gomis, 2003; IMCO, 2006; AMITI, 2011; Ahumada, Zárate, Plascencia & Perusquia, 2012; Buenrostro, 2013; Vázquez, Estrada, & Reyes, 2014). Las empresas mexicanas invierten poco en tecnología (IMCO, 2006; IFT, 2018) en comparación con países desarrollados, lo que implica en primer lugar, ser un síntoma de que los empresarios mexicanos no tienen una clara percepción de las oportunidades de mejora que ofrecen las Tecnologías de la Información, Comunicación y Colaboración (TICC) en términos de productividad o eficiencia administrativa; en segundo lugar, apunta a un problema aún más complejo, en donde intervienen factores de índole económica, social, cultural y educativo, o bien, con capital humano que posee conocimientos de TICC a nivel bajo, así como un limitado acceso a infraestructura física y tecnológica, lo que justifica el incremento de la brecha digital en la industria mexicana.

La inequidad tecnológica en el país y el aumento de la brecha digital en la industria, dificulta el aprovechamiento de las TICC y los beneficios que ofrecen en las organizaciones, en ese sentido, resulta crucial avanzar en términos de cultura digital considerando el desarrollo de competencias tecnológicas en el sector productivo (Tyler, 2001; Nieto, 2004; Savory, 2006; Real, Leal, & Roldán, 2006; Urraca, 2007). El desarrollo de competencias tecnológicas debiera basarse en el aprendizaje constante al interior de las organizaciones (Rojas, García & García, 2011; Martín-Rojas, García-Morales & Mihi-Ramírez, 2011; Martín, García & Bolívar, 2013), considerando las demandas internacionales sobre habilidades técnicas y tecnológicas (Youssef & Dahmani, 2013; Lee, Park & Lee, 2013; Motta, Zavaleta, Llinás & Luque, 2013; European Commission, 2014) y entendiendo la relación de términos como *competencia*, *capacidad* y *habilidad* en un sentido tecnológico (Ordoñez, Gil-Gómez, Oltra & González-Usach, 2015; Wilson, Leahy & Dudley, 2015; Vallejo, Gallo & Plazas, 2016; Candolfi, Chan & Rodríguez, 2019).

Una visión tecnológica en las organizaciones, posibilita la adaptación a cambios desde la planeación organizacional, el aprovechamiento de las TICC e incursionar en el trabajo colaborativo (IFT, 2018). El crecimiento en la industria de las TICC considera tanto el desarrollo y producción de equipamiento e infraestructura, como la transformación de

servicios para posibilitar la distribución global de productos (Hualde & Díaz, 2010)(Carrillo & Gomis, 2003). Sin embargo, las empresas mexicanas en su mayoría no cuentan con competencias tecnológicas que abonen ideologías innovadoras y se consoliden en corto plazo como un grupo de primer nivel, lo que limita su crecimiento a nivel nacional e internacional por tener desventajas competitivas (IFT, 2018), considerando que la manipulación de artefactos tecnológicos, así como la habilidad de comunicarse y colaborar con otros por medio de dispositivos electrónicos en acciones personales y laborales, es la base para el desarrollo de competencias tecnológicas de mayor profundidad.

### 1.1. Competencias tecnológicas y su evaluación

Las competencias tecnológicas en la industria se refieren a los conocimientos, habilidades y valores, como parte de un conjunto de disposiciones cognitivas relacionado al capital humano de una organización, con un dominio tecnológico que no se oriente únicamente a la incorporación y uso consciente de artefactos tecnológicos, si no, al desarrollo de una cultura innovadora, una apropiación inconsciente de las TICC (Candolfi, Chan & Rodríguez, 2019). Una parte esencial en el desarrollo de competencias tecnológicas en el sector productivo, se refiere a la necesidad de identificar las técnicas de aprendizaje del capital humano y el conocimiento general con el que cuentan al relacionarse e interactuar con la tecnología de forma eficiente, en un inicio con equipo y herramientas de práctico uso, con la intención de elevar el dominio y la práctica de forma gradual.

La exploración de competencias tecnológicas se observa desde diversas áreas del conocimiento, como es la pedagogía, la economía, la administración, entre otras. Las metodologías aplicadas para su evaluación se orientan al análisis de docentes, estudiantes o personal de una organización. En (Candolfi & Chan, 2017) se describen resultados sobre la evaluación de las competencias ya habilidades tecnológicas, mismas que se distribuyen en cinco categorías: desde una visión integradora, con un dominio artefactual-competitividad organizacional, con un dominio tecnológico-competitividad organizacional, con un modelado de pensamiento, y con una visión trascendente. En la presente investigación en particular, interesa la categoría sobre *visión trascendente*, en dónde González (1999) propone una metodología centrada en la historia de vida del sujeto, orientada a la noción de uso, y en dónde se documenta la autopercepción de las habilidades. La propuesta de González (1999) valora la génesis histórica, la habilidad de actuar con destreza en la con relación artefactos digitales prácticos y complejos, identifica las disposiciones de aprendizaje como durables en el tiempo, describe que las habilidades digitales son estructuras expandibles y tienen la posibilidad de transponerse.

Con el propósito de analizar a los líderes de la industria, el estudio se orienta a indagar sobre cuál es el conocimiento que tienen respecto al manejo de la tecnología, cómo han



logrado aprenderlo históricamente y cuál es el nivel de habilidad que poseen, todo en un tono de autopercepción del participante. La intención es construir lo que se denomina una *biografía tecnológica* que representa una ruta de aprendizaje que siguen los líderes empresariales, al identificar los medios y las formas con que aprenden sobre herramientas tecnológicas, tanto de software como de hardware, así mismo, medir la habilidad y el tiempo de uso según aparatos electrónicos, de esta manera, se estudia el cómo aprenden tecnología, cuáles son las herramientas tecnológicas que más utilizan y cuál es el nivel de conocimiento de las herramientas tecnológicas.

Una biografía tecnológica posibilita la articulación de esfuerzos gubernamentales, educativos, empresariales y sociales para el mejor aprovechamiento de los recursos asignados a la promoción de las TICC en la industria, considerando la definición de políticas de desarrollo con mayor claridad, y así establecer propuestas de capacitación y actualización pertinentes.

## **2. Enfoque de evaluación en el sector de energías renovables, la población objetivo**

El estudio se desarrolla en base a la metodología de la etnografía de la cultura digital y la innovación, bajo los enfoques de exploración de procesos de alfabetización y concentrización digital, así como la participación social en procesos de innovación y tecnología. Se desarrolla una evaluación cuantitativa, integrada por un cuestionario de autopercepción que indaga sobre el histórico de aprendizaje del participante.

La evaluación es dirigida a los líderes del Sector de Energías Renovables (SER) del estado de Baja California, en el norte de México, en dónde el SER ha tenido gran proyección y se trabaja estratégicamente para su desarrollo y consolidación. Baja California es uno de los estados con mayor potencial para la generación de energía renovable en México, debido a sus condiciones geográficas y naturales, y actualmente se desarrollan proyectos relacionados con las energías solar, eólica, geotérmica, mareomotriz y de biomasa. El SER es un grupo de empresas relativamente nuevo en el estado, una novedosa y prometedora estrategia de inversión nacional, por ello, cuenta con gran impulso dentro de los planes de desarrollo y políticas empresariales. Las empresas del SER, en su mayoría se estructuran por un equipo de ingenieros expertos en las áreas de mecánica, eléctrica, electrónica y mecatrónica, orientadas principalmente a las actividades de capacitación técnica del personal, instalación de equipo eólico y solar, así como a la realización de proyectos a la medida de empresas ecológicamente responsables.

Los participantes del estudio son 12 profesionistas que se desarrollan dentro del SER, denominados para el proyecto «líderes empresariales», los cuales se sitúan en un puesto con la responsabilidad de gerencia de una pequeña y mediana empresa. El grupo de empresas seleccionadas forman parte del registro de organizaciones de la Comisión Estatal de Energía en Baja California, definido como un sector emergente a nivel nacional.

## 2.1. Descripción y validación del instrumento de medición

Se integra un instrumento de evaluación con el objetivo de identificar el historial de aprendizaje de los líderes empresariales, el cuál se construye de seis dimensiones orientadas a medir el uso y el aprendizaje de diversos Dispositivos Tecnológico (DT), Aplicaciones Computacionales (AC) e Internet/Móviles (IM), en la Tabla 1 se describen las dimensiones e indicadores de evaluación. La evaluación se llevó a cabo por medio de la plataforma de *Google forms* de manera virtual.

**Tabla 1 Descripción de las dimensiones e indicadores de evaluación**

Dimensión	Indicadores	Descripción
Tecnologías	1. DT 2. AC 3. IM	Equipo electrónico, lo relacionado con el software y aplicaciones de Internet/móviles con aspectos novedosos de redes sociales.
Usabilidad	1. Utiliza el dispositivo/software 2. No utiliza el dispositivo/software	El líder identifica y responde al reactivo: ¿Sabe utilizar el dispositivo/software?
Aprendizaje	1. Exploración 2. Capacitación 3. Formación profesional 4. Indicar otra: _____	El líder identifica y responde al reactivo: ¿Cómo aprendió a utilizar el dispositivo/software?
Temporalidad	Valor numérico	El líder identifica y responde al reactivo: ¿Hace cuántos años empezó a utilizar el dispositivo/software?
Intensidad de uso	Valor nominal del 1-5	Frecuencia con la que se hace uso de los dispositivos/aplicaciones.
Habilidad de uso	Valor nominal del 1-5	Dominio que se tiene respecto a los dispositivos/aplicaciones.

Fuente: Elaboración propia

Para la validación del instrumento de medición se empleó la metodología de validéz de contenido por juicio de expertos (Lawshe,1975; Tristán, 2008; Díaz & Baéz, 2015). Se definen seis jueces expertos en temáticas sobre estudios sociales en la industria, Tecno-Antropología, liderazgo directivo, análisis e impulso de mercados, mercadotecnia digital, economía y gestión de la innovación y capacitación del capital humano. Se realiza la validación a través de una *tabla de revisión*, integrada por la dimensión de evaluación, el número de reactivo, el reactivo, la relevancia del reactivo – esencial, útil e inútil – , la

claridad en la redacción del reactivo – legible o ilegible –, y las observaciones generales. Una vez realizada la validación, se calcula la Razón de Validez de Contenido (CVR) y el Índice de Validez de Contenido (CVI) utilizando el programa *Microsoft Office Excel*. Se obtiene el CVI de todo el instrumento validando para cada reactivo y dictaminando si es aceptable o inaceptable. En el resultados de la validación se esperan índices superiores a 0.5823, de lo contrario, el reactivo debe eliminarse del instrumento (Tristán, 2008). En la Ecuación 1 y Ecuación 2 se muestran las variables de la operación.

$$CVR = \frac{ne}{N} \quad (1)$$

$$CVI = \frac{\sum_{i=1}^M CVRi}{M} \quad (2)$$

El resultado del CVI global del instrumento es de 0.83, por lo tanto, se registra dentro de lo *aceptable*. Se obtuvieron observaciones sobre la redacción del reactivo, específicamente de la dimensión de dispositivos y aplicaciones, la dimensión de usabilidad y la dimensión de aprendizaje, los resultados se muestran en la Tabla 2.

**Tabla 2 Descripción de reactivo**

Dimensión	Reactivo	Relevancia del reactivo			Cálculo de validación
		A	B	C	CVR
Dispositivos y aplicaciones	Lista de dispositivos y aplicaciones	5	1	0	0.83
Usabilidad	¿Sabe utilizar el dispositivo/software?	5	1	0	0.83
Aprendizaje	¿Cómo aprendió a utilizar el dispositivo/software?	5	1	0	0.83
Temporalidad	¿Hace cuántos años empezó a utilizar el dispositivo/software?	5	1	0	0.83
Intensidad de uso	Evalúe su frecuencia de uso	5	1	0	0.83
Habilidad de uso	Evalúe su habilidad de uso	5	1	0	0.83
<b>Suma</b>		<b>30</b>	<b>6</b>	<b>0</b>	<b>4.98</b>
		<b>CVI Global</b>			<b>0.83</b>

A= Esencial  
 B= Útil  
 C=Inútil

Fuente: *Elaboración propia*

## 2.2. Fiabilidad del instrumento de evaluación

Se considera el cálculo de *Alfa de Cronbach* para medir la fiabilidad del instrumento de evaluación, y se calcula la correlación de las dimensiones respecto a los dispositivos y aplicaciones (Prieto & Delgado, 2010). Los resultados del cálculo de fiabilidad se obtienen utilizando el programa de estadística *Statistical Package for the Social Sciences* (SPSS) de IBM, los cuales se presentan en la Tabla 3 y la Tabla 4.

**Tabla 3** Calculo de Alfa de Cronbach

Dispositivos y aplicaciones	Alfa Cronbach
Equipo	0.847
Software	0.891
Web 2.0	0.865

Fuente: Elaboración propia

**Tabla 4** Análisis de correlación por reactivo

Reactivo	Equipo	Software	Web 2.0
¿Cómo aprendió a utilizar el dispositivo/software?	0.644	0.758	0.48
¿Hace cuántos años empezó a utilizar el dispositivo/software?	0.848	0.657	0.673
Evalúe su frecuencia de uso	0.625	0.858	0.936
Evalúe su habilidad de uso	0.898	0.88	0.897

Fuente: Elaboración propia

Los resultados del análisis de fiabilidad expuesto en la Tabla 3 demuestran una *Alfa de Cronbach* por encima del valor indicado como *aceptable*, por lo tanto, el instrumento de evaluación es confiable. En la Tabla 4 se observa que los reactivos con mayor puntaje tienen una contribución más directa al objetivo del estudio, lo que corresponde a la frecuencia y habilidad de uso de los equipos y aplicaciones, los reactivos con valores por debajo del 0.8 se consideran como datos que definen el contexto.

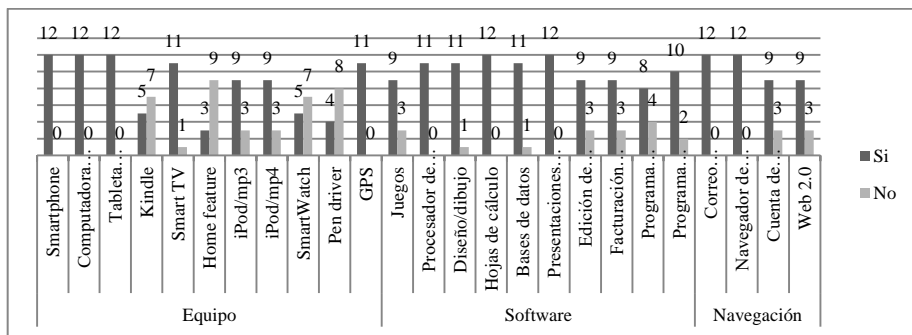
### 3. Resultados

En la *dimensión de usabilidad*, de los equipos como smartphone, computadora digital, tableta digitalizadora, así como aplicaciones de hojas de cálculo, correo electrónico y navegador de internet son las más utilizadas, el 100% de los líderes mostraron conocimiento al respecto; el 91.6% de los líderes, respondieron que utilizan Smart TV, GPS, procesador de texto, programas de diseño y dibujo, así como bases de datos; en un nivel medio entre el 80% y 65% los líderes indican que utilizan i-POD/Mp3, i-POD/Mp4, software de edición de imagen, programas de facturación electrónica, programas de contabilidad de la empresa, programas de gestión y administración de proyectos, cuenta de LinkedIn y aplicaciones en la nube; y con valores porcentuales por debajo del 50%, el uso de Kindle, Home feature, Smartwatch y Pen drive. En la Figura 1 se muestra los resultados en la dimensión de usabilidad.

En la *dimensión de aprendizaje*, los resultados exponen que la mayoría de los líderes en las diversas aplicaciones y equipo aprenden explorando por su propia cuenta, seguido de este valor que representa el 70%, se encuentran en igual valor con un 15% la capacitación y

actualización por medio de cursos y la formación profesional ya sea en licenciatura o posgrado. Los líderes empresariales proyectan un grupo con claridad en el autoaprendizaje constante;

**Figura 1 Resultados de usabilidad**



Fuente: Elaboración propia a partir de resultados

En la *dimensión de temporalidad*, se revisa los años que tienen utilizando cierto equipo o aplicación, que en su mayoría responde a sus inicios en la formación universitaria. En la *dimensión de habilidad de uso*, no se identifican valores que fundamenten una relación directa con la apropiación tecnológica, es decir, a mayor dedicación en el uso, se logra un mayor dominio de las herramientas, sin importar el referente de iniciación del conocimiento.

#### 4. Conclusiones y discusión

Los resultados de la evaluación son positivos, debido a que los líderes muestran un alto conocimiento de las aplicaciones y el equipo que se utiliza tanto en la industria como en actividades de la vida diaria. En general, los líderes demuestran una biografía tecnológica con conocimiento medio, dispuestos a la actualización, con habilidades en herramientas digitales comunes. Sin embargo, se detectan oportunidades de mejora en la visión digital dirigida a lo administrativo, en donde se potencializan los procesos de desarrollo de proyectos, comunicación interna y externa, relación con clientes y proveedores por medio de la implementación de TICC con una frecuencia y habilidad de uso con mayor impacto. Se requiere que la apreciación tecnológica se convierta en un proceso transparente en las actividades laborales y personales del día a día. El presente estudio se desarrolla como un acercamiento al conocimiento y a las habilidades tecnológicas que los líderes de la industria poseen, analizando la manipulación de artefactos básicos y las potencialidades del sector a partir de una visión tecnológica de sus representantes.

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## Evaluación de competencias docentes de instituciones públicas mexicanas de nivel medio superior

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### Resumen

*En la primera década del siglo XXI, en México, se ha intentado implementar un modelo educativo distinto al tradicional, conocido como “modelo de educación basada en competencias” en respuesta a las necesidades laborales que origina la sociedad del conocimiento y/o de la información. Diversas investigaciones se han centrado en observar los procesos de evaluación, el desempeño, el análisis del proceso de enseñanza-aprendizaje de los docentes desde diversas perspectivas; sin embargo, en este trabajo se aborda el análisis de las competencias docentes de forma cualitativa y cuantitativa para el nivel medio superior desde la propuesta de la Reforma Integral de la Educación Media Superior acuerdo 447 publicadas en el Diario Oficial de la Federación en el año 2008. El estudio realizado involucra la comparación de dos unidades de académicas de la Universidad Autónoma del Estado de Guerrero, UAGro. El instrumento de evaluación empleado fue un cuestionario de 98 reactivos con una escala tipo likert constituyendo un inventario y diagnóstico acerca de las competencias docentes con que cuentan los profesores del Nivel Medio Superior. Se encuentra estructurado en seis ejes interdisciplinarios: los saberes pedagógicos; organización de la enseñanza; comunicación; interacción; intervención pedagógica; y desarrollo profesional. Los resultados evidencian que los docentes emplean en mayor proporción la tecnología para desempeñar sus actividades profesionales, es decir, su estilo de enseñanza se basa en el uso de las TIC fortaleciendo sus quehaceres educativos. En general, las habilidades más valoradas y utilizadas por los docentes son saberes pedagógicos e interacción social y las menos valoradas son comunicación, interacción psicopedagógica.*

**Palabras claves:** competencias docentes, evaluación de competencias, ejes interdisciplinarios.





## **1. Introducción**

En la primera década del siglo XXI en México se han intentado implementar un modelo educativo distinto al tradicional, conocido como “modelo de educación basada en competencias” con el objetivo de generar habilidades en los estudiantes que pudieran corresponder a las demandas sociales como individuales del presente siglo, como lo señala Prrenoud (2007) una competencia es cuando se emplea las capacidades o aptitudes para hacer frente a las situaciones que se presente. Este aspecto se vincula a los procesos laborales que fundamentados en las demandas del trabajo.

Esta vinculación entre el sector laboral y el sector productivo ha permitido que se capte con mayor claridad las necesidades reales de la sociedad, (ANUIES: 2003, p.31) favoreciendo de esta manera la búsqueda de soluciones a los problemas que se presentan tanto en la sociedad como en el sector productivo, redefiniendo las políticas educativas. Yolanda Argudín señala que el concepto de competencias en la educación significa básicamente “saberes de ejecución” ya que todo proceso de “conocer” se traduce en un “saber” (Argudín: 2005, p.3). Por otro lado Tobon (2006) menciona que las competencias son procesos complejos en el desempeño que corresponden al contexto con responsabilidad.

La educación por competencias pretende vincular el sector educativo con el sector productivo, a fin de elevar el potencial de los individuos, frente a la sociedad contemporánea (Cejas, p. 4). Así como para cumplir con las demandas del siglo XXI el docente como parte elemental de la educación vanguardista, deberá poseer conocimientos académicos, administrativos y humano-sociales (Aldape, 2008).

De acuerdo a Magda Cejas, el concepto de competencias vinculada a la educación es una combinación de aplicación de conocimientos, habilidades o destrezas en la realización de un trabajo, se puede expresar: El saber, El saber hacer y El saber ser. De tal manera que se llega a las siguientes consideraciones: La formación por competencias debe ir más allá de transmitir saberes y destrezas manuales, por lo que debe buscar incrementar la capacidad de las personas, además de considerar aspectos culturales, sociales y actitudinales.

En el acuerdo 447, publicada en el DOF el día miércoles 29 de octubre de 2008, se define el perfil del docente del Sistema Nacional de Bachillerato (SNB), y se establece las competencias que deberá cumplir los docentes de las instituciones educativas que en la modalidad escolarizada imparten educación de nivel medio superior y operen en el Sistema Nacional de Bachillerato.

Con regularidad se delega a la institución el diseño y evaluación de la evaluación, sin embargo, no se tienen directrices para evaluar el desempeño docente, o la evaluación es manejada por la opinión de los estudiantes, a través de cuestionarios aplicados por los jefes inmediatos o autoevaluaciones a profesores. Por ello, se propuso contribuir a través de este proyecto, una evaluación cuantitativa y cualitativa de los niveles de desarrollo de las competencias docentes de los profesores de las Unidades académicas 23 y 35 de la Universidad Autónoma de Guerrero.

## **2. Materiales y Métodos**

Para elaborar esta investigación fue necesario analizar los programas de capacitación y actualización implementados en el Nivel Medio Superior. Además, se organizó la información estableciendo relaciones, similitudes y diferencias sobre la problemática abordada, su instrumentación y resultados, para lo cual se empleó como instrumento de evaluación el cuestionario de evaluación de competencias docentes (CECD) que constituye un inventario y diagnóstico acerca de las competencias con que cuentan los docentes. El estudio se realizó en las Unidades Académicas No. 23 y 35 de la UAG ubicadas en la Región Costa Grande del Estado de Guerrero. Principalmente se utilizó el cuestionario de evaluación de competencias docentes, elaborado por Dávila y Vaca (2012), para conocer el estado actual que guardan los profesores de la región enunciada con respecto a sus competencias docentes en la enseñanza de un área específica.

Este cuestionario contiene 98 reactivos con descripciones sobre las competencias que deben utilizar los profesores. Cada reactivo incluye una escala con un intervalo de variadas opciones tipo likert, a fin de facilitar y homogeneizar las respuestas de los profesores. Las áreas y ejes que explora el cuestionario de evaluación de las competencias docentes son las siguientes: saberes pedagógicos; organización de la enseñanza; comunicación; interacción social; intervención psicopedagógica; y desarrollo profesional.

El procedimiento en la investigación en primera instancia fue caracterizar las competencias mínimas y las deseables, se realizó el estudio del arte del tema y el análisis de documentos oficiales de la Universidad Autónoma de Guerrero, así como la consulta en las unidades Académicas involucradas. De este análisis se formuló una primera versión de las competencias que deben tener los profesores sobre la base de los aspectos antes descritos., siendo evaluada por los investigadores y los propios profesores para integrar la versión definitiva. Posteriormente se llevó a cabo la aplicación de los cuestionarios de evaluación de las competencias docentes (CECD) a la muestra de población seleccionada de las

unidades académicas 23 y 35. Finalmente se recabo la información para llevar a cabo la representación gráfica, la descripción y análisis de resultados.

### **3. Resultados**

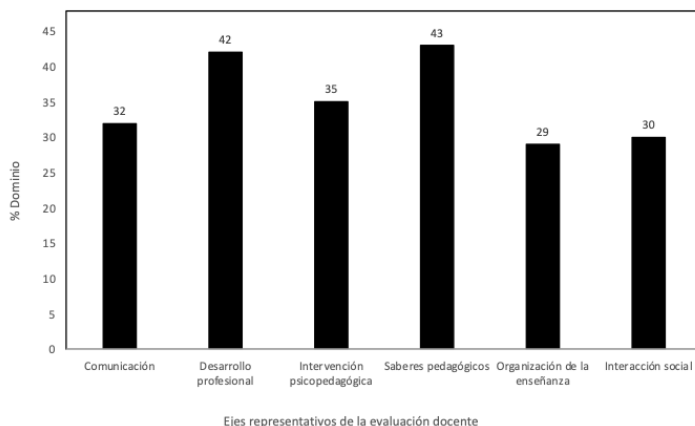
#### **Unidad académica 23**

En la figura 1 se presentan los seis ejes en los que se evaluaron a los docentes de la UA23, inicialmente, el eje de comunicación, al que le corresponden los atributos de lectura; escritura; audición y expresión oral, representa un promedio del 32% de la competencia, considerando que el valor es inferior al 50% en el dominio de la comunicación. El atributo más valorado por los docentes es la expresión oral y el menos valorado es la escritura. Se considera como valor mínimo aceptable el 60% de dominio de las habilidades, sin embargo, los resultados están por debajo de éste. En el área de desarrollo profesional, se consideraron dos atributos: formación permanente y conciencia crítica, alcanzando en promedio 42% de dominio de los dos atributos, considerando que en la formación permanente es más alto el dominio frente a la conciencia crítica del eje valorado.

En el área de la intervención psicopedagógica, los atributos analizados son las estrategias y formas de trabajo resultando en promedio un 35% de dominio del área. Lo que permite inferir que los docentes no emplean diversas estrategias didácticas y que no cuentan con distintas actividades para los momentos de la clase. Carecen de técnicas de la enseñanza y del aprendizaje. En los saberes pedagógicos, los atributos involucrados en esta área son: las concepciones acerca de los adolescentes, el uso de las TIC, el pensamiento lógico y la explicación de la realidad social, en donde el promedio del área es de 43% de dominio. Sin embargo, el atributo con más aplicación por parte de los docentes es el uso de las TIC y la realidad social, mientras que el atributo menos valorado en este eje es la concepción de la adolescencia.

En la organización de la enseñanza, se evaluaron dos atributos: la planeación y la evaluación, que en promedio representa 29% de dominio, valorando la planeación en sus actividades profesionales y enfocándose en los contenidos que el alumno debe conocer, pero omitiendo los indicadores de las competencias que se encuentran inmersos dentro del proceso de desarrollo de los estudiantes. Finalmente, el área de interacción social, que involucra el atributo de la convivencia, tiene un dominio del 30% denotando poca disponibilidad en el trabajo colaborativo y poco compromiso con la institución. En términos generales la UA 23 muestra que sus docentes se encuentran deficientes en el conocimiento, aplicación y dominio de las competencias que el SNB requiere para que los alumnos cumplan con el perfil de egreso requerido.

Los resultados obtenidos de la aplicación del cuestionario en la Unidad Académica 23 (UA23) se muestran en la figura 1.



*Fig 1. Representación por áreas de evaluación de las competencias de los docentes de la UA 23.*

### Unidad Académica 35

En la figura 2 se muestran los seis ejes en los que se evaluaron a los docentes de la UA35, en el primer eje de evaluación esta la comunicación, que obtuvo un promedio de 32%, resaltando que la audición fue el valor que predomina, seguido de la expresión oral y que el atributo menos valorado fue la escritura, especificando que éste último fue igual para la UA23.

En el área de desarrollo profesional, se obtuvo un 44%, destacando que el atributo más valorado por la UA35 fue el de formación permanente y el menos valorado es el de conciencia crítica. Demostrando que los docentes se encuentran en constante actualización, sin embargo, no son lo suficientemente altos para indicar que cubren las especificaciones solicitadas por el Marco Curricular de las competencias docentes. El área de intervención psicopedagógica, fue de un 38% de dominio del área en promedio, sin embargo, este valor se encuentra por debajo de lo requerido.

En los saberes pedagógicos se obtuvo un 53% resaltando que es el promedio más representativo de los ejes evaluados en ambas Unidades Académicas, no obstante, el atributo que más dominan los docentes es el uso de las TIC, lo que implica que el empleo de la tecnología es la herramienta que más utilizan para sus actividades académicas, seguido del pensamiento lógico y el menos estimado fue la concepción de la adolescencia.

En la organización de la enseñanza, se logró un 37% de dominio del eje, resaltando la planeación, por encima de la evaluación con una diferencia mínima, involucrando la planeación en sus actividades profesionales y la evaluación como parte de la misma. Finalmente, en la evaluación del área de interacción social, posee en promedio un dominio del 47% denotando que los docentes se involucran en la comunidad educativa, sin embargo, no es suficiente y se requiere mayor participación y compromiso con sus homólogos y padres de familia.

Los resultados obtenidos de la aplicación del cuestionario en la Unidad Académica 35 (UA35) se muestran en la figura 2.

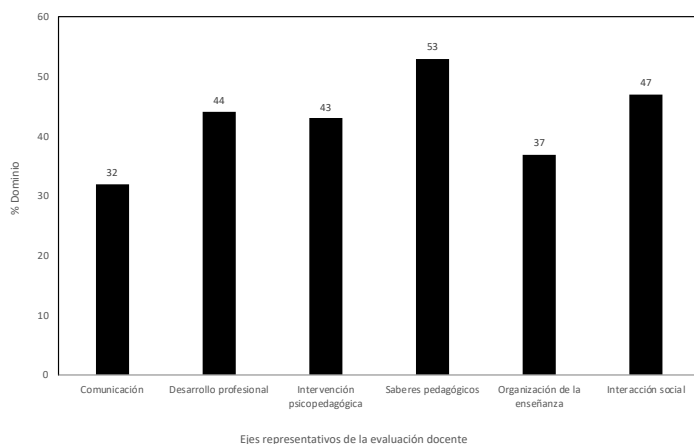


Fig. 2. Representación por áreas de evaluación de las competencias de la UA 35.

#### 4. Discusión

En la Tabla 1 se observan, de manera resumida, los ejes evaluados de la UA 23 y UA 35. El valor más representativo son los saberes pedagógicos, lo que implica, la recuperación de los conocimientos acerca de la adolescencia, el cuidado de la salud física y mental, las relaciones con el medio natural, la explicación de la realidad, el aprovechamiento de la tecnología y el pensamiento lógico matemático. En el valor menos valorado por las UA es el eje de la organización de la enseñanza en la UA23 mientras que para la UA35 es la comunicación, considerando que el promedio se encuentra en un porcentaje inferior al 50%, destacando que estas habilidades son básicas en la formación básica del estudiante.

Los resultados muestran que los docentes emplean en mayor medida la tecnología para desempeñar sus actividades profesionales, su estilo de enseñanza se basa en el uso de las TIC. Algunos rubros con menor aprovechamiento son por ejemplo, el eje de la organización enseñanza de la UA23 en cuanto a la evaluación con un porcentaje del 26%, asimismo, la escritura con un 27% en ambas Unidades.

**Tabla 1.** Competencias docentes de acuerdo a los ejes de evaluación.

Ejes de evaluación	<i>Comunicación</i>				<i>Desarrollo profesional</i>		<i>Intervención psicopedagógica</i>
	Lectura	Escritura	Audición	Expresión oral	Formación permanente	Conciencia crítica	Estrategias y formas de trabajo
Valores de dominio	32	27	34	36	44	40	35
UA23	32				42		35
Valores de dominio	32	27	34	36	49	38	43
UA35	32				44		43
Ejes de evaluación	<i>Saberes pedagógicos</i>				<i>Organización de la enseñanza</i>		<i>Interacción social</i>
	Adolescencia	Realidad Social	Tecnología	Pensamiento lógico	Planeación	Evaluación	Convivencia
Valores de dominio	31	44	58	38	31	26	30
UA23	43				29		30
Valores de dominio	42	48	73	49	38	36	47
UA35	53				37		47

## 5. Conclusiones

Para lograr el perfil educativo solicitado el docente debe colaborar en la construcción de proyectos de formación integral dirigido a los estudiantes en forma colegiada con otros docentes y los directivos de la institución, así como el personal de apoyo técnico pedagógico. En general, los resultados de la evaluación de las competencias docentes de las unidades académicas 23 y 35 evidencian que, en la actualidad, el uso de la tecnología es la herramienta que más utilizan para sus actividades académicas, seguido del pensamiento lógico y el menos estimado fue la concepción de la adolescencia.

Es importante destacar que los resultados obtenidos de esta investigación arrojaron diferencias significativas entre el dominio de las competencias docentes de las dos unidades

académicas atribuibles a la falta de actualización continua e innovaciones estratégicas en el desarrollo profesional.

El porcentaje de dominio de los diferentes ejes evaluados para ambas unidades académicas se encuentran por debajo del valor mínimo aceptable (60%) evidenciando que los docentes se encuentran deficientes en el conocimiento, aplicación y dominio de las competencias que el Sistema Nacional de Bachillerato requiere para que los alumnos cumplan con el perfil de egreso requerido.

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## Aprendizaje basado en problemas, PBL y aprendizaje basado en equipos, TBL aplicado a las prácticas de laboratorio universitario

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### **Resumen**

*Es sabido que para el desarrollo de una carrera exitosa de un profesional de cualquier Grado en Ciencias es imprescindible poder manejar y resolver circunstancias complejas con los conocimientos, habilidades y competencias adquiridas durante los años de formación universitaria. Si aceptamos que el aprendizaje es el resultado solo de lo que el alumnado hace y piensa llegamos a la conclusión, que sólo se puede lograr a través de muchas horas de prácticas de laboratorio.*

*De las distintas metodologías activas y diferentes a las clásicas lecciones magistrales, se han utilizado conjuntamente el PBL, aprendizaje basado en problemas, y el TBL, aprendizaje basado en equipos, con éxito en los primeros cursos de los Grados universitarios de Bioquímica y de Bioinformática. Ello ha aportado a nuestros alumnos un mayor nivel de conocimientos que se ha traducido en una mayor capacidad de resolver problemas, analizar datos y, muy importante, pensar de manera crítica.*

*En este trabajo se presentarán y discutirán, con la participación del propio alumnado, la aplicación de dichas metodologías las cuales, están provocando una intensa transformación en la educación universitaria.*

**Palabras claves:** Experimentos, química, primer curso universitario, metodologías activas, PBL y TBL

### **1. Introducción**

La falta de interés hacia las carreras científicas, en nuestro país y en Europa, (Fensham, 2004 y Martínez, 1998) acompañada de una cierta actitud negativa hacia las ciencias en nuestros jóvenes estudiantes de secundaria condiciona el momento de elegir una carrera





universitaria ya que desestiman algunas de ellas por sus contenidos en matemáticas o en física o química.

Actualmente, desde los centros educativos que enseñan las ciencias bajo el modelo STEM, Ciència-Tecnología-Ingeniería-Matemáticas (Sanders, 2009), se intenta revertir esta actitud negativa. Este enfoque requiere el uso de métodos innovadores y alternativos de enseñanza y aprendizaje, tales como proyectos, prácticas de laboratorio y herramientas tecnológicas. La enseñanza se vuelve eminentemente práctica y se aleja del aprender teórico y repetitivo. Se centra en la capacidad de innovar, inventar y resolver problemas de forma creativa.

Un estudio publicado en 2014 (Freeman et al, 2014) realizado en 225 alumnos de Estados Unidos de América, a los cuales se les analizaba bajo la perspectiva del modelo STEM reveló que dicho aprendizaje reduce drásticamente el porcentaje de fracaso universitario y ha llevado a los estudiantes a obtener un mayor nivel de conocimientos y una mayor capacidad para resolver problemas, analizar datos o pensar de manera crítica. Demuestra que los estudiantes no consiguen una positiva comprensión de un tema, de física o de química o de matemáticas o... de ciencias, solo atendiendo a unas explicaciones teóricas de una forma distante.

La educación científica se basa en la indagación (Jiménez Pérez, 2016 y Camacho, 2008). En ella los estudiantes, trabajando en grupos y colaborando entre ellos, participan en la planificación de una investigación para dar respuesta a preguntas y/o problemas de la vida real. Para ello, deben recopilar información y datos de las fuentes a su alcance. Luego, deben proponer explicaciones ajustadas a sus resultados para comunicarlos a los demás grupos de la clase. Deben expresarse usando términos científicos adecuados, tanto por escrito como de forma oral. Y, finalmente, deben participar en discusiones públicas en defensa de su trabajo y dirigir sus explicaciones hacia popularizar la ciencia.

Implementar este tipo de cambios en los primeros cursos universitarios tiene una ventaja, los resultados son a menudo evidentes. Las metodologías activas más utilizadas en el ámbito de las Ciencias son: CBL, de sus siglas en inglés, *case based learning* o aprendizaje basado en el estudio de casos reales, PBL (Schwartz, 2002), de sus siglas en inglés, *problem based learning* o aprendizaje basado en problemas, TBL (de Vries, 2018), de sus siglas en inglés, *team based learning* o aprendizaje basado en equipos y IBL, de sus siglas en inglés *inquiry based learning* o aprendizaje basado en retos.

De éstas se han utilizado el PBL y el TBL como innovación educativa. Se desarrollan conjuntamente los modelos PBL y TBL en los mismos grupos de estudiantes y al mismo tiempo, para conseguir una mayor motivación y participación por parte del alumnado de primer curso del Grado de Bioquímica de la Universidad de Barcelona (UB) en las asignaturas de Química I y Química II y también en el grado de Bioinformática de la Universitat Pompeu Fabra (UPF) en la asignatura "Aspects of Physical and Organic

Chemistry", ambas impartidas por el autor desde 2011 en el grado de bioquímica y desde 2016 el de bioinformática, año de su implantación.

Para nuestros universitarios el aprendizaje es el resultado de lo que el estudiante hace y piensa y ello, en los estudios científicos, sólo se puede lograr a través de muchas horas de "prácticas" muy reflexionadas y maduradas. Nuestra aproximación educativa, aprendizaje basado en problemas, no solamente abarca los problemas numéricos en general, sino que la aplicamos a la resolución de problemas y/o casos prácticos en el laboratorio de bioquímica y de bioinformática (PBL) y, siempre, es realizada por un grupo, un equipo, de estudiantes (TBL) rompiendo las fronteras entre los distintos modelos de la metodología activa.

En este artículo se presentan y discuten la puesta en marcha de las metodologías PBL y TBL en ambos grados científicos como apuesta clara para que los estudiantes sean los protagonistas. Finalmente, se presentan las conclusiones/aportaciones del propio alumnado acerca de esta innovación educativa.

## **2. Características de los estudiantes del Grado de Bioquímica y del Grado de Bioinformática**

Los diferentes grados científicos dirigen al alumnado a profesiones relacionadas pero distintas y ello queda reflejado en el currículum de cada grado. Así, mientras en los estudios de Bioquímica se potencia la parte experimental con un número importante de créditos de laboratorio, en los estudios de Bioinformática se potencian las prácticas de ordenador.

### **2.1. Grado de Bioquímica**

Proporciona una comprensión y uso de las técnicas estándar de la bioquímica y sus aspectos cuantitativos básicos. El contenido del programa de "Química I y II" reúne un conjunto de conceptos básicos y esenciales para desarrollar posteriormente una buena parte de las asignaturas que constituyen el grado de Bioquímica. 1. Bases de las reacciones químicas. 2. Estructura atómica, enlace químico y estructura molecular. 3. Reacciones en disolución acuosa. 4. Equilibrio químico: equilibrio ácido-base, de oxidación-reducción y de precipitación. 5. Biomoléculas (QI)

El alumnado desarrolla la capacidad para comprender y explicar los principios químicos de las reacciones bioquímicas y las técnicas experimentales utilizadas en dicho estudio.



## **2.2. Grado de Bioinformática**

Proporciona una formación intra e interdisciplinaria en temas tanto computacionales como científicos con una sólida formación básica en química. El contenido del programa de "Aspects of Physical and Organic Chemistry (APOC) Aspectos de la química física y orgánica" cubre conceptos fundamentales en física y química orgánica y está distribuido en: 1. Estructura atómica y enlace químico. 2. Termodinámica química. 3. Reacciones de química orgánica. 4. El equilibrio químico: equilibrio ácido-base, de oxidación-reducción y de precipitación (APOC)

El alumnado integra, procesa, gestiona e interpreta datos químicos básicos para una mayor comprensión de los fenómenos biológicos.

## **2.3. Competencias semejantes en ambos Grados**

Solo se mencionarán algunas para dar una idea al lector:

- Elaboración y defensa de argumentos y la resolución de problemas dentro de su campo de estudio.
- Transmisión de información, ideas, problemas y soluciones a audiencias especializadas y no especializadas.
- Adquisición de conocimientos químicos a nivel micro y macro, con un especial énfasis en aplicaciones de bioquímica y química orgánica.
- Preparación en tecnologías de frontera y en la utilización de herramientas y recursos de investigación.

Si nos centramos en la adquisición de competencias en el marco de un grado científico, estas solo se pueden lograr experimentando, reconstruyendo soluciones anteriores y preparándose para afrontar nuevos retos en contextos reales.

## **3. Metodología**

Con todos estos datos y dada la importancia que el trabajo de laboratorio, de química en este caso, tendrá en el futuro de estos profesionales, se decidió:

Escoger una serie de problemas y/o preguntas relevantes, con un significativo interés por parte de los estudiantes. En la tabla siguiente hay una pequeña lista de dichos problemas que el profesorado discute con los estudiantes para que escojan o presenten una alternativa.

Estas preguntas deben estar relacionadas, en general, con la bioquímica y la bioinformática y, además, han de tener una posible solución dentro del marco de la investigación "bio" y del trabajo en el laboratorio de química. A veces es difícil que surjan ideas de experimentos que ayuden a solucionarlos.

Las distintas aproximaciones experimentales se llevarán a cabo por grupos de entre 3 y 5 alumnos de la clase (Dennick, 1998). Estos grupos se deberían formar espontáneamente entre el alumnado sin necesidad de participación alguna del profesorado.

Trabajos realizados los 2 últimos años con las preguntas que intentan responder	
<b>Hierro en los cereales del desayuno</b> ¿Cómo medir el hierro de los cereales y cómo se puede aprovechar?	<b>Ósmosis, difusión y diálisis.</b> ¿Se puede hacer y explicar la ósmosis inversa en el laboratorio?
<b>Sustancias carcinogénicas</b> Seguridad química de dichas sustancias y su representación tridimensional.	<b>Síntesis del ácido acetil salicílico</b> Estudio de la reacción entre el ácido salicílico y el anhídrido acético.
<b>Alcalosis respiratoria</b> ¿Cómo medir la capacidad pulmonar? Diferencias entre fumador/no fumador.	<b>Regulación del pH sanguíneo</b> Regulación del equilibrio ácido-base. Preparación de soluciones tampón.
<b>Alimentos autocalentables/autoenfriables</b> Elaboración de dispositivos	<b>Isótopos radioactivos en medicina</b> ¿Por qué su uso permite visualizar un órgano en diferentes condiciones?
<b>Antioxidantes alimentarios</b> ¿Cuál es la concentración de polifenoles en distintas bebidas de té?	<b>Leche con y sin lactosa</b> ¿Tiene lactasa la leche sin lactosa y cómo se mide su actividad?

Los grupos deciden que pregunta o problema resolver y para ello dedican unas 8-10 h de trabajo. Diseñan unos experimentos con todo el material del laboratorio a su disposición y bajo la supervisión del profesor.

Los resultados obtenidos, junto con el guión experimental, forman parte de una memoria escrita final de, un máximo de 10 páginas siguiendo las directrices de un artículo científico: Resumen, Introducción, Metodología, Resultados, Discusión, Conclusiones y Referencias.

El profesor hace una revisión profunda de los resultados obtenidos junto a los componentes de cada grupo. Después de su aprobación, cada grupo puede realizar su presentación oral y pública, frente a toda la clase, con soporte informático, donde se discuten y valoran los resultados obtenidos. En estas presentaciones, cada grupo debe contestar las preguntas y sugerencias formuladas por sus compañer@s de clase.

Con todo esto presente, el profesor realiza la evaluación de dicha actividad, todas las presentaciones son valoradas por el profesor como un ejercicio más del curso. Se puntuarán, desde la presentación personal, el material de soporte, la memoria final y la respuesta a las preguntas de sus compañeros de clase. Es importante que el alumnado entienda y comparta los resultados de dicha evaluación para valorar su propio trabajo.

La nota final de dicha actividad, que puede ser distinta para cada miembro del grupo, tiene un valor del 10-20% de la evaluación final de la asignatura correspondiente, "Química" en el Grado de Bioquímica y "APOC" en el Grado de Bioinformática.

Para valorar si el aprendizaje basado en problemas es una actividad que, el alumnado contestó un cuestionario donde, además de preguntas personales y del grado en cuestión, cabe destacar sobre esta actividad:

- ¿Qué dificultades has encontrado durante la realización de tu trabajo?
- ¿Cómo evalúas tu participación en el trabajo experimental, en la preparación de la presentación en ppt y en la preparación del resumen escrito final?
- ¿Cómo evalúas a tus compañer@s de grupo y tu relación con el grupo?
- ¿Cómo se puede mejorar la relación dentro del grupo?
- ¿Qué puntos positivos y negativos de tu trabajo en equipo destacarías?
- ¿Qué cambiarías de tu intervención en un futuro trabajo en equipo?
- ¿Cómo valoras esta actividad?

#### **4. Resultados**

El resultado de utilizar en la enseñanza universitaria los modelos PBL y TBL al mismo tiempo, convierte el aprendizaje de la química en un proceso más participativo, donde los estudiantes pueden explorar juntos nuevas aproximaciones experimentales. En la Figura 1 i 2 se muestrn distintos momentos de esta actividad educativa.

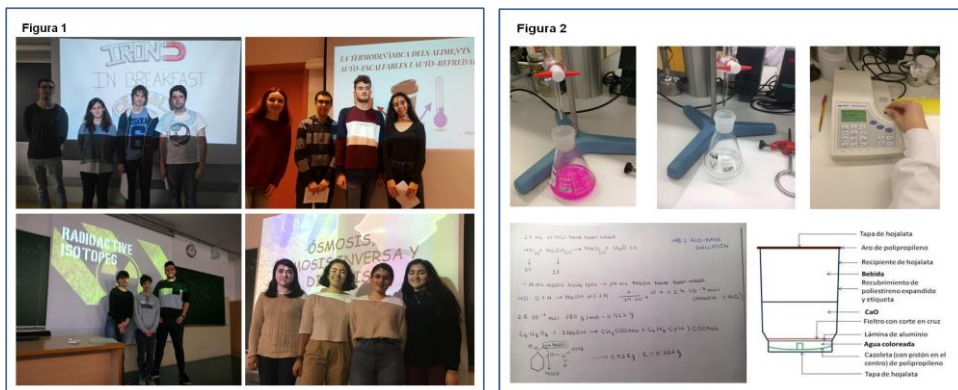


Fig. 1. Se muestran 4 presentaciones: hierro en los cereales, la termodinámica de los alimentos autocalentables y autoenfriables, los isótopos radioactivos y la ósmosis inversa.

Fig. 2. Se muestran distintos momentos en el laboratorio: valoraciones de solución tampón, medida de polifenoles por espectro-fotometría, notas sobre la síntesis de la aspirina de un grupo de alumnos y un dispositivo autocalentable de otro grupo de alumnos.

El lector entenderá que no es necesario, en este punto, comparar los resultados académicos de dicho alumnado con otros que no han realizado dicha actividad porque para ello debería dividirse, al empezar el curso, la clase en dos grupos, uno con las clases formales y el otro con la actividad propuesta. El autor cree que si se remite a los cursos sobre química dados por él, al mismo tipo de alumnado, en cursos anteriores al 2011-2012, la diferencia de actitud y de aprovechamiento es notorio.

Al terminar el curso, los estudiantes fueron requeridos a responder unas preguntas dirigidas a evaluar esta iniciativa educativa. Entre sus respuestas cabe destacar:

Algunos grupos han tenido dificultad para encontrar la información necesaria para ampliar el conocimiento sobre el tema a desarrollar. Otros han tenido problemas para distribuirse el trabajo y, algún miembro ha trabajado bastante menos que el resto. También, el hecho de hacer algunas presentaciones en inglés representa cierta dificultad.

Sobre la evaluación personal y del grupo respecto a la preparación y presentación, son más exigentes a la hora de evaluarse a sí mismos y la participación de cada miembro del grupo. Pero, en ningún caso la variación ha superado el 20% de la puntuación del profesor.

Para mejorar el trabajo es necesario analizar los puntos negativos, básicamente, poca comunicación entre los miembros del grupo que repercute en la no correcta distribución del trabajo. También han indicado que, para futuros trabajos, tratarían de organizarse mejor y, sobretodo, dedicarían más tiempo a preparar y realizar la presentación.

Finalmente, 245 participantes del grado de Bioquímica y 62 del grado de Bioinformática, han puntuado esta innovación educativa entre 1-5, siendo 1 (valoración negativa) y 5 (valoración muy positiva). Los resultados recogidos del grado de bioquímica han sido de  $4,5 \pm 0,4$  mientras que los del alumnado de bioinformática han sido de un  $4,3 \pm 0,6$ .

## 5. Conclusiones

- El alumnado del grado de bioinformática presentó, inicialmente, cierta reticencia al trabajo de laboratorio que, posteriormente, pasó a entusiasmo. Mientras que el alumnado del grado de bioquímica siempre ha estado predispuesto al trabajo de laboratorio.
- Esta actividad educativa da la posibilidad de aprender a través de unos proyectos prácticos ideados para responder a las inquietudes científicas del alumnado dentro de un escenario real. Con ello aumenta la motivación e interés por la ciencia en los estudiantes.
- La gran aceptación de dicha metodología entre el alumnado estimula al profesorado a continuar en dicha dirección. La aplicación de dichas metodologías (Deslauriers, 2011) está provocando una intensa transformación en la educación universitaria.

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## Plan de Conservación para la Maquinaria del area de Producción de la Empresa Calzado Selecto Zolinka S.A. de C.V.

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### Resumen

*La empresa Calzado Selecto Zolinka S.A. de C.V. no cuenta con un Plan de Conservación en los recursos que utiliza en producción. La mayoría de las actividades relacionadas con mantenimiento son de mantenimiento correctivo. Por lo tanto, se pretende disminuir la cantidad de acciones correctivas que incrementen los costos de mantenimiento. El concepto de mantenimiento ha crecido y ha adquirido madurez progresiva para adaptarse a las distintas necesidades y requerimientos de una empresa. La mayoría de las fallas que se presentan en los recursos de la empresa son el resultado de la intensa carga de trabajo. Al inicio de las operaciones sólo se hace mantenimiento correctivo, también conocido como "Mantenimiento de Ruptura". El mantenimiento correctivo se espera a que se presente la falla en la máquina para realizar actividades de conservación. Se pretende realizar una propuesta para que en función de los manuales de operación o recomendaciones del fabricante se inicie a administrar la conservación evitando fallas imprevistas aumentando el rendimiento y prolongar la vida útil de los componentes físicos de la empresa. Para elaborar la propuesta de el plan de conservación de la maquinaria y equipo de la empresa se genera el análisis de criticidad y el análisis del AMEF, esto con el fin de saber de su importancia en el área de producción y a su vez identificar las fallas del diseño de un producto o de un proceso antes de que éstas ocurran.*

**Palabras clave:** *Plan de Conservación, maquinaria, Análisis del Modo y Efectos de Falla, Mantenimiento.*



## **1. Introducción**

Aplicar mantenimiento correctivo es costoso porque implica demasiado tiempo perdido en el proceso de producción cuando ocurre una falla no prevista. Algunos de los problemas por no tener una gestión adecuada de mantenimiento son: gastos en las reparaciones, problemas con la satisfacción del cliente, probables accidentes que pueden afectar a los operadores, entre otros. Elaborar un plan de mantenimiento preventivo reduciría las afectaciones antes mencionados. Elaborar planes de mantenimiento ayudara a la eficiente gestión del mismo ademas de desarrollar una arma competitiva al incrementar el rendimiento de la empresa.

Contar con un registro de las actividades de conservación es posible programar las acciones preventivas (lubricación, limpieza de abrasivos, cambio de bandas, cojinetes, chumaceras, etc.) Sin interferir con las áreas de producción. El registro también ayuda a prever fallas de la maquinaria para evitar los paros de emergencia en horas de trabajo.

Debido a dicha importancia sobre el mantenimiento preventivo de la maquinaria y equipo, se presenta un plan de conservación. El plan de conservación tiene como finalidad maximizar la disponibilidad y confiabilidad en la maquinaria y equipo del área de producción. Para lograrlo se propone el Mantenimiento Centrado en la Confiabilidad (RCM).

El proyecto se compone de tres capítulos: En el primero, se describen aspectos relevantes de la empresa estos es; sus antecedentes, la situación en la que se encuentra actualmente, sus principales `productos, la distribución de la planta y su localización. En el segundo capítulo se presentan los conceptos teóricos necesarios para dar soporte a la investigación y desarrollo del proyecto, tales como, la evolución del mantenimiento, los tipos de mantenimiento, su importancia al aplicarlo. Además, de presentar la técnica del mantenimiento centrado en la confiabilidad (RCM) y el análisis de modo y efecto de fallas (AMEF). Finalmente en el último capítulo se encuentran las actividades realizadas y son: El listado de la maquinaria utilizada para la producción de calzado, el listado de las Herramientas, la clasificación de los equipos de producción dependiendo del nivel de criticidad, el formato utilizado para la realización de las fichas técnicas, y la determinación de fallos funcionales y técnicos y por consiguiente la propuesta de un programa de mantenimiento que satisfaga la necesidades de los recursos físicos por atender.

## 2. Descripción de las Actividades

En el presente proyecto se tuvo participación de la empresa Calzado Selecto Zolinka y el Instituto Tecnológico de Jiquilpan. Las dos partes trabajaron en conjunto en la gestión de las actividades realizadas para obtener los objetivos del presente. A continuación se presentan las actividades que se realizaron para obtener el Plan de Conservación de la empresa Calzado Selecto Zolinka.

### 2.1. Listado de la Maquinaria (Inventario Inicial de Maquinaria)

La primera actividad implica realizar una tabla que contiene la maquinaria de producción de la empresa Calzado Selecto Zolinka. Esta lista se realiza elaborando un inventario mostrado en la tabla 1, en la que se especifica la maquinaria, el área a la que pertenece el equipo y sus cantidades.

**Tabla 1. Lista de la maquinaria de producción de Calzados Selectos Zolinka.**

Maquina	Cantidad	Área
Troqueladora de bolsa	1	Producción
Troqueladora de marca	1	Producción
Troqueladora de número	1	Producción
Cabina	1	Producción
Conformadora de talón	1	Producción
Doblilladora	1	Producción
Embarradora de plantilla	1	Producción
Flejadora	1	Empaque
Máquina de pegadura	1	Producción
Máquina de respunte	3	Producción
Montadora de talón	1	Producción
Rebajadora	2	Producción
Remachadora	1	Producción
Máquina de ribete	1	Producción
Suajadora	2	Producción
Triple arrastre	1	Producción
Sacadora de correa	2	Producción
Máquina cortadora de laser	1	Producción
Suajadora de puente	1	Producción
Compresora	1	Producción
Banco de carda	1	Producción
Flameadora	1	Producción

*Fuente. Elaboracion propia*

Esta lista permite que se genere control en el manejo de los recursos de la empresa. Si existe alguna baja o algún robo se percibe de inmediato porque está contabilizada la maquinaria y equipo de la empresa. De manera similar se realiza este inventario con la herramienta lo que permite ver las fortalezas y debilidades del área de mantenimiento, desarrollando de esta manera el plan mas conveniente para la atención adecuada de los recursos físicos.

## 2.2. Sistema de Codificación de los Equipos

El siguiente paso se presenta la forma de realizar la codificación de los equipos, La forma en que se codificarán los activos se muestra en la figura 1.

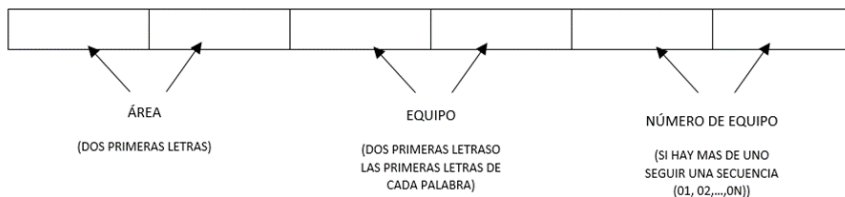


Fig. 1. Sistema de Codificación propuesto  
Fuente: (García, 2003)

Como se observa en la Figura 1, el área de la Planta en que está ubicado el equipo estaría definido por dos caracteres alfanuméricos, igual el equipo, y el número consecutivo en relación a la cantidad por dos caracteres numéricos. La tabla 2 muestra los equipos con el código asignado.

**Tabla 2. Codificación de la Lista de Producción**

Equipo	Sistema	Código
Troqueladora de bolsa	Sistema eléctrico e hidráulico	PR-TB-01
Troqueladora de marca	Sistema eléctrico	PR-TM-01
Troqueladora de número	Sistema eléctrico	PR-TN-01
Cabina	Sistema eléctrico	PR-CA-01
Conformadora de talón	Sistema eléctrico y neumático	PR-CT-01
Doblilladora	Sistema eléctrico	PR-DO-01
Embarradora de plantilla	Sistema eléctrico	PR-EP-01
Flejadora	Sistema eléctrico	EM-FL-01
Máquina de pegadura	Sistema eléctrico y neumático	PR-MP-01
Máquina de respunte	Sistema hidráulico y eléctrico	PR-PE-01
Máquina de respunte	Sistema hidráulico y eléctrico	PR-PE-02
Máquina de respunte	Sistema hidráulico y eléctrico	PR-PE-03
Montadora de talón	Sistema eléctrico y neumático	PR-MT-01
Rebajadora	Sistema hidráulico y eléctrico	PR-RE-01
Rebajadora	Sistema hidráulico y eléctrico	PR-RE-02
Remachadora	Sistema mecánico	PR-RM-01
Remachadora	Sistema mecánico	PR-RM-02
Máquina de ribete	Sistema hidráulico y eléctrico	PR-RI-01
Suajadora	Sistema hidráulico y eléctrico	PR-SU-01
Suajadora	Sistema hidráulico y eléctrico	PR-SU-02
Triple arrastre	Sistema hidráulico y eléctrico	PR-TR-01
Sacadora de correa	Sistema eléctrico	PR-SC-01
Sacadora de correa	Sistema eléctrico	PR-SC-02
Máquina cortadora de laser	Sistema eléctrico	PR-CL-01
Suajadora de puente	Sistema hidráulico y eléctrico	PR-SP-01
Compresora	Sistema eléctrico y neumático	PR-CP-01
Banco de cardar	Sistema eléctrico	PR-BC-01
Flameadora	Sistema eléctrico	PR-FL-01

*Fuente. Elaboracion propia*

De esta manera se pueden rastrear con mayor eficiencia los equipos, logrando un mejor control e incrementando la productividad del área de mantenimiento.

### 2.3. Análisis de Criticidad

Los equipos de producción tienen diferentes niveles de importancia en una planta industrial. Dada la limitación de recursos de una empresa para mantener la planta, se debe destinar la mayor parte de esos recursos a los equipos más importantes, logrando resolver en un alto porcentaje la mayoría de los problemas que puedan presentarse en relación a las necesidades de los equipos por atender.

Según el principio de V. Pareto, aproximadamente el 20% de las causas son responsables del 80% del efecto total; y el 80% de las causas restantes solo son responsables del 20%

De acuerdo con el libro *La Productividad en el Mantenimiento Industrial* de Enrique Douce Villanueva.

Para poder apreciar los diferentes tipos de criticidad véase la tabla 3. Después de analizar cada uno de los equipos utilizados para la producción, con los criterios anteriores se define el nivel de criticidad dentro del área de producción, Se realiza el análisis a cada uno de los recursos a clasificar. Dicha tarea se presenta resumida en la tabla 4.

#### **2.4. Análisis del Modo y Efectos de Fallo**

Para poder aplicar el Análisis del Modo y Efectos de Fallo (AMEF) es necesario realizar el análisis para cada uno de los equipos, se aplica mediante un proceso continuo para la identificación de las fallas en los equipos antes de que éstas ocurran, por lo que se utilizará una tabla con cinco columnas: la primera columna se refiere al equipo, la segunda al sistema, la tercera al tipo de fallo, la cuarta a la descripción del fallo, la quinta a la descripción del modo de fallo. En la tabla 5 se muestra el AMEF de un solo equipo, dado que la tabla que se genera es muy extensa. En la tabla 5 se muestran los fallos técnico, fallos funcionales, modos de fallo, entre otras columnas que permiten tener un registro de cada equipo y de esa manera reducir los tiempos de conservación.

**Tabla 3. Codificación de la Lista de Producción**

Tipo de equipo	Seguridad y medio ambiente	Producción	Calidad	Mantenimiento
Critico (A)	Pueden originar acciones muy graves.	Su parada afecta al plan de producción	Es clave para la calidad del producto	Alto costo de reparación en caso de avería
	Necesita revisiones periódicas frecuente (mensuales)		Es causante de un alto porcentaje de rechazos	Averías muy frecuentes
	Ha producido acciones en el pasado			Consumo una parte importante de los recursos de mantenimiento (mano de obra y/o materiales)
Importante (B)	Necesita revisiones periódicas (anuales)	Afecta a la producción , pero es recuperable (no llega a afectar a clientes o plan de producción )	Afecta a la calidad, pero habitualmente no es problemática	Costo medio en mantenimiento
	Puede ocasionar accidente grave, pero las probabilidades son remotas			
Prescindible (C)	Poca influencia en seguridad	Poca influencia	No afecta a la calidad	Bajo costo de mantenimiento

Fuente. Elaboración propia



**Tabla 4. Resumen del Análisis de Criticidad**

	Listado de la maquinaria del área de producción	
	Fecha: 16/10/2018	
Nombre del equipo	Criticidad	Color
Troqueladora de marca	A	Red
Troqueladora de número	A	Red
Embarradora de plantilla	A	Red
Máquina de pegadura	A	Red
Máquina de respunte	A	Red
Máquina de respunte	A	Red
Máquina de respunte	A	Red
Montadora de talón	A	Red
Suajadora	A	Red
Suajadora	A	Red
Sacadora de correa	A	Red
Sacadora de correa	A	Red
Suajadora de puente	A	Red
Compresora	A	Red
Conformadora de talón	B	Yellow
Doblilladora	B	Yellow
Troqueladora de bolsa	B	Yellow
Rebajadora	B	Yellow
Rebajadora	B	Yellow
Máquina de ribete	B	Yellow
Triple arrastre	B	Yellow
Máquina cortadora de laser	B	Yellow
Flameadora	B	Yellow
Remachadora	C	Green
Remachadora	C	Green
Cabina	C	Green
Flejadora	C	Green
Banco de cardar	C	Green

Fuente. Elaboracion propia

Tabla 5. Análisis del Modo y Efectos de Fallo

Equipo	Sistema	Tipo de fallo	Descripción de la falla	Descripción del modo de fallo
Troqueladora de bolsa	sistema eléctrico	Fallos Funcionales	Fallo en la alimentación	Corto circuito
			Fallo en la comunicación del sistema	Falsos contactos
				Bobinas en mal estado
		Fallos técnicos	Fallo en la comunicación del sistema	Falsos contactos
	Sistema mecánico	Fallos técnicos	Ruidos excesivos	Cojinetes en mal estado u/o turbina desgastada
	Sistema Hidráulico	Fallos Funcionales	Fallo en la Bomba de aceite	Retenes en mal estado
				Mal funcionamiento de la bomba
			Falta de presión	Falta de aceite
		Falla en el troquel	Falla de Sensores	
		Fallo Técnicos	Fallo en las mangueras	Fugas de aceite
Fallo en las válvulas	Obstrucción de las válvulas			

Fuente. Elaboracion propia

### 3. Resultados

De acuerdo con el análisis anterior se realiza un plan de mantenimiento inicial que se muestra a continuación. Con los resultados del AMEF se percibe que se pueden presentar algunas fallas en el momento de estar llevando a cabo el proceso de producción, las cuales a su vez pueden ser corregidos por el operador. El plan de mantenimiento se realiza para

cada uno de los recursos con los que cuenta la empresa. En la tabla 6 se muestra el plan de mantenimiento inicial para uno de los recursos de la organización (La máquina denominada doblilladora).

Ahora bien, gracias al análisis del AMEF y al análisis de criticidad se puede saber qué tipo de mantenimiento es necesario aplicar a cada una de la máquinas, por lo tanto, esta propuesta está basada en un plan de mantenimiento preventivo. A continuación, se presentan varias actividades de mantenimiento claves y de gran importancia para conservar la maquinaria en perfecto estado de funcionamiento.

- Actividades de mantenimiento diarias
- Actividades de mantenimiento semanales
- Actividades de mantenimiento mensuales
- Actividades de mantenimiento trimestrales
- Actividades de mantenimiento semestrales

**Tabla 6. Plan de Mantenimiento Inicial para la Doblilladora**

Doblilladora	Mantenimiento diario	Limpieza de residuos de pegamento	Operador
	Mantenimiento semanal	Lubricación de engranes del buril	Operador-mecánico
		Engrasado del pedal arrancador	Operador-mecánico
	Mantenimiento semestral	Engrasado de cojinetes del motor	Mecánico
		Cambio de banda	Operador-mecánico
		Limpieza de abrasivos acumulados en partes eléctricas (interruptores, resistencias, etc.)	Mecánico

*Fuente. Elaboración propia*

En cada uno de los recursos se hace un plan de mantenimiento inicial. Se pretende aplicar el ciclo de mejora continua en la declaración de las actividades de mantenimiento.

## 4. Conclusiones

Los equipos e instalaciones de una industria están sometidos a varios tipos de mantenimiento, que pueden ser correctivo, predictivo, preventivo o proactivo, cada uno de estos son aplicables a la maquinaria en la proporción que este lo requiere. La planeación y programación del plan de mantenimiento tiene la finalidad de trazar las actividades o acciones que deben realizarse durante la jornada de trabajo para el mejor desempeño de la maquinaria. Por ende, el mantenimiento debe proporcionar confiabilidad, eficiencia y productividad a la industria dado que los resultados se evalúan en cantidad y calidad de producto.

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## Diferencias significativas en el uso de redes sociales entre universitarios españoles y colombianos

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### Resumen

*La fuerte influencia de las redes sociales en todos los ámbitos de la sociedad moderna ha convertido a estas plataformas en protagonistas de un fenómeno de dimensiones globales que traspasa fronteras, para afianzarse a ambos lados del Atlántico. El presente trabajo examina las posibles diferencias en el uso que, hoy por hoy, hacen los universitarios españoles y colombianos de estas plataformas.*

*En la investigación toman parte 425 estudiantes: 198 de Administración y Dirección de Empresas de la Universidad Rey Juan Carlos en España y 227 de Ingeniería Industrial de la Universidad Pontificia Bolivariana en Colombia. En ambas instituciones, los participantes completan un cuestionario, elaborado ad hoc por los investigadores a partir de una revisión previa de la literatura. El cuestionario recoge, por un lado, datos relativos a la frecuencia de acceso a las redes sociales de referencia (Twitter, Facebook e Instagram) y, por otro, información tocante a la importancia que el estudiante otorga a determinados usos de la plataforma. Los datos recabados son sometidos a análisis descriptivo e inferencial paramétrico para muestras independientes empleando la prueba t-Student.*

*Los resultados obtenidos revelan la existencia de diferencias significativas en diversos puntos relativos a la utilización que los estudiantes de ambos países hacen de las redes sociales objeto de análisis. Estas diferencias se observan, por ejemplo, en la frecuencia de acceso a las redes Facebook e Instagram; plataformas en las que los estudiantes españoles acceden con*



*mayor asiduidad que los colombianos. Asimismo, el estudio muestra diferencias significativas en ambos países en lo que atañe a la importancia otorgada a la funcionalidad “me gusta”, donde el mayor uso promedio corresponde a los estudiantes de la URJC, y en cuanto a la participación en debates a través de estas plataformas el comportamiento es inverso.*

**Palabras claves:** *Redes sociales, estudiantes universitarios*

## **1. Introducción**

Internet y el avance tecnológico han venido revolucionado los diferentes sectores económicos. El sector educativo no es la excepción. Así las universidades han sido unas de las grandes beneficiadas por la tecnología en el ámbito científico y pedagógico (Guzmán-Duque, Alba Patricia; Luzardo Briceño, Marianela; Aguilar-Jiménez, 2013).

La evolución de la web y las facilidades de interacción que trajo consigo la web 2.0 son un aporte a las ciencias. Por un lado, porque facilitan la participación de los usuarios y, por otro, porque permiten la interacción entre ellos (Musser & O'reilly, 2007). En este sentido, cabe mencionar que el trabajo colaborativo en ambientes virtuales incluye un variado rango de temas de estudio y de metodologías que fomentan la autonomía en el aprendizaje. Los usuarios de la web y en concreto, de plataformas tales como blogs, wikis, redes sociales, chats, etc.- acceden diariamente para compartir experiencias y gustos en común (Christodoulou & Styliaras, 2008) comunicándose e interactuando.

En este sentido, la integración de las Tecnologías de Información y Comunicación (TIC) en la práctica docente a nivel universitario es un tema que ha venido siendo estudiado desde diversas perspectivas, no solo a nivel tecnológico sino también didáctico en las universidades (Luzardo Briceño, Sandia Saldivia, Aguilar-Jiménez, Macías Martínez, & Herrera Díaz, 2017; Villarraga Plaza, Aguilar-Jiménez, Luzardo Briceño, Sandia Saldivia, & Del Alba Catherin, 2017), mostrando resultados que invitan a los docentes a considerar las TIC en su práctica pedagógica.

Si bien las TIC tienen un potencial importante para los procesos académicos, estudios anteriores han identificado que los jóvenes prefieren el uso de las TIC en actividades de ocio (Sanz Arazuri, Alonso Ruiz, Saénz de Jubera Ocón, Ponce de León Elizondo, & Valdemoros San Emeterio, 2018). Por tanto, la tecnología, en la actualidad, aún tiene mucho por aportar tanto a docentes como a estudiantes en su incorporación de nuevas didácticas en los procesos educativos. De hecho, hay estudios que revelan que los estudiantes que tienen acceso y usan las TIC en casa muestran mejor rendimiento académico que quienes no lo hacen (Alderete, Di Meglio, & Formichella, 2017).



En este sentido, el presente documento pretende examinar las posibles diferencias en el uso que, hoy por hoy, hacen los universitarios españoles y colombianos de herramientas TIC, en particular de los medios sociales.

## **2. Marco de referencia**

Si bien el uso de las TIC como apoyo a actividades académicas ha venido creciendo, es probable que aún no estén impactando significativamente en la educación universitaria. Es claro también que en este proceso no solo influye el interés pedagógico (Luzardo Briceño et al., 2017; Menéndez, Díaz, Sánchez, & Linares, 2014; Sancho Gil, 2011) y la dinámica tecnológica (Velandia, Ríos, & de León, 2010; Villarraga Plaza et al., 2017), sino también el compromiso organizacional (Luzardo-Briceño, Aguilar-Jiménez, Sandia-Saldivia, & Acosta-Santiago, 2017), cuyo cambio cultural es necesario para que las TIC impacten de manera significativa en la formación (Sorroza Rojas, Nancy Azucena; Jinez Sorroza, Jean Pool; Rodríguez Villacis, Jesús Eliecer; Caraguay Ambuludi, 2018).

Las herramientas de la web 2.0 o de los medios sociales -blogs, wikis, foros, Flickr, Facebook, Delicious entre otras- son funcionales para las universidades (Siemens & Tittenberger, 2009). Asimismo estudios anteriores sugieren que el uso de plataformas sociales ayuda a obtener mejor rendimiento (por ejemplo, para la comunicación con familia y amigos) aumentando las probabilidades de adopción en el futuro (Calderón, López, & Peña, 2017).

Según estudios anteriores, los estudiantes españoles valoran positivamente las herramientas web 2.0, blog y/o edublog, WebQuest y wiki, para promover las estrategias de los entornos educativos inclusivos, así como el uso de redes sociales con fines académicos (Requena & Berea, 2017). Por su parte, los estudiantes universitarios de en Colombia no parecen apropiarse de las posibilidades productivas de estas plataformas más allá de los usos básicos o recreativos (Berrío Zapata & Rojas Hernández, 2014).

## **3. Metodología**

Se realizó una investigación mixta, no experimental, de corte transversal con un alcance exploratorio descriptivo y correlacional.

La muestra estuvo conformada por 425 estudiantes de los cuales 198 pertenecen a los diferentes cursos de Administración y Dirección de Empresas de la Universidad Rey Juan





Carlos (URJC) en España y 227 forman parte de diferentes cursos de Ingeniería Industrial de la Universidad Pontificia Bolivariana (UPB) en Colombia.

La edad promedio de los estudiantes de la URJC 19.58 ( $DT = 2.67$ ), con una distribución género de 32.32% (femenino), 67.68% (masculino), mientras que en la UPB se situó en 20.77 ( $DT = 2.37$ ), siendo la distribución de género de 56.39% (femenino), 43.61% (masculino).

Los datos recabados para la investigación se obtuvieron empleando un cuestionario de construcción propia, elaborado por los investigadores. El instrumento de medición se sometió a la evaluación de un equipo de jueces expertos en el ámbito de la educación superior, compuesto por ocho profesores: cuatro de la UPB y cuatro de la URJC. El cuestionario final consta de dieciocho ítems que miden aspectos relacionados con el uso de redes sociales en universitarios.

Para la comparación en la puntuación obtenida en el uso de las distintas redes sociales entre los estudiantes de ambas universidades se utilizó la prueba  $t$  de Student para muestras independientes del software IBM-SPSS V 24.

#### **4. Resultados**

La tabla 1 *Estadísticos descriptivos uso Redes Sociales* presenta los estadísticos descriptivos del uso de las redes sociales consideradas en el estudio.

Los resultados revelan como, en la mayoría de los casos, las puntuaciones promedio obtenidas en la muestra de universitarios colombianos superan a las recogidas en la muestra de estudiantes españoles.

**Tabla 1. Estadísticos descriptivos uso Redes Sociales**

Ítem	Universidad	Media	DT
Frecuencia de uso de Twitter	URJC	3.04	1.826
	UPB	2.78	2.003
Frecuencia de uso de Facebook	URJC	3.71	2.021
	UPB	5.15	1.821
Frecuencia de uso de Instagram	URJC	4.30	1.290
	UPB	5.48	1.906
Empleo de Menciones	URJC	2.80	.945
	UPB	2.71	.947
Empleo de Hashtags	URJC	2.08	1.029
	UPB	1.93	.943
Empleo de Likes	URJC	3.73	1.050
	UPB	3.42	1.054
Relevancia dada a seguir amigos	URJC	3.80	1.069
	UPB	3.62	1.080
Relevancia dada a seguir personajes públicos	URJC	2.42	1.048
	UPB	2.42	1.046
Relevancia dada a menciones a amigos	URJC	3.30	.992
	UPB	3.25	1.097
Relevancia dada a menciones a personajes públicos	URJC	2.12	1.102
	UPB	2.21	1.042
Relevancia dada a ver videos	URJC	3.31	1.057
	UPB	3.59	1.087
Relevancia dada a publicar videos	URJC	2.30	1.139
	UPB	2.37	1.172
Relevancia dada a la búsqueda de información	URJC	3.72	1.075
	UPB	3.89	1.040
Relevancia dada a ver fotos	URJC	3.62	1.019
	UPB	3.83	1.025
Relevancia dada a publicar fotos	URJC	3.06	1.214
	UPB V	3.11	1.118
Relevancia dada a publicar reflexiones personales	URJC	2.22	1.161
	UPB	2.23	1.146
Relevancia dada al acceso a promociones	URJC	2.21	1.147
	UPB	2.57	1.262
Relevancia dada a la participación en debates	URJC	1.99	1.099
	UPB	2.51	1.191

Fuente:Elaboración propia

Los resultados muestran que existe una diferencia significativa en el uso promedio de las redes Facebook e Instagram. Asimismo, como se observa en la tabla 2 también diferencias significativas en el uso de likes y de la importancia otorgada al medio como instrumento de participación en debates.

**Tabla.2 Comparación promedio de uso de redes sociales entre la URJC y UPB**

Red social	<i>t</i>	<i>p-valor</i>
Frecuencia de uso de Twitter	1.050	.295
Frecuencia de uso de Facebook	-6.441	.000***
Frecuencia de uso de Instagram	-5.204	.000***
Empleo de Menciones	-.318	.751
Empleo de Hashtags	1.048	.296
Empleo de Likes	2.191	.030**
Relevancia dada a seguir amigos	.660	.510
Relevancia dada a seguir personajes públicos	-.862	.390
Relevancia dada a menciones a amigos	.460	.646
Relevancia dada a menciones a personajes públicos	-1.714	.088*
Relevancia dada a ver videos	-.069	.945
Relevancia dada a publicar videos	-.781	.436
Relevancia dada a la búsqueda de información	-1.070	.286
Relevancia dada a ver fotos	-.461	.645
Relevancia dada a publicar fotos	-.472	.637
Relevancia dada a publicar reflexiones personales	-.445	.656
Relevancia dada al acceso a promociones	-.804	.422
Relevancia dada a la participación en debates	-2.667	0.008***

\*\*\* Significativa al 1%

\*\* Significativa al 5%

\*Significativa al 10%

Fuente:Elaboración propia

## 5. Conclusiones

El uso de las redes sociales esta cada vez más aceptado por los estudiantes universitarios como un mecanismo de comunicación para llegar a sus grupos de interés, en especial aquellas que favorecen la interacción y participación entre ellos.

El análisis estadístico, desarrollado por los autores, muestra la existencia de diferencias significativas en el uso promedio que hacen los estudiantes españoles de la URJC, en comparación con el uso realizado por los estudiantes colombianos de la UPB. Estas diferencias se observan principalmente en la frecuencia de acceso a las redes Facebook e Instagram; plataformas en las que los estudiantes españoles acceden con mayor asiduidad que los colombianos.

Asimismo, el estudio muestra diferencias significativas en ambos países en lo que atañe a la importancia otorgada a la funcionalidad “me gusta” y la participación en debates a través de estas plataformas. En el primer caso, son los estudiantes de la URJC los que dan mayor relevancia a esta utilidad de reconocimiento del contenido. En el segundo, son los universitarios de la UPD los que muestran mas interés por el componente de discusión y debate en las redes sociales objeto de observación.

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## La interdisciplinariedad en el proceso de enseñanza-aprendizaje en postgrado. Una experiencia

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### Resumen

*El aprendizaje en postgrado supone un reto didáctico de especialización universitaria que debe ser abordado; puesto que en un mismo máster podemos encontrar perfiles de alumnos de diferente procedencia de estudios y con experiencias laborales también variadas. Esta diversidad se amplía al participar en un máster con un doble itinerario: profesionalizador e investigador.*

*Al mismo tiempo, debemos tener presente que dicho aprendizaje es de difícil fragmentación en asignaturas, puesto que todo un postgrado debe dotar de competencias, habilidades y conocimientos propuestos en su plan de estudios; claramente, el reto está en el equilibrio entre la transversalidad del ámbito de estudio y la especialización desde cada asignatura y que ésta sea percibida de forma correcta por todo el alumnado de postgrado.*

*Teniendo en cuenta estas premisas, se presenta una experiencia basada en esta interdisciplinariedad en el máster de intervención socioeducativa en menores y familia (MISO) de la Universitat de les Illes Balears, en concreto, a través de la asignatura “Mediación en contextos sociales y educativos” se vertebra un trabajo intra e interdependiente; por un lado, los trabajos dentro de la asignatura permiten un grado de especialización a los alumnos en determinados aspectos clave de la asignatura que desemboca, finalmente, en un trabajo grupal y que contempla el itinerario profesionalizador e investigador. Por otro lado, se complementa con una vinculación directa con un taller de mediación realizado por un profesor universitario especialista en mediación y con un alto grado de experiencia laboral en este ámbito y con un vínculo directo con la asignatura “Técnicas de intervención educativas y conductuales en menores y familia” que se cursa en paralelo.*

**Palabras clave:** Innovación educativa, interdisciplinariedad, universidad



## **1. Introducción**

Las instituciones educativas deben fomentar el incremento de actividades metodológicas, de estrategias didácticas diversas y de diseños curriculares, que sean dinámicas y adaptadas a las necesidades actuales y a los diferentes perfiles estudiantiles. Por consiguiente, se debe apostar por métodos educativos que fomenten la interdisciplinariedad, porque es a partir de ésta que se podrán conseguir los anteriores objetivos metodológicos (Llano et al., 2016). La interdisciplinariedad podría ser definida como una puesta en común de saberes, una forma de conocimiento que se producen en la intersección de los saberes (Escobar & Ramos, 2007). Además, hará referencia al método, al modelo y a la aplicación de la técnica. Por último, apuesta por procesos de aprendizaje desarrollados por diferentes docentes o profesionales, que, de manera conjunta, puedan aportar enfoques diversos (Bolarín, Moreno & Porto, 2013; Vargas, Payrol, Hernández, & Zambrana, 2018).

Las relaciones interdisciplinarias forman el método que posibilita mejorar, e incluso, optimizar, el proceso de enseñanza a los profesionales. El ámbito laboral, y las exigencias que tiene asociadas, implicará que los profesionales sean capaces de analizar la información que reciben de manera integral (Llano et al., 2016). Y que, además, deban responder de manera eficaz y resolutive ante las diferentes demandas que emergerán. Por consiguiente, deben de estar provistos de un bagaje relevante de recursos y de conocimientos. El interdisciplinariedad permitirá construir esa perspectiva integral necesaria y un abanico de recursos obtenidos a partir de la aportación de diversas materias (Llano et al., 2016).

Como explica Souza Da Silva (2008), el concepto de interdisciplinariedad rompe con el modelo hegemónico en la producción científica, que destacaba la verdad como un objeto nuclear y que sólo abordaba los conocimientos que eran valorados como un producto acabado. La lucha por intentar acabar con esa rigidez en los modelos científicos, ha exigido la incorporación de nuevas perspectivas. La interdisciplinariedad permite reconocer nuevas fórmulas de aprendizaje, al considerar diferentes contextos académicos.

No obstante, también implica una cierta responsabilidad y retos. Su correcto uso y desarrollo implica que se conozcan las fronteras entre las diferentes disciplinas que deben de ser utilizadas (Souza Da Silva, 2008). Así como, que se aclaren y diseminan que aportaciones se pueden realizar si se combinan ambas disciplinas. Para conseguirlo, primero, se debe establecer donde convergen las disciplinas.

En el ámbito universitario, y específicamente, cuando se trata de educación de posgrado, es frecuente identificar heterogeneidad entre los perfiles de los estudiantes. El reto se inicia al intentar aportar conocimientos útiles y eficaces a los diferentes perfiles que se identifican. Cada tipología de estudiante ha adquirido conocimientos durante su formación universitaria

y ha consolidado un aprendizaje asociado a su especialización. Además, la diversidad se podrá ver incrementada debido a que muchos alumnos de posgrado ya poseen experiencia en el mundo laboral. Por lo tanto, uno de los objetivos de las formaciones de posgrado es proporcionar equilibrio entre la transversalidad del ámbito de estudio y la especialización desde cada asignatura.

Al mismo tiempo, experiencias interdisciplinares permiten desarrollar competencia genéricas (potenciando el aprendizaje significativo) y competencias específicas de cada una de las asignaturas que comparten este espacio interdisciplinar (Sandín, Lazo, Giménez & Rodríguez, 2015).

Por lo tanto, los estudios de posgrado se convierten en un escenario por excelencia para fomentar el desarrollo integral del alumno. La interdisciplinariedad desde el ámbito universitario permite dotar de saber globales, fomentar la búsqueda de soluciones aplicables a otras disciplinas y encontrar un diálogo tanto para disciplinas cercanas o como más alejadas (Escobar & Ramos, 2007; Vargas et al., 2018). Sin embargo, a pesar de su elevada recomendación, no es habitual identificar en los currículos vigentes la interdisciplinariedad (Escobar & Ramos, 2007).

## 2. Interdisciplinariedad en máster. Un ejemplo

### 2.1. Las asignaturas

La asignatura “*Técnicas de intervención educativas y conductuales en menores y familia*” se establece como una asignatura obligatoria del máster MISO, impartida durante el segundo trimestre. Su finalidad principal consiste proporcionar y dotar de conocimientos, actitudes y estrategias orientadas a la intervención en menores y en familia. En concreto, se forma al alumnado en el uso y la aplicación de técnicas de intervención. Teniendo en cuenta que los alumnos son potenciales profesionales de atención directa a la familia (padres e hijos), es relevante que tengan herramientas suficientes para saber cómo actuar ante las posibles situaciones que puedan identificar. En concreto, las estrategias se dirigen a ser aplicadas en contextos sociales, educativos y familiares, y, por consiguiente, son de tipología educativa, cognitiva, conductual o emocional.

El diseño de la asignatura se establece en dos categorías principales:

a) *Contextualización de los problemas de comportamiento y de las conductas no saludables*. Este primer apartado, incorpora e identifica cuáles son los posibles factores de vulnerabilidad y de protección ante posibles trastornos, conductas problemáticas o conductas no saludables. Además, a partir de diferentes teorías y/o modelos teóricos explica los



factores de predisposición y los factores de mantenimiento de los trastornos psicológicos. Así como establece posibles mecanismos inadecuados que emergentes de estructuras familiares disfuncionales o de pautas de crianza inadecuadas. Por consiguiente, en el primer apartado se establecen las bases teóricas y los conocimientos para realizar las evaluaciones de las situaciones en las que los profesionales deberán intervenir.

#### *b) Técnicas de intervención*

En este segundo apartado, se enseñan técnicas básicas de intervención para la modificación de patrones comportamentales inadecuados o de conductas problemáticas. Indudablemente, se enseñan técnicas de modificación de conducta; esenciales para la actuación directa con menores. En concreto, se identificarán aquellas dirigidas tanto al incremento, como a la disminución de conductas (extinción, reforzamiento, atención diferencial, coste de respuesta, tiempo fuera, modelado, moldeamiento, sobrecorrección, etc.). También se apuesta por estrategias de gestión emocional, donde se priorizará aquellas dirigidas a la relajación y el autocontrol. Además, se incorporan otras estrategias educativas para mejorar el clima en las escuelas y en el aula; un porcentaje relevante del alumnado son docentes o equipo orientativo. Por último, se realiza una aproximación a las técnicas cognitivas, como la reestructuración cognitiva (no obstante, el tiempo de la asignatura no permite profundizar en éstas últimas).

La asignatura “*Mediación en Contextos Sociales y Educativos*” se imparte también en el mismo master, de carácter obligatorio y en el mismo semestre que la asignatura con la que comparte experiencia educativa y comparten el mismo bloque temático “Intervención con menores y familia”. Cuenta con 4 créditos ECTS y se trabaja, básicamente, en tres bloques temáticos:

En el primer bloque, se trabajan conceptos básicos sobre el conflicto: conceptualización, etiología y epistemología de la convivencia. Habilidades para la gestión del conflicto (habilidades básicas para la gestión pacífica del conflicto, comunicación, empatía, escucha activa y asertividad). Se finaliza el bloque analizando tres modelos principales de análisis del conflicto.

El segundo bloque se centra en la mediación; para ello, se inicia el bloque trabajando sobre estrategias de gestión del conflicto, como arbitraje, conciliación, negociación y mediación. Entrando en la mediación, se analizan las principales fases-objetivos, sus características básicas, modelos de mediación, habilidades y estrategias de los mediadores y se analiza código ético del mediador/a.

Finalmente, el tercer bloque aborda las características específicas de la mediación escolar, de la mediación familiar y de la mediación comunitaria.

## 2.2. Metodología

Al ser un máster que dispone de un perfil profesionalizador e investigador, se plantean diferentes asignaturas para dar cabida a ambos perfiles. Al mismo tiempo, se pretende que todas las actividades estén relacionadas entre sí, de cara a que se entienda desde el primer momento la interconectividad.

En una primera fase, se trabaja en 3 tareas específicas:

1. *Actividades en sesiones presenciales*: se incorporan actividades prácticas en cada una de las sesiones presenciales que complementan las explicaciones y lecturas complementarias. La participación activa del alumnado en ella se evalúa; en las últimas sesiones, por ejemplo, se realizan role-playings relacionados con cada ámbito de mediación y, si es posible, similares a los casos que, por grupos, los alumnos analizarán como trabajo grupal final.
2. *Análisis y revisión de lecturas específicas*: Se crearán grupos de 3 alumnos para la elaboración del trabajo final grupal; cada uno de los componentes realizará la lectura y análisis de un tema específico trabajado también en las sesiones presenciales: análisis del conflicto, fases/objetivos de la mediación y estrategias en mediación. La organización será la misma para todos los grupos de alumnos. La siguiente fase de la tarea convierte a cada alumno en revisor del trabajo previo de sus compañeros; así, si un alumno del grupo 1 ha analizado las fases, se convierte (de forma anónima) en revisor del trabajo realizado sobre las fases de su compañero del grupo X. La profesora se encarga de la distribución anónima de las revisiones a realizar y de devolver, también de forma anónima a cada alumno la revisión de su compañero para poder realizar la entrega final, resaltando los cambios realizados a partir de la revisión y comentarios adicionales a éstos. De esta manera, podemos trabajar ya con los alumnos la entrega de artículos y sus revisiones en el perfil académico.
3. *Modelos en mediación*: Finalmente, se analizan los modelos de mediación (tradicional, transformativo y circular-narrativo) siguiendo la misma dinámica de la actividad anterior; cada miembro del grupo realiza una lectura específica de cada modelo. En la sesión presencial, todos los alumnos se organizan según la lectura realizada (intergrupal), se comparan todos los modelos a través de una tabla comparativa y, al finalizar la sesión, cada grupo de trabajo grupal se reúne para evaluar qué tipo de modelo en mediación se adecua más a su caso práctico.

A partir de estas actividades, que asientan las bases y competencias, se plantean tres actividades interdisciplinares:

1. *Taller de mediación*: realizado por un profesor invitado, se realiza un taller de mediación familiar que permite asentar los conocimientos y competencias trabajadas en las asignaturas.
2. *Estrategias grupales*: a partir de la escala de provención, se organizan grupos de 2-3 alumnos los cuales deben organizar una actividad relacionada con el tema correspondiente. En esta ocasión, la sesión se realiza en tiempo de la asignatura “*Técnicas de intervención educativas y conductuales en menores y familia*”, en su segunda hora y coincidiendo en día con la asignatura “*Mediación en Contextos Sociales y Educativos*”, la cual continua en tercera y cuarta hora al terminar esta actividad de una hora de duración. Las actividades de la escala de provención que preparan los alumnos (organizados una semana antes para su elaboración) son: presentación, conocimiento, estima, confianza, comunicación y cooperación. La escala termina con la resolución de conflictos, pero no se realiza puesto que se trabaja de forma más específica en la asignatura de mediación.
3. *Trabajo grupal*: la tarea grupal encomendada engloba los principales conocimientos y competencias trabajados. A partir de un caso mediable, donde el grupo puede seleccionar el ámbito que desee (escolar, familiar o comunitario), deben realizar un análisis de conflicto, definir las fases/objetivos de la mediación y las principales estrategias que se ponen en marcha en su caso (correspondiente a la actividad 2 descrita anteriormente *Análisis y revisión de lecturas específicas*); seleccionar y describir el modelo de mediación sobre el que se basarán (actividad 3, *Modelos en mediación*) y analizar y describir el tipo de mediación (a partir de las *sesiones presenciales*, actividad 1 y lecturas específicas). El trabajo se completa con la descripción del caso, la evaluación de la mediación, conclusiones y autoevaluación y evaluación del grupo.

De cara a valorar los resultados, se realizó un cuestionario a los alumnos que incluía su perfil sociodemográfico y vinculación con el mundo laboral con familias y menores y un segundo bloque con la valoración de esta experiencia didáctica. Finalmente, se comprobaron también los resultados de aprendizaje a través de una prueba pre-post coincidente con el inicio y el final de la asignatura de “*Mediación en contextos sociales y educativos*”.

### 2.3. Resultados

El grupo de alumnos de este curso académico (18-19) es altamente femenino (80%), donde un 70% ha trabajado o trabaja como profesional en atención en menores y familias (entre un año -30%- o más de 5 años -30%-).

La mayoría de alumnos recomiendan la combinación de asignaturas para el aprendizaje (75%), donde básicamente se valora la autoreflexión y participación en clase (37,5%) y la explicación docente de calidad (25%). La opción preferida por los alumnos es la realización grupal de un caso práctico (50%) y de actividades prácticas en clase (25%).

Este cuestionario fue complementado con una revisión de la evaluación inicial en la asignatura de “Mediación en contextos sociales y educativos”, donde se ha podido observar la afianzación de contenidos así como la adquisición de aquellos no consolidados.

### 3. Conclusiones

El aprendizaje interdisciplinar permite trabajar, desde diferentes perspectivas, la adquisición de unas competencias profesionales e investigadoras desde diferentes perspectivas y metodologías de aprendizaje; en este sentido, debe contemplar un doble objetivo, por un lado, asegurar la adquisición de competencias específicas de cada asignatura y, al mismo tiempo, potenciar la consolidación de competencias generales trabajadas desde diferentes asignaturas (Sandín et al, 2015). Todo ello, teniendo en cuenta, en el caso de nuestro ejemplo, los perfiles profesionales e investigadores que permite el máster así como la adaptabilidad al perfil académico y profesional de cada una de las promociones del máster.

Desde la experiencia explicada, hemos querido aportar unas bases para la reflexión sobre algunas propuestas para poder adquirir contenidos y competencias específicas en un máster de intervención socioeducativa en menores y familia con su aplicabilidad en el ámbito profesional (Escobar & Ramos, 2007), centrada en un aprendizaje global (Vargas et al., 2018).

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## La opinión de los alumnos en cuanto a qué recursos y tipos de clases favorecen su aprendizaje

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### Resumen

Los retos de la educación superior en el siglo XXI plantean la necesidad de abandonar el modelo de enseñanza pasiva (el maestro enseña y los alumnos aprenden de él), para procurar el aprendizaje activo (los alumnos aprenden a aprender). En este enfoque, los recursos que los estudiantes tienen a su disposición para el seguimiento de las asignaturas, así como la organización de las clases, constituyen un elemento fundamental para adaptar la tarea docente a sus necesidades. En este marco, el objetivo de este trabajo es conocer en qué medida los alumnos hacen uso de dichos materiales de apoyo, así como de la importancia que ellos le dan a los distintos tipos de clase para fomentar su aprendizaje. Con esta finalidad, se ha realizado una encuesta a los matriculados en el Máster Universitario en Ciencia e Ingeniería de Alimentos y en el de Gestión de la Seguridad y Calidad Alimentaria, ambos de la Universitat Politècnica de València. Los resultados muestran que el perfil del alumno es muy semejante en ambos másteres, pero difieren en el tiempo dedicado a la realización de prácticas en empresas y en el porcentaje de asistencia a clase. Los recursos de “PoliformaT”, seguido de la web, son en ambos másteres los más utilizados, en cambio Riunet y Polimedia son los menos. Los estudiantes valoraron las clases “Teoría de aula” y “Prácticas de aula” como las más importante para su aprendizaje, mientras que “Seminarios” las que menos. Por último, para un mejor aprendizaje ellos plantearon la necesidad de realizar más casos prácticos en el contexto de las asignaturas. En conclusión, una revisión del material de “PoliformaT” y un incremento en el aula de “casos reales” son las líneas de



*actuación que se adoptarán en nuestra asignatura para adaptarnos a las necesidades de los alumnos y optimizar su rendimiento.*

**Palabras claves:** Recursos, tipos de clase, aprendizaje.

## **1. Introducción**

En el siglo XXI, el principal reto del docente es desarrollar en el alumno la capacidad crítica e innovadora, así como los valores y actitudes que les permitan su incorporación en un mercado laboral cada vez más competitivo y global (Brunner & Bricali, 2000; Arce & Medina, 2016). Para alcanzar este objetivo, el ámbito educativo cuenta con nuevas tecnologías que tienen un papel fundamental en el día a día de las aulas, facilitando el aprendizaje de los estudiantes y mejorando su rendimiento (Blasco, et al., 2016; González, et al., 2017; Serrano Pastor, & Casanova López, 2018). Algunas de las principales ventajas es que con ellas se amplía la oferta informativa y las posibilidades para la orientación y tutorización, eliminan barreras espacio-temporales, facilitan la creación colectiva de conocimiento y la flexibilidad en el aprendizaje (Cabero, 2001; Marquès, 2008; Gairín, 2010; Bautista Sánchez, 2014; Caldeiro, 2014; Gallardo, & Buleje 2010). No obstante, los beneficios que aportan estas nuevas tecnologías pueden ponerse en peligro si se hace un mal uso de ellas, dejando de ser simples herramientas en el proceso de enseñanza-aprendizaje, para convertirse en el objetivo, pudiendo llegar a colapsar la dinámica del aula y saturar al alumno.

En la Universidad, al igual que en otros ámbitos, el uso constante de las tecnologías ha estado dictado por su evolución y desarrollo, y, aunque se han aplicado a la educación desde mucho tiempo atrás, es a partir de la década de los ochenta cuando comienza su apogeo. En este ámbito, lo más importante no es desarrollar materiales didácticos, sino que éstos se ajusten al contenido de la clase, y de este modo se conviertan en potentes facilitadores del aprendizaje y maximicen el éxito de los resultados académicos (Bautista Sánchez, 2014; Tourón, Santiago y Díez, 2014).

Con este enfoque, los recursos que los estudiantes tienen a su disposición para el seguimiento de las asignaturas, así como la organización de las clases, constituyen un elemento fundamental para adaptar la tarea docente a sus necesidades. En este marco, el objetivo de este trabajo es conocer en qué medida los alumnos hacen uso de dichos materiales de apoyo, así como de la importancia que ellos le dan a los distintos tipos de clase para fomentar su aprendizaje.

## 2. Metodología

La recogida de información se ha realizado a través de una encuesta llevada a cabo a los alumnos matriculados en el Máster Universitario en Ciencia e Ingeniería de Alimentos (MUCIA) y en el Máster de Gestión de la Seguridad y Calidad Alimentaria (MUGSCA), ambos de la Universitat Politècnica de València.

DATOS DE PERFIL
Edad _____
Grado o licenciatura cursada _____
Universidad en la que ha cursado los estudios anteriores _____
Nota media de su expediente _____
Compagina estudios con trabajo _____
Ha trabajado en alguna empresa en prácticas _____ ¿tiempo? _____

RECURSOS UTILIZADOS
Porcentaje aproximado de asignaturas a las que asiste de manera presencial _____
Porcentaje aproximado de clases a las que asiste de esta asignatura _____
Porcentaje de uso de los siguientes recursos ( <i>puntuar de manera individual cada recurso de 1 a 100</i> ):
• Poliformat _____
• Riunet _____
• Libros de la biblioteca _____
• Artículos docentes _____
• Webs _____
• Polimedia _____
• Videos didácticos _____

AULA
Según su opinión asigne un porcentaje de utilidad para su estudio, de los siguientes tipos de clases ( <i>puntuar de manera individual cada recurso de 1 a 100</i> ):
• Teoría de aula _____
• Prácticas de aula _____
• Prácticas de campo _____
• Prácticas de informática _____
• Seminarios _____
Según su opinión asigne un porcentaje de utilidad para su estudio de la realización de ( <i>puntuar de manera individual cada recurso de 1 a 100</i> ):
• Casos _____
• Portafolio _____
Según su opinión proponga tres mejoras en esta asignatura. Justifica la respuesta
1- _____
2- _____

Fig. 1 Preguntas de la encuesta formulada a los alumnos

Fuente: Propia



La Fig. 1 muestra las preguntas de la encuesta pasada a los alumnos, la cual se dividió en tres bloques: 1. Se preguntaba sobre aspectos relacionados con el alumno, 2. Se pedía información sobre el uso que el alumno da a los distintos recursos y 3. Se debía valorar individualmente la influencia que, a su criterio, para su aprendizaje tenía cada tipo de clase.

El tratamiento estadístico de los datos se realizó con el programa Statgraphics Centurión XVI, a través del análisis de la varianza multifactorial, para determinar el nivel de significación de los resultados obtenidos. Los diagramas de caja-bigote, obtenidos permitían comparar de forma sencilla las pautas de variabilidad existentes entre los distintos conjuntos de datos. En todos los casos se ha tomado como límite de la significatividad estadística una  $p < 0.05$ .

### **3. Resultados**

#### **3.1. Perfil del alumno**

La tabla 1.1 muestra el perfil de los alumnos del MUCIA y del MUGSCA encuestados del detallando para cada apartado el número de respuestas obtenidas y el porcentaje que este valor representaba con respecto al total. Los resultados indican que los estudiantes de ambos másteres tienen características muy semejantes, no encontrando diferencias significativas en edad (p-valor 0.5038), nota del expediente (p valor 0184), porcentaje de alumnos que simultanean los estudios con un trabajo (p-valor 0.6792), los que han realizado prácticas en empresa (p valor 0.3366), ni en el tiempo que han estado en ellas (p valor 0.7653).

Según la información recogida, podemos decir que nuestro alumno medio tiene una edad de 25 años, su nota de expediente es de  $7.2 \pm 0.9$  y asiste a clase en un 90%. Son alumnos que proceden en su mayoría del grado de Ciencia y Tecnología de Alimentos (CTA) o del grado de Ingeniería Agroalimentaria y del Medio Rural (IAMR). En cuanto a las prácticas de empresa en un 73% de los casos ya había realizado antes de empezar sus estudios de Máster. Se observó diferencias significativas entre el factor “edad” del alumno y el factor “tiempo de duración de las prácticas” (p-valor 0.0000). Además, en un 30% de los casos, el alumno combinaba trabajo y estudios.

Por otra parte, sólo un 20% de los alumnos pertenecientes al MUGSCA había realizado sus estudios de grado en la UPV, un 42% en otras universidades españolas y en un 37.8% había estudiado en el extranjero. Por el contrario, si estaban matriculados en el MUCIA, en un 48.5% de los casos había estudiado en la UPV y sólo un 15% en otras universidades españolas, viniendo el resto (36.4%) del extranjero.

Tabla 1.1. Perfil del alumno

Características	Categoría	Respuestas (%)	Respuestas (%)
		Ingeniería (n= 33)	Gestión (n= 45)
Edad	22-27	24 (72.7)	37 (82.2)
	28-33	8 (24.2)	6 (13.3)
	>34	1 (3)	1 (2.2)
Grado/licenciatura	Biología	1 (2.4)	3 (6.7)
	Biotecnología	1 (2.4)	2 (4.4)
	CTA*	17 (40.5)	10 (22.2)
	Farmacia	0	1 (2.2)
	Industrias pecuarias	1 (2.4)	0
	Ingeniería alimentos	18 (42.9)	11 (24.4)
	Ingeniero agrícola	0	1 (2.2)
	Ingeniero agroindustrial	0	2 (4.4)
	Ingeniero químico	3 (7.1)	0
	Microbiología	0	2 (4.4)
	Nutrición	0	9 (20)
	Química	0	2 (4.4)
	Veterinaria	1 (2.4)	2 (4.4)
Universidad	UPV	16 (48.5)	9 (20)
	España no UPV	5 (15.2)	19 (42.2)
	No España	12 (36.4)	17 (37.8)
Nota expediente	5-7	10 (30.3)	22 (48.9)
	7.01-10	23 (69.7)	23 (51.1)
Estudios y trabajo	Estudia y no trabaja	22 (66.7)	32 (71.1)
	Estudia y trabaja	11 (33.3)	13 (28.9)
Prácticas empresa	Prácticas sí	26 (78.8)	31 (68.9)
	Prácticas no	7 (21.2)	14 (31.1)
Tiempo prácticas	1-3 meses	7 (21.2)	12 (26.7)
	4-6 meses	8 (24.2)	9 (20)
	7-12 meses	8 (24.2)	16 (35.6)
	>12 meses	10 (30.3)	8 (17.8)
Asistencia clase (%)	<50	0	2 (4.4)
	51-70	1 (3)	5 (11.1)
	71-90	2 (6.1)	11 (24.4)
	91-100	30 (90.9)	27 (60)

\*CTA= Ciencia y tecnología de los alimentos

Fuente: Propia

### 3.2. Recursos

En lo que respecta a la utilización de los recursos por parte de los alumnos, la Fig. 2, muestra el resultado obtenido para el MUCIA (A) y el MUGSCA (B). En ambos, los recursos más utilizados, con aproximadamente un valor medio del 90% de los casos, son los que corresponden al material que el profesor sube en la plataforma de la UPV, denominada “PoliformaT”, seguida de las búsquedas en la “web”, no habiendo diferencias significativas entre ambos másteres ( $p$  valor 0.1784 y 0.1960, respectivamente). Por el



contrario, sí se observan diferencias significativas entre el uso de Polimedia (p valor 0.0023) y artículos (p valor 0.0425).

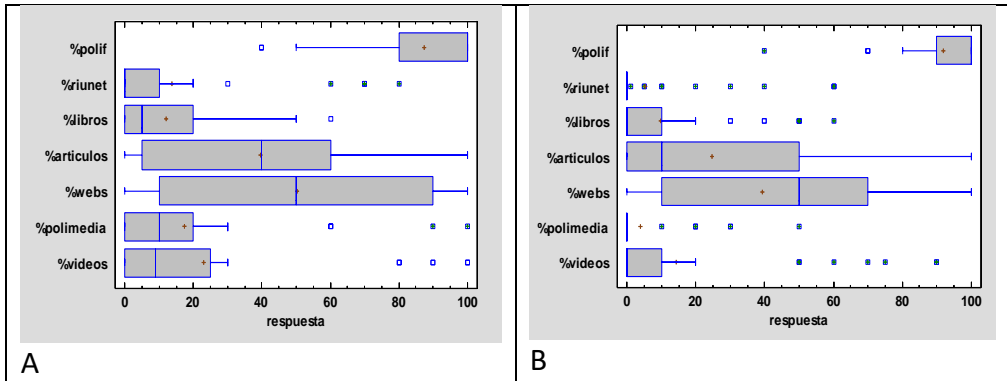


Fig. 2 Opinión de los alumnos sobre la importancia de los distintos recursos en el aprendizaje. A (MUCIA) y B (MUGSCA)

Fuente: Propia

### 3.3. Tipos de clase

En relación al papel de los distintos tipos de clase en el aprendizaje, no se observaron diferencias significativas entre las respuestas de los alumnos de ambos másteres. Siendo la teoría de aula (TA) la más valorada en un 77%, seguida por las prácticas de aula (PA) en un 68.6%, los casos (65%), y las prácticas de informática (PI) en un 55.4%.

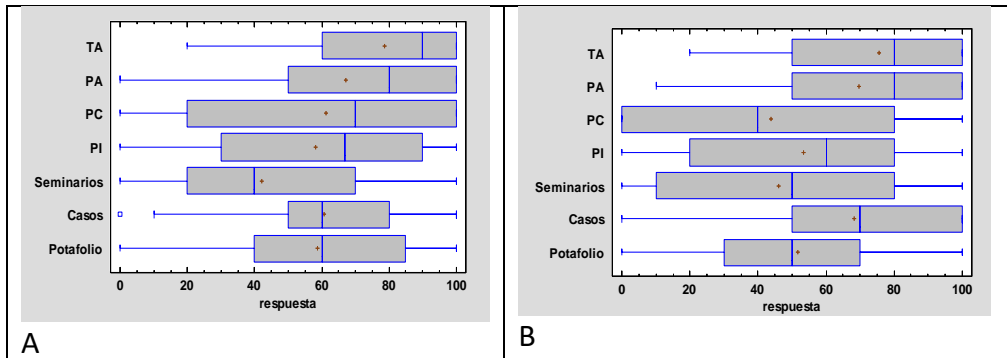


Fig. 3 Opinión de los alumnos sobre la importancia de los distintos tipos de clase en el aprendizaje según másteres: A (MUCIA), y B (MUGSCA); siendo (TA) teoría de aula; (PA) prácticas de aula; (PC) prácticas de campo; (PI) prácticas de informática.

Fuente: Propia

## 4. Conclusión

El alumno de hoy en día ha crecido con el “boom tecnológico”, el mundo de la información y de las redes sociales. No es de extrañar que los recursos que más utiliza sean los de la plataforma “PoliformaT” y la “web”. Por otra parte, es coherente la alta asistencia a clase de los alumnos que le dan importancia para su aprendizaje a la teoría y a las prácticas de aula.

En conclusión, el profesor de hoy en día tiene que dedicar sus esfuerzos a mantener un alto nivel en sus clases, a actualizarse y a proporcionar materiales didácticos, que guíen al estudiante y le ayuden a “aprender a aprender”, aportándole nuevos conocimientos y ejercitando sus habilidades.

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## El perfil del alumno en el marco universitario de la enseñanza-aprendizaje

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### Resumen

*Los profesores universitarios, en el contexto de la enseñanza-aprendizaje, se están enfrentando a nuevos retos marcados por una sociedad educativa cada vez más influenciada por la globalización y los nuevos modelos pedagógicos. En este sentido, el objetivo del presente trabajo es conocer el perfil del alumno de la asignatura de Trazabilidad y Seguridad Alimentaria (enmarcada en el Máster profesionalizante de Ingeniería Agronómica de la UPV), así como sus preferencias con relación al tipo de clase y a las actividades en grupo que se proponen durante el transcurso de la misma. Esta información ha sido obtenida mediante encuestas cumplimentadas por 65 alumnos. El 81.5% de ellos son menores de 26 años, el 37% compaginan estudios con trabajo, y aproximadamente el 65% ha realizado prácticas en empresa. En cuanto a la asignatura, el 70% afirma poder llevar la materia al día y al 26% le gustaría el modelo de “clase inversa”. En relación a la explicación de los contenidos teóricos por parte del profesor, el 61% prefiere que sea completa, frente a un 37% que valora más que sólo se haga un resumen. Los recursos más utilizados por el alumno para estudiar son una plataforma de gestión del aprendizaje (LMS) utilizado en la UPV, denominada “PoliformaT”, “libros” y “videos”. Los trabajos que se realizan en la asignatura son considerados muy útiles, aunque en el cómputo total del Máster, consideran tener excesivos trabajos. El 63% prefiere que estos trabajos sean en grupo y un 56% ven necesario una puntuación individual para reflejar la implicación que cada uno de ellos ha tenido. En*



*conclusión, la información obtenida permite plantear algunas mejoras en la metodología de la asignatura para adaptarla a las preferencias de aprendizaje y opiniones de nuestros alumnos y de este modo conseguir un máximo rendimiento.*

**Palabras clave:** *Perfil de alumno, metodología docente, aprendizaje.*

## **1. Introducción**

El Espacio Europeo de Educación Superior ha supuesto importantes cambios en el proceso de enseñanza-aprendizaje para la adquisición de competencias transversales y específicas (Cid, 2008). El proceso de convergencia establece la necesidad de utilizar estrategias y metodologías activas para el aprendizaje con la finalidad de desarrollar en los estudiantes la capacidad del aprendizaje autónomo, cooperativo y continuo dentro de la sociedad del conocimiento, de la información y de las nuevas tecnologías (Caldeiro, 2014; Álvarez, 2015). Hoy en día, resulta evidente que el modelo de la clase magistral, en el que el docente hablaba y el estudiante copiaba no tiene cabida. Los nuevos enfoques pedagógicos buscan rescatar al alumno de la pasividad y convertirlo en un agente activo con participación en el aula que interactúe con el profesor y sus compañeros.

El diseño de una guía docente implica un proceso de toma de decisiones en relación, no sólo a los contenidos, sino también a las actividades y recursos que se deben llevar a cabo para consolidar los conocimientos.

Entre las nuevas propuestas de enseñanza-aprendizaje que se plantean se encuentra el método inverso o “Flipper”, que brinda mayor autonomía a los estudiantes, además de favorecer la comunicación profesor-alumno y entre compañeros (Bergmann & Sams, 2014; Blasco et al., 2016; Prieto, 2017; González et al., 2017). El trabajo en equipo y los casos prácticos son también estrategias de aprendizaje destinadas a adquirir información, analizarla, organizarla y comunicarla de forma coherente, logrando una mayor autonomía en los aprendizajes de los alumnos (Vázquez et al., 2017).

Por otra parte, a nivel universitario y más concretamente a nivel de Máster, los alumnos son cada vez más heterogéneos, tanto en edad, titulación, procedencia, experiencia previa en prácticas, etc. Esto hace que cada uno de ellos tenga unas necesidades distintas y por lo tanto, no existe un modelo pedagógico universal capaz de satisfacer a todos por igual.

En este contexto, el objetivo del presente trabajo es conocer el perfil del alumno de la asignatura de Gestión de la Seguridad y la Trazabilidad en la Industria Alimentaria

(enmarcada en el Máster profesionalizante de Ingeniería Agronómica de la UPV), así como sus preferencias con relación a la dinámica de clase y a las actividades en grupo que en ella se proponen durante el transcurso de la misma. Todo ello con la finalidad de adaptar la metodología de la asignatura al estudiante y de este modo maximizar su rendimiento académico, mejorar sus habilidades, destrezas y competencias previstas en la guía docente.

## **2. Metodología**

Se recogió la opinión de 65 alumnos de la asignatura de Gestión de la Seguridad y la Trazabilidad en la Industria Alimentaria (Máster profesionalizante de Ingeniería Agronómica de la Universitat Politècnica de València). La tabla 1.1 muestra las preguntas formuladas en la versión definitiva de la encuesta que cumplimentaron los alumnos. En el cuestionario se plantearon preguntas relacionadas con las preferencias por el tipo de clase y con las actividades en grupo que se proponen durante el transcurso de la asignatura. Mediante un “pre-test” 10 alumnos corroboraron previamente la comprensión de dichas preguntas.

El tratamiento estadístico de los datos se realizó con el programa Statgraphics Centurión XVI, aplicando un análisis de la varianza multifactorial, para determinar el nivel de significación de los resultados obtenidos. Los diagramas de caja-bigote, obtenidos permitieron comparar de forma sencilla las pautas de variabilidad existentes entre los distintos conjuntos de datos. En todos los casos se ha tomado como límite de la significatividad estadística una  $p < 0.05$ .

## **3. Resultados**

### **3.1. Resultados del pre-test**

El estudio del “pre-test” destinado a comprobar la comprensión de las preguntas iniciales puso en evidencia problemas en dos de ellas, la 2 y la 9. La Fig. 1 muestra cómo dichas preguntas habían sido formuladas con anterioridad a la versión definitiva del cuestionario que se ha mostrado en la tabla 1.1. La pregunta 2 se planteó para que los alumnos asignaran un porcentaje de 0 a 100 a cada recurso, según su utilidad para estudiar; sin embargo, se interpretaba mal ya que en vez de entender que cada recurso debía puntuarse individualmente, entendían que el conjunto de recursos debía sumar el 100%. Para evitar esta confusión, se añadió la palabra “individualmente” y se separaron en filas cada uno de



los recursos, evitando así que se vieran como un conjunto. Por otra parte, en la pregunta 9 algún entrevistado, al ser preguntado por el número de compañeros ideal de un grupo, pensó en el tamaño de la clase en lugar de los formados para realizar los trabajos y tareas propuestas por el profesor en el transcurso de la asignatura. En este caso, como se ve en la versión definitiva de la encuesta, tabla 1.1, se especificó “trabajo de clase” para evitar confusión.

**Tabla 1.1. Preguntas formuladas en la encuesta**

<b>PERFIL DEL ALUMNO MÁSTER AGRONOMOS</b>		
Edad _____		
Grado o licenciatura cursada _____		
Universidad en la que ha cursado los estudios anteriores _____		
Nota media de su expediente _____		
Compagina estudios con trabajo _____		
Ha trabajado en alguna empresa en prácticas _____ ¿Tiempo en meses? _____		
1. ¿Tienes tiempo de llevar las asignaturas al día?	Si	
	No	
2. ¿Qué material te resulta más útil para estudiar por tu cuenta?  Asigna un % de 0-100 a cada uno ellos, individualmente	Diapositivas de clase	
	Libros	
	Web	
	Artículos	
	Videos	
3. ¿Te gustaría que impartiéramos esta asignatura como clase inversa?	Si	
	No	
4. ¿Cuál es tu porcentaje de asistencia a clase de esta asignatura?	<30%	
	30-60%	
	60-80%	
	>90%	
5. Cuando estudias por tu cuenta el material teórico, ...	Me resulta más difícil y tardo más tiempo	
	No me cuesta más y lo prefiero	
6. ¿Como prefieres que se den los contenidos teóricos en clase?	Explicación teórica completa	
	Solo breve resumen	
	Nada de teoría, me lo leo en casa	
7. En cuanto a los trabajos, ... (se sincero)	Son muy útiles para mi aprendizaje	
	El tiempo invertido no compensa	
	Son útiles, pero hay un exceso de trabajos y es imposible involucrarse el 100%	
8. En cuanto a las presentaciones en clase de los trabajos de los compañeros	Son muy útiles	
	Son poco útiles	
	Hacer la presentación a los demás es incómodo, pero aprendo a hablar en público	
9. ¿Cuál es el número de compañeros ideal de un grupo de trabajo de clase?		
10. ¿Crees que una evaluación individual del trabajo en grupo...	Me obligaría a trabajar mas	
	No me importa	
	Es deseable para evitar que tenga la misma nota el que no trabaja	

Fuente: Propia

<p>2. ¿Qué te resulta más útil para estudiar por tu cuenta? Puntúa del 1-100 cada recurso</p> <p>Diapositivas de clase _____</p> <p>Libros _____</p> <p>Web _____</p> <p>Artículos _____</p> <p>Videos _____</p>	<p>9. ¿Cuál es el número de compañeros ideal de un grupo?</p>
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Fig 1 Preguntas del pre-test antes de ser corregidas en la encuesta definitiva, presentada en la Tabla 1.1.

Fuente: Propia

### 3.2. Perfil del alumno

La tabla 1.2 muestra el perfil de los alumnos encuestados. El 81.5% de ellos eran menores de 26 años, prácticamente todos provenían del grado de Ingeniería Agronómica (98.1%), siendo el 75.9 % de la UPV. En cuanto a su nota media de expediente, el 46.3% estaba por encima del 7.0. Sólo el 37% de ellos compaginaba estudios con trabajo y aproximadamente el 65% había realizado prácticas en empresa antes de ingresar en el Máster.

Tabla 1.2. Perfil del alumno

Características	Categoría	Respuestas (n=54)	Porcentaje
Edad	22-25	44	81.5
	26-33	7	13.0
	>34	3	5.6
Grado/licenciatura	Ingeniería agrónomos	53	98.1
	Ingeniero montes	1	1.9
Universidad	UPV	41	75.9
	No UPV España	13	24.1
Nota expediente	5-7	29	53.7
	7.01-10	25	46.3
Estudios y trabajo	Estudia y no trabaja	34	63.0
	Estudia y trabaja	20	37.0
Prácticas en empresa	Prácticas realizadas sí	35	64.8
	Prácticas realizadas no	19	35.2
Tiempo prácticas	1-3 meses	13	24.1
	4-6 meses	11	20.4
	7-12 meses	10	18.5
	>12 meses	1	1.9

Fuente: Propia



### 3.3. Opinión de los alumnos

El 62% de los alumnos encuestados afirmaba poder llevar la asignatura al día. La Fig. 2. muestra de forma descriptiva mediante gráficos de cajas y bigotes los valores obtenidos en relación al tipo de material que resulta más útil para estudiar. Este gráfico permite la comparación de los diferentes conjuntos de datos, quedando el 50% de los valores de cada grupo dentro de la caja. El recurso mejor valorado fue, con un valor medio del 66%, las diapositivas de los temas impartidos en clase disponibles a través de la plataforma “PoliformaT” de la UPV. Es importante destacar que un 36% de los estudiantes dieron a las diapositivas una importancia del 100%. El segundo recurso más valorado fue los “libros” (27%), al que el 14.5% de los alumnos le dio la máxima puntuación. En tercer lugar, se sitúan los “videos” con un valor medio del 25%, pero solo el 7% le dio el máximo porcentaje. Entre los recursos menos valorados, con aproximadamente un 15% se encuentran “la web” y “los artículos”. Hay que destacar que “la web” en ningún caso fue valorada con un 100% y sólo 3 de los 55 encuestados le dieron a “los artículos” la máxima puntuación.

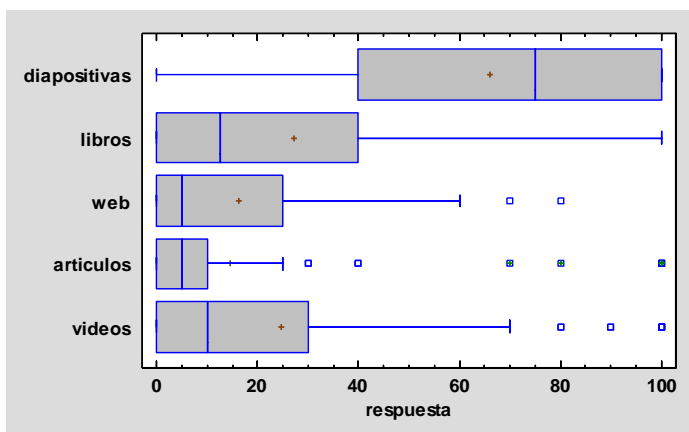


Fig. 2. Gráfico caja-bigotes sobre el uso de los distintos recursos didácticos

Fuente: Propia

En relación a la clase inversa, sólo el 26% de los encuestados afirmó que le gustaría que la asignatura se impartiera de esta manera, sin diferencias significativas entre aquellos que compaginan trabajo/estudio y los que no ( $p$  valor 0.4110); si bien el número de respuestas en este sentido fue algo mayor entre los primeros. Tampoco se observaron diferencias atendiendo a la edad del encuestado ( $p$  valor 0.6456), ni al porcentaje de asistencia a clase ( $p$  valor 0.2809). Este resultado concuerda con la afirmación de que estudiar el material teórico por su cuenta les resulta más difícil (92.5%) y con la respuesta a la pregunta

“¿Cómo te gustaría que se impartieran los contenidos teóricos en clase?”. En esta última, el 61.1% afirmó que completa, frente el 37.04% que prefería sólo un resumen y el 1.8% que no quería nada de teoría en clase. Por otra parte, el 100% de los que no querían nada de teoría y el 43.7% de los que preferían el resumen, son los que están más conformes a su vez con la clase inversa.

En cuanto a los trabajos en grupo, el 40% era partidario de hacerlos individualmente. Por otra parte, el 92.5% consideraba que son muy útiles, pero de ellos el 80% opinaba que hay un exceso de trabajos en el conjunto del Máster y es imposible involucrarse totalmente en todos. La mayoría de los alumnos (el 65%) también opinaba que el tamaño de grupo más adecuado es “entre dos y cuatro compañeros”. Con relación a la exposición, sólo el 25% afirmaba que es poco útil. Por último, en lo que respecta a la evaluación de los trabajos, el 55% pensaba que una valoración individual sería deseable para evitar compañeros que no participan; sin embargo, el 42.5% cree que no es necesario y un 2.5% afirmó que una evaluación individual le obligaría a trabajar más.

#### **4. Conclusión**

En el nuevo marco del proceso de enseñanza-aprendizaje, para la adquisición de competencias transversales y específicas, el alumno ha pasado a tener un papel protagonista y por lo tanto no puede excluirse en el momento de diseñar las metodologías a utilizar en la asignatura. De este modo, la encuesta propuesta en este trabajo aporta información útil para poder adaptarnos a las características del alumno que tenemos en clase. Así, conoceremos las necesidades de “nuestro público”, permitiéndonos adaptar el modo de impartir la asignatura y de este modo aumentar la efectividad de nuestro trabajo.

Tomando como referencia los resultados obtenidos, los profesores de la asignatura darán en clase un breve pero completo resumen de los contenidos teóricos, que se complementarán con un libro editado para dicha asignatura y con el material didáctico disponible en la plataforma de gestión del aprendizaje, “PoliformaT”. Los trabajos serán realizados por grupos de tres personas y se dará tiempo en las clases prácticas para realizarlo, con la finalidad de reducir la saturación de tareas a realizar en casa de las que se quejan los alumnos. Por último, habrá una evaluación individual por parte de los miembros de cada grupo, con relación a la participación de sus compañeros, que complementará la nota del profesor sobre el trabajo. De esta manera, se pretende motivar la participación de todos los miembros del grupo.

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## Aprendiendo del siglo XXI a través de la experiencia. Un ejemplo universitario

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### Resumen

*La presente comunicación se centra en la asignatura “Las personas mayores en el SXXI: Nuevos roles, nuevos retos”, en el programa universitario para personas mayores de la Universitat de les Illes Balears.*

*En ella, se analizan los nuevos retos y oportunidades que supone envejecer en el siglo XXI a través de una metodología activa. Para ello, se trabajan de forma conjunta, profesorado y alumnado, temas como el edadismo, la vulnerabilidad social o el envejecimiento activo a partir de los indicadores básicos de las personas mayores, las tendencias demográficas, sociales, psicológicas, económicas y culturales, las políticas sociales o la institucionalización de los programas preventivos o de intervención socioeducativa.*

*El valor añadido es la mirada analítica y crítica que permite la metodología en la que se basa la asignatura, donde se da un protagonismo a los alumnos permitiéndoles, entre otras, debatir los 8 elementos claves de las ciudades amigables (protocolo Vancouver) centrado en su entorno universitario y su lugar de residencia, debates intergeneracionales (sobre los retos de la sociedad actual uno y sobre el proceso de envejecimiento el segundo) con alumnos de la Facultad de Educación o el análisis del protocolo de detección e intervención de situaciones de maltrato doméstico y auto negligente creado por el Observatorio de Personas Mayores del Consell de Mallorca.*

*Así pues, el enfoque didáctico se centra, primordialmente en el proceso de análisis y reflexión de todos y cada uno de los alumnos a partir de su experiencia vital, así como de las aportaciones de otros compañeros que enriquecen la mirada, la reflexión y el aprendizaje sobre los nuevos retos y roles que aparecen para las personas mayores en el siglo XXI.*



**Palabras clave:** *Aprendizaje a lo largo de toda la vida, universidad, innovación educativa.*

## **1. Introducción**

El aprendizaje a lo largo de toda la vida se ha convertido en un elemento básico y clave en nuestra sociedad. No sólo a nivel de políticas internacionales, puestas de manifiesto a través del Pacto Internacional de los Derechos Económicos, Sociales y Culturales de las Naciones Unidas (ONU, 1995); especialmente relevantes son los derechos relacionados con la igualdad entre hombres y mujeres (art.3); los relacionados con la no discriminación por edad (art 6-8), derecho a la seguridad social (art.9), derecho de protección a la familia (art.10), a un nivel de vida adecuado (art.11), a la salud física y mental (art.12) y, especialmente relevante para esta comunicación, el derecho a la educación y a la cultura (art.13), tanto como receptores de programas educativos como la disposición de oportunidades para poner a disposición de los más jóvenes sus conocimientos y experiencias.

Sin ser objeto de esta comunicación el desarrollar un análisis profundo de los derechos de las personas mayores a nivel nacional, internacional y autonómica, debemos no obstante citar dos citas internacionales más. La primera, a nivel internacional, la actual “*Estrategia y Plan de Actuación Mundial de la OMS sobre envejecimiento y salud 2016-2020*” en el cual podemos destacar los objetivos de garantizar a las personas mayores la igualdad de oportunidades y vida digna en todos los ámbitos o propiciar formas de organización y participación de las personas mayores que permitan aprovechar su experiencia y su conocimiento. Anteriormente, la Asamblea Mundial del Envejecimiento realizada en Madrid (2002) tuvo como resultado una declaración política que fue evaluada en 2010.

A nivel nacional, no sólo debemos citar la constitución Española, especialmente el artículo 16 que cita el derecho a la libertad ideológica, complementado con el 20 que se refiere al derecho a la información y a la libertad de expresión, sino también 50, el cual reconoce los principios rectores de la política social y económica, garantizando su suficiencia a través de pensiones adecuadas y periódicamente actualizadas y en especial el sobre educación, el cual entiende a la educación como vía “*para un pleno desarrollo de la personalidad humana en el respeto a los principios democráticos de convivencia y a los derechos y libertades fundamentales*” (art.12). A nivel nacional, es de obligada mención el proyecto “*Estrategia Nacional de Personas Mayores para un Envejecimiento Activo y para su Buen Trato 2018-2021*” aprobado por el Pleno del Consejo Estatal de Personas Mayores en noviembre de 2017, sino que anteriormente se agrupó en el documento “*Marco de Actuación*”

(IMSERSO, 2014) las principales directrices del Consejo Europeo sobre envejecimiento activo y solidaridad intergeneracional (2015).

Todo ello permite dar cabida a la filosofía del envejecimiento activo, entendido siguiendo a la OMS como aquel “proceso por el cual se optimizan las oportunidades de bienestar físico, social y mental durante toda la vida, con el objetivo de ampliar la esperanza de vida saludable, la productividad y la calidad de vida en la vejez” (OMS, 2015). Así pues, las tendencias sociodemográficas a nivel internacional presentan a las personas mayores como un grupo cada vez más heterogéneo, que aumenta de forma progresiva a lo largo de los años y donde las políticas sociales (y también educativas) deben proporcionar ambientes que fomenten opciones saludables, es decir, políticas que potencien más personas con calidad de vida positiva y con más vías de participación activa. Claramente en ellos debemos también asumir retos actuales como la solidaridad intergeneracional, el fomento de la responsabilidad personal en los cuidados y salud individual, potenciar entornos adecuados y trabajar hacia una visión positiva de la vejez sin olvidar colectivos vulnerables (personas mayores que viven una soledad no deseada, por ejemplo) o colectivos no visibilizados (personas mayores LGTBI, por ejemplo). Ciertamente, en España también debemos tener en cuenta la gran evolución sociodemográfica que tenido como consecuencia efecto directo en el colectivo de personas mayores; nos referimos, no sólo al aumento progresivo del número de personas mayores (18.8% de la población española tiene 65 años o más, frente a un 34,6% que se espera en el año 2066) , sino en un perfil feminizado, rural y con una previsión a corto plazo de la llegada a la edad de jubilación de la generación del baby-boom (Abellán, Ayala, Pérez & Pujol, 2018).

## 2. Aprendiendo del s.XXI a través de la experiencia

### 2.1. Conceptualización y objetivos

La asignatura sobre la cual se ha trabajado corresponde a tercer curso de un diploma universitario para personas mayores. En él, el **objetivo principal** es posibilitar una experiencia didáctica que permita trabajar los retos a los que nos enfrentamos como sociedad (Vives, Orte, & March, 2015) para con las personas mayores:

1) Transformación del modelo actual de la estructura social (rol social de los abuelos, aumento de la esperanza de vida, feminización de la vejez, familias interculturales...) así como de los modelos familiares actuales (intergeneracionales, monoparentales, familias reconstituidas,...); 2) Aumento de las situaciones de dependencia (o enfermedades crónicas que no permiten desarrollar las Actividades Básicas de la Vida Diaria), 3) Aumento del nivel cultural y educativo del colectivo de personas mayores; 4) Equilibrar económicamente



el sistema de protección social; 5) Aumentar las alternativas a las viviendas para las personas mayores: residir en casa, con familiares, en residencias, en cooperativas, en pisos tutelados,...; 6) Luchar contra los (micro)edadismo.; 7) Dar visibilización a las personas mayores LGBTI; 8) Hacer frente a la soledad no deseada; 9) Analizar con una visión crítica, la imagen de las personas mayores en los medios de comunicación y 10) Sensibilizar y detectar, por parte de toda la sociedad, las situaciones de vulnerabilidad / maltrato hacia las personas mayores.

A partir de aquí, se organizan las sesiones (8) de la asignatura en 5 ejes temáticos:

- a) Mitos y realidades de las personas mayores, hacer frente a los edadismos.
- b) Políticas sociales para con las personas mayores (derechos, análisis de políticas internacionales, nacionales y autonómicas) y ámbitos y tipologías de participación de las personas mayores.
- c) Hacer frente a las situaciones de vulnerabilidad: análisis de las políticas y realidades de la dependencia en las personas mayores y análisis de protocolos contra el maltrato y auto negligencia.
- d) Mejorar y adaptar el entorno: las ciudades amigables con las personas mayores (Protocolo Vancouver) a nivel internacional y autonómico y viviendas (adaptaciones de las viviendas) y diferentes formas de convivencia (hogares intergeneracionales, residencias, *cohousing*, viviendas tuteladas, ...)
- e) Relaciones intergeneracionales: beneficios, dificultades, ámbitos de participación intergeneracional (familiar, laboral, educativo, ...).

## **2.2. Temporalización y contenidos**

La asignatura contempla 8 sesiones de una duración de 2,5 horas cada una; dos veces por semana. La programación va cambiando cada curso en función de las necesidades actuales de las personas mayores, así como del horario de los alumnos de tercero del grado de pedagogía, los cuales participan en los dos diálogos intergeneracionales. La tabla 1 muestra la distribución de los temas, así como de las actividades cooperativas y participativas:

Tabla 1. Propuesta general

Sesión	Tema	Actividad principal
1	Personas mayores en el siglo XXI. Mitos y realidad. (Micro) edadismos	Debate sobre (micro)edadismos
2	Envejecimiento activo	Lectura no presencial del protocolo Vancouver. Primera sesión de Ciudades Amigables (adaptado a entorno universitario)
3	Calidad de vida y apoyo social	Debate sobre retos de futuro sobre políticas sociales
4	Tendencias sociodemográficas, sociales, psicológicas, económicas y culturales del envejecimiento en el siglo XXI	Lectura no presencial del protocolo Vancouver. Segunda sesión de Ciudades Amigables (adaptado a entorno universitario)
5	Políticas sociales, personas mayores y perspectivas de futuro	Debate intergeneracional 1: personas mayores en el siglo XXI
6	Entornos saludables, opciones de convivencia en el siglo XXI. <i>Revisión de las aportaciones del protocolo Vancouver adaptado a entorno universitario</i>	Vídeo y debate sobre cohousing y otras formas de convivencia alternativas a vivir en casa o en residencia
7	Programas socioeducativos intergeneracionales	Debate intergeneracional 2: relaciones intergeneracionales en el siglo XXI
8	Situaciones de vulnerabilidad y maltrato en personas mayores. <i>Revisión de las aportaciones de los dos debates intergeneracionales</i>	Prueba final. Evaluación

Fuente: Elaboración propia

Como puede observarse en la tabla anterior en cada sesión los alumnos disponen de un espacio importante para su participación en su aprendizaje. Básicamente, se trabaja a partir de 3 actividades principales:

1. **Debates:** A partir de unas lecturas base, los alumnos puede debatir sobre la propuesta temática. Así, en la primera sesión se debate sobre edadismos, su presencia y la detección de los microedadismos, sensibilización ante ellos y formas de combatirlos. Se trabajan en este debate no sólo los ámbitos familiares y comunitarios, sino que se incorpora en ellos los medios de comunicación y la imagen de las personas mayores en la publicidad.

El segundo debate se centra en las políticas sociales, analizando carteras de servicios de diferentes instituciones a nivel autonómico; el debate se centra en su conocimiento o no, en posibles accesos a ellos y en propuestas de mejora. Ello permite a los alumnos no sólo conocer la cartera de servicios autonómicos de los servicios sociales, sino que permite que se conviertan en agentes activos para su derivación e información a su entorno en caso de que se necesite.

El tercer debate se centra en las formas de convivencia. A partir del visionado de un vídeo sobre cohousing, se valoran las ventajas e inconvenientes de residir en casa propia, hacerlo con ayuda a domicilio o acudir unas determinadas horas a un centro de día,

vivir en casa de un familiar, residencia, en una vivienda tutelada, en una vivienda compartida o en una cooperativa siguiendo el modelo cohousing.

2. ***Ciudades Amigables con las personas mayores (Protocolo Vancouver)***. A partir del protocolo Vancouver sobre ciudades amigables con las personas mayores, se realiza primero una lectura del documento de forma no presencial; la sesión dedicada a ello se repasan tanto las principales aportaciones a nivel mundial de cada dimensión así como las aportaciones realizadas a través del *Observatori de Persones Majors*, en concreto del proyecto “Dar voz a los mayores” (Observatorio de Personas Mayores de Mallorca 2016), realizado en diversas poblaciones de Mallorca ( Petra, Pollensa, Sant Llorenç, Consell, Búger, Banyalbufar, Manacor, Inca, Palma y Calviá).

El primer curso, se realizó siguiendo dicho protocolo, con las autorizaciones pertinentes y grabando las aportaciones. La actividad se centraba en adaptar dicho protocolo a la universidad, realizando propuestas sobre cómo hacerla amigable para las personas mayores. Los siguientes cursos, se han analizado las aportaciones realizadas en los cursos anteriores y se han incorporado ideas u otras propuestas de mejora a partir de las ya realizadas, elemento que permite, al mismo tiempo, ver la evolución de las propuestas anteriores.

3. ***Debates intergeneracionales***: dicha actividad necesita de la incorporación de un grupo de estudiantes de Grado. En nuestra experiencia, se incorporan los alumnos de tercero del grado de Pedagogía, los cuales realizan durante todo el semestre una hora práctica quincenal en grupos de discusión. Esto permite disponer de un grupo de alumnos de grado ya familiarizados con esta dinámica. Los grupos intergeneracionales se crean de forma aleatoria, siendo, en la medida de lo posible, el mismo número de alumnos de grado que de alumnos mayores. Los alumnos de grado, debido a la experiencia previa en sus prácticas de asignatura, son los que lanzan las preguntas y se encargan de elaborar el resumen por escrito de su grupo. Generalmente cada curso se crean 5-6 grupos con una media de 8 participantes en cada uno. Los grupos intergeneracionales son estables para las dos sesiones.

En la primera sesión, el debate se centra en los retos de las personas mayores en el siglo XXI. Se inicia el debate a partir de la identificación de los principales retos a los que se enfrentan las personas mayores, reflexionando a continuación sobre la evolución de dicho colectivo, de su imagen social actual y hace 50 años; se analizan los principales motivos de estos cambios y sobre cuál es el momento en que se inicia el envejecimiento. Debido a que los alumnos seniors también han trabajado en las sesiones, o trabajarán retos como los edadismos, la calidad de vida, o la imagen en los medios de comunicación, son estas también preguntas en este debate. Se finaliza el debate dando importancia a la participación activa de las personas mayores, en cuáles son los principales ámbitos de

participación, en cómo se puede potenciar y cómo dar voz a las personas mayores. El segundo debate intergeneracional se basa principalmente en las relaciones intergeneracionales (Orte et al, 2017). El debate se inicia a través de la (auto)definición de las dos generaciones que están presentes en el debate (jóvenes y personas mayores) y si esta (auto)conceptualización ha cambiado o cambiará a lo largo de los años. Se analizan valores y prejuicios de cada generación. La segunda parte del debate se centra en las relaciones intergeneracionales, a partir de la experiencia propia, en una buena relación intergeneracional, en las aportaciones personales y posibles causas de ésta buena relación. Se debate en cómo poder potenciarlas en nuestra sociedad de hoy en día y en qué elementos deben ser claves para la elaboración de un programa intergeneracional.

### 3. Conclusiones

La experiencia didáctica en la asignatura se centra en el aprendizaje centrado en los alumnos, en dar, desde la experiencia directa, voz activa al colectivo de alumnado senior universitario. La legislación citada en el primer apartado de esta comunicación, nos remarca el derecho a la educación (desde la Declaración de la ONU en 1995 sobre Derechos Económicos, Sociales y Culturales de las Naciones Unidas (art.13), o nuestra Constitución Española (1978), que reconoce el derecho a la educación “para un pleno desarrollo de la personalidad humana en el respeto a los principios democráticos de convivencia y a los derechos y libertades fundamentales” (art.12) ; todo ello contextualizado en las políticas efectivas y culturalmente adaptadas para potenciar un envejecimiento activo (OMS, 2015), que tuvieron como fecha clave el 2002, con la realización de la Asamblea Mundial del Envejecimiento.

Dicho derecho, siguiendo en informe Delors (1996), ya encaminaba dicha educación a través de 4 pilares básicos: *aprender a conocer*, *aprender a hacer*, *aprender a convivir con los demás* y *aprender a ser*. Y principalmente estos han sido los pilares que se han pretendido trabajar en la asignatura sobre las personas mayores en el siglo XXI: *aprender a conocer*, entendiendo que la educación no es meramente una transmisión de conocimientos, sino que el alumnado debe participar de forma activa en él; *aprender a hacer*, especialmente a poner en práctica sus conocimientos, por ejemplo, a través de la sensibilización de los microedadismos o en potenciar nuestro envejecimiento activo o mejorar nuestra calidad de vida; *aprender a convivir con los demás*, potenciando las sesiones de aprendizaje intergeneracionales y activando su participación activa en sus ámbitos familiares, comunitarios, y, en algunos casos, también laborales; y, finalmente, *aprender a ser*, a ser una persona activa, valorada y que contribuye al desarrollo de su comunidad, que aporta de forma muy importante (social, económicamente y también en la

transmisión de valores familiares) en su entorno, especialmente en el cuidado de personas dependientes (personas mayores, personas con discapacidad y, sobretodo de nietos).

Finalmente, podemos destacar que el objetivo principal de la presente experiencia de aprendizaje se ha cumplido; puesto que a través de la asignatura las personas mayores han podido ser conscientes de la transformación del modelo actual de la estructura social y familiar (reto1), han identificado a la dependencia como un reto social y al mismo tiempo han podido conocer los recursos autonómicos, nacionales e internacionales activos actualmente (reto 2); se ha trabajado de forma constante y transversal con diferentes metodologías en su proceso de enseñanza-aprendizaje (reto 3); se ha conocido y debatido sobre el sistema de protección social, las alternativas a la vivienda para personas mayores y el maltrato hacia personas mayores (retos 4, 5 y 10); se han incorporado en los contenidos de las sesiones de forma transversal el debate referente actitudes discriminatorias hacia las personas mayores como son el microedadismo (reto 6), la homofobia en personas mayores (reto 7) y se ha trabajado, especialmente con los debates intergeneracionales en una visión realista y reflexiva sobre las personas mayores y el proceso de envejecimiento y cómo este se refleja en los medios de comunicación (reto 9).

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## **Análisis de los Ambientes virtuales para el diseño de una propuesta de interfase que sirva como herramienta en el desarrollo de proyectos de investigación**

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### **Resumen**

*En el contexto de las universidades públicas y privadas, la investigación en Diseño Industrial no se ha destacado a nivel de otras disciplinas, en el caso particular de la Universidad Autónoma del Estado de México y sus escuelas donde se imparte el curso de Diseño Industrial: Toluca, Zumpango y Valle de Chalco, el área de investigación está por debajo de los estándares institucionales y otras disciplinas (UAEMéx Agenda estadística, 2015).*

*De acuerdo con las estadísticas de varios organismos de evaluación acreditados, certificados y reconocidos para el Área de Diseño Industrial en México, como ANUIES, CIEES y COMAPROD, entre los factores que más influyen para no mejorar el desempeño de la investigación de diseño se encuentran: la falta de proceso de investigación organizado; falta de herramientas digitales para la gestión de recursos; e ignorancia del proceso de investigación. Entre varios investigadores sobre el tema, destacar las contribuciones de Margolin (2005) menciona que uno de los desafíos particulares que enfrenta la comunidad de investigadores en diseño es aceptar e incluir especialistas ubicados dentro de diferentes tradiciones disciplinarias, esto no permite seguir avanzando en la búsqueda de nuevas formas de representación de diseño, por lo que el área permanece sumergida en proyectos, formas y aspectos ya existentes al intentar diseñar nuevos objetos, sin generar mayores contribuciones / contribuciones al diseño y mucho menos al proceso de investigación.*

**Palabras clave:** *investigación, enfoques metodológicos, interfaces, multidisciplinar.*





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## **Abstract**

*In the context of public and private universities, research in Industrial Design has not excelled at the level of other disciplines, in the particular case of the Autonomous University of the State of Mexico and its schools where the Industrial Design course is taught: Toluca, Zumpango and Valle de Chalco, the research area is below the institutional standards and other disciplines (UAEMéx University Statistics Agenda, 2015).*

*According to the statistics of several accredited, certified and recognized evaluating bodies for the Industrial Design Area in Mexico, such as the ANUIES, CIEES and COMAPROD, among the factors that most influence not to improve the performance of design research are: the lack of an organized research process; lack of digital tools for resource management; and ignorance of the research process.*

*Among several researchers on the subject, highlight the contributions of Margolin (2005) mentions that one of the particular challenges facing the community of researchers on design is to accept and include specialists who are located within different disciplinary traditions, this does not allow to follow advancing in finding new forms of design representation, so the area remains submerged in projects, forms and aspects already existing when trying to design new objects, without generating greater contributions / contributions to the design and much less to the research process .*

**Keywords:** *research, Methodological approaches, interfaces, multidisciplinary*

## **1. Introducción**

En México la investigación en diseño es un gran reto, Margolín (2005) referenciado por salinas (2007), ya que si bien es cierto que existen muchas formas de diseñar, metodologías y enfoques diseñísticos, la mayoría de ellos se quedan cortas o inconclusas ya que no existen investigaciones previas que sustenten lo que se está realizando para obtener un resultado integral y que garantice que será un producto de calidad en el mercado (calidad no solo en el ámbito estético o funcional, si no enmarcando otros aspectos como; el objetivo, mensaje expresivo, durabilidad, consecuencias ambientales, seguridad al consumidor, etc), siendo estos aspectos fruto de una ardua investigación previa, de esta forma lograr así un resultado favorable para el principal objetivo que son los usuarios.

En caso particular de algunas áreas del diseño como lo son: el rediseño de productos, la invención, construcción y el dibujo se utiliza muy poco la investigación organizada, esto se debe al pensamiento poco razonable de que “el diseño puede ocurrir sin necesidad de una investigación”, sin embargo no solo basta con practicar el diseño, como ya se había mencionado anteriormente, falta encontrar la verdadera identidad del diseño dentro del país y esto no se lograra si no existe desde la raíz una verdadera investigación de los componentes culturales y antropológicos que nos lleven a detectar que es lo que no está permitiendo que se tenga una visión clara de lo que verdaderamente es el diseño industrial y de qué manera afecta o influye en la vida cotidiana.

De aquí que el uso de los ambientes virtuales son una gran herramienta para mejorar el proceso de investigación en diseño, por lo tanto en parte de esta trabajo se comentará la relevancia que tiene no solo para la disciplina del diseño industrial, sino para la investigación en el contexto nacional.

## 2. Antecedentes

Se considera a un ambiente virtual de aprendizaje como el espacio físico donde convergen las nuevas tecnologías para desarrollarse y potencializarse y rebasar aquellos entornos escolares tradicionales, y que a su vez favorecen al conocimiento (Avila y Bosco 2001) y a la apropiación de contenidos, experiencias y procesos pedagógico-comunicacionales; creando nuevas escenarios vistos como formas de trabajo, y de interacción entre los usuarios, en proyectos vanguardistas que crean ambientes educativos innovadores, nuevas experiencias de aprendizaje, pero sobretodo que son poderosas herramientas para la diversificación de aplicaciones actividades académicas y de investigación, sobre esto último se verá la importancia que tienen los ambientes virtuales y su relación con el proceso de investigación.

Para Samaja (2002), las universidades tienen una postura bien definida y precisa respecto al tipo de investigación que deben promover y el porque la realizan, y para él gran parte del porque tiene que ver con la palabra ciencia, independientemente de su enfoque y de sus acepciones, este autor define cuatro tipos:

- A. Ciencia como los saberes tradicionales.
- B. Ciencia como saber reflexivo.
- C. Ciencia como conocimiento obtenido.
- D. Ciencia como investigación destinada.



Después de esta breve semblanza, es obvio que la que merece atención prioritaria para cada universidad y dependiendo del contexto institucional, nacional e internacional es la investigación destinada a la innovación tecnológica; Todo lo anterior indica que las universidades que quieren hacer investigación deben de adaptarse a los tiempos y contextos actuales, pero las condiciones son muy diferentes en estos ámbitos, por lo tanto el nivel de desarrollo no puede ser el mismo para todos; diversos autores e investigadores mencionan que es necesario trabajar en estos cuatro grandes pilares:

- 1) Formar a los individuos en una percepción de la realidad inspirada en una actitud protagónica, que se nutra de todas las riquezas creadas por la evolución y la historia de la humanidad, promoviendo una formación estética que incluya la ética, la reflexión, la comprobación productiva y la vocación innovadora.
- 2) Formar profesionales orgullosos de las tradiciones más actualizadas y consensuadas por la comunidad de pares, y con la capacidad para aplicarlas con creatividad en el estricto marco de la ética de su corporación profesional.
- 3) Formar docentes universitarios calificados con lo más altos estándares académicos, capaces de expandir las fronteras de los conocimientos en su disciplina, de realizar síntesis de profundo valor reflexivo que mantengan vivos los ideales regulativos de la razón en su campo disciplinario particular, y abierta la reflexión interdisciplinaria y transdisciplinaria.
- 4) Formar investigadores experimentales rigurosos, capaces de someter al control de los hechos mediante diseños imaginativos.

Para la Universidad Autónoma del Estado de México (UAEMéx) la investigación es una función sustantiva que sostiene y da razón de ser a esta institución, junto con la docencia y la extensión definen sus identidad esencial, atendiendo a los preceptos de humanismo y filosofía que sirven como base para la construcción de una ética universitaria comprometida con la responsabilidad social.

A través de ella, se pueden lograr objetivos fundamentales, tales como:

- Fortalecer la producción de conocimiento científico.
- Favorecer la formación de una comunidad académica (docentes, investigadores y alumnos) con mentalidad proactiva en la búsqueda de soluciones, aplicando conocimientos y trabajo multidisciplinario.
- Integrar redes de colaboración promoviendo el desarrollo y la innovación.
- Ofrecer un servicio real y de utilidad a la sociedad.

La investigación y el desarrollo (sus siglas I+D) comprenden el trabajo creativo llevado de forma sistemática para la generación de líneas de generación y aplicación del conocimiento. Para la UAEMéx el desarrollo científico tecnológico representa un instrumento indispensable para el avance social. Las universidades representan el espacio natural para el desarrollo y fortalecimiento de la producción de conocimiento científico, ya que es en ellas donde se deben generar soluciones creativas e innovadoras para las innumerables áreas del quehacer social. En este sentido para la UAEMéx la investigación es un área estratégica para el avance del Estado de México y del propio país.

Técnicamente un proyecto de investigación se define como el conjunto de actividades de ID+i a realizarse por un equipo idóneo de personas (de preferencia tipo interdisciplinario), en un lugar y periodo determinado, con determinados recursos y condiciones para lograr objetivos y metas preestablecidas; atendiendo una planeación minuciosa de métodos, estrategias y herramientas para desarrollar la alternativa de solución seleccionada ante un problema de carácter científico, técnico o tecnológico.

Los proyectos académicos de investigación se deben caracterizar por la calidad, tanto de la información, como de las decisiones. La garantía de esa calidad es el profesor-investigador, quien debe ser especialista en el área de la ciencia o la tecnología a la cual se adscribe el problema, experto en la aplicación de los métodos y técnicas del área, acucioso en la tanto del problema, como de la alternativa de solución y exigente con la calidad de la información que respalda el problema y las decisiones del proyecto.

Gestión de Proyectos Académicos.

Para diferentes autores, la gestión de proyectos es el proceso organizado y sistemático en donde se organiza y administran los recursos de tal forma que se alcancen los objetivos y generen los productos de un proyecto en tiempo y forma, caso contrario los proyectos de investigación académicos se diferencian de otros tipos de proyectos por abordar problemas no rutinarios, con técnicas y procedimientos no estandarizados, buscando resultados nuevos y novedosos. Estas características los convierten en proyectos con un alto grado de incertidumbre y riesgo; hecho que demanda procesos continuos y minuciosos de planificación, organización, seguimiento y control.

### **3. Propósito**

Anteriormente se discutió la importancia que tiene a nivel institucional y nacional la investigación, pero aunque pareciera que se debió de empezar con el status a nivel mundial, cabe señalar que es un contexto recíproco, ya que el diseño industrial forma parte



indispensable del desarrollo económico y social de la mayoría de los países, las propias características del diseño le permiten idear y desarrollar productos y servicios que logren cubrir las necesidades de los clientes y consumidores, o bien aportando mejoras a los productos ya existentes o a los futuros, pero a pesar de tantas bondades como disciplina a nivel internacional, el Diseño en México se ha limitado en la etapa de “construir objetos”, dejando fuera un factor indispensable como lo es la investigación.

Por ello cuando se escucha el término de investigación en diseño, inmediatamente se piensa en acciones tales como consultorías, trabajo de oficina (papeleo), conferencias, trabajo en salas de lectura, asistencia a bibliotecas, etc. una de las razones por lo que posiblemente esto ocurre, es por la asociación de la palabra diseño al contexto de la creatividad, innovación y visión futurista, mientras que para muchos la investigación significa rigor y evidenciar que realmente existe; de primera instancia parecería que los dos términos se contraponen porque van en caminos diferentes, pero esta “contraposición” crea un espacio muy interesante de interpretación y adaptación para la actividad del diseñar, lo que genera nuevas oportunidades para que la disciplina siga creciendo en diferentes ambientes y contextos.

#### **4. Metodo**

Una investigación según Sampieri (2010) se define como un conjunto de procesos sistemáticos, críticos e inclusive empíricos que se aplican al estudio de ciertos fenómenos y problemas. Según la clasificación de este autor quién divide la investigación en tres tipos que son: investigación aplicada (de las más utilizadas en el diseño), investigación científica, e investigación y desarrollo (en esta última es donde el diseño debería de participar en mayor proporción, ya que su propósito es desarrollar productos y/o servicios que justifiquen las propuestas generadas). Es por ello que uno de los desafíos particulares que enfrenta el método de esta investigación en dos momentos en particular: al principio en analizar como la comunidad de investigadores sobre diseño dentro del enorme contexto de distintas tradiciones disciplinarias, avanza en encontrar nuevas formas de investigar para la representación del diseño (hacer investigación), y posteriormente en como la carencia de herramientas para lograr una óptima investigación genera que los resultados sigan sumergidos en proyectos, formas y aspectos ya existentes al momento de tratar de diseñar nuevos objetos, sin dar mayores aportaciones al diseño y mucho menos a la parte de investigación.



Esquema 1.1. resultados sobre investigación en Diseño en la UAEMéx  
Fuente: Elaboración propia (2019)

## 5. Objetivo

Analizar el proceso de investigación en diseño y explotar las posibilidades de la generación de futuras herramientas que involucren información sobre el binomio de diseño-investigación, y que sean capaces de enfrentar con mayor certeza temas específicos y problemas de índole profesional.

## 6. Resultados

De todo lo anterior hay que puntualizar que la investigación sin una previa, bien planteada y justificada metodología no podría estar encaminada correctamente. Para Margolin (2005), el proceso metodológico es considerado como una parte crucial en el desarrollo de cualquier tipo de investigación, ya que indica los pasos a seguir, las diferentes etapas del

proceso de trabajo, el dominio y manejo de las teorías más importantes o los conceptos más relevantes de la investigación que serán el sustento principal de todo proyecto.

Es por ello que después de analizar el contexto de diferentes instituciones sobre los principales obstáculos y oportunidades que tiene el diseño Industrial y el proceso de investigación en México, de ser bien afrontados estos obstáculos y ser aprovechadas las oportunidades se perciben nuevos escenarios a futuro dentro del contexto nacional, estatal e institucional siendo el caso de la UAEMéx (Tabla 1.1).

**Tabla 1.1. resultados sobre investigación en Diseño en la UAEMéx**

Organismo	Obstáculos	Oportunidades
CIEES	<ul style="list-style-type: none"> <li>• Falta de un proceso de investigación establecido para la licenciatura.</li> <li>• Falta del uso de ambientes virtuales e instrumentos digitales.</li> </ul>	<ul style="list-style-type: none"> <li>• Establecer bases para la generación de un método, metodología o enfoque específico de la licenciatura que contribuya a crear una identidad en el área de investigación.</li> </ul>
COMAPROD	<ul style="list-style-type: none"> <li>• Falta de infraestructura para generar investigación.</li> <li>• Falta de sitios especializados para publicar.</li> <li>• Alto costo de las publicaciones.</li> </ul>	<ul style="list-style-type: none"> <li>• Generar más productos sobre investigación en diseño.</li> <li>• Elevar el nivel de las publicaciones.</li> <li>• Obtener mayores recursos para el área y proyectos.</li> </ul>
ANUIES	<ul style="list-style-type: none"> <li>• Falta del uso de ambientes virtuales e instrumentos digitales.</li> </ul>	<ul style="list-style-type: none"> <li>• Utilizar temas innovadores basados en las herramientas digitales y difundir en espacios especializados.</li> </ul>
SIEA (organismo Interno UAEMéx).	<ul style="list-style-type: none"> <li>• No se cuenta con información precisa sobre el tema.</li> </ul>	<ul style="list-style-type: none"> <li>• Generar bases de datos sobre la carrera y sus núcleos de información.</li> </ul>

*Fuente: Elaboración propia (2019)*

## 7. Conclusiones

- En México la investigación en diseño es un gran reto, ya que si bien es cierto que existen muchas formas de diseñar, metodologías y enfoques diseñísticos, la mayoría de ellos se quedan cortas o inconclusos ya que no existen investigaciones previas que sustenten lo que se está realizando para obtener un resultado integral
- Los resultados previos demuestran la necesidad de apoyar el proceso de investigación en Diseño industrial, ya que esto aumentará el número de investigadores de la disciplina en la UAEM, es por ello que los ambientes virtuales y digitales juegan un papel importante en este proceso.
- El uso de la realidad virtual, las animaciones, modelados digitales son importantes herramientas que ayudarán a crecer el proceso de investigación.
- Es indispensable que existan lugares apropiados y accesibles para poder compartir y difundir los resultados de las investigaciones en diseño, porque a la fecha son muy pocos además de costosos.
- los diseñadores desde su etapa como estudiantes (para efectos de esta investigación se tomará en cuenta la etapa de formación académica universitaria), se enfrentan a la paradoja de la investigación sin saber como realizarla y mucho menos aplicarla.

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## Incorporación del aula invertida en prácticas preclínicas de Odontopediatría.

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### Resumen

*El aula invertida es una forma de aprendizaje semipresencial. Los estudiantes aprenden contenidos, viendo vídeos, sin la presencia física del profesor. En el aula, se ponen en práctica los conocimientos ya adquiridos y sólo se resuelven dudas con el profesor.*

*Sus principales ventajas son: interacción profesor-estudiante más personalizada; autonomía y autorresponsabilidad en el aprendizaje y mayor relación entre el profesorado.*

*En el Grado de Odontología de la Universidad Complutense de Madrid (UCM), la asignatura Odontopediatría debe capacitar al alumno en la adquisición de las destrezas necesarias para su incorporación a las prácticas clínicas con pacientes infantiles.*

*El objetivo principal de este trabajo fue introducir el modelo pedagógico “aula invertida” en el área de la Odontopediatría (Grado de Odontología-UCM).*

*La metodología de trabajo fue:*

- 1. Los profesores de Odontopediatría realizaron un vídeo demostrativo de un procedimiento de terapia pulpar en dientes temporales (simulación en tipodonto).*
- 2. Una semana antes de la práctica, se incorporó el vídeo al Campus Virtual UCM y se informó a los alumnos de la obligatoriedad de su visualización.*
- 3. Durante la práctica, el profesor propuso a los alumnos realizar dicho procedimiento, resolviendo sus dudas.*
- 4. Al finalizar, se realizó un cuestionario anónimo valorando la satisfacción de los alumnos.*



5. *Utilizando herramientas del Campus Virtual de la UCM, se valoró cuándo y cuantas veces visualizó cada alumno el vídeo.*

*En el estudio participaron 6 profesores y alumnos matriculados en la asignatura del Grado de Odontología: Odontopediatría.*

*Los resultados indicaron que la satisfacción de los alumnos fue alta, a pesar de que, muchos de ellos, realizaron una visualización muy próxima en el tiempo a la práctica con el profesor y la mayoría, sólo lo hizo una vez.*

*En conclusión, consideramos que el aula invertida es una metodología muy adecuada para la realización de prácticas preclínicas en Odontopediatría.*

**Palabras claves:** *aula invertida, educación dental, aprendizaje centrado en el estudiante.*

## **1. Introducción**

El “Aula Invertida” o “Flipped Classroom” es una forma de aprendizaje semipresencial que se popularizó a partir de los trabajos de Jonathan Bergmann y Aaron Sams, dos profesores de química que en 2007 empezaron a subir sus lecciones a You Tube. La “clase invertida” es un modelo pedagógico basado en invertir la estructura tradicional de la clase presencial expositiva a través del empleo de tecnologías de información y comunicación. El docente produce o selecciona un material digital (presentación audiovisual, vídeo, infografías, página Web, etc.) en donde se exponen determinados contenidos del curso y se desarrollan distintos tipos de actividades (Bergmann & Sams, 2012).

Sus principales ventajas son: interacción profesor-estudiante más personalizada; autonomía y autorresponsabilidad en el aprendizaje y mayor relación entre el profesorado. Además incentiva a los alumnos a aprender unos de otros, a través de un aprendizaje en equipo y permite al docente aplicar una enseñanza más personalizada atendiendo a la diversidad. Pero este modelo de aprendizaje también presenta algunos inconvenientes como: la preparación previa por parte del docente (lo cual requiere mucho tiempo) y el acceso a los materiales, ya que no todos los estudiantes poseen un acceso similar a la red (Torre, 2017; Schwartz, 2014).

Este tipo de estrategia docente está siendo utilizada en otras áreas con éxito, como en Ingeniería de la Energía (Badenes, 2018), Ingeniero Agrónomo (Moreno-Ramón, 2018), Organización de Empresas (Cortés Aguilar, 2018) o Enfermería (Schwartz, 2014). En la enseñanza a nivel odontológico aún no ha sido apenas utilizada. La metodología de

enseñanza en Odontología está experimentando grandes cambios. Es necesario que los estudiantes desarrollen un pensamiento crítico, sepan resolver problemas y tengan la capacidad de autodirigir estrategias de búsqueda de información necesarias para poder desarrollar correctamente la práctica profesional (Albino et al, 2008; Pyle et al, 2006). En el Grado de Odontología de la Universidad Complutense de Madrid (UCM), la asignatura Odontopediatría debe capacitar al alumno en la adquisición de las destrezas necesarias para su incorporación a las prácticas clínicas con pacientes infantiles.

Por todo lo anterior, nos pareció muy interesante introducir este modelo pedagógico en las prácticas preclínica de la asignatura Odontopediatría ya que al explicarse determinadas técnicas mediante videos, antes de las clases prácticas, puede mejorar el aprendizaje de los estudiantes.

Este trabajo está incluido como Proyecto Innova-Docencia 2018/19 de la UCM.

## 2. Objetivos

El objetivo principal de este trabajo fue introducir el modelo pedagógico “Aula invertida” en la asignatura de Odontopediatría (Grado de Odontología- Universidad Complutense de Madrid).

El objetivo secundario fue evaluar la satisfacción de los alumnos en el uso de esta herramienta para mejorar su aprendizaje en dicha materia.

## 3. Metodología

La metodología de trabajo fue:

- Los profesores de Odontopediatría realizaron un vídeo de un procedimiento de terapia pulpar en dientes temporales (simulación en tipodonto) (Figura 1).
- Una semana antes de la práctica, se incorporó el vídeo al Campus Virtual UCM y se informó a los alumnos de la obligatoriedad de su visualización.
- Durante la práctica, el profesor propuso a los alumnos realizar dicho procedimiento, resolviendo sus dudas.
- Al finalizar las prácticas, se realizó un cuestionario anónimo valorando la satisfacción de los alumnos (Figura 2).

- En el estudio participaron 6 profesores y 76 alumnos matriculados en Odontopediatría.



Fig. 1. Video empleado para la realización del estudio: "Técnica de Pulpotomía en dientes primarios". Proyecto de innovación para la mejora de la calidad docente. N° 100 (UCM – 2006/08) ISBN:978-84-96704-12-1.

#### **QUESTIONARIO**

1.- Visualizar vídeos explicativos que le muestren cómo realizar la práctica preclínica de Odontopediatría previamente a la misma y poder resolver dudas con el profesor, le ha parecido:

- a) Muy útil
- b) Útil
- c) Indiferente
- d) No lo considero necesario, con una explicación teórica del profesor es suficiente

2.- El contenido de los vídeos explicativos me ha ayudado a adquirir conocimientos sobre el tema de la práctica o me ha facilitado realizar la práctica.

- a) Totalmente de acuerdo
- b) Parcialmente de acuerdo
- c) En desacuerdo
- d) No sabe no contesta

3.- Disponer a través del Campus Virtual de esos vídeos explicativos, previamente al desarrollo de la práctica preclínica, le ha parecido:

- a) Muy útil
- b) Útil
- c) Indiferente
- d) Prefiero la explicación del profesor directamente en la práctica

4.- Indique cuántas veces ha visualizado los videos por completo antes de realizar la práctica:

- a) Ninguna
- b) 1
- c) 2 ó 3
- d) Más de 3

5.- ¿Cree que incorporar los vídeos a otras plataformas, como aplicaciones que permitan verlos directamente a través de móviles o tablets, aumentaría su interés o le facilitaría la visualización de los mismos?

- a) Sí
- b) Probablemente
- c) No
- d) No sabe no contesta

Fig. 2: Cuestionario de diseño propio realizado a los alumnos.

## **4. Resultados y Discusión**

En general, los resultados indicaron que la satisfacción sobre el empleo del "aula invertida" fue alta a pesar de que muchos de ellos, realizaron una visualización muy próxima en el

tiempo a la práctica con el profesor y el 40% sólo vio una vez los vídeos. Los resultados obtenidos en cada cuestión los podemos ver en los Gráficos del 1 al 5.



Gráfico 1: Visualizar vídeos explicativos que le muestren cómo realizar la práctica preclínica de Odontopediatría previamente a la misma y poder resolver dudas con el profesor, le ha parecido.



Gráfico 2: El contenido de los vídeos explicativos me ha ayudado a adquirir conocimientos sobre el tema de la práctica o me ha facilitado realizar la práctica



Gráfico 3: Disponer a través del Campus Virtual de esos vídeos explicativos, previamente al desarrollo de la práctica preclínica, le ha parecido.

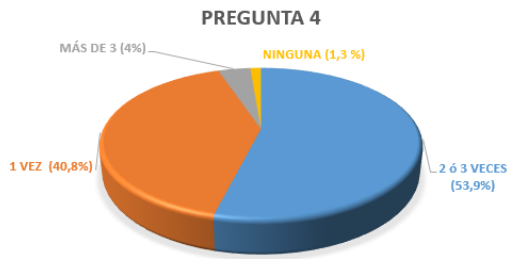


Gráfico 4: Indique cuántas veces ha visualizado los videos por completo antes de realizar la práctica.



Gráfico 5: ¿Cree que incorporar los videos a otras plataformas, como aplicaciones que permitan verlos directamente a través de móviles o tablets, aumentaría su interés o le facilitaría la visualización de los mismos?

Nuestros resultados sobre el grado de satisfacción al emplear este modelo pedagógico coinciden con autores como Sang (Sang & Howard, 2015), que lo utilizaron en la asignatura de Anatomía dental y evaluaron la satisfacción de los alumnos. Los comentarios que recibieron en la encuesta posterior fueron positivos, y al 85% de los alumnos les gustaría tener más asignaturas con esta metodología ya que las consideraban más divertidas, interactivas y colaborativas. Como inconvenientes, los alumnos señalaban la necesidad de conectarse a la red para poder ver el material didáctico (Sang & Howard, 2015).

Igualmente, otros estudios han sugerido la validez de este método educativo en Odontología. Bohaty y cols. aplicaron el aula invertida en la asignatura de Odontología Pediátrica donde se observó que las calificaciones mejoraron y la satisfacción por parte de los alumnos fue alta (Bohaty, 2016).

## 5. Conclusiones

En conclusión, durante el curso 2018-2019 hemos podido introducir, por primera vez, el aula invertida en las prácticas preclínicas en Odontopediatría. Teniendo en cuenta el alto grado de satisfacción mostrado por los alumnos (hasta un 85% han considerado que el

vídeo les ha ayudado a mejorar la realización de la práctica; y a un 63,2% les ha parecido muy útil el disponer de los vídeos antes de la práctica en el Campus Virtual), consideramos, que el aula invertida es una metodología muy adecuada en el campo de la Odontología y en concreto, en la enseñanza de la Odontopediatría.

Durante el próximo curso académico pretendemos incorporar el uso de aplicaciones o plataformas informáticas especialmente diseñadas, para que faciliten tanto a alumnos como a profesores, el uso de esta herramienta educativa.

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## Reestructuración preventiva frente a insolvencia. Aproximación didáctica a la novísima normativa de la Unión Europea (2019) ilustrada por la xilografía de Katsushika Hokusai (1760-1849)

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### Resumen

*Para desarrollar una educación que propicie una sociedad más crítica, justa e igualitaria es necesario contar con material didáctico que facilite la incorporación de perspectivas transversales en todas las materias. Ello fomentará el aprendizaje reflexivo y duradero. En concreto, en la docencia del Derecho preconcursal, tanto en el ámbito universitario como previo -en la Enseñanza Secundaria, el Bachillerato y la Formación Profesional- puede ser valioso el recurso didáctico a la pintura y la xilografía, que permitirán ilustrar los principios y las connotaciones sociales, económicas y jurídicas de esta parcela jurídica y que favorecerá un enfoque vivamente crítico sobre la materia societaria y de la crisis económica de los empresarios y de los particulares. Este trabajo atiende a esta innovadora propuesta docente.*

**Palabras clave:** *insolvencia; reestructuración preventiva; Derecho concursal; crisis económica; Derecho de la empresa; Derecho mercantil; pintura; docencia; sociedad justa e igualitaria; xilografía; Katsushika Hokusai*

### 1. Introducción

La situación de insolvencia inminente para un consumidor o para un empresario significa casi siempre, para quien la sufre, verse engullido por *una ola gigante* de la que probablemente saldrá malparado, puesto que las soluciones que ha venido ofreciendo hasta ahora el Derecho para estos casos, como ha demostrado la grave crisis económica que acabamos de padecer, no son eficaces para resolver los problemas que se generan en el entorno familiar o empresarial y no impiden la expansión de estas situaciones, con un “efecto onda”, a la economía y a la sociedad en su conjunto.





Hokusai, *La gran ola de Kanagawa* (1830)<sup>1</sup>

Los procedimientos concursales existentes tradicionales, en España y en el resto de la Unión Europea, *no* dan una solución a las situaciones de crisis e insolvencia, ni a los consumidores, ni a las familias, ni a los empresarios. Este trabajo propone una reflexión introductoria muy básica, especialmente dirigida a discentes anteriores a los estudios de Grado, sobre la materia de la reestructuración preventiva como mecanismo para evitar la insolvencia y el concurso. La insolvencia y la evitación de la insolvencia son materias de gran importancia teórica y, sobre todo, práctica. Nos afectan, directa o indirectamente a todos los ciudadanos e incluso pueden determinar la evitación de crisis económicas como las que acabamos de padecer. Como entiende que los mecanismos de reestructuración preventiva son capitales y que trascienden, con mucho, la perspectiva de cada uno de los Estados miembros, la Unión Europea ha dictado recientemente una normativa comunitaria, con contenido de alcance general y obligatorio para todos los Estados miembros, que tratará de aumentar de forma significativa la eficacia de los procedimientos de condonación, insolvencia y reestructuración. Esta propuesta, pues, puede ser especialmente valiosa en la docencia relacionada con los empresarios, con la economía y con las empresas en cualquier Grado, Formación Profesional o Bachillerato, en cuanto dará a conocer, aunque sea ahora sucintamente y en líneas muy generales y únicamente introductorias, los elementos esenciales y las características de la nueva regulación europea para los deudores en dificultades financieras cuando la insolvencia sea inminente, con el fin de evitar la insolvencia y también de garantizar la viabilidad del deudor.

Hasta aquí podría decirse que la perspectiva será introductoria a una cuestión eminentemente jurídica y empresarial. Pero la propuesta, en este momento, tiene un objetivo complementario también relevante: la ilustración, mediante obras artísticas de los principales problemas que origina la nueva normativa “pre” y “anti” crisis y “sobre marcos de reestructuración preventiva”. Se trata de introducir un elemento didáctico anecdótico pero muy útil, puesto que podrá conducir a la fijación y comprensión de la situación actual en las situaciones de crisis y de las nuevas propuestas comunitarias desde la atención a las

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<sup>1</sup> La conocida obra de Katsushika Hokusai, *La gran ola de Kanagawa*, que ilustra una tempestad en alta mar justo cuando va a impactar contra una barca, es expresiva de la situación de dificultad a la que se enfrentan los empresarios o particulares ante las situaciones de crisis económica o insolvencia inminente y del efecto expansivo de estas crisis en todo su entorno personal, económico y social.

obras de la serie *Treinta y Seis Vistas del Monte Fuji* de Hokusai (1760-1849), propiciando a través de estos ejemplos visuales un aprendizaje duradero fundamentalmente en los alumnos de preuniversitario.

## 2. Motivos que conducen a la Unión Europea a la adopción de la nueva Directiva sobre insolvencia

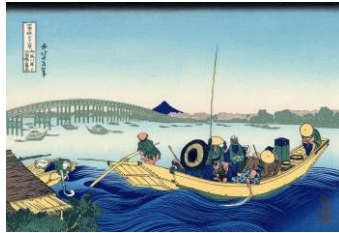
El día 28 de marzo de 2019 se aprobó en Estrasburgo la Directiva del Parlamento Europeo y del Consejo sobre marcos de reestructuración preventiva, segunda oportunidad y medidas para aumentar la eficacia de los procedimientos de condonación, insolvencia y reestructuración, y por la que se modifica la Directiva 2012/30/UE (COM(2016)0723 – C8-0475/2016 – 2016/0359(COD))<sup>2</sup>. ¿Qué significa esta normativa? En primer lugar hay que señalar que es una Directiva comunitaria. Se trata de una norma de la Unión Europea muy original. Obliga a todos y cada uno de los Estados miembros de la Unión a adaptar su legislación interna, por los medios que cada Estado considere apropiados, al contenido de la propia Directiva y en un plazo fijado en ella misma. Si los Estados miembros incumplieran los plazos dados y no adaptaran su normativa interna a la Directiva, si ésta tiene un contenido claro, preciso e incondicional, los particulares podrían incluso solicitar en el curso de un juicio su aplicación directa.

Pues bien: la Unión Europea legisla, mediante esta Directiva de 2019, en la materia de los procedimientos de insolvencia y reestructuración *previa* al concurso. Frente a la divergencia de las legislaciones de los Estados miembros, la Unión Europea se decide a regular de forma coordinada una materia tan sensible a la historia y a la cultura jurídica de cada uno de los Estados miembros tendiendo hacia su homogenización. Realmente la Directiva de 2019 marca un momento histórico, pues la Unión Europea contribuye por primera vez en este campo al logro de un mejor funcionamiento del mercado interior evitando a la vez los obstáculos al ejercicio de las libertades fundamentales que resultan de las regulaciones, tan dispares, de los Estados miembros. Concretamente, la Unión Europea se preocupa por la incertidumbre que genera la dispersión normativa sobre la materia de insolvencia y pre-insolvencia en el seno comunitario. Considera que esas divergencias normativas entre los entre los Estados miembros se traducen en costes adicionales para los inversores, que tendrán que evaluar, por ejemplo, el posible riesgo de que sus deudores vayan a sufrir dificultades financieras en uno o más Estados miembros. Y es aquí, en la

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<sup>2</sup> Resolución legislativa del Parlamento Europeo, de 28 de marzo de 2019, sobre la Propuesta de Directiva del Parlamento Europeo y del Consejo sobre marcos de reestructuración preventiva, segunda oportunidad y medidas para aumentar la eficacia de los procedimientos de condonación, insolvencia y reestructuración, y por la que se modifica la Directiva 2012/30/UE (COM(2016)0723 – C8-0475/2016 – 2016/0359(COD)).

cuestión de la incertidumbre, donde la Unión Europea justifica la necesidad de la Directiva, en cuanto observa que esa incertidumbre sí tiene un efecto disuasorio que *obstaculiza la libertad de establecimiento de las empresas* y el fomento del espíritu empresarial, a la vez que *perjudica el funcionamiento correcto del mercado interior*. Esa incertidumbre tiene consecuencias muy perniciosas, sobre todo, para las microempresas y pequeñas y medianas empresas, que no disponen generalmente de los recursos necesarios para evaluar los riesgos en que pueden incurrir cuando llevan a cabo actividades transfronterizas en el mercado interior. El fundamento para esa nueva regulación es el llamado “efecto dominó” de las crisis empresariales en el mercado único, en el que “la insolvencia de un deudor puede conllevar la insolvencia de otros varios eslabones del mercado”<sup>3</sup> en una cadena sin final. En definitiva, todos estamos en el mismo barco: la crisis de unos, afectará tarde o temprano a todos los ciudadanos. Es necesario que el Derecho ofrezca soluciones prácticas eficaces cuanto antes se aprecien signos de alarma.



Hokusai, *Puesta de sol a través del puente Ryogoku desde la orilla del río Sumida, en Onmagayashi* (1830)<sup>4</sup>

Además la Unión Europea observa el rotundo fracaso de las soluciones jurídicas que se han venido dando por los sistemas jurídicos nacionales ante situaciones de insolvencia. Los procedimientos de reestructuración, insolvencia y exoneración de deudas tienen una excesiva duración y tienen costes demasiado elevados. Pasar por uno de los procedimientos actuales de reestructuración de deuda y de concurso (anterior quiebra) es realmente un desafío para quien sigue esa senda.

<sup>3</sup> Así, el Considerando (11) de la Directiva establece que “los obstáculos al ejercicio de las libertades fundamentales no se limitan a las situaciones de naturaleza estrictamente transfronteriza. Un mercado interior cada vez más interconectado, en el que las mercancías, los servicios, los capitales y los trabajadores circulan libremente, y con una dimensión digital cada vez mayor supone que muy pocas empresas son estrictamente nacionales si se tienen en cuenta todos los elementos pertinentes, como la clientela, la cadena de suministro, el ámbito de actividad, los inversores y el capital. Incluso las insolvencias estrictamente nacionales pueden incidir en el funcionamiento del mercado interior a través del denominado «efecto dominó» de las insolvencias, mediante el cual la insolvencia de un deudor puede dar lugar a la insolvencia de otros eslabones de la cadena de suministro”, llegando a todas las capas sociales sin excepción.

<sup>4</sup> Hokusai, K., *Puesta de sol a través del puente Ryogoku desde la orilla del río Sumida, en Onmagayashi* (1830). File:Sunset across the Ryogoku bridge from the bank of the Sumida river at Onmagayashi.jpg. (2014, July 24). *Wikimedia Commons, the free media repository*. Retrieved 21:04, May 24, 2019 from <https://commons.wikimedia.org/w/index.php?title=File:Sunset across the Ryogoku bridge from the bank of the Sumida river at Onmagayashi.jpg&oldid=129772361>.



Hokusai, *Puente colgante* (1830)<sup>5</sup>.

La imagen de Hokusai de unas personas cruzando el puente colgante es muy expresiva de la realidad actual ante estos procedimientos todavía vigentes. En total contraste, la Directiva comunitaria de 2019 diseña un marco preventivo para la reestructuración financiera cuando la insolvencia sea inminente, para garantizar la viabilidad del deudor y establece una serie de medidas que aumentarán en todos los Estados miembros la eficiencia de los procedimientos de reestructuración, insolvencia y exoneración de deudas.

### 3. Medidas propuestas en la Directiva

La Directiva de 2019 procura que no se vean afectados ni los derechos fundamentales de los trabajadores ni sus libertades. Entiende que es esencial un mayor grado de armonización de materia de reestructuración e insolvencia para conseguir una mayor resiliencia de la economía europea y especialmente para la creación y el mantenimiento de los puestos de trabajo. En lo que respecta a los trabajadores, la Directiva trata de reforzar su apoyo de modo que los Estados miembros velen por que se permita a los representantes de los trabajadores acceder a información pertinente y actualizada sobre la disponibilidad de herramientas de alerta temprana, gocen de información sobre la propuesta de plan de reestructuración a fin de que puedan efectuar una evaluación en profundidad de las distintas posibilidades y se preste asistencia a los representantes de los trabajadores a la hora de evaluar la situación económica del deudor. Los Estados miembros podrán excluir los créditos de los trabajadores del ámbito de aplicación de los marcos de reestructuración preventiva. Con el punto de mira en los trabajadores, se diseñan *medidas preventivas*.

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<sup>5</sup> Hokusai, K., *Puente colgante* (1830). *The Suspension Bridge on the Border of Hida and Etchū Provinces (Hietsu no sakai tsuribashi)*, from the series *Remarkable Views of Bridges in Various Provinces* (Shokoku meikyō kiran). The Met. <https://www.metmuseum.org/art/collection/search/53192>



Hokusai, *Tormenta debajo de la cumbre* (1830)<sup>6</sup>

En lugar de que el camino sea el seguido hasta ahora, en que la insolvencia lleva a la liquidación de la empresa, se abre una nueva vía: se tiende a favorecer planteamientos que tengan por objeto la *recuperación* de la empresa o de sus unidades económicamente viables. Tan pronto como se observen signos de *alarma o de alerta* deberán ponerse en marcha los mecanismos *preventivos* previstos para evitar la insolvencia y el concurso.

La reestructuración permitirá a los deudores en dificultades financieras *continuar* con su actividad empresarial, en su totalidad o en parte, modificando la composición, las condiciones o la estructura del activo y del pasivo o de cualquier otra parte de su estructura de capital, por ejemplo, en su caso mediante la venta de activos o de parte de la empresa.



Hokusai, *Rueda Hidráulica* (1830)<sup>7</sup>

La Directiva ofrece pues *un puente* para que las medidas de reestructuración permita superar la etapa de peligro de la insolvencia y la crisis económica.

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<sup>6</sup> Hokusai, *Tormenta debajo de la cumbre* (1830), File:Lightnings below the summit.jpg. *Wikimedia Commons, the free media repository*. Retrieved 20:24, May 24, 2019 from [https://commons.wikimedia.org/w/index.php?title=File:Lightnings\\_below\\_the\\_summit.jpg&oldid=72583332](https://commons.wikimedia.org/w/index.php?title=File:Lightnings_below_the_summit.jpg&oldid=72583332).

<sup>7</sup> La xilografía de Katsushika Hokusai *Rueda Hidráulica* o *Molino de agua japonés en Onden* (hacia 1830) en que los operarios siguen trabajando puede ayudarnos a recordar la continuidad de la empresa y del mantenimiento de los puestos de trabajo durante la sustanciación de los nuevos procedimientos preventivos y ante la insolvencia inminente que instaura la Directiva de insolvencia de 2019. File:Watermill at Onden.jpg. (2015, May 6). *Wikimedia Commons, the free media repository*. Retrieved 19:40, May 24, 2019 from [https://commons.wikimedia.org/w/index.php?title=File:Watermill\\_at\\_Onden.jpg&oldid=159996240](https://commons.wikimedia.org/w/index.php?title=File:Watermill_at_Onden.jpg&oldid=159996240).



Hokusai, *Bajo el puente Mannen en Fukagawa* (1832)<sup>8</sup>

En conclusión, los marcos de reestructuración preventiva permitirán, ante todo, la *reestructuración efectiva de los deudores en un momento temprano y evitar la insolvencia*, limitando la liquidación innecesaria de empresas viables. Con las nuevas medidas se ayudará a evitar la pérdida de puestos de trabajo y de conocimientos y competencias y se maximizará el valor total para los acreedores en comparación con lo que habrían recibido, por ejemplo, en caso de liquidación de los activos de la empresa. Todo ello será en beneficio de la empresa, de sus acreedores, de sus socios, de sus trabajadores y de la economía en su conjunto”.

La Directiva también atiende a la situación de los empresarios *de buena fe* insolventes o sobreendeudados, que podrán gozar de la total exoneración de deudas, acogidos pues a una “*segunda oportunidad*”. Tras la tormenta, siempre que su conducta haya respetado las reglas de la buena fe, podrán ver sus deudas exoneradas y podrán “recomenzar” “desde cero”, “en limpio”, “sobre blanco” y sin el lastre de sus deudas anteriores.



Hokusai, K., *Casa de Té en Koishikawa. La mañana después de una Nevada* (hacia 1830)<sup>9</sup>

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<sup>8</sup> Katsushika Hokusai, *Bajo el Puente Mannen en Fukagawa* (1832), File:Watermill at Onden.jpg. (2015, May 6). *Wikimedia Commons, the free media repository*. Retrieved 19:40, May 24, 2019 from [https://commons.wikimedia.org/w/index.php?title=File:Watermill\\_at\\_Onden.jpg&oldid=159996240](https://commons.wikimedia.org/w/index.php?title=File:Watermill_at_Onden.jpg&oldid=159996240).

<sup>9</sup> Hokusai, K., *Casa de Té en Koishikawa. La mañana después de una Nevada* (hacia 1830). File:Tea house at Koishikawa. The morning after a snowfall.jpg. (2019, February 26). *Wikimedia Commons, the free media repository*. Retrieved 20:09, May 24, 2019, [https://commons.wikimedia.org/w/index.php?title=File:Tea\\_house\\_at\\_Koishikawa\\_The\\_morning\\_after\\_a\\_snowfall.jpg&oldid=340606293](https://commons.wikimedia.org/w/index.php?title=File:Tea_house_at_Koishikawa_The_morning_after_a_snowfall.jpg&oldid=340606293).



Y por fin, se diseñan en la Directiva unos *procedimientos* de reestructuración y de exoneración de deudas más eficaces y más ágiles que los que hay hasta ahora en los sistemas jurídicos de los Estados miembros.

#### 4. Conclusión

La nueva Directiva de insolvencia de la Unión Europea de 2019 alienta la *cultura del rescate* de las empresas y particulares inmersos en una situación de oleaje de dificultades financieras, para permitir su reestructuración temprana, mientras se mantiene su actividad y evitando el concurso. Con la batería de medidas propuestas por la Unión Europea, que los Estados miembros deberán incorporar a sus Derechos internos, se aportará transparencia, seguridad jurídica y previsibilidad en la Unión Europea en beneficio de todos. Que los alumnos preuniversitarios de asignaturas económicas y jurídicas puedan conocer, aunque sea someramente, las propuestas de la normativa comunitaria y que puedan recordar, a través del recurso al arte, en este caso de Hokusai, de forma duradera, crítica y sencilla, la existencia de estas medidas legales, su contexto y su importancia, supone una innovación docente original en un campo como el jurídico en el que no se suele acudir a este medio y que puede propiciar un avance en la docencia del Derecho de las crisis de empresarios y particulares.

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## Participación activa de las y los estudiantes en el diseño de su aprendizaje. Una experiencia educativa en Trabajo Social

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### Resumen

*Se presenta una reflexión teórico-práctica sobre experiencias docentes metodológicas y de aprendizaje en el Grado en Trabajo Social de la Universitat de València basadas en las teorías del aprendizaje significativo de Ausebel, del aprendizaje social de Bandura o Vigosky y las propuestas de intervención Social de Ander-Egg y De Robertis, comunidades de aprendizaje, Aprendizaje Servicio e Investigación-Acción Participativa. En las conclusiones se presentan algunas implicaciones para la docencia universitaria y para futuras investigaciones.*

**Palabras clave:** *innovación docente, aprendizaje significativo, metodología docente universitaria, competencias de aprendizaje*

### 1. Introducción

Los cambios producidos en el contexto del EEES (Espacio Europeo de Educación Superior) se han dirigido hacia un proceso de enseñanza-aprendizaje cuyo centro de atención es el alumnado. En este sentido, dicho proceso constructivista se ha orientado a las percepciones, preferencias y concepciones del alumnado sobre la enseñanza y el aprendizaje. En el caso de la disciplina del Trabajo Social, de ella deriva una actividad profesional que tiene por objeto el diagnóstico, la intervención y la evaluación social de las necesidades sociales para promover la resolución de los problemas en las relaciones humanas, el fortalecimiento democrático y la promoción del cambio social para el logro de una sociedad inclusiva y cohesionada. Todo ello hace necesario considerar el contexto social, económico, tecnológico y cultural en el cual se inscribe el Trabajo Social, pues las características de dichos contextos tan diversos deben aplicarse en la formación de las y los futuros profesionales del trabajo social.



Los perfiles de dicha figura profesional están influidos por un conjunto de factores que presentan una relación dialéctica con la sociedad. Por ello, resulta imprescindible incorporar las aportaciones procedentes de las nuevas demandas sociales y de las dinámicas demográficas actuales, favoreciendo una profundización de la reflexión sobre la propia práctica.

El presente estudio analiza y evalúa la experiencia docente de las autoras en cuatro asignaturas de los cursos de segundo, tercero y cuarto del Grado en Trabajo Social de la Universitat de València y que son: Proyectos Sociales, Comunicación Profesional, Trabajo Social con personas con Diversidad Funcional y Trabajo Social en Diferentes Contextos Educativos. Cabe destacar que en todas ellas se incorpora, además y de forma transversal, la perspectiva de género.

La formación académica de las y los trabajadores sociales comprende una dimensión integral que atiende a contenidos disciplinares, competenciales y actitudinales que contribuyen a generar profesionales que no solo sepan hacer, sino que también conozcan la diversidad sociocultural y étnica del contexto en el que van a desempeñarse profesionalmente (tendrán que tratar con grupos diversos) para que sean capaces de analizar críticamente la realidad e intervenir para disminuir las discriminaciones y las desigualdades socioeconómicas.

## **2. Aproximación metodológica y teórica**

La forma en cómo accedemos al conocimiento en las Ciencias Sociales es circular, cada conocimiento se nos presenta de una manera y volvemos a él desde diferentes perspectivas y posiciones, de forma que nunca está cerrado o acabado. Este rasgo característico de las Ciencias Sociales otorga a nuestro trabajo como docentes las dificultades añadidas de la secuenciación de unos contenidos que, en la realidad, se dan todos a la vez, en una o varias dimensiones, pero en un mismo contexto temporal. Una vez somos conscientes de esta premisa epistemológica, tenemos la libertad de articular todos estos conocimientos desde ópticas diferentes y, en función de realidades también diferentes, se adapta el proceso de enseñanza-aprendizaje a un contexto social teniendo en cuenta el grupo, el aula y la materia a impartir.

La experiencia docente a lo largo de siete cursos académicos desde la puesta en marcha del plan de estudios del Grado nos ha permitido identificar qué se va a aprender (además de lo que se describe en las guías docentes de cada una de las diferentes asignaturas) y la pertinencia de que el alumnado participe en el cómo se va a aprender, siendo éste el

protagonista y responsable de su propio aprendizaje. Para ello, comparten sus vivencias y recursos personales y sociales, así como identifican y localizan aquellos recursos disponibles en su entorno social más próximo, compartiéndolos, a su vez, con otros estudiantes. Por ello, resulta imperativo flexibilizar la metodología de enseñanza, pues está en permanente conexión con el contexto y permite que las situaciones que el alumnado experimenta y percibe puedan ser aprovechadas como potencialidades y oportunidades para enriquecer el proceso de enseñanza-aprendizaje.

El objeto de estudio de la investigación ha consistido en el estudio sobre los beneficios en el aprendizaje para los y las estudiantes del Grado en Trabajo Social de la Universitat de València a través de la metodología significativa-social para la asimilación de contenidos. En dicha investigación se ha utilizado una metodología de carácter cualitativo en la que se han aplicado las siguientes técnicas: el análisis documental y bibliográfico sobre pedagogías de aprendizaje; la observación participante realizada en las aulas y en las actividades conexas (jornadas, reuniones) y el análisis de los instrumentos de registro y evaluación aplicados a los y las estudiantes a lo largo de siete cursos académicos en el Grado en Trabajo Social. El periodo de estudio inicia en el curso 2012/13 y finaliza en el curso 2018/19, con una muestra de 278 estudiantes.

Este proceso está basado en las aportaciones de diversos autores y autoras que abarcan tanto pedagogías tradicionales como contemporáneas, y que se combinan con las teorías del aprendizaje significativo de Ausubel y del aprendizaje social de Alfred Bandura o de Vigosky. También incorpora las propuestas metodológicas de intervención Social de Ezequiel Ander-Egg o Cristina de Robertis y otras metodologías como: Comunidades de Aprendizaje, Aprendizaje y Servicio e Investigación Acción Participativa.

Partimos de la premisa de que el alumnado experimenta una serie de vivencias y conocimientos que afectan su aprendizaje y que, además, pueden ser aprovechados para su beneficio. Ausubel resume este hecho de la siguiente manera: "Si tuviese que reducir toda la psicología educativa a un solo principio, enunciaría este: El factor más importante que influye en el aprendizaje es lo que el alumno ya sabe. Averígüese esto y enséñese consecuentemente" (1983:2). Por otro lado, Vygotsky afirmó que "el aprendizaje activa una serie de procesos internos de desarrollo que son capaces de operar sólo cuando el alumno/a está interactuando con personas de su entorno y en cooperación con sus compañeros" (1979: 89).

Las anteriores aportaciones teóricas han cristalizado en la metodología aplicada que aunaría las teorías de estos dos autores y que nosotras la hemos denominado "metodología significativa-social". A modo de ejemplo, en la asignatura de Proyectos Sociales de 3º curso, mediante el aprendizaje significativo logramos que el alumnado se involucre en el proceso de aprendizaje haciéndoles responsables del mismo; que observe y vigile su



entorno; que obtenga información actualizada y la aporte al aula (revisión de prensa y de otros medios de comunicación); que comparta su experiencia y recursos personales y que tenga la oportunidad de participar en eventos y actividades de su entorno sociocultural que puedan estar relacionados con los temarios que se están tratando en el aula. En este caso, el trabajo obligatorio a realizar para superar la asignatura consiste en realizar un Proyecto de Intervención Social. Para ello, desde la primera sesión se crean los grupos de trabajo para facilitar que compartan sus propios recursos personales y sociales, que localicen los que tienen en su entorno social más próximo (y que hasta el momento eran invisibles o pasaban desapercibidos, quizá por que no los habían nombrado o no se habían parado a pensar por que no los habían necesitado). El aula se convierte en un espacio de reflexión que posibilita el pensamiento crítico y creativo. Este fenómeno no se da de manera espontánea, pues hay que posibilitarlo dentro del aula para descubrir al alumnado los beneficios que a las personas nos supone tener información. Todo este proceso está muy relacionado con la metodología Investigación-Acción-Participativa.

Tomas Villasante destaca que uno de los principios freirianos acerca de que nadie puede educar a nadie, ni siquiera a sí mismo, ha de darse en el aprendizaje común mediatizados por el mundo. Es decir, construir espacios creativos en donde todas las personas podamos ir aprendiendo, desde la experiencia que cada cual traiga (Villasante, 2000 y 2008).

### **3. Resultados**

La metodología significativa-social aplicada en las aulas ha desarrollado un enfoque participativo y experiencial y, por tanto, las y los estudiantes han estado en contacto constante con las diversas realidades de su entorno territorial y con las diversidades socioculturales y étnicas de su entorno más próximo. Para promover dicha participación se ha contado con la implicación del propio alumnado en la organización de las sesiones docentes. Por otro lado, también ha sido necesario conocer previamente sus potencialidades, sus recursos y experiencias sociales, es decir, es importante saber quiénes son los y las estudiantes universitarios como sujetos y objetos en su eco-territorio.



*Fig.1 Alumnado de la asignatura Trabajo Social con personas con Diversidad Funcional. Sesión Lenguaje de signos impartida por una alumna del grupo. Curso 2018/19*  
*Fuente: Llum Campos*

En cuanto a las cuestiones metodológicas se utilizan y combinan diferentes estrategias, en función del tipo de actividad, de la secuenciación de la misma, de los contenidos implicados y de los resultados de aprendizaje a obtener. Por ello, la intervención teórica y de exposición por parte del profesorado va a ser mínima en las primeras sesiones. Lo más idóneo es utilizar una metodología grupal y participativa, significativa y experiencial, tanto fuera como dentro del aula. De esta forma, se consigue fomentar las vivencias y experiencias sobre los diversos contenidos de las asignaturas por lo que salir de las aulas y encontrar esa parte significativa que da sentido al aprendizaje de dichos contenidos teóricos y su asimilación posibilita, a su vez, que los conocimientos adquiridos sean más estables y duraderos.

El proceso de aprendizaje se completa con la consulta, estudio de textos y análisis documental (artículos científicos, informes y estudios de casos) que promueven y favorecen una reflexión situada sobre los conceptos estudiados y las perspectivas en el ámbito del desarrollo comunitario y social, así como de las técnicas de investigación aplicadas. De esta forma, se fomenta la creatividad y la aplicación y uso de las nuevas tecnologías, pues está constatado que entre las y los estudiantes el uso de las redes sociales es un elemento fundamental de socialización y comunicación, y no es posible obviar esta realidad.

Como ya se ha indicado, en la mayoría de las sesiones las y los estudiantes se organizan en grupos mixtos (para incorporar la diversidad sexual existente en cada aula), para después realizar una exposición con las conclusiones sobre la temática realizada al gran grupo, o bien, fomentar debates participativos. El alumnado experimenta en el aula una dinámica y forma de trabajar similar a la que sería ideal encontrar en su futuro profesional en el ámbito del trabajo social, donde trabajará como miembro de un equipo interdisciplinar más amplio y con una diversidad de grupos humanos. Como se ha descrito en la introducción, ello está



en consonancia con los perfiles de la figura profesional que está en constatación dialéctica con la sociedad.

Adicionalmente, se fomenta el uso de una metodología participativa que pretende que las y los estudiantes participen de manera activa en el aula. Se estimula su participación para realizar aportaciones y favorecer el diálogo entre iguales y se establecen debates. Todo ello hace imprescindible realizar previamente sesiones para que el alumnado “aprenda a aprender”, realizando diferentes técnicas y dinámicas de grupo que, además, son estrategias claves en la formación de los y las futuros profesionales del Trabajo Social.



*Fig. 2 Alumnado de la asignatura Proyectos Sociales. Sesión de cohesión grupal.  
Fuente: Llum Campos*

Nuestro alumnado se incorpora a la universidad con la competencia adquirida para aprender a aprender, ya que es una de las competencias clave de la LOMCE donde se afirma que aprender a aprender es fundamental para el aprendizaje permanente que se produce a lo largo de la vida y que tiene lugar en distintos contextos formales, no formales e informales. Supone la habilidad para iniciar, organizar y persistir en el aprendizaje. Respecto a las actitudes y valores, la motivación y la confianza son cruciales para la adquisición de esta competencia. Ambas se potencian desde el planteamiento de metas realistas a corto, medio y largo plazo. Al alcanzarse las metas aumenta la percepción de auto-eficacia y la confianza, y con ello se elevan los objetivos de aprendizaje de forma progresiva. Las personas deben ser capaces de apoyarse en experiencias vitales y de aprendizaje previas con el fin de utilizar y aplicar los nuevos conocimientos y capacidades en otros contextos, como los de la vida privada y profesional, la educación y la formación (LOMCE, 2013).

Desde la perspectiva de las y los docentes es necesario destacar el enorme esfuerzo que supone la tarea de diseño, planificación, realización, coordinación con otras asignaturas y evaluación para aplicar con rigor dicha propuesta metodológica de aprendizaje, la cual requiere la interrelación y conectividad de los contenidos de las propias asignaturas con los procedimientos metodológicos para alcanzar los resultados de aprendizaje de cada materia y evaluarlas adecuadamente. En este sentido, se proporciona al estudiantado instrumentos de registro que ayudan tanto a la evaluación docente, como a la autoevaluación de manera

continua y así poder modificar aquellas dinámicas de trabajo que no estén resultando productivas o positivas para el grupo. Se ha diseñado un acta para registrar en cada sesión el funcionamiento del grupo en el espacio de trabajo, su composición y dinámica. El alumnado recoge en ella información de manera clara, fácil de rellenar, se genera reflexión y debate y extraen sus propias conclusiones. Se registra a las personas que han participado en cada sesión y el cumplimiento de objetivos, lo que plantea repensar la operatividad y resultados de los temas abordados y los acuerdos alcanzados, la propuesta de trabajo para la próxima sesión, así como la dinámica en general del equipo.

Dependiendo de la materia, se utilizan también como instrumentos de registro básicos fichas de registro de las actividades realizadas y una ficha de entidades, que diseñarán según las necesidades cada grupo, se proporcionan algunos ejemplos pero han de adaptar y crear sus propias fichas donde recogen los datos pertinentes para cada caso. En ella incluyen además de los datos generales de la entidad un apartado con las observaciones de información que esta entidad a proporcionado a su trabajo, como se ha establecido el contacto, el proceso y la dinámica de la colaboración generada, así como la evaluación de la experiencia.

Los resultados de aprendizaje consiste en que: el alumnado aprende a sistematizar el trabajo a través de la utilización de los diferentes instrumentos de registro planteados y aprende a definir qué información es relevante. Por otro lado, para el profesorado aporta información cualitativa sobre sus motivaciones para hacer la actividad, el crecimiento personal y la evolución hacia lo profesional en una secuencia desde la primera a la última acta, así como de las expectativas previas a la experiencia vivida en el aula y sus valoraciones respecto al resultado final. También aporta información que nos ayuda a evaluar y analizar los vínculos y las relaciones establecidas antes y después. Con esta información diseñamos indicadores para la evaluación final de su trabajo y de la propia materia impartida y se realizan conjuntamente propuestas de mejora que se tendrán en cuenta para el futuro.

En la aplicación de esta metodología se es consciente de que no todas las materias del Grado permiten el uso de la metodología planteada, sobre todo aquellas que requieren de unos conocimientos previos teóricos, históricos o de conocimiento legislativo entre otros. A partir de transmitir al alumnado la base del conocimiento científico-teórico es más fácil participar. Si el estudiantado cuenta con una información de partida la puede ampliar, sistematizar, comparar, abstraer y alcanzar sus propias conclusiones para las materias más prácticas donde se aplica la metodología propuesta.

De forma sintética, los principales resultados obtenidos tras la aplicación de las técnicas de investigación descritas han sido los siguientes:

Se ha constatado la significativa motivación del alumnado por la experiencia vivencial obtenida en cada una de las sesiones. En su gran mayoría, han valorado positivamente la

forma en la que han adquirido el conocimiento. A diferencia de otras metodologías, en la que se ha estudiado se han adquirido los contenidos de forma compacta, cada elemento está relacionado con otros, como en una gran red o sistema. En concreto, los estudiantes obtienen un gran mapa conceptual relacionado, más que una serie lineal y estática, porque la realidad social no es lineal ni estática, sino multiforme y dinámica.

Los resultados indican que es más importante considerar los contenidos procedimentales referidos a cómo han asimilado la metodología propuesta y, al mismo nivel, las actitudes que el alumnado ha adquirido en su proceso de maduración y evolución personal y académica. En este sentido, los resultados de aprendizaje son muy positivos, pues se ha demostrado el logro, en un porcentaje elevado (96% de los 278 estudiantes analizados), de adquisición de las competencias generales contempladas en el plan de estudios del grado, y que son básicas para devenir un buen profesional del Trabajo Social: 1) Capacidad para trabajar y valorar de manera conjunta con personas, familias, grupos, organizaciones y comunidades sus necesidades y sus circunstancias. 2) Capacidad para planificar, implementar, revisar y evaluar la práctica del Trabajo Social con personas, familias, grupos, organizaciones, comunidades y con otros y otra profesionales. 3) Capacidad para apoyar a las personas para que sean capaces de manifestar las necesidades, puntos de vista y circunstancias. 4) Capacidad para actuar en la resolución de las situaciones de riesgo con las personas así como para las propias y las de las y los colegas de la profesión. 5) Capacidad para administrar y ser responsable, con supervisión y apoyo de la propia práctica dentro de la organización y, por último, 6) Capacidad para demostrar competencia profesional en el ejercicio del Trabajo Social.

Todas estas competencias generales están vinculadas a la competencia transversal y a todas las materias del título y que es la relativa a la capacidad para transmitir y potenciar la igualdad de oportunidades, la accesibilidad universal a los derechos humanos de mujeres y hombres, los valores de democracia y paz y la sostenibilidad. (Memoria de verificación del título oficial de Grado: Graduado en Trabajo Social, Universidad de Valencia, 2011).

#### **4. Conclusiones**

Las conclusiones de la investigación que se presenta tienen la consideración de aproximaciones al objeto de estudio, pues la obtención de conclusiones de mayor alcance requeriría de la utilización de un mayor número de técnicas de investigación y de la ampliación de la muestra. Aún así, los resultados de esta investigación demuestran la pertinencia de seguir impulsando este tipo de metodologías para poder avanzar en la mejora del proceso de enseñanza-aprendizaje y contribuir, además, al desarrollo de habilidades y

capacidades en el alumnado para su futuro desarrollo profesional en una sociedad cambiante y diversa. La adquisición de éstas favorece su contribución a la transformación social y a la reducción de las desigualdades, siendo capaces de transferir lo aprendido al campo profesional donde seguirán sumando experiencias que favorezcan la reorganización de su pensamiento, la adaptación de sus actuaciones y la incorporación de otras habilidades para ejecutar eficientemente sus intervenciones. Es decir, la adquisición de capacidades y habilidades para un aprendizaje continuo a lo largo de toda la vida.

La neuroeducación, como aplicación de la neurociencia en el ámbito de las aulas, nos dice que el gran cambio está en las emociones, en cómo el alumnado vive y experimenta su proceso de aprendizaje. La metodología propuesta motiva a las y los estudiantes al trabajo en el aula, pero también al profesorado al comprobar que somos responsables de generar emociones positivas en este espacio de aprendizaje, obteniendo así un aula con un ambiente colaborativo y donde el alumnado muestra una respuesta positiva ante la propuesta metodológica de trabajo donde ellos y ellas son, a su vez, responsables de crear un ambiente de motivación y de trabajo donde se valora su autoaprendizaje. De esta forma, el profesorado nos sorprende, aprendemos del alumnado y mostramos interés, nos motivamos orientándoles en el proceso pero, a la vez, aceptando sus propuestas e ideas lo que favorece procesos de empoderamiento y de generación de la seguridad en la toma de decisiones, que constiyuyen características básicas para su futuro profesional y personal.

Consideramos que nuestra profesión, como docentes de educación superior, impacta en la comunidad estudiantil universitaria en dos vías: por un lado, en la formación de alta calidad de las y los futuros profesionales del Trabajo Social o investigadores sociales. Y, por otro lado, en la generación de estudiantes dotados de una conciencia crítica y comprometidos con su entorno y, por tanto, con los valores de solidaridad, cooperación y justicia social. Forma parte de los principios éticos y morales contribuir a la mejor formación profesional de los y las estudiantes para que puedan impulsar los cambios necesarios para conformar sociedades más justas, inclusivas y democráticas.

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# Selección de Aplicación para Gamificación en una Asignatura de los Grados en Ingeniería Eléctrica y Electrónica Industrial y Automática

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## **Resumen**

*Debido al gran número de beneficios que reporta, el número de aplicaciones para gamificación se ha incrementado considerablemente desde 2002. Por ello, la selección de la aplicación idónea a emplear en una asignatura universitaria de grado se ha vuelto más compleja. Esta contribución pretende ayudar en esta toma de decisiones proponiendo un modelo objetivo elaborado mediante Measuring Attractiveness by a Categorical Based Evaluation Technique (MACBETH). Este modelo se ha aplicado a una asignatura de los grados en Ingeniería Eléctrica e Ingeniería Electrónica Industrial y Automática de la Escuela Técnica Superior de Ingenieros Industriales de Ciudad Real, empleándose como centro decisor uno de los profesores de la asignatura. El modelo emplea diez criterios de decisión dispuestos en una estructura jerárquica. Para cada criterio, a partir de una matriz de comparaciones por parejas construida a partir de los juicios emitidos por el centro decisor, se obtiene mediante programación lineal una función de valor. Mediante la aplicación de la metodología MACBETH, y con la ayuda del software M-MACBETH, que emplea un método simple aditivo, se obtiene una clasificación completa de las diferentes aplicaciones para gamificación evaluadas.*

**Palabras Claves:** Gamificación, Toma de decisiones, MACBETH.

## **1. Introducción**

Frente al modelo tradicional de enseñanza basado en la lección magistral y actitud pasiva de los estudiantes, las nuevas tendencias en educación defienden metodologías activas y participativas de los estudiantes (Corchuelo-Rodríguez, 2018). En este sentido, la gamificación se muestra como una herramienta que adapta las mecánicas y elementos del



juego a la educación (Rodríguez & Santiago, 2015). Los beneficios de aplicar gamificación a docencia son numerosos (Hurtado, 2017): incrementar la implicación y motivación de los participantes, integrar teoría y práctica, la retroalimentación es inmediata por lo que errar motiva a volver a intentarlo, hacer divertido el aprendizaje de conceptos o materias difíciles, mejorar dinámicas de grupo, promover una competitividad sana, aumentar el empleo de la creatividad, desarrollar las competencias digitales, ayudar en la resolución de problemas, promover la interacción con otros estudiantes, incrementar el interés por participar en las aulas, etc. Además, la gamificación evalúa al estudiante de una forma innovadora ya que permite valorar el alcance del conocimiento durante el proceso de aprendizaje y no solamente aportar una calificación final (Acuña, 2018).

Existe numerosas contribuciones que muestran experiencias positivas en el uso de gamificación en asignaturas universitarias, entre ellas se encuentra la desarrollada por Serna, Mauricio, San Miguel y Megías, (2016) que aplicaron gamificación a los estudiantes de Grado de Odontología de la Universidad de Valencia y, como resultado, apreciaron que al 97,30% de los estudiantes les había ayudado a entender mejor los conceptos, el 95,95% expusieron que era más fácil mantener la atención que si se utilizasen clases teóricas/prácticas tradicionales y, el 83,78% apoyaron el hecho de que repasar la materia en grupo había sido más provechoso que hacerlo de forma individual. Corchuelo-Rodríguez (2018) la aplicó entre 89 estudiantes de pregrado de la Universidad de La Sabana empleando ClassDojo, Kahoot! y Educaplay; se aprecia que el 96,2% de los estudiantes considera que es útil, así como la aceptación positiva de los estudiantes es del 89%; además, el 88% de los encuestados indicó que es una metodología motivante. Morís (2017) describe su experiencia en la asignatura Fundamentos Biológicos del Lenguaje del Grado en Logopedia de la Universidad de Oviedo, en la que empleó Kahoot! y, posteriormente efectuó una encuesta para conocer el grado de satisfacción de los estudiantes. Entre los resultados se puede destacar que se había adquirido, con respecto a una clase expositiva clásica: más conocimiento (62,50%), mayor motivación (91,67%), superior cooperación entre alumnos (70,83%), más interés en asistir a clase (75,00%), o una valoración global buena de las clases con tecnologías innovadoras (83,33%). Sin embargo, hay que cuidar el diseño, planeación e implementación de la estrategia de gamificación ya que por ejemplo en la experiencia en la Universidad de Barcelona Taller de creación de JOCS, los estudiantes disminuyeron su nivel académico en la asignatura (Corchuelo-Rodríguez, 2018).

Además, la gamificación ya se encuentra presente en grandes empresas como SEAT, KPMG, Chiesi y Novartis. Así se ha contabilizado que un 55% de las compañías más empleadoras en España ha implantado metodologías relacionadas con la gamificación (Martínez, 2016). Este empleo se ha efectuado en marketing, recursos humanos, destinado a la formación de trabajadores o altos directivos, o en la gestión de las

relaciones con los clientes. Por tanto, para los estudiantes universitarios supone un gran avance conocer estas metodologías que también estarán presentes durante su futuras actividades laborales.

Todos estos beneficios y éxitos en su aplicación han hecho que se incremente considerablemente el número de aplicaciones destinadas a gamificación, así se pueden encontrar las siguientes: Arcademics, Brainscape, Knowre, Cerebriti, Minecraft: Education Edition, Pear Deck, Kahoot!, Edmodo Gamificación, CodeCombat, ClassDojo, Triventy Genially, Quizlet, Toovari, The World Peace Game, Play Brighter, Quizizz, Classcraft, Trivinet, etc. (Educación 3.0, 2018). Este número de aplicaciones se prevé que se incrementará en el futuro (Rodríguez & Santiago, 2015). El gran número de aplicaciones dificulta la elección de la más idónea para una asignatura. Por tanto, en esta contribución se ha desarrollado un modelo multicriterio mediante la metodología *Measuring Attractiveness by a Categorical Based Evaluation Technique* (MACBETH) para la selección de la aplicación para gamificación más conveniente destinada a la asignatura Sistemas de Fabricación y Organización Industrial, destinada en concreto al bloque de Organización Industrial de los grados en Ingeniería Eléctrica e Ingeniería Electrónica Industrial y Automática impartidas en la ETS Ingenieros Industriales de Ciudad Real.

## **2. Modelo para la selección de aplicación para gamificación en una asignatura de los Grados en Ingeniería Eléctrica y Electrónica Industrial y Automática**

### **2.1. Metodología MACBETH**

La metodología MACBETH fue creada por Bana e Costa y Vansnick (1997) y permite evaluar las alternativas a partir únicamente de juicios cualitativos sobre la diferencia de atractivo entre dos elementos. Además, facilita una toma de decisiones objetiva para lo que requiere una serie de pasos como la definición de indicadores asociados a cada criterio, definición de niveles de escala para cada indicador que faciliten la evaluación de las alternativas, construcción de funciones de valor que garanticen una comparación de los criterios en una escala común, validación de las asignaciones a efectuar en cada alternativa y garantiza que los juicios empleados en la metodología son consistentes. Además, la técnica dispone para su aplicación del software M-MACBETH.



## 2.2. Estructuración

Como centro decisor se ha empleado uno de los profesores de la asignatura.

Para cada criterio se ha definido un descriptor, que permitirá valorar las alternativas en cada criterio a partir del establecimiento de varios niveles de escala. Dentro de los niveles de escala se deben identificar dos niveles de referencia: neutro (N), calificado por el decisor ni satisfactorio ni insatisfactorio, y bueno (B) que es considerado por el decisor un nivel completamente satisfactorio (Bana e Costa & Chagas, 2004). En esta investigación se han empleado descriptores contruidos, que son aquellos elaborados a partir de combinaciones de estados de varios niveles de escala.

Después de analizar la literatura sobre gamificación, se han establecido los siguientes criterios de decisión:

- Calidad de la biblioteca de preguntas y foro de experiencias (C1). Se evalúa si la aplicación dispone de una biblioteca con calidad y cantidad de cuestionarios públicos disponibles para su utilización, así como que los cuestionarios puedan compartirse, duplicarse y editarse. Se considera también la posibilidad de disponer de un foro activo en la red que intercambio de experiencias e información
- Capacidad de competición por equipos (C2). Analiza la opción de interactuar en equipos en el desarrollo de cuestionarios, permitiendo la competición en modo pizarra.
- Capacidad para aplicar *Just-in-Time-Teaching* (JITT) (C3). Se evalúa la posibilidad de efectuar un JITT débil (preguntas abiertas sobre estudio previo, preguntas sobre lo que se comprende o no y sobre lo que insistir o reforzar), así como el JITT fuerte (preguntas cerradas, directas a comprobar el conocimiento sobre contenidos, para evaluarlos).
- Control del ritmo de cumplimentación del cuestionario (C4). Se analiza si el ritmo de cumplimentación del cuestionario por el estudiante puede ser controlado por el profesor que dispone de las opciones de marcar un tiempo límite o que cada alumno pueda cumplimentar el cuestionario a su ritmo con un tiempo ilimitado y el número de veces que quiera (no hay que esperar las respuestas de los demás).
- Elementos de gamificación (diversión) con impacto/motivación en el alumnado (C5). Se evalúa la capacidad de la aplicación de incluir elementos de gamificación propios de juegos, como por ejemplo que cada estudiante pueda desarrollar su propio avatar o hacer uso de los que dispone la aplicación, mensajes de ánimo y apoyo (memes), posibilidad de añadir imágenes, embeber videos de Youtube o añadir música a las preguntas, además, se muestra una clasificación final de participantes divertida
- Flexibilidad en la creación de cuestionarios (C6). Se evalúan la flexibilidad de las aplicaciones para poder incluir diferentes tipos de preguntas (verdadero/falso, preguntas cortas, etc.), posibilidad de puntuar cada pregunta de forma independiente, número de respuestas con cada pregunta, opción de incluir preguntas con imágenes o videos.

- Obtención de resultados e informes (C7). Se evalúa la capacidad de obtener informes así como de mostrar resultados de los participantes durante el juego. La opción de ocultar nombres se ha considerado ya que en algunos casos, los estudiantes prefieren que no se conozcan los resultados obtenidos por cada uno.
- Valoración de las preguntas del cuestionario (C8). Se evalúa si el profesor puede asignar una puntuación independiente a cada pregunta o bien, se valora cada pregunta en función del número de aciertos, tiempo empleado a contestar, etc.
- Versatilidad de utilización en clase mediante dispositivos informáticos y necesidad de equipos auxiliares (C9). Se analizan la versatilidad de aplicación en clase a través de diferentes dispositivos como móvil, tablet o portátil y la necesidad de equipos auxiliares para el lanzamiento de cuestionarios como por ejemplo videoproyectores.
- Limitaciones en las versiones gratuitas (C10). Se analiza el número de usuarios que pueden desarrollar una actividad simultáneamente y las funcionalidades que no se incluyen en las versiones gratuitas. Puesto que la asignatura cuenta con unos 70-80 alumnos por curso académico, al ser común a dos grados, este criterio es relevante ya que garantizaría poder efectuar los cuestionarios entre todos los estudiantes matriculados y además no tener problemas por la restricción de funcionalidades en la versión gratuita.

En la Tabla 1 se muestra, a modo de ejemplo, el descriptor asociado al criterio Limitaciones en las versiones gratuitas. La estructura jerárquica del problema se muestra en la Fig. 1.

**Tabla 1. Descriptor del criterio Limitaciones en las versiones gratuitas.**

Nivel de escala	Descripción
N1 (Bueno)	No se limita el número de usuarios por sesión ni las funcionalidades de la aplicación.
N2	No se limita el número de usuarios por sesión aunque presenta funcionalidades limitadas de configuración y acceso a estadísticas de uso.
N3 (Neutro)	No se limita el número de usuarios por sesión pero las versiones de pago ofrecen más utilidades a la hora de organizar, editar y particularizar los cuestionarios.
N4	Se limitan a 50 el número de usuarios por sesión y las versiones de pago ofrecen más utilidades a la hora de organizar, editar y particularizar los cuestionarios. Solo permite lanzar una actividad a la vez.
N5	No hay versiones gratuitas.

*Font: Elaboración propia*

Para construir la matriz de juicios entre los niveles de escala de un descriptor, se solicita al decisor juicios sobre la diferencia de atractivo entre los niveles de C10 (véase la Tabla 1). Cada vez que se incluye una respuesta en la matriz, se testea la consistencia de los juicios anteriores. Se aplica el mismo proceso a cada descriptor.

El software M-MACBETH genera, mediante programación lineal, una función de valor que asigna las valoraciones 0 y 100 a los niveles de referencia del descriptor neutro y bueno respectivamente (Bana e Costa & Chagas, 2004). En la Fig. 2 se muestra la matriz de juicios MACBETH del criterio Limitaciones en las versiones gratuitas y su función de valor.

Todas las matrices de juicios emitidas por el decisor son consistentes. En todos los criterios se han obtenido funciones de valor con escalas numéricas lineales continuas debido a que los descriptores empleados son cualitativos; dichas funciones fueron finalmente validadas.

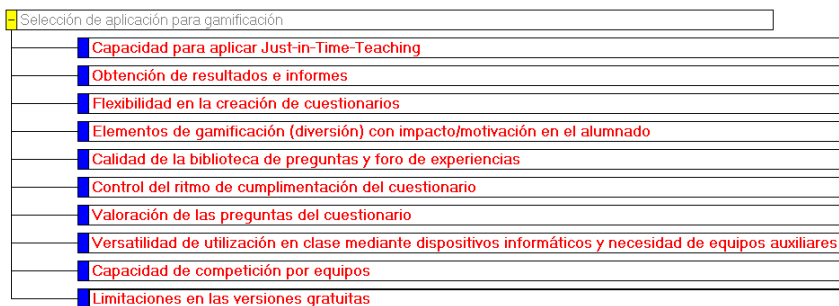


Fig. 1. Estructura jerárquica.  
Fuente: elaboración propia

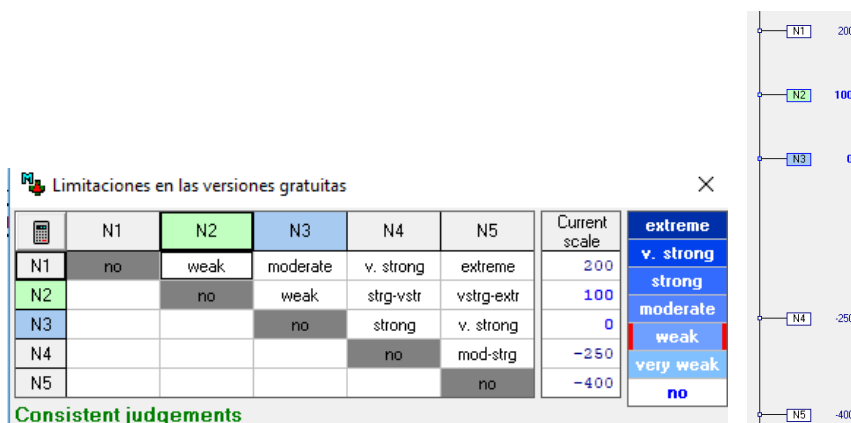


Fig. 2 Matriz de juicios MACBETH del criterio Limitaciones en las versiones gratuitas y función de valor.  
Fuente: elaboración propia

### 2.3. Ponderaciones

Para obtener la ponderación de los criterios, se definió una alternativa que se encontrase en el nivel neutro en todos los criterios y subcriterios. El decisor fue preguntado, empleando las categorías semánticas MACBETH, el incremento en atractivo global proporcionado por un cambio del nivel neutro al bueno en cada criterio. A continuación el decisor comparó cuanto más preferible era el cambio desde el neutro al nivel bueno en el criterio C5 con respecto al mismo cambio en el criterio C10. Esta comparación se repite entre el criterio C5 y el criterio C8 y así sucesivamente. Los juicios emitidos y las ponderaciones, normalizadas en porcentajes, se muestran en la Fig. 3.

	[C5]	[C10]	[C8]	[C6]	[C7]	[C9]	[C3]	[C1]	[C2]	[C4]	[all low]	Current scale	
[C5]	no	weak	weak-mod	weak	weak-mod	vweak-weak	weak-mod	moderate	strong	strg-vstr	positive	16.92	extreme
[C10]		no	weak	weak	weak-mod	vweak-weak	weak-mod	moderate	strong	strg-vstr	positive	15.38	v. strong
[C8]			no	vweak-weak	weak-mod	vweak-weak	weak-mod	moderate	strong	strong	positive	13.84	strong
[C6]				no	no	no	weak	mod-stg	strong	strong	positive	12.31	moderate
[C7]				no	no	no	weak	mod-stg	strong	strong	positive	12.31	weak
[C9]				no	no	no	weak-mod	mod-stg	mod-stg	strong	positive	12.31	very weak
[C3]							no	weak	weak-mod	mod-stg	positive	9.23	no
[C1]								no	vweak-weak	weak-mod	positive	6.16	
[C2]									no	no	positive	0.77	
[C4]									no	no	positive	0.77	
[all low]											no	0.00	

Consistent judgements

Fig. 3 Matriz de juicios MACBETH para los criterios  
Fuente: elaboración propia

### 3. Resultados

La valoración  $V(A)$  de una alternativa  $A$  se obtiene aplicando la ecuación (1).

$$V(A) = \sum_{i=1}^n w_i v_i(\text{impacto de } A \text{ en el criterio } i) \tag{1}$$

Con  $\sum_{i=1}^n w_i = 1$ ;  $w_i > 0$

$$y \begin{cases} v_i(\text{nivel de impacto con nivel de escala bueno en } i) = 100 \\ v_i(\text{nivel de impacto con nivel de escala neutro en } i) = 0 \end{cases}$$

donde se están considerando  $n$  criterios de decision,  $w_i$  es la ponderación de cada criterio y  $v_i(\text{impacto de } A \text{ en el criterio } i)$  es la valoración de  $A$  en el criterio  $i$ .

Las aplicaciones para gamificación evaluadas son: Kahoot! (K), Quizizz (Q) y Socrative (S). Las valoraciones finales obtenidas son:

$$V(Q) = 0,0616 * 0 + 0,0077 * 100 + 0,0923 * (-233,33) + 0,077 * (-150) + 0,1692 * 100 + 0,1231 * 50 + 0,1231 * 60 + 0,1384 * 50 + 0,1231 * 100 + 0,1538 * 50 = 35,46$$

$$V(S) = 0,0616 * (-133,33) + 0,0077 * 0 + 0,0923 * 100 + 0,077 * 100 + 0,1692 * 0 + 0,1231 * 100 + 0,1231 * 100 + 0,1384 * 0 + 0,1231 * 100 + 0,1538 * (-125) = 19,49$$

$$V(K) = 0,0616 * 100 + 0,0077 * 0 + 0,0923 * (-100) + 0,077 * (-250) + 0,1692 * 0 + 0,1231 * 0 + 0,1231 * 0 + 0,1384 * 0 + 0,1231 * 0 + 0,1538 * 0 = -5,22$$

Por tanto, la aplicación para gamificación idónea propuesta por el modelo es Quizizz.

El análisis de sensibilidad de los resultados muestra que cuando se varían ligeramente las ponderaciones de los criterios hasta valores considerados factibles por el decisor, no se modifica la clasificación de alternativas.

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## Reutilización de componentes en la producción de MOOC: un caso de estudio

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### Resumen

*Los MOOC (Massive Open Online Courses) son un recurso docente potencialmente muy valioso, bien como instrumento en sí o como complemento de la docencia presencial. Uno de sus principales inconvenientes es la dedicación y esfuerzo requerido para el desarrollo de un MOOC de calidad.*

*El número de MOOC que una institución educativa desarrolla con temáticas similares, personalizados para distintas audiencias y contextos se incrementa cada año. Por tanto, cobra importancia la oportunidad de reutilizar componentes de los MOOC ya desarrollados para disminuir el coste y el tiempo de producción de los nuevos MOOC.*

*Dado que es un fenómeno relativamente reciente, no es infrecuente que las instituciones, se planteen esta necesidad de reutilización únicamente a posteriori, cuando surgen las necesidades de nuevos MOOC relacionados o de variantes del inicial. Esto les enfrenta a importantes dificultades, que podrían haberse paliado con un diseño orientado desde el principio a la flexibilidad y la reutilización, adoptando metodologías como las propuestas en este trabajo.*

*Esta orientación a la reutilización puede inspirarse en metodologías desarrolladas en otros ámbitos con ese mismo propósito, como la programación estructurada, la programación modular y más concretamente la programación orientada a objetos.*

*Los componentes de los MOOC cuyo desarrollo consume más recursos son normalmente los vídeos y los test de evaluación. En este trabajo se revisan buenas prácticas de diseño de estos componentes que facilitan su reutilización de forma eficiente.*

*Este trabajo presenta el caso de reutilización de diversos componentes de un MOOC de la plataforma edX dedicado a Sistemas de Información,*





*inicialmente diseñado para una gran diversidad de participantes, cuyos componentes son reutilizados para desarrollar otros dos cursos virtuales: un SPOC (Small Private Online Course) específico para alumnos de ingeniería y un segundo sobre la toma de decisiones empresariales dirigido a personal de administración y servicios de Naciones Unidas (UN).*

**Palabras clave:** MOOC, SPOC, reutilización, metodología, producción.

## **1. Introducción: MOOC una tendencia al alza en los procesos de enseñanza**

Los MOOC (Cursos Online Masivos Abiertos) son herramientas docentes innovadoras que permiten a las universidades contribuir a la enseñanza de calidad de la sociedad, sin restricciones espacio temporales. Básicamente, se dice que un MOOC es abierto porque es accesible a cualquier usuario.

Los MOOC marcan tendencia en el mundo del e-learning y la actividad de creación de MOOC por parte de las universidades va en aumento. Cada vez hay más usuarios de este tipo de cursos, y lo que es más importante, el porcentaje de personas que después de realizar un MOOC están dispuestas a volver a participar en este tipo de cursos va en aumento (Callejo-Gallego & Agudo-Arroyo, 2018).

Los MOOC se diseñan para una audiencia masiva global, pero en muchas ocasiones surge la necesidad de adaptación a contextos específicos, siendo preciso personalizar los MOOC a audiencias determinadas.

Una vez se decide la temática y objetivos del MOOC, el proceso de creación de un MOOC es laborioso, requiriendo gran dedicación y esfuerzo. La elaboración de un MOOC precisa que se planifiquen y diseñen en detalle los distintos componentes que lo constituyen, tales como:

- Vídeos donde se explican los conceptos grabados por el profesor. Estos vídeos son vídeos de corta duración (inferiores a 10-15 minutos) confeccionados con modelos tales como el de busto parlante y/o de pizarra electrónica tipo Khan Academy (Khan Academy Inc, 2019). Una lección está constituida por uno o varios vídeos. Y un conjunto de lecciones constituyen un módulo del MOOC. Las tres fases principales del proceso de elaboración de los vídeos, en términos de consumo de recursos, son: preproducción (planificación y creación del guion), captura (grabación), y procesamiento (postproducción).
- Transcripciones con el guion escrito del vídeo, que contienen el texto escrito de todo lo dicho por el profesor en el vídeo; pueden utilizarse también para el subtítulo.

- Material de apoyo tal como dibujos y transparencias que se utilizan en el vídeo u otros materiales complementarios (otros vídeos, artículos etc.). Requieren mención especial, por su potencial didáctico pero también por el esfuerzo que requieren, los distintos tipos de animaciones, desde las basadas en gráficos móviles a las creadas con software específico de animación (como Goanimate© o Powtoon©). Es aconsejable, que los dibujos y transparencias no contenga mucha información y fuercen al alumno a prestar atención a las explicaciones del profesor para entenderlos (Unidad de Tecnología e Innovación Docente Servicio de Biblioteca Universidad Carlos III de Madrid (UTEID), 2014).
- Actividades de autoevaluación de lecciones (vídeos) o módulos. Para evaluar los vídeos se hacen pequeños test (quizzes) que evalúan la asimilación de los conceptos explicados en la lección. Para los módulos se usa un test que permita valorar el grado de desarrollo y evolución del alumno a lo largo del MOOC. Los quizzes se responden en poco tiempo y en ellos se ofrece varias opciones de respuesta a las preguntas, entre las que se encuentra la respuesta correcta. Los test de módulos son pruebas de evaluación más extensas y complejas que consisten en una serie de preguntas, tareas y/o problemas a resolver, que requieren de mayor análisis y razonamiento para responderlas. Dentro de estos componentes también se pueden incluir ejercicios o asignaciones de proyectos, así como el sistema de corrección utilizado.

La creación de vídeos de calidad requiere el uso de software de edición de vídeo que a menudo es complejo y precisa conocimientos técnicos de grabación de vídeo y de utilización de la línea de tiempo. Recientemente se están desarrollando software y metodologías para facilitar y simplificar el proceso de producción de los vídeos (Bakkay et al., 2019).

La razón por la que los vídeos que constituyen los MOOC son de corta duración (Leton, Durban, D'Auria, & Lee, 2009) es que el tiempo de atención sostenida de una persona no suele superar los 10-15 minutos.

## **2. Reutilización de Componentes: un aspecto clave para la eficiencia**

La personalización de MOOC y las necesidades de adaptación a múltiples entornos precisa el uso de metodologías de producción de contenidos, que al igual que la programación basada en objetos del desarrollo software, minimicen el coste del desarrollo basándose en la reutilización de componentes.

La reutilización de componentes es un elemento clave en la eficiencia de múltiples actividades de los procesos educativos. Cuando aparecieron las plataformas LMS (Learning

Management System) o VLE (Virtual Learning Environment) tal como Moodle, Claroline, Edooome etc, se definieron estándares como SCORM (Sharable Content Object Reference Model) que permitían la creación de SCO (sharable content objects/objetos de aprendizaje) que pueden reutilizarse en diferentes plataformas y contextos. De este modo, componentes de un MOOC que sigan el estándar SCORM pueden transferirse entre plataformas que sigan dicho estándar.

Mediante el uso de recursos de aprendizaje modulares se mejora la actividad educativa de los LMS de recursos en formatos SCORM. Actualmente se habla del diseño instruccional basado en objetos.

Además de construir componentes reutilizables en otras plataformas, puede considerarse la reutilización de componentes desarrollados para la confección de MOOC derivados. A la hora de grabar el vídeo de la presentación, puede ser conveniente segmentarlo y tener en cuenta ciertos aspectos que faciliten la reutilización de los distintos segmentos en futuras adaptaciones del MOOC.

Un caso sería el primer vídeo de la lección 1.1, correspondiente a la presentación del curso donde se incluiría puntos como: presentación del profesorado, objetivos, temario, criterios de evaluación, examen, recursos bibliográficos o videográficos, planificación del curso, calendario/duración, metodología docente, conocimientos requeridos, competencias que adquirirá el alumno, funcionamiento del MOOC, etc.

Este vídeo puede realizarse pensando en la posibilidad de cortar partes del mismo, y que en cualquier momento se pueda cambiar una de las secuencias del vídeo, por ejemplo, con un temario reducido, y que el vídeo pueda tener sentido. Con este enfoque no hay que incluir lista detallada de las partes de la presentación tipo índice, sino que basta con incluir mediante un esquema cronológico o espacial los puntos de la presentación al más alto nivel, con tres componentes estructurales, por ejemplo:

### **“Presentación” → “Programa” → “Evaluación”**

De este modo, en la componente “Presentación” se podría incluir la presentación del profesorado, recursos bibliográficos, conocimientos requeridos, competencias a adquirir y Objetivos; en la parte de “Programa” se incluirían la planificación del curso, duración, temario, metodología docente, y en la “Evaluación” cualquier asunto relacionado con pruebas y ejercicios.

Especialmente en vídeos que utilizan, al menos en parte, el enfoque de “busto parlante”, no es recomendable incorporar posteriormente nuevos segmentos grabados que incluyan el profesor, dada la práctica imposibilidad de igualar vestuario, peinado etc. Por tanto, es recomendable incluir en la grabación adicional diversas variantes (p.ej., diversos inicios y finales), junto con las mini-pausas orientadas a facilitar el ensamblado de distintos vídeos.



Sin embargo, un escenario en el que no es recomendable la reutilización de las secuencias es en el vídeo de presentación, que se difunden fuera del contenido del MOOC, bien en la propia página de introducción (o en la página informativa “A cerca de”) del curso para inscribirse en el curso o en otras plataformas webs como YouTube, redes sociales o webs de la propia universidad etc, ya que ese vídeo tiene un componente publicitario que ha de adaptarse al público objetivo, por lo que en este caso se trata de un vídeo que ha de personalizarse para cada MOOC (Rajas, Puebla-Martínez, & Baños, 2018).

### **2.1. Ideas para la reutilización de vídeos**

El punto clave para la reutilización de vídeos (lecciones) es que cada vídeo solo tenga un objetivo docente y solo explique un único concepto. Esto conduce a que en un MOOC puedan existir vídeos de duración variable (desde menos de 1 minuto hasta 15 minutos si fuera necesario). Los vídeos han ser cortos y concretos.



**Tabla 1. Recomendaciones para facilitar la reutilización de vídeos**

Recomendaciones
Si se plantea una pregunta a la audiencia, incluir la respuesta en el propio vídeo
Si se plantea un ejercicio en el vídeo, incluir la respuesta en el propio vídeo
Vídeo completo independiente con el/los objetivos del curso /modulo / lección
Si se relaciona el tema con un caso de la vida real, que sea adecuado a la audiencia global
Evitar cometarios/referencias relacionando conocimientos previos o lecciones/vídeos anteriores
Vídeo independiente para desglosar los puntos que se desarrollan en el curso / módulo / lección
Evitar evidenciar una sucesión de contenidos o temáticas
Evitar usar expresiones locales o adaptadas a una audiencia concreta.
Mantener el mismo ritmo en los vídeos, evitando sorpresas o puntos de giro narrativos.
Poner ejemplos y referencias de lo que se está hablando en el vídeo (no de otros)
Establecer conclusiones de acuerdo con lo planteado en el inicio del vídeo.
Realizar resúmenes o síntesis de lo abordado en el vídeo ( si es resumen de un conjunto de vídeos/lección, hacerlo en otro vídeo)
Cerrar los vídeos con un mensaje de despedida de “hasta pronto” o “hasta el próximo vídeo” y si se hacen referencias a los ejercicios asociados al vídeo que alumno debería realizar, separar la secuencia claramente para poder cortarla.
Evitar mencionar los puntos que se verán en la siguiente lección o vídeo
Evitar cambios de plano en la cámara entre los distintos vídeos
Mantener el formato del material de apoyo (gráficos, diagramas, dibujos, ppt's etc.) constante a lo largo de todos los vídeos; mismo color de pizarra, mismo tipo de letra, estilo de vestuario del profesor, mismos entorno, mismo tipo de gráficos y colores.
Las imágenes que aparecen en cada vídeo se relacionan con el contenido del mismo ( lección)
Utilizar el número mínimo de imágenes y transparencias/diapositivas , sin saturarlos de texto, solo incluir palabras clave, ideas y conceptos.

Los vídeos han de realizarse lo más independiente posible sin que unos citen a otros vídeos. Hay que evitar expresiones del tipo “como hemos visto en el vídeo anterior...”, “según hemos estudiado en el capítulo...” etc. Además, hay que tratar de mantener el mismo formato en todos los vídeos.

En la Tabla 1 se indican recomendaciones relacionadas con la secuenciación de los vídeos en relación a su estructura narrativa para facilitar la reutilización.

### 3. Caso de Estudio

Se presenta el caso de reutilización del material audiovisual del MOOC “Introducción a los Sistemas de Información Gerencial (SIG): Una guía de supervivencia”. (“Introduction to Management Information Systems (MIS): A Survival Guide”) de la plataforma edX



dedicado a entender los Sistemas de Información Gerencial y el papel que estos desempeñan en las organizaciones de hoy en día.

Este MOOC se diseñó a lo largo del año 2015, la primera edición fue en 2016, destinado a una audiencia diversa con conocimientos básicos de informática a nivel de usuario y con inquietudes sobre conocimientos de gestión empresarial. El curso se planteó con 6 módulos para una duración de 6 semanas, cuya estructura de módulos se muestra en la Tabla 2.

Cada módulo consta de un máximo de 6 lecciones, cada una de las cuales consta de 1 o 2 vídeos. Cada lección incluye un test tipo quiz con 2 a 4 preguntas. Al final de cada módulo se realiza una prueba de evaluación del módulo más extensa.

A partir de este MOOC inicial surgió la necesidad de crear dos nuevos cursos virtuales: uno en versión SPOC (Curso Online Privado Pequeño-Small Private Online Course) específica para alumnos del European Virtual Exchange (EVE) en ingeniería de la Universidad Carlos III en la plataforma de MOOC de la propia universidad (spoc.uc3m.es), basada en Open edX; y un segundo sobre la toma de decisiones empresariales dirigido a otra audiencia tal como el personal de administración y servicios de la Organización de Naciones Unidas (ONU).

### **3.1. Curso virtual EVE**

En el caso del EVE, el ámbito de contenidos a cubrir era análogo al del MOOC original, lo que permitió mantener la estructura básica del curso. Adicionalmente, la similitud de las plataformas (Open edX vs. plataforma edX) permitió la exportación directa de gran parte del contenido.

Fueron necesarias, no obstante, ciertas particularizaciones para adaptar el curso al nuevo ámbito. Una primera diferencia afectaba al público objetivo, restringido, en el caso del EVE, a estudiantes de ingeniería. Una segunda, relacionada, afectaba a la evaluación. Aparte de las implicaciones del cambio en el público objetivo, y a diferencia de los cursos MOOC, el SPOC de EVE conducía a la obtención de créditos formales. La combinación de ambos factores exigió complementar el MOOC original con diversas adiciones. Los cuestionarios sumativos (que repercuten en la evaluación, a diferencia de los formativos, centrados en la autoevaluación) se modificaron para estar basados en librerías de preguntas. De esta forma, a cada alumno se le presentaba una selección al azar de preguntas de la librería, diferente para cada uno, mejorando así la garantía de “originalidad”. Esto se complementaba con la introducción de un examen presencial integrado obligatorio; asimismo, los trabajos asignados en el MOOC se complementaban con un proyecto integrado (“Capstone Project”), cuya realización exigía una comprensión en mayor

profundidad del material presentado, así como recurrir a material adicional que en el MOOC se trataba como opcional.

Adicionalmente, el nuevo entorno y las nuevas reglas exigieron una serie de cambios que, gracias al diseño modular inicial, pudieron compaginarse con la reutilización del material. Así, en parte se plasmaron en el material escrito, tanto el “Syllabus” como las entradillas de texto en html que posicionan y relacionan los vídeos y ejercicios, y que son más fácilmente modificables. En cuanto a los cambios requeridos en los vídeos en sí, la práctica de grabar, desde la primera versión, distintos inicios y finales para cada vídeo permitió minimizar el impacto de los cambios.

Resulta interesante destacar que una parte del trabajo adicional requerido para generar el curso derivado pudo reutilizarse para enriquecer el producto original. Así, el uso de librerías en las preguntas sumativas, si bien no resulta imprescindible en un MOOC no orientado a otorgar créditos (y normalmente los MOOC no lo incluyen), sí supone una mejora útil. Así pues, en este caso, habiendo hecho ya el trabajo, se implantó asimismo en el MOOC abierto.

### **3.2. Curso Information Management para la toma de decisiones (UN)**

El objetivo del segundo curso virtual fue hacer ver al alumno la importancia de los sistemas de información para la toma de decisiones en las organizaciones, ya que no son solo el medio para recolectar, procesar y almacenar los datos que genera la organización en sus operaciones, sino que aportan distintas herramientas que facilitan la realización de un análisis de los datos y la toma de decisiones informadas.

En este caso, a diferencia del anterior, el ámbito de contenidos a cubrir era tan sólo un subconjunto del MOOC original, exigiendo no sólo la selección de un subconjunto de los componentes del MOOC original sino adicionalmente la reconstrucción de los enlaces entre ellos, así como cubrir mínimamente los aspectos introducidos en los vídeos no incluidos a los que se hacía referencia en los vídeos incluidos.

En la grabación del primer MOOC se siguieron las recomendaciones indicadas en la Tabla 1, lo que permitió introducir los cambios necesarios en los vídeos originales, y “reenlazarlos” mediante cuatro nuevos “vídeos de posicionamiento”, con un tiempo neto total de tan sólo 15 minutos de nuevas grabaciones. También se usaron las entradillas de texto.

Tabla 2. Estructura de los módulos del MOOC

	Videos / Script	Tests	Examen/ Proyecto /Trabajo
<b>Módulo 1. SIG. Importancia. Desarrollo o compra</b>			
0. Presentación	0.0 Bienvenida al curso, introducción y estructura		
1.1. La invasión de los Sistemas de Información Cerecial	1.1.1 SIGs: en la frontera entre TI y negocio 1.1.2 No se puede vivir sin SIGs (ni con)	Ejercicio 1.1	Test 1
1.2. Adquisición de SIG	1.2.1 Hacer o Comprar 1.2.2 Subcontratación, deslocalización	Ejercicio 1.2	
1.3. Desarrollo de SIG	1.3.1 Desarrollo de SIG. Metodologías	Ejercicio 1.3	
1.4. Sistemas abiertos. Código abierto	1.4.1 Sistemas abiertos. Código abierto	Ejercicio 1.4	
<b>Módulo 2. La revolución de las comunicaciones – Sistemas de Información Distribuidos</b>			Test 2
2.1. Introducción: Sistemas distribuidos e infraestructura distribuida	2.1.1 Introducción: Sistemas distribuidos e infraestructuras distribuidas	Ejercicio 2.1	
2.2. SI distribuido. Cliente-servidor	2.2.1 SI distribuido. Cliente-servidor de 2 niveles 2.2.2 Cliente-servidor multinivel	Ejercicio 2.2	
2.3. Infraestructuras distribuidas. Redes de telecomunicaciones	2.3.1 Infraestructuras distribuidas. Red de área local (LAN) 2.3.2 Infraestructuras distribuidas. Red de área amplia (WAN)	Ejercicio 2.3	
2.4. La Nube	2.4.1 Nubes privadas 2.4.2 Nubes públicas 2.4.3 Beneficios de nubes privadas, nubes públicas y nubes híbridas	Ejercicio 2.4	
<b>Módulo 3. Datos, Bases de Datos, Big Data</b>			Test 3
3.1. Datos: un ingrediente clave en un SIG	3.1.1 Datos: un ingrediente clave en los SIG (2017_ESP_3_1_Datos: Un ingrediente clave en los SIG)	Ejercicio 3.1	
3.2. Bases de datos, Estructura de la Base de Datos y Sistemas de Gestión de Bases de Datos (SGBD)	3.2.1 Bases de datos, estructura de la base de datos y SGBD 3.3.1 Modelización de datos I. SGBD Jerárquico y relacional (2017_ESP_3_3 Modelado de Datos I. SGBD Jerárquico y Relac)	Ejercicio 3.2	
3.3. Modelización de datos. Bases de datos relacionales	3.3.2 Modelización de datos II. Relaciones. Claves (2017_ESP_3_4 Modelado de Datos II. Relaciones. Claves.)	Ejercicio 3.3	
3.4. Normalización. SQL. Selección de SGBD	3.4.1 Redundancia y Normalización. Papel del SGBD (2017_ESP_3_5_Redundancia y Normalización. Papel del SGBD) 3.4.2 SQL. Selección de SGBD (2017_ESP_3_6_SQL. Elección del SGBD)	Ejercicio 3.4	
3.5. Big Data	3.5.1 Big Data (ESP_3.5.1_Big Data)	Ejercicio 3.5	
<b>Módulo 4. Sistemas de Información Integrados (ERP) y Procesos de Negocio Integrados</b>			Test 4
4.1. Introducción a los Sistemas Integrados de Información (ERP)	4.1.1 Introducción a los Sistemas Integrados de Información (ERP)	Ejercicio 4.1	
4.2. Procesos de Negocio integrados y SI integrados	4.2.1 Procesos de Negocio, Subprocesos y Transacciones de Negocio 4.2.2 Procesos de negocio integrados y multifuncionales y SI integrados	Ejercicio 4.2	
4.3. Estructura ERP: Módulos, Base de Datos común	4.3.1 Módulos ERP semi-independientes 4.3.2 Consecuencias de compartir una Base de Datos Común I 4.3.3 Consecuencias de compartir una Base de Datos común II	Ejercicio 4.3	
4.4. Ventajas y desventajas del enfoque ERP	4.4.1 Ventajas e inconvenientes del enfoque ERP	Ejercicio 4.4	
4.5. Sesión práctica ERP	4.5.1 Sesión práctica ERP I 4.5.2 Sesión práctica ERP II	Ejercicio 4.5	
<b>Módulo 5. Implementación y personalización de ERPs y otros grandes SIGs. ¿Quién se adapta a quién?</b>			Test 5
5.1. Desafíos y enfoques en la aplicación y adaptación de los principales sistemas de información de gestión	5.1.1 Desafíos y enfoques en la aplicación y adaptación de los principales SIGs 5.1.2 ¿Quién se adapta a quién? Introducción	Ejercicio 5.1	
5.2. Adaptación de la práctica actual. Reingeniería de Procesos de Negocio (RPN)	5.2.1 Adaptación de la práctica actual. RPN	Ejercicio 5.2	
5.3. Adaptación del ERP	5.3.1 Elección del ERP. Parametrización 5.3.2 Personalización basada en la codificación	Ejercicio 5.3	
5.4. Implementación del ERP	5.4.1 Enfoques de implementación de ERP: Big Bang, Roll out, Modul 5.4.2 Desafíos y costos de la implementación del ERP	Ejercicio 5.4	
5.5. Post-implementación del ERP	5.5.1 Post-Implementación de ERP: una historia interminable	Ejercicio 5.1	
<b>Módulo 6. SIG en la toma de decisiones</b>			Test 6
6.1. Toma de decisiones	6.1.1 Toma de decisiones. Los que lo hacen, los que deciden	Ejercicio 6.1	
6.2. Sistemas transaccionales vs. Sistemas de Apoyo a la Decisión	6.2.1 La pirámide TPS vs. la DSS	Ejercicio 6.2	
6.3. Retos de los sistemas de apoyo a la toma de decisiones	6.3.1 Obstáculos y enfoques del DSS I 6.3.2 Obstáculos y enfoques del DSS II	Ejercicio 6.3	
6.4. DSS, datos no estructurados y Big Data	6.4.1 DSS, datos no estructurados y Big Data. Análisis	Ejercicio 6.4	
6.5. Una palabra sobre el futuro	6.5.1 Una palabra sobre el futuro: Inteligencia Artificial, Machine Learning...	Ejercicio 6.5	
6.6. Despedida	6.6.1 Despedida	Ejercicio 6.6	



Tabla 3. Estructura de los módulos del curso virtual para UN

	Videos /Script	Tests	Examen/ Proyecto /Trabajo
<b>Módulo 1. SIG. Importancia. Desarrollo o compra</b>			
0 Introducción	0.1 Bienvenida al curso, introducción y estructura		
	0.0 Introducción Conocimientos base TIC		
1.1. La invasión de los Sistemas de Información Gerencial	1.1.1 No se puede vivir sin SIGs (ni con)	Ejercicio 1.1	Test 1
	1.2.1 Datos: un ingrediente clave en los SIG (2017_ESP_3.1_Datos: Un ingrediente clave en los SIG)	Ejercicio 1.2	
1.2. Datos: un ingrediente clave en un SIG			
1.3. Bases de datos, Estructura de la Base de Datos y Sistemas de Gestión de Bases de Datos (SGBD)	1.3.1 Bases de datos, estructura de la base de datos y SGBD	Ejercicio 1.3	
	1.4.1 Modelización de datos I. SGBD jerárquico y relacional (2017_ESP_3.3 Modelado de Datos I. SGBD Jerárquico y Relac)	Ejercicio 1.4	
1.4. Modelización de datos. Bases de datos relacionales			
	1.4.2 Modelización de datos II. Relaciones. Claves (2017_ESP_3.4 Modelado de Datos II. Relaciones. Claves.)	Ejercicio 1.5	
1.5. Big Data	1.5.1 Big Data (ESP 3.5.1 Big Data)	Ejercicio 1.6	
<b>Módulo 2. SIG en la toma de decisiones</b>			Test 2
0 Introducción	2.0 Video Contextual		
2.1 Toma de decisiones	2.1.1 Toma de decisiones. Los que lo hacen, los que deciden	Ejercicio 6.1	
2.2. Sistemas transaccionales vs. Sistemas de Apoyo a la Decisión	2.2.1 La pirámide TPS vs. la DSS	Ejercicio 6.2	
2.3. Retos de los sistemas de apoyo a la toma de decisiones	2.3.1 Obstáculos y enfoques del DSS I	Ejercicio 6.3	
	2.3.2 Obstáculos y enfoques del DSS II		
2.4. DSS, datos no estructurados y Big Data	2.4.1 DSS, datos no estructurados y Big Data. Análisis	Ejercicio 6.4	
2.5 Despedida	2.5.1 Despedida		

Muchos de los componentes del primer MOOC fueron reutilizados, ocasionalmente con cambios menores, para desarrollar los nuevos cursos. En concreto, se utilizó un vídeo del módulo 1, cinco del módulo 3 y cinco del módulo 6, quedando estructurado en una introducción, dos módulos unidos por un nuevo vídeo para poner en contexto al alumno (vídeo contextual) y un vídeo de despedida. En la Tabla 3 se muestran sombreados los nuevos vídeos que se han grabado para realizar este curso virtual.

Se grabaron dos nuevos vídeos para la introducción 4 y 7 minutos, el vídeo contextual que se corresponde con la introducción al segundo módulo (5 min) y el de despedida (2 min).

Los quizzes fueron los correspondientes a los vídeos del primer MOOC, y los cuestionarios de los módulos fueron una selección de preguntas de la librería de preguntas correspondientes a los módulos 3 y 6 del MOOC original. En este caso, la mayor diferencia entre las plataformas (edX vs. Moodle) dificultó el trasvase automatizado de los test de evaluación, lo que llevó al uso de cuestionarios no basados en librerías.

La carga de trabajo que supuso la producción del curso virtual destinado a Naciones Unidas puede estimarse en menos del 10 % de la carga productiva del primer MOOC.

## 4. Conclusiones

Se han recopilado un conjunto de recomendaciones que facilitan la reutilización de los vídeos, con lo que se incrementa la eficiencia del proceso de producción de MOOC. Se ha mostrado un caso que muestra que la reutilización de componentes de un MOOC para producir otros cursos virtuales adaptados a otra audiencia y otros objetivos docentes.

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## Arquitecturas híbridas para el diseño de prácticas docentes con recursos online: un caso de estudio

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### Resumen

*La enseñanza de Sistemas de Información Gerencial (SIG) precisa una metodología activa en la que el alumno utilice y experimente con estos sistemas en entornos similares a la realidad empresarial.*

*Ahora bien, el diseño y desarrollo de prácticas de laboratorio con estos sistemas exige como prerrequisito disponer del correspondiente software, cargado con un conjunto de datos apropiado.*

*En los últimos años, el auge de los sistemas de código abierto y el movimiento hacia la computación en la nube, hacen habitual, por una parte, encontrar en internet “demos” online de libre acceso, o sistemas de prueba con distintos grados de usabilidad, de aplicaciones empresariales. Por otra parte, los sistemas de código abierto permiten, si se dispone de los conocimientos y las plataformas hardware adecuadas, su descarga, instalación y configuración en modo local sin incurrir en coste de licencias.*

*Esto abre un abanico de opciones en cuanto a la arquitectura a utilizar para el diseño de actividades educativas basadas en aplicaciones software, con diferentes ventajas, inconvenientes y requerimientos de recursos.*

*Desde el simple acceso en modo visualización a “demos” existentes en la nube a la descarga y personalización del software en local, pasando por opciones híbridas que combinan estos enfoques en la misma práctica docente.*

*Así, en este trabajo se presentan posibles arquitecturas híbridas para la implantación de actividades docentes de prácticas de laboratorio basadas en la combinación de tareas realizadas en sistemas de libre acceso en la nube y en sistemas implantados localmente.*

*Estos conceptos se ilustran con una experiencia de aplicación de estas arquitecturas híbridas en el diseño de una práctica de laboratorio de la*



*Universidad Carlos III de Madrid basada en aplicaciones de código abierto. Esta experiencia combina un entorno implantado localmente y aplicaciones online en la nube, partiendo del mismo juego de datos en ambos entornos.*

**Palabras claves:** *Prácticas docentes, arquitecturas, Sistemas de Información Gerencial, Odoo.*

## 1. Introducción

Hoy en día pocos dudan de la importancia de las actividades prácticas docentes con ordenador que promueven el aprendizaje activo en la enseñanza. El aprendizaje basado en actividades prácticas constituye un pilar del modelo de enseñanza actual en la educación superior. Los procesos de aprendizaje en el área de ingeniería, un área de la ciencia eminentemente práctica, precisan contar con actividades educativas que permitan la experimentación y la práctica en entornos similares a la realidad empresarial.

Si además se trata de enseñar Sistemas de Información Gerencial (SIG) a futuros ingenieros, también denominados MIS por sus siglas en inglés Management Information Systems, se hace imprescindible plantear prácticas de formación online donde el alumno utilice dichos sistemas en distintos escenarios empresariales.

La tendencia de avance en la adopción de las tecnologías de la información y comunicaciones (TIC) en la educación superior confirma que los estudiantes son cada vez más hábiles en relación a los entornos digitales y más favorables a que la tecnología y formación online ocupe parte de la formación presencial (Adams Becker, S. Cummins, Davis, Freeman, Hall Giesinger, & Ananthanarayanan, 2017).

Las teorías del aprendizaje constructivistas se apoyan en el aprendizaje activo, en el que el aprendizaje consiste principalmente en la construcción de la estructura de conocimiento y posterior refinamiento en la mente del alumno. Las clases en las que los estudiantes construyen su propio aprendizaje son más eficientes en la formación de las actitudes y habilidades que el ingeniero precisa para el desempeño de su profesión (Caro & Reyes, 2003).

En el área de Sistemas de Información para la Gestión empresarial (SIG), este aprendizaje activo se lleva a cabo mediante actividades diseñadas por el docente sobre los propios sistemas, en base a la construcción de entornos simulados y juegos que desarrollan capacidades de manejo y análisis de la información. De este modo, se plantean escenarios del mundo empresarial en los que el alumno ha de enfrentarse a problemas de gestión y toma de decisiones, que posteriormente son objeto de debate en relación al uso de la

información o sobre los que realizan trabajos de análisis crítico sobre las problemas y situaciones planteadas. De este modo, el alumno construye su propio conocimiento sobre la utilidad de los Sistemas de Gestión.

La enseñanza con apoyo de ejercicios prácticos basados en TIC tiene claras ventajas para los alumnos (Marcos Ortega, de Borja Varona, & Manuel Lopez, 2013).

Para plantear la enseñanza como un proceso de descubrimiento y entendimiento por parte del alumno, es fundamental basar el aprendizaje en la realización de ejercicios prácticos que sumerjan gradualmente al alumno en la lógica de dichos sistemas.

Diseñar ejercicios prácticos basados en el uso de la tecnología informática constituye una tarea compleja que requiere tener muy presentes los objetivos docentes.

Según los modelos de diseño instruccional, como el RASE (Churchill, King, & Fox, 2013), se precisa disponer de recursos para diseñar actividades educativas que motiven e involucren alumno. Con estos recursos han de definirse las actividades que posteriormente puedan ser evaluadas para determinar el progreso del aprendizaje y aseguren que el alumno consiga los objetivos docentes planteados.

El diseñador instruccional requiere disponer de las aplicaciones y los conocimientos sobre las mismas que le permitan adaptarlas a los objetivos docentes. Los conocimientos que se requiere son tanto a nivel informático-técnico como a nivel de características y funcionalidades de las aplicaciones. El docente fija los objetivos docentes que quiere transmitir y ha de tener la capacidad para utilizar y manejar el software específico para crear entornos simulados, en los que el alumno pueda experimentar con las aplicaciones y valorar las ventajas e inconvenientes del empleo de las distintas funcionalidades del software.

El diseño de unas prácticas educativas basadas en SIG, adecuadas a los contenidos curriculares, es un proceso complejo y multidisciplinar que requiere tener acceso a los sistemas de información y a los datos correspondientes. Estos datos han de ser adecuados y en consonancia con el escenario simulado sobre el que se plantea la actividad educativa.

Existe gran variedad de tipos de sistemas de información sobre los que se puede plantear docencia: sistemas de información para la gerencia, sistemas de organización industrial, sistemas productivos y logísticos, de gestión de calidad, de gestión de proyectos, sistemas de información geográficos, sistemas de comercio electrónico (eCommerce), bases de datos especializadas, etc. Muchos de estos sistemas son componentes de los llamados ERP (Enterprise Resource Planning), CRM (Customer Relationship Management), ECM (Enterprise Content Management) o BIS (Business Intelligence Systems).

No siempre es fácil disponer de estos sistemas software y de juegos de datos para diseñar y desarrollar prácticas de laboratorio en las que el alumno pueda acceder a las aplicaciones de gestión empresarial en entornos similares a situaciones de la vida real.

En los últimos años, el auge del código abierto ha incrementado la disponibilidad y calidad de aplicaciones de carácter libre gratuito disponibles para ser descargadas e instaladas en un ordenador. Adicionalmente, el movimiento hacia la computación en la nube hace que, en muchas ocasiones, sin necesidad de descarga e instalación, sea habitual encontrar en internet “demos” online, o sistemas de prueba con distintos grados de usabilidad, para distintos ámbitos empresariales, libremente accesibles en las correspondientes nubes.

Muchas instituciones han creado repositorios y portales con material educativo que incluye herramientas software y plataformas on-line creadas con intencionalidad educativa (González Ruiz, Martín Gómez, & Vega Navarro, 2018).

Todo esto posibilita la compartición y adaptación del software para la construcción de actividades docentes, sin que esto suponga coste de licencias de uso (Ecology & For, 2017).

## **2. Arquitecturas**

La enorme disponibilidad de recursos de internet abre un abanico de opciones en cuanto a la arquitectura a utilizar para el diseño de actividades educativas basadas en aplicaciones software con diferentes ventajas e inconvenientes.

Así, en un extremo estaría el simple acceso en modo visualización a “demos” existentes en la nube, donde el alumno tiene una capacidad muy limitada de interacción, y los datos están total o parcialmente predefinidos, lo que dificulta alcanzar los objetivos docentes. Así mismo, estos datos predefinidos pueden ser inicialmente compartidos si, por ejemplo, los alumnos acceden con el mismo usuario (login), o pueden ser datos independientes para cada alumno, aunque estos sean inicialmente iguales para todos, en cuyo caso cada uno tendrá una copia de los mismos datos y podrá modificarlos sin alterar los datos del resto.

En el extremo opuesto, estaría la instalación completamente en local (incluso, en el caso más extremo, instalando determinados módulos o componentes o incluso habiendo modificado parcialmente el código descargado con desarrollos a medida), parametrizada y cargada con datos específicamente generados para alcanzar dichos objetivos. Este extremo requiere el uso intensivo de recursos y exige conocimientos, dedicación y esfuerzo. En este caso se abre la posibilidad a dar al alumno los privilegios que se estimaran oportunos para las actividades que debiera realizar: uso, parametrización, instalaciones, accesos directos a los datos y extracciones a otros sistemas, etc. Este tipo de entornos pueden ajustarse

completamente a los objetivos de aprendizaje, pero requiere disponer de suficientes recursos informáticos, tiempo y conocimiento a nivel local.

Entre estos extremos se sitúan las alternativas intermedias con distintos juegos de datos de prueba personalizados o replicando datos predefinidos del software de la nube en entornos locales. Estas opciones híbridas permiten combinar distintos enfoques en la misma práctica o en un conjunto integrado de éstas, para explotar óptimamente las fortalezas relativas de cada uno.

Como no siempre los datos y aplicaciones disponibles en la nube se adaptan a los objetivos docentes, se precisa una adaptación y personalización de los mismos. Dado que el docente no es el propietario de los sistemas en la nube, no es fácil y a veces inviable, la adaptación de los datos y aplicaciones. Los sistemas disponibles en la nube están diseñados para otros fines, fines comerciales principalmente, que permiten comprobar la calidad de los mismos, alejados del enfoque didáctico que el docente precisa.

Con actividades docentes en entornos híbridos que combinan el acceso a sistemas en la nube y sistemas en local, el alumno no solo practicará con sistemas de información gerencial, sino que también se habituará a trabajar con entornos híbridos, cada vez más comunes en la empresa.

Con objeto de explorar el abanico de arquitecturas para la implantación de actividades prácticas de laboratorio sobre SIG disponibles en internet se plantea un mapa en base a dos dimensiones.

Una primera dimensión determinada por la localización de las aplicaciones y datos (local/nube), y una segunda dimensión con el grado de personalización de estos.

En los entornos de la nube el docente tiene poco control y es difícil que tenga acceso a personalizar los datos y aplicaciones. En la mayoría de los casos el entorno en la nube se ajustará de forma parcial a los objetivos del docente. En los entornos en local el grado de personalización es total.

Las dimensiones mencionadas generan un espacio de arquitecturas híbridas para el diseño de las actividades prácticas formativas basada en aplicaciones libres donde se combinan sistemas en local y en la nube, tal como se muestra en el esquema de la Fig. 1.



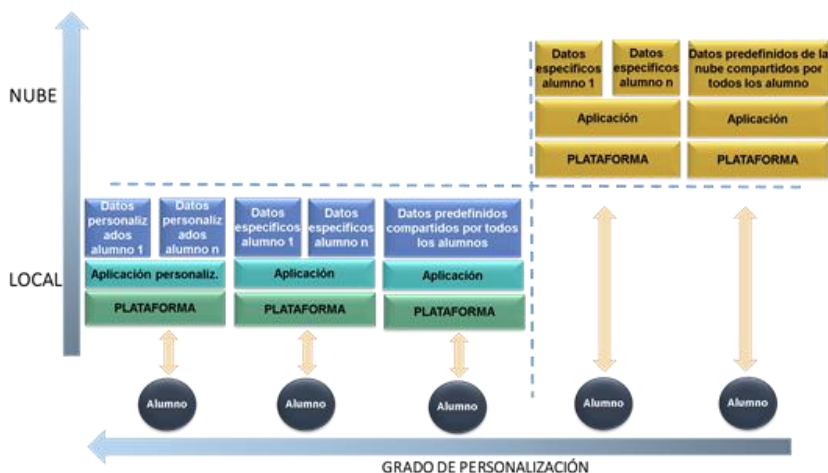


Fig. 1 Arquitecturas. Fuente: elaboración propia

Entre las dos situaciones extremas, el uso de demos de terceros en la nube y el uso de sistemas instalados localmente, es posible encontrar puntos intermedios híbridos que reducen el esfuerzo de la implantación local combinando el uso de dicha implantación local para ciertas tareas con la utilización de determinadas tareas disponibles de forma genérica en la nube que permitan la personalización de las actividades formativas adaptadas a los objetivos docentes.

Los cuadrantes de la derecha corresponderían a las aplicaciones (demos) que ofrecen algunos fabricantes de SIG (software de código abierto o propietario) a modo de pruebas gratuitas (por ejemplo, Odoon SA, 2019; SAP AG, 2019) que permiten acceso gratuito a los distintos componentes de las aplicaciones en la nube.

En el caso de demos en la nube, es habitual que contengan precargados unos datos de ejemplo, que llamamos “datos específicos” o “predefinidos”. Estos datos, en algunos casos pueden personalizarse con datos que interese al docente y en otras ocasiones no es posible. En los sistemas implantados en local siempre será posible cargar los datos personalizados que se dispongan, incluso se podrán cargar los datos específicos de las demos de la nube. Así mismo, en los sistemas implantados en local siempre será posible la instalación de los módulos adecuados, o combinarlos con otras aplicaciones o herramientas como en el caso que se comenta en la próxima sección.

### 3. Caso de estudio

Se presenta una experiencia de aplicación de una arquitectura híbrida utilizada en el diseño de una práctica de laboratorio de la asignatura de Dirección y Sistemas de Información del Master en Ingeniería Industrial de la Universidad Carlos III de Madrid basada en aplicaciones de código abierto.

Los objetivos docentes que se plantean son, en primer lugar, comprender que la capacidad de integración de un ERP reside en su base de datos y su modelo de datos compartido por todos los módulos funcionales, y en segundo lugar, experimentar la conversión de datos en ‘información y conocimiento’ mediante la elaboración de informes a medida a partir de datos transaccionales. Se trata de que el alumno tenga una experiencia de acceso al Sistema de Gestión de Base de Datos (SGBD) de un ERP que almacena los datos operativos transaccionales, con la posibilidad de elaborar informes personalizados nivel táctico a partir de los datos almacenados en tablas de dicho SGBD, a diferencia de los informes predefinidos que el ERP pueda proporcionar.

En este caso se utilizó un ERP de código abierto Odoo, el cual se descargó gratuitamente, se instaló en una plataforma local y se configuró una “instancia” con datos personalizados sobre productos, proveedores, inventarios, clientes, pedidos de venta y de compra etc.

Con el nombre de “instancia” nos referimos de forma genérica, a lo que en los sistemas ERP como SAP se conoce como “mandante”. Un “mandante” o “cliente”, en terminología SAP y desde el punto de vista funcional, se define como una unidad independiente del ERP que tiene sus propios datos y características (tipo de moneda, nombre de empresa, fiscalidad, productos etc.).

Por otro lado, en la web pública de Odoo correspondiente al “programa educativo” se creó una instancia inicial configurada por el profesor con el mismo conjunto de datos específicos que los de la instancia local.

Cada alumno crea su propia instancia del ERP en la nube a partir de la instancia del “programa educativo” con los mismos datos específicos, es decir, con los mismos productos, inventarios, pedidos de venta etc.

El uso de una “instancia” por alumno permite que el alumno modifique los datos de su sistema, por ejemplo, ordenando la reposición de un producto cuyo inventario es insuficiente sin afectar a los datos de inventario del resto de los alumnos en sus sistemas (instancias).

El ejercicio consiste en acceder a la base de datos del ERP para extraer una serie de datos y confeccionar un informe a medida sobre productos que hay pendiente de envío a

determinados clientes. Como por cuestiones de privilegios no es posible el acceso a la base de datos de las instancias en la nube, el acceso se realiza a una base de datos del ERP instalado en local.

Para esto, se utiliza una herramienta de administración de SGBD denominada DbVisualizer (Free edition) instalada en la plataforma de cada alumno. Con esta herramienta, cada alumno extrae los datos de interés, mediante una consulta SQL y posteriormente se vuelcan a una hoja Excel con objeto de generar el informe a medida con dichos datos.

En la Fig. 2 se muestra un esquema de la arquitectura. Cada alumno accede con su herramienta de administración al SGBD de la plataforma local, el cual contiene los mismos datos que el SGBD de la plataforma en la nube. De este modo extrae los datos para confeccionar su informe el cual no está disponible como informe predefinido en el sistema ERP de la nube.

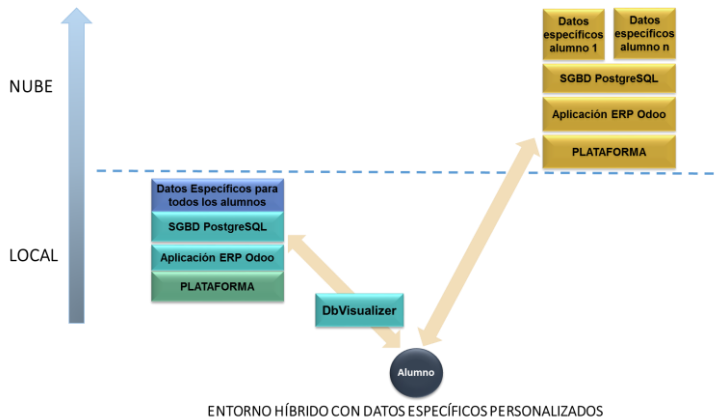


Fig. 2 Arquitectura híbrida de la práctica docente. Fuente: Elaboración propia

#### 4. Conclusiones

El diseño de actividades prácticas efectivas con SIG, requiere disponer de software y datos con los que crear casos y escenarios en los que el alumno pueda desarrollar habilidades y enfrentarse a situaciones similares a la realidad empresarial.

Esto puede ser costoso y laborioso, por lo que una alternativa, es apoyarse en software abierto y gratuito disponible en la web. En la mayoría de las ocasiones, este software se adapta parcialmente a los objetivos docentes, por lo que es preciso integrarlo con otros sistemas instalados en plataformas locales con objeto de conseguir funcionalidades y experiencias de aprendizaje idóneas.

Se plantean distintas arquitecturas para combinar SIG en la nube y en local, con las que diseñar actividades docentes adecuadas a objetivos curriculares que faciliten el aprendizaje del alumno.

Estas arquitecturas se centran en construir escenarios de utilidad educativa que cubran objetivos docentes específicos a partir de demos o software disponible en internet y aplicando distintos grados de personalización.

Con objeto de facilitar la confección de prácticas de laboratorio combinando sistemas disponibles en internet y sistemas implantados localmente, se concluye que la arquitectura de diseño de una práctica de laboratorio, viene determinada por la localización del SIG, nube o local, lo cual condicionará el grado de control y personalización que se tendrá sobre la aplicación y los datos.

La inmersión en un entorno SIG como el planteado, además de mejorar el conocimiento de los estudiantes sobre áreas de administración de empresa (contabilidad, logística, fabricación etc.), aporta un contexto significativo para el desarrollo de habilidades en la toma de decisiones y la resolución de problemas de gestión empresarial.

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# Percepción de la felicidad en jóvenes universitarios no unidos en pareja, versus, jóvenes no estudiantes universitarios y unidos en pareja

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## Resumen

*Esta investigación ofrece resultados de cómo entienden la felicidad los jóvenes de la zona metropolitana de la ciudad de Pachuca, específicamente la percepción de que objeto o concepto es el ancla de su felicidad. La fuente de datos es una encuesta que tiene un grado de confianza del 93 por ciento, con un error de estimación del 8 por ciento a nivel global y una no respuesta del 20%. Recabó información de 640 hogares útiles seleccionados. Los resultados diferenciados son producto de la comparación de dos grupos de jóvenes, el primero de ellos universitarios que no se encuentran unidos en pareja, para estos las variables de peso para alcanzar la felicidad fueron 1) Haber conseguido cosas importantes que quieren en la vida; 2) la salud; 3) las finanzas; 4) las relaciones afectivas con la familia y 5) su libertad de los jóvenes universitarios. Por otra parte los jóvenes que son unidos en pareja sin importar el tipo de unión, y que no son estudiantes universitarios, anclan su felicidad principalmente en tres variables, el ingreso percibido por su trabajo, la salud y la familia.*

**Palabras clave:** Jóvenes unidos, jóvenes universitarios, felicidad, bienestar subjetivo percibido.

## 1. Introducción

La presente investigación pretende analizar la percepción de que hace felices a los jóvenes, entendiendo esta edad entre los 18 y 28 años, para ello se analizarán dos encuestas cuantitativas, apuntaladas desde una perspectiva demográfica. El objetivo que guía la presente investigación se sustenta en lo referido por diversos autores, en donde la posesión de un bien ya sea material o inmaterial, deseado o anhelado por una persona dará la felicidad (Alarcón, 2002). Es muy importante referir que esta postura parece que genera un brete, ya que para algunos lo que es anhelado vehemente, para otros puede incluso no tener ningún valor. De igual forma en esta postura pueden incluirse elementos físicos materiales



tal como dinero, ropa, autos, viviendas, o elementos no materiales como la salud, hasta cuestiones de religiosidad, de moralidad y por supuesto de ética, al margen de lo que se entienda y desde las diversas aristas que se le analice. Además se pretende investigar dos grupos de personas jóvenes, que por diversas posturas pueden alcanzar de formas diferentes la felicidad, por un lado, jóvenes estudiantes universitarios que no estén unidos en pareja, por otra parte jóvenes no estudiantes unidos, ya sea esta legal o consensual. Este análisis se hace imaginando la situación incardinada en la tradición mexicana, donde los jóvenes a la edad casadera -ya sea que estén dentro de un matrimonio o uniones consensuales- juega un papel preponderante en su realización de la vida adulta, incluso sobre la idea de continuar sus estudios de nivel profesional.

Este proyecto de investigación parte de la definición de felicidad, que prácticamente fue revivido por conceptos de calidad de vida y bienestar, cuyo ideal estaba más allá de los bienes materiales, por ende, generaron la duda y discusión académica resucitando conceptos filosóficos, y sobre todo con aquella intención de medirlos en nuestras sociedades. Hay que diferenciar entre la felicidad, que técnicamente para algunos se llama bienestar subjetivo percibido de lo que es nivel de vida. El bienestar subjetivo percibido o calidad de vida es el disfrute que tienen las personas a partir de su realidad vivencial, es decir, es la delta entre lo que tengo y vivo diariamente, con lo que aspiro. Si esa diferencia es mayúscula, entonces generará infelicidad, por el contrario, si la delta es baja, entonces el sujeto encuentra la felicidad, entiende su vida y su entorno vivencial (López, 2018). Por el contrario, nivel de vida tiene que ver con el dinero, con las posesiones materiales, por ello se entendería que a mayor dinero mayor nivel de vida, aunque no necesariamente mayor felicidad. Sin embargo para muchos puede haber una gran relación y correlación entre estos dos conceptos (López, 2018).

Aristóteles con su libro *Ética a Nicómaco*, hace mención que el hombre alcanza esa felicidad a partir de que adquiere el bien deseado, por ello debe haber felicidad asociada a ese bien anhelado, pero siempre de la mano de la ética. Para Aristóteles también la felicidad llega cuando hay autosuficiencia, pues parece que el bien completo es autosuficiente, pero la autosuficiencia no la define como la vida en soledad, o vida solitaria. Por ello para Ferrater se refiere al hombre dotado de bienes, que le permite vivir una vida contemplativa, que asociada a la ética, cuenta con los bienes que le dan tranquilidad, paz espiritual y por ende felicidad (Ferrater, 1969).

Para Alarcón los objetos o bienes materiales que promueven la felicidad pueden ser de naturaleza variada y pueden ser éticos, económicos, religiosos, estéticos, sociales, materiales o incluso ideales (Alarcón, 2002). Esta idea la asocia a lo referido por Kant, quien mencionó que el hombre no sabe cómo ser feliz, porque hay muchas formas de alcanzar la felicidad, puede ser a través de cosas materiales, espirituales, de valor monetario, de valor de conocimiento, pretende una larga vida, tener salud, belleza u otros

bienes u objetos (Kant, 1946). Estos ideales llevan a discutir si en realidad la felicidad está atada a los objetos materiales, Alarcón retomando a Aristóteles refiere que para ser feliz se necesitan bienes exteriores que permitan dedicarse a la vida contemplativa y satisfacer sus propias necesidades. De esta idea plantea, que la felicidad en cierta medida depende de bienes, ya sean materiales o no, pero bienes perseguidos por los seres humanos (Alarcón, 2002).

Lu, Gilmour y Kao (2001) analizó la felicidad de los jóvenes, entre Taiwán e Inglaterra, el trabajo mostró resultados similares, donde los jóvenes de Taiwán observan la felicidad anclada a cuestiones culturales, como es entender el ying y el yang, y ese sentido de equilibrio que permite alcanzar la felicidad. Por el contrario los estudiantes universitarios de Inglaterra, si bien entienden a la felicidad como un estado mental deseable, lo asocian a cuestiones materiales, de esfuerzo y logro individual, enfoque legalista y progreso social y material (Lu, Gilmour y Kao, 2001).

En un trabajo de French y Joseph (1999) realizaron un estudio entre estudiantes universitarios, entre sus hallazgos se encontró una alta correlación entre felicidad y religiosidad (French y Joseph, 1999).

Un estudio realizado por Mogilner, Whillans y Norton (2017) encontraron que hay una relación y correlación alta entre la felicidad y el dinero, pero también debe incluirse el tiempo. Los resultados indicaron que la preocupación de las personas radica en cómo distribuir el tiempo y dinero, en cada grupo de personas, para poder alcanzar en mayor medida ese concepto de felicidad. Luego entonces estarían planteando que el dinero no es automático con respecto a la producción de la felicidad, por el contrario el vector tiempo y dinero, de acuerdo a cómo se aplique, produce felicidad, esto en distintos niveles según sea la combinación y claro, las características de cada grupo (Mogilner, Whillans y Norton, 2017).

Recientemente Grover y Helliwell (2019) parten del supuesto de diversos estudios transversales en las sociedades industriales que han demostrado que los que están casados y los que viven como casados, tienen significativamente mayor satisfacción en la vida que aquellos que son solteros, separados, divorciados o viudos. Incluso algunos estudios utilizando encuestas de panel de países como Alemania y Reino Unido, han sugerido que si bien la satisfacción de vida puede elevarse durante algunos años después de la unión, con el tiempo vuelve a caer a niveles prematrimoniales (Grover y Helliwell, 2019).

Por otra parte Clark y Georgellis (2013) también encontraron que las personas casadas son más felices en los años inmediatamente antes y después de su matrimonio, pero para aquellos que habían estado casadas durante al menos 5 años, la felicidad tiene a disminuir (Clark y Georgellis, 2013).



Qari (2014) trabajando con jóvenes de Berlín encontró que el uso de los 5 años referidos por Clark y Georgellis, permite calcular la utilidad, pero si se utilizan sólo 1-2 años antes del matrimonio como categoría de referencia, probablemente hay un error, ya que en ese momento se vivía entre los jóvenes un romance, un periodo de enamoramiento, lo que puede generar un aumento en la felicidad reportada. Anteriormente Zimmermann y Easterlin (2006) analizaron datos de una encuesta transversal y encontraron que cuando los individuos permanecen casados dos o más años no vuelven a su valor inicial de felicidad que tuvieron antes del matrimonio (Zimmermann y Easterlin, 2006).

La hipótesis que guio este trabajo, radica en que los jóvenes universitarios no unidos anclaban su felicidad a objetos totalmente diferentes a los jóvenes unidos no universitarios.

## **2. Resultados**

### **2.1. Descripción del método**

Diseño estadístico de la Encuesta Percepción de la Felicidad en jóvenes de la Zona Metropolitana de la Ciudad de Pachuca Hidalgo 2019. La población objeto de estudio está compuesta por las personas estudiantes de nivel profesional de 18 años o más que habitan en viviendas particulares de la zona metropolitana de la ciudad de Pachuca, no se han incluido a las personas que habitan en viviendas de tipo colectivo, tal como cárceles, hospitales, asilos, conventos, hoteles, casas de huéspedes, instalaciones militares, etcétera. Los municipios incluidos en la muestra fueron, Pachuca, Mineral del Monte, Mineral del Chico, Mineral de la Reforma, Epazoyucan, Zempoala, San Agustín Tlaxiaca y Zapotlán de Juárez, en el Estado de Hidalgo.

El levantamiento de campo de la prueba piloto se realizó en la zona metropolitana de la ciudad de Pachuca Hidalgo en el mes de febrero del año 2019, el número de viviendas que se visitaron para aplicar la encuesta de la prueba piloto fueron 40, la aplicación de la encuesta en las dos zonas fue aceptable y funcional. La realización de la encuesta piloto permitió mejorar el cuestionario y la redacción de algunas preguntas, así como mejorar el entrenamiento de los entrevistadores en la aplicación del cuestionario.

Se utilizó un diseño de muestreo probabilístico multietápico por conglomerados, lo que obligó a corregir la muestra en un 20% por la no respuesta. La unidad de muestreo de la primera etapa fue municipal, y se continuó de acuerdo a todas las áreas geográficas básicas (AGEBs) existentes.

La encuesta tiene un grado de confianza del 93 por ciento, con un error de estimación del 8 por ciento a nivel global y una no respuesta del 20%. El trabajo de campo para el

levantamiento de la encuesta se efectuó en el periodo del 1º al 25 de febrero del año 2019; el cuestionario estuvo conformado por 15 preguntas que condensa 98 ítems. La encuesta recabó información de 640 hogares útiles seleccionados.

Las exigencias de precisión y confianza anteriores, obligaron a utilizar un esquema de muestreo simple sin reemplazo, con un tamaño de muestra entre 138 y 320 casos para cada dominio, a efectos del diseño se tomó el punto máximo el de 320 para que fuesen representativos para cada sexo y por la diferenciación estudiantes no unidos, así como unidos y no estudiantes (Sánchez, 2018; Martínez, 2019). En conclusión, se levantaron dos diferentes encuestas, una para jóvenes alumnos no unidos, y una segunda para jóvenes unidos no alumnos, cada una de ellas con la representación por sexo antes mencionada, así como con un total de 320 cuestionarios levantados en cada encuesta. Los municipios que se incluyeron dentro de la muestra son 8, y en promedio se aplicó el siguiente porcentaje de cuestionarios en cada uno de ellos, Mineral del Monte (2.5%), Epazoyucan (2.5%), Mineral de la Reforma (26.2%), Zapotlán de Juárez (3.1%), Pachuca de Soto (49.4%), San Agustín Tlaxiaca (6.3%), Zempoala (8.1%) y Mineral del Chico (1.9%).

## 2.2. Resumen de resultados

Como se ha referido anteriormente se hará la comparación de dos encuestas, la primera jóvenes universitarios no unidos, y una segunda, jóvenes unidos no universitarios, ambas levantadas en la zona metropolitana de la ciudad de Pachuca Hidalgo. Esta comparación según sexo, se genera en razón de los planteamientos teóricos que aducen que los jóvenes casados son más felices (Grover y Helliwell, 2019), mientras que otros como Ahn et al. (2019) ha encontrado que el joven que estudia es más feliz que el joven que trabaja, y refiere la importancia del dinero, ya que los jóvenes que ganan más dinero en sus trabajos son más felices que los jóvenes que ganan menos dinero (Ahn et al., 2019). Se describirán algunos resultados generales para cada una de las encuestas, para después proceder a trabajar con ellas.

Todos los entrevistados ya fueran hombres o mujeres, no vivían unidos en pareja, es decir no estaban casados legalmente, consensualmente, religiosamente, no vivían en concubinato, y tampoco no habían vivido en pareja. De ellos 36.9% dijeron que trabajaban y estudiaban, ligeramente se observa que en esta situación se ubican un mayor número de hombres que de mujeres. En la economía formal están insertos apenas 15% de ellos, que reportan tener empleos de ese tipo, una gran mayoría de estos (85%) lo hace dentro de la economía informal, esto sin duda se explica por el tiempo que deben cubrir no solamente en su trabajo remunerado, también en sus horarios escolares, lo que les impide tener un trabajo formal. Las edades de este grupo oscilaron entre los 18 y 27 años de edad.

Por lo que hace a los jóvenes unidos y que no estudian actualmente en la universidad, inicialmente es posible mencionar que un 90.6% de los hombres refirió que se encuentra laborando, mientras que un 70.3% de las mujeres también mencionó que trabaja de forma asalariada y que es un porcentaje muy alto. De forma global un 32.7% trabaja en el mercado formal, mientras que 66.3% lo hace en el informal, se observa que una mayoría de mujeres están en la formalidad, principalmente en el sector terciario y de servicios. Los hombres se desempeñan más como cuentapropias o empleados, pero dentro de un mercado mayoritariamente informal.

Un dato interesante es que la correlación de Pearson entre la variable ingreso y el nivel de felicidad reportado por los alumnos no unidos es de 0.588, lo que indica que existe una correlación media, pero que en cierta medida sugiere una correlación aceptable; el chi cuadrado es 0.000, lo que indica que existe relación entre ambas variables. Por otra parte la correlación de Pearson entre la variable ingreso y el nivel de felicidad reportado por los jóvenes unidos no universitarios es 0.455, lo que sugiere que existe una correlación media, el chi cuadrado es de 0.000, lo que indica que existe relación entre ambas variables. Sin embargo parecen más felices los alumnos universitarios solteros que trabajan, que los jóvenes unidos que trabajan, aunque porcentualmente obtengan mejores ingresos.

También existe otro dato interesante por comparar, hablando de los jóvenes universitarios solteros es que aquellos que no trabajan reportan un promedio de 8.43 de felicidad, mientras que los que sí trabajan asalariadamente alcanzan en promedio 7.55 de felicidad, tal vez se deba a la doble carga de trabajo que deben enfrentar los jóvenes que estudian y trabajan.

Hablando de los jóvenes no universitarios que viven en pareja y que trabajan asalariadamente se autocalifican con un promedio de 8.55 de felicidad, mientras que los jóvenes de ese mismo grupo que no laboran alcanzan un 8.20 de felicidad, diferenciando según sexo, ligeramente se reportan más felices los hombres que no trabajan con 8.27, mientras que las mujeres alcanzan un 8.13 de felicidad.

Para dar inicio a las preguntas que tienen que ver con la percepción de la felicidad, todas se construyeron de forma Likert, por ello es factible obtener un alfa de Cronbach para que nos indique el grado de fiabilidad del instrumento aplicado, para la encuesta de los jóvenes universitarios no unidos el alfa de Cronbach alcanza 0.819, lo que se traduce como un buen indicador que valida la correcta construcción del cuestionario.

Por lo que hace a la encuesta de jóvenes unidos no universitarios evaluando el alfa de Cronbach fue de 0.859, lo que se traduce como un buen indicador que también valida la correcta construcción del cuestionario

Al analizar estas preguntas se advierten diferencias importantes entre el grupo de universitarios solteros no unidos, y el grupo de jóvenes unidos no universitarios. Al preguntar si en la mayoría de los sentidos, su vida se acerca a su ideal, destaca como dos de cada tres universitarios estuvo de acuerdo, mientras que solo uno de cada tres pensó en ese sentido de los jóvenes unidos no universitarios. Al cuestionar sobre si las condiciones de su vida son excelentes, nuevamente seis de cada diez universitarios dijeron que era así, mientras que tres de cada diez no universitarios pensaron de esa forma, sin duda las responsabilidades de familia, las necesidades alimentarias, de vivienda, salud, entre otras, sugieren que la forma de observar la vida es totalmente diferente.

A los universitarios las cosas que más refieren les han causado satisfacción en el último mes son, su instituto, escuela o facultad (81.6%), su desempeño en la escuela (83.5%), su salud (84.4%), sus amigos (85%), sus relaciones afectivas con la familia (85.7%), su desempeño en el hogar (86.6%), su vivienda (87.6%) y su libertad (88.4%). Lo que menos les causa satisfacción es la situación de su país (36.6%), su seguridad (57.8%) y la seguridad de los suyos (58.1%).

Los jóvenes no universitarios difieren un poco, consideran que los elementos que les brindan mayor felicidad son la salud (80.8%), su desempeño en el hogar (80.8%), sus relaciones afectivas de pareja (81.6%) y sus relaciones afectivas de familia (93.4%). Las situaciones con menor puntaje fueron la situación de su país (15.4%), su futuro (29.8%) y sus finanzas (34.3%).

### 2.3. Conclusiones

Dentro de los resultados de la presente investigación, se concluye que la felicidad de los jóvenes universitarios solteros y los jóvenes no universitarios unidos en pareja, está anclada en una parte importante de la estabilidad económica de los primeros, y el ingreso percibido de los segundos, esto es a mayor dinero mayor felicidad. Un dato complementario es que no existe una diferencia significativa de declararse feliz, a partir de ser estudiante universitario soltero, o por estar unido si ser estudiante, la percepción de la felicidad es muy similar, 0.4 puntos hace la diferencia en favor de los jóvenes unidos no universitarios.

De igual forma los objetos o bienes materiales que promueven la felicidad pueden ser de naturaleza variada, aunque para los jóvenes de la zona metropolitana de Pachuca está anclado al dinero de forma importante, corroborando la conclusión anterior. Incluso, se parecen en ese sentido a jóvenes de otras latitudes como el caso de Irlanda, donde las personas tienen infelicidad por no contar con dinero, con amigos, familiares u otros conocidos, y que si tienen esos elementos entonces serán felices.

Es de mencionar que para los dos grupos analizados la religión no jugó un papel importante en la felicidad. Un dato que merece ser mencionado fue al momento de preguntar sobre los

principales problemas que observan a municipal, los jóvenes universitarios mencionaron la pobreza (13.1%), el desempleo (24.3%) y el deterioro ambiental con 24.3%; mientras que los jóvenes unidos no universitarios refirieron la violencia (11.0%), la pobreza (19.8%) y el desempleo (36.9%), aquí destaca que el deterioro ambiental nunca fue referido por el segundo grupo, lo que sugiere que se desarrollan en contextos diferenciados y los jóvenes universitarios lo aprenden a partir de todas las discusiones que se dan en torno a la importancia del cuidado del planeta y del ambiente que nos rodea.

Por otra parte la regresión logística binomial aplicada en jóvenes universitarios solteros, muestra que las variables de peso que explican la felicidad en ellos, está el sentir que han conseguido cosas importantes en su vida hasta ahora, otra variable importante es la salud, sus finanzas son muy importantes, aunque dependan en gran parte de los padres, otro punto es que haya buenas las relaciones afectivas con la familia, así como su libertad. Por lo que hace a los jóvenes unidos en pareja no universitarios explican la felicidad a través de tres variables, el ingreso en sus empleos, la salud y las buenas relaciones afectivas con la familia.

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## Plataforma web para torneos de juegos 2x2

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### Resumen

*En este trabajo presentamos una plataforma web diseñada para introducir la teoría de juegos en el aula mediante torneos 2x2. La aplicación está inspirada en el torneo de Axelrod celebrado en 1980 (dilema del prisionero iterado).*

*La plataforma web que hemos desarrollado no solo permite reproducir las condiciones del torneo original de Axelrod, sino que ofrece la posibilidad de configurar la matriz de pagos de cualquier otro juego 2x2.*

*Un torneo comienza cuando el administrador determina el tipo de juego introduciendo la matriz de pagos. A continuación, los alumnos se incorporan y pueden diseñar y probar sus estrategias en NetLogo. Posteriormente, eligen la mejor estrategia, la envían y finaliza el torneo, confrontándose todas las estrategias enviadas. Además de la funcionalidad principal, la aplicación permite almacenar resultados y llevar a cabo más de un torneo simultáneamente.*

*La aplicación, que puede ser descargada en el enlace: <https://github.com/JoseBarbero/PlataformaTorneos2x2>, cumple un doble objetivo: introducir al alumno en el estudio de la teoría de juegos y enseñarle a formalizar, (ya que las distintas estrategias habrán de formalizarse y traducirse a código en NetLogo). Estos dos aspectos son de especial interés en ingeniería, donde por un lado nos encontramos con múltiples problemas estratégicos, y por otro lado, es fundamental el desarrollo del pensamiento abstracto y de la capacidad de formalización como paso previo a la programación en los diversos lenguajes. No obstante, nuestra herramienta puede emplearse en un contexto disciplinar mucho más amplio que el de la ingeniería, ya que en disciplinas como la economía, la biología, la sociología, la psicología, etc., los problemas estratégicos son también frecuentes.*





**Palabras claves:** Teoría de Juegos, Torneos 2x2, Aplicación Web, Recurso Docente, Problemas Estratégicos, Formalización.

## 1. Introducción

Las nuevas tecnologías tienen cada vez más repercusión en el ámbito docente. La utilización y el desarrollo de herramientas digitales están cambiando la manera en que se explican los contenidos, consiguiendo al mismo tiempo involucrar al alumno de forma más activa en su aprendizaje. Por ello, a día de hoy es casi imprescindible que dotemos a los alumnos de cualquier titulación de unos conocimientos básicos de programación. A su vez, la gamificación, i.e., el empleo de juegos en el aula para ilustrar y/o introducir distintos temas de interés, es otra metodología docente en auge (Kapp, 2012). Dentro de la gamificación, encontramos diversas posibilidades, siendo especialmente interesante para nosotros la ejecución de juegos en computadores y la realización de simulaciones.

Por otra parte, la teoría de juegos es un campo en constante evolución y crecimiento debido a la gran cantidad de áreas del conocimiento en las que tiene aplicación: economía, biología, sociología, psicología y ciencias de la computación, entre otras. Además, en relación con todo lo anterior, varios de los problemas que aborda la teoría de juegos encajan a la perfección con la enseñanza basada en simuladores o juegos, siendo numerosos los trabajos que han explorado esta posibilidad en el ámbito de la docencia en economía (Galán Ordax, J. M., Izquierdo Millán, L. R., Izquierdo Millán, S., López Paredes, A., Pascual Ruano, J. A., Posada Calvo, M., Santos Martín, J. I. y Villafañez Cardeñoso, 2007; Pascual, J. A., Galán, J. M., Izquierdo, L. R., Santos, J. I., Izquierdo, S. S., & González Tapia, 2009).

Teniendo en cuenta todo lo anterior, decidimos desarrollar una herramienta docente que permitiera realizar simulaciones *online* para explicar los famosos torneos 2x2 de la teoría de juegos, y que a su vez obligara al alumno a programar mínimamente. Este doble objetivo es precisamente el elemento diferenciador de nuestra herramienta, ya que si bien todas las implementaciones existentes (Brodie, 2011; Gareev, 2017; Savani & von Stengel, 2014; Vasconcelos, 2016) permiten explorar las distintas posibilidades de los juegos que presentan, ninguna -excepto la nuestra- exige la formalización y programación de las estrategias. Cabe destacar que aunque nuestra aplicación fue ideada de tal forma que permitiera reproducir torneos 2x2 de cualquier tipo, durante todo su desarrollo se utilizó como torneo de referencia el dilema del prisionero (Poundstone, 1992).

Los dos objetivos funcionales principales que establecimos para nuestra aplicación fueron: (1) permitir que el administrador (profesor) configure cualquier torneo 2x2 en base a la



introducción de la matriz de pagos correspondiente; (2) permitir que distintos participantes (alumnos) se unan a dichos torneos y participen en los mismos desde sus ordenadores.

Más allá de los objetivos funcionales principales, entre los aspectos más interesantes de la implementación cabe destacar que: (i) cada participante (alumno) deberá desarrollar -en forma de código- una estrategia que le permita obtener mayor puntuación que el resto de los participantes a lo largo de sucesivas iteraciones; (ii) se les proporciona a los participantes un medio en el que desarrollar y probar su estrategia compitiendo contra estrategias preestablecidas (un modelo implementado en *NetLogo* que presenta varias estrategias predefinidas); (iii) tanto los alumnos como el profesor pueden consultar las puntuaciones al final del torneo para sacar conclusiones.

### **1.1. Conceptos teóricos – Teoría de juegos**

“La teoría de juegos estudia situaciones de conflicto y cooperación a las que denominamos juegos, en las que interactúan individuos racionales, analizando los comportamientos y resultados que son de esperar, bien mediante decisiones individuales (caso de los juegos no cooperativos), bien mediante acuerdos entre los participantes (caso de los juegos cooperativos)” (Navarro, Tena, & Pastor, 2004).

Dentro de la teoría de juegos, la aplicación que aquí presentamos se centra en un subconjunto denominado juegos 2x2, en los que dos jugadores se enfrentan con dos estrategias posibles cada uno. Concretamente, el juego 2x2 en el que nos inspiramos, el dilema del prisionero, resulta ser el más popular de los juegos 2x2 y uno de los embajadores de la teoría de juegos en general.

El dilema del prisionero es un sencillo juego no cooperativo que fue ideado en 1950 por Melvin Dresher y Merrill Flood (Poundstone, 1992). En su versión clásica, dos individuos, (el individuo 1 y el individuo 2), han sido arrestados por ser sospechosos de haber cometido conjuntamente un delito grave, si bien no hay pruebas suficientes para incriminarlos, y con la evidencia disponible solo podríamos acusarlos de delitos menores. Se les separa y a ambos se les ofrece el mismo trato: proporcionar las pruebas suficientes para incriminar al otro. Si solo uno de los dos elige esta opción (i.e., delatar a su compañero), al delator se le premiará con la libertad mientras que su compañero será condenado a una dura pena de 12 años de prisión. Si, por el contrario, ambos delatan a su compañero, la evidencia disponible será suficiente como para poder condenar a ambos por el delito grave; sin embargo, en este caso, se tendrá en cuenta que han facilitado la labor de la justicia y la condena será de 10 años de prisión para cada uno (en lugar de 12). Por último, si ninguno de los dos colabora con la justicia, sino que cooperan entre sí, con las pruebas disponibles solo se podrá condenar a ambos a un año de prisión por delitos menores. En la tabla 1 tenemos la matriz

de pagos del dilema del prisionero, correspondiéndose cada pago con la utilidad que esa decisión tiene para el individuo. Por este motivo, cada pago es el complementario (valor negativo) del número de años de cárcel, -mayor utilidad cuanto menor sea el valor absoluto del número-.

**Tabla 1: Matriz de pagos del dilema del prisionero**

1↓ / 2→	Delatar	Cooperar
Delatar	(-10, -10)	(0, -12)
Cooperar	(-12, 0)	(-1, -1)

En 1980, Robert Axelrod reunió a numerosos expertos en varias áreas del conocimiento con el objetivo de enfrentarlos en un torneo en el que jugarían al dilema del prisionero de forma iterada (Axelrod, 1980). A diferencia del dilema del prisionero clásico, en el dilema del prisionero iterado los jugadores juegan varias veces consecutivas, recordando cuál fue la decisión previa de su oponente y cambiando su propia estrategia en consecuencia. Por tanto, esta modalidad permite a los jugadores castigar a su oponente por no haber cooperado en juegos anteriores.

En el torneo de Axelrod, el objetivo era obtener la máxima puntuación final posible después de enfrentarse a cada una de las otras estrategias por separado, a la suya propia y a una estrategia de toma de decisiones aleatoria, durante exactamente doscientos movimientos en cada enfrentamiento. La estrategia que ganó fue la de la “toma y daca” (*tit for tat*), estrategia que coopera la primera vez y a continuación hace lo que hizo su oponente en la ronda anterior (Amnon Rapoport, Seale, & Colman, 2015).

Tal y como se comentó con anterioridad, dado que nuestra aplicación determina el tipo de juego en base a la matriz de pagos, permite configurar cualquier juego 2x2 y no solo el dilema del prisionero. Por ello, nuestra propuesta docente consiste en utilizar la aplicación para trabajar en clase sobre tres de los juegos 2x2 más arquetípicos: el dilema del prisionero, la batalla de los sexos y el juego de la gallina, -en este orden-, con el fin de afianzar conceptos y de facilitar la comprensión, formalización y el análisis de los mismos.

Brevemente, comentar que la batalla de los sexos es el ejemplo clásico de un juego de coordinación en el que una pareja tiene que elegir entre dos opciones de entretenimiento; el hombre prefiere un tipo de actividad y la mujer otro, primando para ambos el deseo de estar juntos frente a realizar las actividades en solitario (Colman, 1995; Leyton-Brown & Shoham, 2008). Como dato importante, cabe destacar que los jugadores no pueden comunicarse con el otro y por tanto, decidirán sin saber qué eligirá su pareja. Si ambos optan por realizar la actividad que prefieren, acabarán yendo solos, siendo los pagos (2, 2). Si por el contrario, ambos deciden actuar de forma heroica y sacrificarse acudiendo a la actividad que no les gusta, irán también solos (su pareja se habrá ido a la otra actividad),

por lo que los pagos serán (1,1). Por último, si uno elige su opción preferida y el otro se sacrifica, los pagos serán (3, 4) ó (4, 3), mejores para ambos que en cualquiera de las otras dos opciones, pero no tan buenos para quien se sacrifica como para el otro.

**Tabla 2: Matriz de pagos de la batalla de los sexos**

1↓ / 2→	C	D
C	(2, 2)	(4, 3)
D	(3, 4)	(1, 1)

Por su parte, la versión más habitual del juego de la gallina (también conocido como del montón de nieve *-snowdrift-*) es la siguiente (Colman, 1995; Anatol Rapoport & Chammah, 1966): dos motoristas conducen a gran velocidad el uno hacia el otro. Cada uno de ellos tiene la opción de apartarse para evitar una colisión frontal (estrategia de ser un “gallina”) o de continuar conduciendo de frente con determinación (estrategia del “valiente” o “machito”). Si ambos jugadores son “gallinas”, el resultado será un empate con pagos (3, 3) -ambos salvan la vida-. Si ambos son “machitos” y continúan conduciendo de frente, se arriesgan a morir o sufrir graves lesiones, por lo que los pagos serían (1,1). Sin embargo, si uno de ellos se aparta (“gallina”) y el otro aprovecha esta situación y continúa conduciendo de frente, el “gallina” salvará la vida pero habrá perdido prestigio mientras que su oponente, al haber explotado esta estrategia, se llevará la victoria y quedará como el valiente; los pagos serán (2, 4) o (4, 2) dependiendo de quién sea el “gallina”.

**Tabla 3: Matriz de pagos del juego de la gallina**

1↓ / 2→	Cooperar	Defectar
Cooperar	(3, 3)	(2, 4)
Defectar	(4, 2)	(1, 1)

## 2. Materiales y métodos

### 2.1. Tecnologías utilizadas

Debido a la naturaleza de los juegos 2x2, hemos empleado *NetLogo 5.3.1* (Wilensky, 1999) en nuestra aplicación. *NetLogo* es un lenguaje de modelado multiagente basado en Java y con disponibilidad multiplataforma, que fue especialmente concebido para la simulación de fenómenos naturales y sociales, i.e., para el modelado de sistemas complejos que evolucionan en el tiempo. *NetLogo* permite dar órdenes a cientos de agentes independientes

simultáneamente, y facilita el estudio y la visualización de los patrones micro y macro que emergen como consecuencia de las interacciones entre agentes.

Además, *NetLogo* es de acceso abierto, dispone de una versión web (*NetLogo* web) que permite ejecutarlo en cualquier lugar sin necesidad de instalación previa, cuenta con una amplia galería de modelos ya implementados y su uso se encuentra muy extendido en el ámbito académico.

En lo referente al desarrollo web, las herramientas utilizadas fueron *PHP* y *MariaDB*, para el lado del servidor, y *JavaScript* y *Bootstrap* (versión 3.3.7) para el lado del cliente. Con respecto al despliegue en un equipo local, éste se realizó utilizando *XAMPP*.

## 2.2. Estructura y funcionamiento

El primer paso para comenzar un torneo es su creación por parte de un usuario de tipo administrador, (el único tipo de usuario que puede crear y terminar torneos). Al crear el torneo es cuando se introducen los pagos o parámetros de recompensa, definiendo así el tipo de juego 2x2 deseado.

Una vez creado el torneo, éste pasa a estar disponible para todos los usuarios, de modo que pueden inscribirse en él. Tras inscribirse, cada participante tendrá que desarrollar su propia estrategia en *NetLogo*. Para ello, se proporciona un entorno en el que, introduciendo las líneas de código de su solución, pueden probar su estrategia contra varias ya preestablecidas, recibiendo la evolución de su puntuación en forma de gráfica. Una vez realizadas las pruebas pertinentes, cada participante podrá enviar su estrategia para inscribirla en el torneo, teniendo también la oportunidad de descargarla para futuras ocasiones.

Por último, se celebra el torneo, en el que todas las estrategias se enfrentan una a una contra todas las demás, generándose una tabla de clasificación con las puntuaciones totales obtenidas y el usuario correspondiente.

## 2.3. Desarrollo

La estructura general de la aplicación consta de tres bloques principales: (1) el modelo de *NetLogo* destinado a que los alumnos prueben sus estrategias; (2) el modelo global de *NetLogo* en el que se disputa el torneo final entre todos los alumnos, y (3) todos los elementos relacionados con la propia web, es decir, el servidor y la aplicación web en sí misma.

Como detalles de implementación cabe destacar (i) que los jugadores de cada juego 2x2 han sido modelados como agentes individuales (*turtles*); (ii) que cuando el alumno entrega su estrategia a través de la web, ésta se guarda en el servidor en forma de archivo (.nlogo), archivo que posteriormente será extraído en un fichero (.nls) e importado por el modelo global de *NetLogo* para celebrar el torneo final; (iii) a su vez, los resultados del torneo son también exportados en un fichero que es posteriormente leído por el servidor y almacenado en la base de datos; (iv) la gestión de usuarios se ha realizado limitando las funcionalidades a las que tienen acceso los usuarios con perfil de alumno con respecto a aquellas a las que tienen acceso los profesores.

#### 2.4. Manual de usuario - ¿Cómo implementarlo en clase?

Dada la versatilidad de nuestra aplicación en cuanto al tipo de juego 2x2 en el que basar cada torneo, nos ha parecido oportuno presentar a modo de ejemplo una propuesta docente específica; en ella, indicamos un esquema tipo a seguir, que es el que a nosotros nos parece más apropiado para utilizar la herramienta en el aula y a su vez conseguir un mayor aprovechamiento de las clases.

Nuestra propuesta sugiere empezar con el juego más universalmente conocido (el dilema del prisionero) y avanzar posteriormente hacia los juegos menos populares. Más concretamente, a nuestro parecer, la secuencia lógica de implementación sería:

1. Introducción a la teoría de juegos y a sus conceptos más elementales (*estrategia dominante, equilibrio de Nash, equilibrio óptimo de Pareto*, etc.), para que los alumnos se familiaricen con ellos y puedan luego identificarlos en los diferentes juegos que se desarrollen en clase.
2. Diferenciación entre juegos repetidos y no repetidos y con finalización y horizonte finito e infinito.
3. Presentación de la aplicación web. Registro como usuarios con perfil alumno. Explicación del entorno de programación en el que habrán de desarrollar sus estrategias.
4. Torneo iterado del dilema del prisionero. Evaluación de las distintas estrategias presentadas. Conclusiones.
5. Torneo iterado sobre la batalla de los sexos. Análisis de estrategias. Conclusiones.
6. Torneo iterado sobre el juego del gallina. Evaluación de estrategias. Conclusiones.
7. Recapitulación. Lecciones aprendidas.

### 3. Discusión

La plataforma web para torneos de juegos 2x2 está orientada a la docencia. Idealmente, esta herramienta debería usarse en las sesiones prácticas para afianzar los conceptos teóricos previamente explicados en teoría y para a su vez adquirir habilidades de programación (en este caso en *NetLogo*).

Dado que el nivel de abstracción en los problemas clásicos de teoría de juegos es bastante alto, resulta muy interesante disponer de una aplicación que permita pasar de lo general a lo particular (mediante la configuración de la matriz de pagos del juego 2x2 correspondiente) y que brinde la posibilidad de interactuar y experimentar directamente con cada modelo, facilitando así el análisis de los distintos problemas, de los fenómenos emergentes y de la dependencia del contexto.

### 4. Conclusiones y líneas futuras

La herramienta docente desarrollada busca mejorar la comprensión de los distintos juegos 2x2 haciendo que el alumno interactúe directamente con el problema. Esto favorece que el alumno saque sus propias conclusiones y facilita la evaluación del impacto del contexto, así como de los fenómenos que emergen durante la dinámica del torneo.

Dentro de las líneas futuras cabe señalar dos posibles líneas de trabajo: (a) la integración de esta herramienta con la plataforma Moodle y (b) desarrollar una versión evolutiva de esta aplicación.

Una versión evolutiva de la aplicación actual se correspondería con la versión también evolutiva que el propio Axelrod desarrolló (Axelrod, 1997). La implementación evolutiva implicaría crear poblaciones de estrategias que interactuarían unas con otras, y estudiar su desarrollo y variación en el tiempo, así como las condiciones bajo las cuales algunas de esas estrategias son evolutivamente estables.

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## Proyecto IDDEA: realización de una instalación artística en Educación Infantil

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### Resumen

*El proyecto IDDEA (Investigación del Desarrollo Didáctico de la Expresión y el Arte) es una iniciativa educativa que nace desde Asire Educación, una Asociación que apuesta por una educación integral potenciando, entre otros aspectos, el desarrollo intelectual, personal y social tanto de los alumnos como de los profesionales de la educación.*

*Tomando como referencia la pedagogía artística, IDDEA surge de la necesidad de atender temas sociales y planteamientos escolares desde una perspectiva artística a través de la cual la obra de arte y el artista se convierten en foco didáctico mediante el que se trabajan los diferentes contenidos temáticos.*

**Palabras clave:** pedagogía artística infantil, creatividad

### 1. Introducción

Durante el curso 2018/2019 se ha llevado a cabo una intervención con alumnos de Educación infantil con los que se ha realizado una instalación artística a partir de la obra pictórica “El Jardín” de Joan Miró.

La instalación artística es un género de arte contemporáneo que surge como un movimiento artístico donde la idea de la obra prevalece sobre sus aspectos formales y se caracteriza por poder presentarse en cualquier espacio.

Esta intervención se ha desarrollado desde la pedagogía artística, concibiendo al arte como un instrumento de trabajo pedagógico versátil y reflexivo que ayuda al alumno a proyectar ideas y también a recibirlas y recrearse en las de otros. En definitiva, constituye un diálogo visual en el que se establecen interrelaciones intencionales y no intencionales que enriquecen el proceso didáctico y facilitan los aprendizajes.



Ligado a la pedagogía artística, encontramos la metodología “*Art thinking*”, la cual se fundamenta en los descubrimientos de la neuroeducación y se inspira en los procesos de creación de arte siendo su principal hallazgo que para que se produzca el aprendizaje es necesario encender una emoción y/o despertar la curiosidad del alumno.

## 2. Fundamentación

Uno de los pilares fundamentales para la Educación Infantil desde el siglo XIX, es el juego. Fröebel, ya idea un centro infantil cuyo desarrollo parte de actividades espontáneas y el juego se convierte en el proceso esencial y principal para desarrollar los aprendizajes de una forma natural.

También Piaget desde su teoría evolucionista, desarrolla este principio:

“...se encuentran tres grandes tipos de estructuras que caracterizan los juegos infantiles y dominan la clasificación: el ejercicio, el símbolo y la regla; los juegos de “construcción” constituyen la transición entre los tres y las conductas adaptadas...ejercicio, símbolo y regla parecen ser los tres estadios sucesivos característicos de las grandes clases de juegos, desde el punto de vista de sus estructuras mentales.” (Piaget, 1982, p.149).

IDDEA parte como proyecto de una concepción lúdica del aprendizaje y mediante un proceso artístico, en cuyo desarrollo quedan integrados los aprendizajes de forma globalizada. Para Alonso-Geta (2007) el juego, construye la personalidad, el entendimiento y los estilos cognitivos, los sentimientos y emociones, valores intelectuales y también el autocontrol, autonomía y la autoestima del niño. El objetivo principal del proyecto es desarrollar la creatividad partiendo de objetivos didácticos y mediante procesos artísticos.

El arte, la expresión artística original, ha sido planteado en este proyecto como un juego en el que no hay una única producción válida sino que se pueden y deben explorar y utilizar diferentes materiales.

Siguiendo a Delgado Linares (2011), para el desarrollo de las sesiones del proyecto se han contado con las siguientes etapas o características para desarrollar la intervención educativa:

- **Diagnóstico previo:** Mediante el contacto con el profesorado del centro, para conocer sus necesidades y encajar la actividad dentro de la programación habitual.
- **Objetivos didácticos:** Para esta instalación artística se desarrollaron objetivos didácticos entorno a la obra y características de esta del artista Joan Miró. Siempre desde una metodología activa y lúdica.
  - Conocer hitos relevantes de la vida del artista.
  - Desarrollar conocimientos sobre la obra: formas y colores utilizados

- Conocer y realizar una “Obra Mironiana”
- Plasmar con originalidad sus ideas
- Generar un clima creativo y artístico
- Desarrollar pautas estéticas
- **Justificación de la actividad:** La actividad se justifica desde el enfoque globalizado, como nexo de unión entre las diferentes áreas de educación infantil y como punto de reflexión sobre los contenidos programados para el proyecto.
- **Planificación adecuada:** Se han realizado tres sesiones (una por semana) lo cual daba continuidad a la instalación y permitía reforzar los aprendizajes.
- **Evaluación de la actividad:** La actividad ha sido evaluada observacionalmente y mediante unos sencillos cuestionarios. Se ha realizado tanto a los niños como a las profesoras del centro.

Otro de los principios fundamental de la educación infantil es la **globalización**, el cual, según Suarez, supone entender que el aprendizaje es un proceso unitario y global, a la vez que desarrollar un conjunto de habilidades y capacidades (cognitivas, afectivas y motrices) y que permitan significación y relación Suarez (2011).

La globalización forma parte del desarrollo de la idea de educación integral, teoría que se mantiene en las más actuales corrientes pedagógicas, el arte ha sido en algunas metodologías el elemento aglutinador de las áreas, contenidos y objetivos en educación infantil, como en la pedagogía waldorff o en Reggio Emilia

Esta intervención queda enmarcada dentro de la clasificación que realiza Medina, aglutinando *La globalización como estructura psicológica de aprendizaje* que está centrada en el alumno: los alumnos observan, manipulan, clasifican y establecen relaciones de los procesos de E-A.

Para materializarlo en el aula de educación infantil, como estructura psicológica y siguiendo los pasos de Medina, se han realizado las actividades de la intervención siguiendo estas pautas globalizadoras:

- a) No fragmentar los contenidos.
- b) Inclusión de contenidos de diversas áreas y sus relaciones entre ellas.
- c) Partir de los conocimientos previos y significativos
- d) Seleccionar una temática adaptada a cada grupo y contexto.

### **3. Desarrollo de la intervención:**

Para esta intervención del proyecto IDDEA se distribuyeron las actividades en tres días de 9.00 a 12.00 adaptándonos al horario de clases habitual y respetando la media hora de recreo de cada uno de los grupos.

Se realizó la intervención con tres clases de educación infantil de un ceip público de la zona centro de Burgos. Un total de 60 niños de edades comprendidas entre los tres y los cinco años.

#### **3.1 Sesiones**

Las sesiones se dividieron en tres días, en horario de 9h a 12h en las que se fueron alternando actividades en gran grupo: vídeos, cuentos o pequeñas dramatizaciones sobre los contenidos, con actividades en grupos pequeños: manipulativas y cooperativas e individuales: reflexivas y creadoras.



*Fig. 1*

*Fuente: Elaboración Propia*

Durante las intervenciones el aula se convierte en un espacio abierto, se utilizan los pasillos, los patios (si existe esta posibilidad).

Los materiales son accesibles al alumno y se incluyen materiales de uso no habitual en el colegio para despertar la curiosidad y fomentar la manipulación y el juego con el material. El ambiente de trabajo es flexible y poco directiva, pues son numerosos los autores que consideran que el ambiente flexible favorece la fluidez, flexibilidad y originalidad (Esprú, 2005).

### 3.2 Evaluación

En cuanto a la evaluación, se desarrolló de forma observacional sin poner ningún énfasis en el resultado final sino en el proceso de creación y en la evolución del niño dentro del proyecto. En esta parte de la evaluación se pudo comprobar como los niños van interactuando entre ellos y disfrutando del proceso de aprendizaje y creación que se les propone, cada día son más autónomos en el uso de los materiales y más arriesgados en sus propuestas.

Para la evaluación de esta intervención como eje globalizador de contenidos de diferentes áreas, se pasó un breve cuestionario de conocimientos de diferentes áreas de educación infantil, evaluando contenidos legislados en la L.O.M.C.E., actual Ley Orgánica Española, aprobada en 2013.

Las áreas de conocimiento del Segundo Ciclo de Educación Infantil son las siguientes:

- Conocimiento de sí mismo y autonomía personal.
- Conocimiento del entorno.
- Lenguajes: comunicación y representación.

Estas áreas son definidas por el MECD como: “Ámbitos de actuación, como espacios de aprendizajes de todo orden: de actitudes, procedimientos y conceptos que contribuirán al desarrollo de niñas y niños y facilitarán su interpretación del mundo, otorgándole significado y promoviendo su participación activa en él” (MECD, 2013).

La interrelación de las áreas de educación infantil legisladas y el desarrollo de la intervención ha sido realizado a través de los objetivos y contenidos interdisciplinares, flexibles y abiertos.



Fig. 2

Fuente: Elaboración Propia

Las evaluaciones de los niños ponen de manifiesto que aglutinando los contenidos en ejes más amplios y llevándolos a la práctica mediante intervenciones artísticas es posible el desarrollo de un aprendizaje más profundo y significativo.

En cuanto a la evaluación de satisfacción que realizaron las profesoras de educación infantil, a pesar de que ninguna de ellas había realizado con anterioridad un proyecto de este tipo, se han mostrado muy satisfechas con los resultados, si bien puntualizan que las intervenciones deberían haber durado más tiempo.

Concluyendo, coincidimos con Rabkin y Redmon en que el arte es un facilitador curricular pues acerca la distancia entre el alumno y el aprendizaje. Según estos autores los programas que integran el arte dentro de las asignaturas, obtienen mejores resultados que los aprendizajes curriculares aislados. Generando a su vez beneficios emocionales entre los alumnos tanto en la interacción como en la motivación, se facilita la interdisciplinariedad de las asignaturas a través del arte, los contenidos son más tangibles y la evaluación es más reflexiva (Rabkin y Redmon, 2006).

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## Estudio comparativo de la normativa europea en materia de residuos de construcción y demolición, enmarcado en el proyecto CONDEREFF

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### Resumen

*Los Residuos de Construcción y Demolición son cualquier sustancia o elemento que, según la definición de residuo, se produce en obras tanto de construcción, rehabilitación o demolición. En España se genera aproximadamente una tonelada de estos residuos por persona y año, en total unos 45 millones de toneladas de residuos generados en el sector de la construcción, sólo el 25 % de ellos se gestionan de forma adecuada. Esto supone graves consecuencias para el medio ambiente debido a la contaminación de los suelos y acuíferos, además de suponer un gran consumo de los recursos del planeta tanto en materias primas como en recursos energéticos para su producción.*

*El proyecto CONDEREFF es un proyecto europeo que pretende acelerar la labor de la política de gestión de este tipo de residuos, mejorando la eficiencia de los recursos en los países de la asociación. Su principal objetivo es el impulso de una política común a nivel europeo y buenas prácticas que permitan el reciclado y la reutilización de materiales.*

*Para alcanzar estos objetivos, el proyecto reúne a 8 socios de 7 países para intercambiar experiencias y prácticas, así como estudios sobre residuos C & D, empleando un enfoque de cooperación transnacional que involucra a las autoridades públicas, empresas del sector, organismos competentes y partes interesadas.*

*La UPV lidera el proyecto internacional, centrándose en el análisis de políticas existentes en este ámbito, en cada uno de los países socios, en cada*



*una de las etapas de la construcción y demolición y en todos los agentes implicados.*

*El objetivo final es apoyar a los socios CONDEREFF para transferir las lecciones aprendidas en las políticas regionales y planes de acción. Esperando como consecuencia, la proliferación de infraestructuras, y métodos para el reciclaje y la reutilización de los materiales de desecho e iniciando una transición hacia una economía circular.*

**Palabras Clave:** *Residuos, construcción, demolición, reciclaje, reutilización, normativa europea.*

## **1. Introducción**

En los últimos años, el nivel de actividad en el sector de la construcción ha sido muy significativo, posicionándose como uno de los sectores clave en el crecimiento económico de los países. Esto ha conllevado, por tanto, un aumento en la generación de residuos derivados de la construcción de infraestructuras y nuevos inmuebles como la demolición de construcciones antiguas, además de los generados por pequeñas obras de reformas (Real Decreto 105/2008, 2008). Dichos residuos se engloban en la categoría de residuos de construcción y demolición.

Como se describe en el Real Decreto 105/2008, en el BOE publicado el 13/02/08 “*el problema ambiental que plantean estos residuos se deriva no solo del creciente volumen de su generación, sino de su tratamiento, que todavía hoy es insatisfactorio en la mayor parte de los casos. En efecto, a la insuficiente prevención de la producción de residuos en origen se une el escaso reciclado de los que se generan. Entre los impactos ambientales que ello provoca, cabe destacar la contaminación de suelos y acuíferos en vertederos incontrolados, el deterioro paisajístico y la eliminación de estos residuos sin aprovechamiento de sus recursos valorizables.*”

Según la Federación Española de Asociaciones de Empresas de Valorización de Residuos de Construcción y Demolición en 2017, en España se genera aproximadamente una tonelada de estos residuos por persona y año, en total unos 45 millones de toneladas de residuos generados en el sector de la construcción, sólo el 25 % de ellos se gestionan de forma adecuada (Federación RCDs alerta que más del 75% de los residuos de construcción se gestionan de forma irregular, 2017).

Los poderes públicos deben intentar evitar la generación de nuevos residuos, disminuir la cantidad que se produce y reducir la peligrosidad que suponen algunos de ellos,

valorizándolos si fuera posible. Garantizando una utilización responsable de los recursos naturales con el fin de proteger el medio ambiente.

## 2. Conceptos

Según el Plan Nacional de Residuos de Construcción y Demolición 2001-2006 define el concepto de Residuos de Construcción y Demolición, RCD, como:

“**RCD**: aquellos residuos que proceden en su mayor parte de derribos de edificios o de rechazos de los materiales de construcción de las obras de otros de nueva planta y de pequeñas obras de reformas en viviendas o urbanizaciones” (Plan Nacional de Residuos de Construcción y Demolición , 2001-2006).

En esta línea, el Real Decreto 105/2008, de 1 de febrero, por el que se regula la producción y gestión de los residuos de la construcción y demolición en España los define, en su art. 2.a) como “*cualquier sustancia u objeto que, cumpliendo la definición de “Residuo” incluida en el artículo 3.a) de la Ley 10/1998, de 21 de abril, [sustancia u objeto perteneciente a alguna de las categorías que figuran en el anejo de esta Ley, del cual su poseedor se desprenda o del que tenga la intención u obligación de desprenderse. (Ley 10/1998, 1998)] se genere en una obra de construcción y demolición”* (Real Decreto 105/2008, 2008).

Estos RCD son clasificados según sus componentes en dos grandes categorías: (ADMIN, 2012)

- Residuos Peligrosos
  - Categoría I: Residuos de construcción y demolición, que contienen sustancias peligrosas según se describen en la Lista Europea de Residuos aprobada por Orden MAM/304/2002, de 8 de febrero, por la que se publican las operaciones de valorización y eliminación de residuos y cuya producción se realice en una obra de construcción y/o demolición.
- Residuos Inertes
  - Categoría II: Residuos inertes de construcción y demolición sucio, es aquel no seleccionado en origen y que no permite, a priori, una buena valorización al presentarse en forma de mezcla heterogénea de residuos inertes.

- Categoría III: Residuos inertes de construcción y demolición limpio, es aquel seleccionado en origen y entregado de forma separada, facilitando su valorización.
- Categoría IV: Los residuos comprendidos en esta categoría, serán residuos inertes, adecuados para su uso en obras de restauración, acondicionamiento y relleno o con fines de construcción.

Dado que la gran parte de los RCD generados son inertes, conviene referirse a la definición que el Real Decreto 105/2008 ofrece en su artículo 2.b):

*“Residuo inerte: aquel residuo no peligroso que no experimenta transformaciones físicas, químicas o biológicas significativas, no es soluble ni combustible, ni reacciona física ni químicamente ni de ninguna otra manera, no es biodegradable, no afecta negativamente a otras materias con las cuales entra en contacto de forma que pueda dar lugar a contaminación del medio ambiente o perjudicar a la salud humana. La lixiviabilidad total, el contenido de contaminantes del residuo y la ecotoxicidad del lixiviado deberán ser insignificantes, y en particular no deberán suponer un riesgo para la calidad de las aguas superficiales o subterráneas” (Real Decreto 105/2008, 2008).*

Además, existe una clasificación más especializada para este tipo de residuos, dentro del capítulo 17 “Residuos de la construcción y demolición” de la Lista Europea de Residuos, aprobada por Orden MAM/304/2002, con códigos LER.

### **3. El proyecto CONDEREFF**

Actualmente el Real Decreto 81/2013 debe ser revisado de acuerdo con el protocolo de gestión de residuos C&D de la UE, para incluir disposiciones para el sector de la construcción.

Este decreto es un instrumento de política regional destinado a mejorar el Plan de Gestión de Residuos de la Región de Valencia (PLAN INTEGRAL DE RESIDUOS DE LA CV - PIRCV). Incluye 8 Anexos (Áreas temáticas) que proporcionan un marco regulativo para la implementación del plan PIRCV bajo la Prioridad de Inversión 6a, a saber, *“invertir en el sector de residuos para cumplir con los requisitos del acervo ambiental de la Unión y atender las necesidades, identificadas por los Estados Miembros, para una inversión que va más allá de esos requisitos”*

El Protocolo de Gestión de Residuos de Demolición y Construcción de la UE y la transición hacia la Economía Circular pueden guiar el despliegue regulatorio de la gestión de residuos

C&D en todas las regiones de la UE; En consecuencia, la proliferación de infraestructuras y métodos para reciclar y reutilizar los materiales de desecho de C&D puede presentar una oportunidad de crecimiento ecológico.

La Universitat Politècnica de València es líder del Proyecto CONDEREFF, cuyo principal objetivo es el impulso de una nueva política común a nivel europeo y buenas prácticas para mejorar el reciclaje y la reutilización de materiales en este sector.

El proyecto CONDEREFF reúne a 8 socios de 7 países para intercambiar experiencias y prácticas sobre cómo avanzar desde los procedimientos existentes en la gestión de residuos de C&D hacia la adopción y una mayor explotación de las mejores prácticas y medidas aplicadas en el campo. El proyecto permitirá a las regiones participantes avanzar en sus objetivos de eficiencia de recursos y crecimiento verde a través de la gestión adecuada de los residuos de C&D, lo que puede aumentar la demanda de materiales reciclados de C&D y respaldar la sostenibilidad y el reciclaje en el sector de la construcción.

En concreto, La Universidad Politécnica de Valencia (UPV), es responsable de la actividad A 1.1 “Análisis comparativo de los marcos regulatorios para la gestión y evaluación de los derechos de C&D junto con la UE”, la cual tiene como objetivo identificar las diferentes regulaciones en el marco de la generación de RCD en la Unión Europea. Para ello se desarrolla una metodología para que los socios del proyecto identifiquen las regulaciones relacionadas con sus países. En segundo lugar, se elaboró otro cuestionario para las partes interesadas, intentando identificar dónde mejorar la regulación actual de acuerdo a la percepción de los diferentes tipos de interesados en función de los procesos que siguen a la CDW, desde su generación hasta su final destino. Siendo, por tanto, los socios de cada país los encargados de recopilar toda la información necesaria.

### **3.1. Procesos**

Para la estructura general de los cuestionarios se ha decidido seguir como modelo las diferentes fases por las que pasa un residuo ya provenga de la construcción como de la demolición.

La primera decisión administrativa con la cual comienza el ciclo de todo RCD es sobre la aprobación del permiso para la actividad de construcción o demolición. Cualquier proyecto de construcción o demolición implica planificación y gestión. Uno de esos documentos de planificación son las auditorías de gestión de residuos, documentos que ayudan a identificar los residuos y permiten facilitar los datos necesarios a la autoridad competente para tomar la decisión de aceptar la ejecución de dicha actividad.

El siguiente paso es la clasificación de la RCD. Para esa clasificación se creó la lista europea de residuos, anteriormente citada. Esta lista sirve como base para las clasificaciones y elaboración de las leyes complementarias de cada Estado y región.

Una vez clasificados los residuos, se transportan según sus características. La Unión Europea elaboró el Reglamento (CE) N°1013/2006 relativo al transporte fronterizo, y con el fin de garantizar la salud y la preservación del medio ambiente en este proceso. Excluyendo ciertas exportaciones de RCD de la UE a países que no están sujetos a la decisión de la OCDE. El transporte interno está regulado por cada país y región, buscando un seguimiento exhaustivo del material transportado, origen, destino, etc.

El destino final de los residuos puede ser el vertido en espacios habilitados para este propósito o el tratamiento en plantas especializadas. En ambos casos, deben regularse como espacios para el tratamiento y almacenamiento de estos materiales.

La Directiva 1999/31/CE relativa al vertido de residuos excluye de su ámbito de aplicación el uso de residuos inertes aptos para operaciones de restauración/acondicionamiento y llenado, o con fines de construcción, en vertederos (artículo 3.2.2) y proporciona un vertedero específico únicamente para residuos inertes (artículos 4 y 6. d).



*Fig. 1 Proceso de los RCD*  
*Fuente: Propia*

#### **4. Metodología**

La metodología presentada buscar dar las herramientas necesarias a los participantes en el proyecto para identificar las políticas específicas de generación, tratamiento, vertido, reciclaje y reutilización de RCD y conocer la opinión de diferentes interesados en la aplicación de la normativa estos procesos.

La metodología desarrollada se compone de:

- Un cuestionario para que los socios conozcan la situación actual de la RCD en sus países.
- Un cuestionario para que las partes interesadas para recopilar la opinión pública.

La combinación de estos dos cuestionarios permite obtener detalles de la situación actual, identificando aquellos aspectos que se pueden mejorar y conociendo la percepción de las personas que trabajan en este campo y que constantemente se enfrentan a las diferentes regulaciones.

La Universidad Politécnica de Valencia se encarga de la redacción de los documentos y de las encuestas para posteriormente hacérselos llegar a cada uno de los miembros integrantes del proyecto. Una vez reciban la información es cada miembro el encargado de remitir los cuestionarios tanto a los expertos en la materia como a los posibles interesados dentro de su país. Una vez recopilada la información necesaria se remite de nuevo a la UPV, quien valorará los resultados y redactará un informe final de resultados. Una vez concluida la investigación los resultados se pondrá en común con el proyecto CONDEREFF.

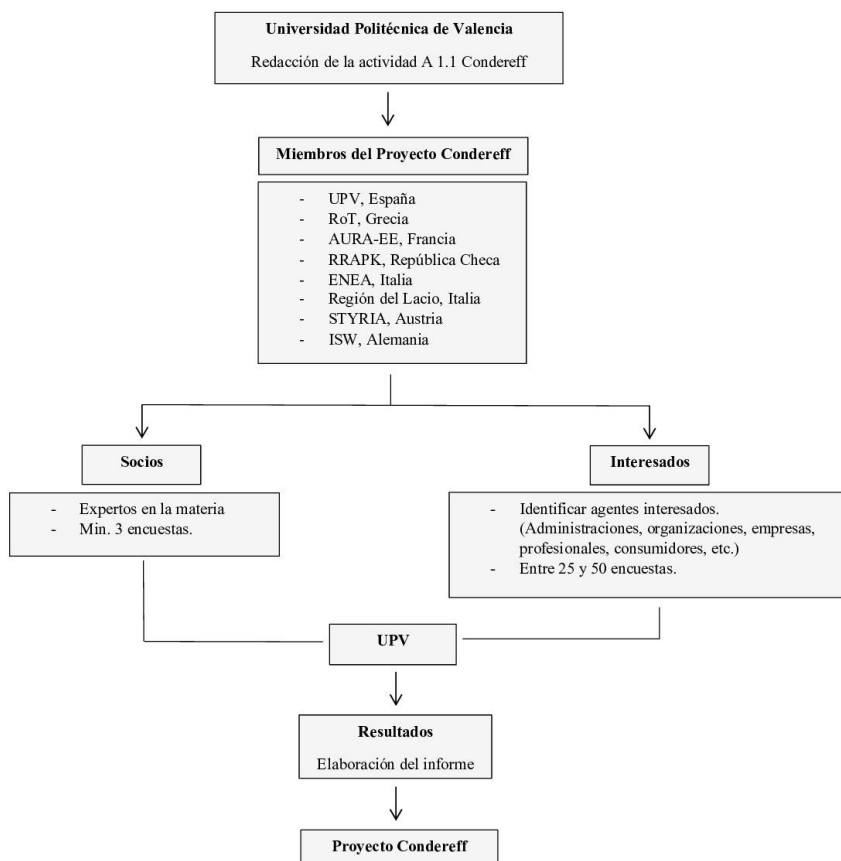


Fig. 2 Metodología recopilación de datos

Font: Propia



#### **4.1. Cuestionario para los socios**

Este cuestionario está dirigido a los miembros del proyecto CONDEREFF. El objetivo principal es conocer el marco regulatorio de su país, los documentos que deben entregar a los diferentes agentes implicados en el ciclo de vida de CDW y la situación actual que presenta el país a la CDW de acuerdo con los diferentes procesos.

Este cuestionario incluye preguntas sobre regulaciones y procedimientos relacionados con, los permisos de ejecución, el control, la clasificación de residuos, el transporte, el tratamiento/vertido, reciclaje/reutilización, tasas y otras cuestiones de interés.

#### **4.2. Cuestionario para los interesados**

Este cuestionario está dirigido a agentes interesados en el proyecto. El objetivo principal es conocer la opinión pública sobre la regulación que regula este sector, según los procesos que siguen a los residuos. De esta manera se pretende conocer cuán difícil es el acceso a la información, las áreas de trabajo, la profundidad que los agentes tienen en los diferentes procesos, la posibilidad de regular el reciclaje y la reutilización, entre otros.

De la misma manera que el cuestionario anterior, las diferentes preguntas están secuenciadas en el ciclo de vida de los desechos de acuerdo con las diferentes fases por las que pasan.

#### **4.3. Guía de recopilación de datos**

Las herramientas de la encuesta se preparan en inglés. Estos cuestionarios se preparan en formato on-line para que la recopilación de datos sea más directa. Para facilitar la comunicación con las diferentes partes interesadas, los socios del proyecto están habilitados para traducir los cuestionarios de las partes interesadas, la aplicación permite diferentes idiomas para los cuestionarios y se mostrará en el idioma en el que el navegador está configurado.

Para que los resultados sean representativos se solicitan un mínimo de tres encuestas para los socios del proyecto y un mínimo de veinticinco encuestas para los interesados. A partir de las encuestas solicitadas a las partes interesadas, se debe tener en cuenta que la variedad de encuestas en función del punto de vista de todos los procesos de la manera más equitativa posible, asegurando que al menos cada una de las secciones se complete por 4 expertos en el campo.

## **5. Conclusiones**

Esta metodología es el primer paso para el estudio de la situación actual de la normativa en distintas regiones de la Unión Europea. El seguimiento de estas pautas por parte de los participantes en el proyecto servirá para atender a todas las partes implicadas en cada uno de los procesos y etapas por los cuales pasa cualquier RCD, desde su generación hasta su eliminación o su puesta en valor. Como resultado se pretende tomar consciencia de cuales son las etapas en las cuales se podría mejorar, así como las regiones que presenten los procesos más eficientes para tomarlos como punto de partida para una normativa común con el fin de cumplir los propósitos establecidos por la UE para el año 2020.

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## Una asignatura universitaria para el desarrollo de las competencias personales transversales

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### Resumen

*Hoy en día es una realidad el hecho de que nuestros alumnos necesitan desarrollar competencias transversales de cara a poder cumplir con su vocación y misión en su vida, ya sea en el ámbito personal, social, académico o empresarial. En este sentido, el Espacio Europeo de Educación Superior (EEES) recoge la necesidad de que la educación superior forme en competencias genéricas (no sólo específicas). También la empresa demanda cada vez más que los empleados tengan desarrolladas ciertas habilidades sociales o blandas (soft skills) antes de contratarles o promocionarles. Sin embargo, no parece que el sistema educativo, en concreto, el referente a la educación superior, ofrezca a sus alumnos programas o asignaturas diseñadas ad hoc para el desarrollo de estas competencias transversales tan críticas para el EEES y tan demandas en el ámbito empresarial; y en la vida en general. Es por esto que, nuestro estudio ofrece una propuesta innovadora de asignatura, impartida con una metodología experiencial por docentes expertos en esta materia, cuya finalidad es el desarrollo de dichas competencias transversales y su transferencia a la realidad: personal, social, académica y profesional.*

**Palabras clave:** Competencias genéricas, educación superior, habilidades blandas, programa de desarrollo de competencias transversales

### 1. Introducción

La universidad Francisco de Vitoria, conectando con el origen y misión de toda universidad, pretende formar una auténtica comunidad universitaria que, por su formación y liderazgo, promuevan la generación de una sociedad sustentada por la búsqueda continua de la verdad y del bien (*Nuestra misión hoy*, 2016). “Una comunidad de buscadores de la



verdad, de la verdad sobre el hombre, sobre la realidad y sobre el sentido último de la vida” (Crespí, 2018 p.31). En definitiva, un comunidad que, siguiendo a autores como García Ramos (1991,2017), Jaspers (2013), Moncada (2008), Ortega y Gasset (2004) y Pérez-Díaz (2010):

- Favorezca el desarrollo de la dignidad del hombre.
- Ponga al alumno en búsqueda de su propia vocación y proyecto vital.
- Facilite la formación integral del alumno, dirigida a su pleno desarrollo.

Una universidad que anhela hacer crecer a toda la persona, que es el alumno, y que quiere prepararle lo mejor posible para su vida (personal, académica y profesionalmente). En este sentido, pretendemos ofrecer una formación que atienda individualmente a cada alumno, de modo que este pueda dar respuesta a su propia vida; convirtiéndose a su vez en una persona excelente (en cualquier ámbito: personal, social, académico, profesional).

Por tanto, queremos ofrecer a nuestros alumnos una formación integral, dirigida al pleno desarrollo de todo su ser. En este sentido, nos unimos a la reflexión del EEES y del ámbito empresarial y entendemos que los planes de estudio han de ofrecer una formación específica en competencias transversales (competencias genéricas para el EEES y *soft skills*, para la empresa) además de en competencias técnicas (Alles, 2008; Benito y Cruz, 2006; González Ariza, 2017; Gutiérrez Tobar, 2010; Villardón-Gallego, 2015).

En este sentido, la UFV plantea la materia de Habilidades y Competencias de la Persona. Esta asignatura, a través del desarrollo de las competencias personales, especialmente las transversales, pretende acompañar a sus alumnos en la búsqueda de su vocación y misión, de modo que cada uno de ellos pueda llegar a ser quién está llamado a ser.

## 2. Metodología

### 2.1. La asignatura de HCP (Habilidades y Competencias de la Persona)

Dentro del plan de formación integral, la UFV, ofrece la asignatura de HCP. Esa asignatura es común para todos los alumnos de primero, independientemente de su titulación. HCP, pretende, dentro del abanico de formación integral, acompañar al alumno en el desarrollo de sus competencias personales, fundamentalmente las transversales, para ponerle en su propio camino de madurez, excelencia y plenitud (Crespí, 2018).

Hablamos de **competencia personal** como “el conjunto dinámico de conocimientos (saber), habilidades o destrezas (saber hacer), actitudes y valores (saber ser) que, interiorizados y encarnados en nuestros actos, comportamientos o maneras de hacer, nos

ponen en el camino de nuestra propia madurez, excelencia, plenitud y felicidad” (Crespí, 2019, p. 98).

HCP pretende desarrollar especialmente las competencias transversales, aquellas que están relacionadas con un desempeño excelente en algún área de nuestra vida (personal o social; académico o profesional). En la educación superior reciben el nombre de genéricas y en el ámbito empresarial, el de *soft skills*. Por tanto, aunque también alude, de manera indirecta a las competencias técnicas, aquellas que están relacionadas con desempeño excelente ante una determinada actividad relativa a un área o tema específico, no son estas su principal objeto de desarrollo, sino que lo son del resto de asignaturas técnicas y específicas del grado. En la educación superior reciben el nombre de específicas y en el ámbito empresarial, el de *hard skills* (Crespí y García Ramos, 2019).

HCP es una asignatura que está claramente centrada en el alumno (no en los contenidos), y más concretamente en su desarrollo personal, ya que pretende que los alumnos aumenten su nivel competencial en relación a las competencias transversales críticas que le ofrece esta materia. Emplea una metodología dialógica, para que el alumno se ponga en verdadera búsqueda, y experiencial, para que pueda ser transferible a su realidad. Por último, esta asignatura requiere de un formador experto en el desarrollo de las competencias personales transversales y que se mantenga en la incesante búsqueda de la excelencia y plenitud personal.

Esta asignatura pretende desarrollar específicamente las competencias:

- Intrapersonales, aquellas principalmente de “relación con uno mismo”, como “la proactividad, la mirada profunda, el conocimiento y superación personal y la búsqueda de sentido” (Crespí, 2018, p. 202).
- Interpersonales, aquellas principalmente de relación con el otro, como “el trabajo en equipo, la comunicación, la resolución de conflictos-negociación y el liderazgo” (Crespí, 2018, p. 202).
- Cognitivas, aquellas principalmente relacionadas con nuestra capacidad de pensar, como la gestión del tiempo y proyectos y la estrategia. Estas competencias están al servicio de las otras dos; es decir HCP pretende que el alumno las desarrolle en tanto que son necesarias para el desarrollo de las intra e interpersonales (Crespí, 2019).

## 2.2. Ámbitos de desarrollo de HCP

Para provocar el desarrollo de estas competencias, HCP, se configura en dos ámbitos complementarios (Crespí, 2018):



**La mentoría:** ámbito de encuentro, en el que el alumno, acompañado individualmente por su mentor, desarrolla especialmente las competencias personales intrapersonales, y subsidiariamente las cognitivas. El programa de mentoría cuenta con 6 encuentros individuales y presenciales de una hora de duración cada uno. Estos están distribuidos a lo largo del curso (tres en el primer cuatrimestre y otros tres en el segundo). Existe un programa concreto para cada mentoría, que pasamos a detallar:

En la primera mentoría las competencias principales objeto de desarrollo son: mirada profunda y proactividad. Se pretende que el alumno empiece a verse como el protagonista de su propia vida y descubra el valor transformador de la mirada profunda respecto de sí mismo, de los demás y de la realidad.

En la segunda mentoría la competencia principal objeto de desarrollo es el conocimiento personal. Se pretende que el alumno empiece a conocerse mejor. Para ello, se aplican diversas técnicas que le ayudan en esta tarea como el análisis DAFO y el test de caracterología; todo ello con la finalidad de que empiece a descubrir su propia personalidad, forjada a su vez de temperamento y carácter.

En la tercera mentoría las competencias principales objeto de desarrollo son: aceptación y superación personal. Se pretende que el alumno entienda que no todos los caminos conducen a la excelencia y plenitud personal; y en este, la importancia de los hábitos creativos.

En la cuarta mentoría la competencia principal objeto de desarrollo es nuevamente el conocimiento personal; pero desde una perspectiva más profunda e interpelante que sitúa al alumno como alguien único e irreplicable para los demás: familia, universidad, amigos, futuro trabajo, etc. (don para el otro).

En la quinta mentoría la competencia principal objeto de desarrollo es la búsqueda de sentido. Se pretende que el alumno empiece a dar respuesta a su vocación; y en tanto que esta, a su visión y misión.

En la sexta mentoría se recogen todas las anteriores a través de la técnica del portafolio, donde el alumno ha de presentar con sentido global una recopilación de todas las mentorías y competencias trabajadas, presentando todos sus trabajos autónomos.

La nota de la mentoría supone el 25% de la nota final de HCP.

**El aula:** ámbito de encuentro en el que el estudiante, acompañado por su formador y sus compañeros, desarrolla especialmente las competencias de carácter interpersonal, y subsidiariamente las cognitivas. Se pretende que el aula (profesor y alumnos), partiendo del trabajo en equipo y con una adecuada comunicación, pueda llegar a convertirse en una verdadera comunidad de aprendizaje.

Para ello, los alumnos trabajan en equipo desde el primer día de clase, con el objetivo de poner en marcha un proyecto transversal que, tratando un tema técnico (propio de su titulación), implique una mejora transformacional de la sociedad en la que viven.

Este proyecto recibe el nombre de transversal porque:

1. Un primer objetivo es lograr que sea un espacio real de aprendizaje de las competencias transversales objeto de la asignatura: interpersonales (trabajadas más en el aula), intrapersonales (trabajadas más en la mentoría) y cognitivas (aula y mentoría).
2. Un segundo objetivo es generar una mejora transformacional que les permita integrar, por un lado, las competencias técnicas que les ofrecen las otras asignaturas de su grado, y por otro, las competencias transversales objeto de HCP.

Este proyecto implica las siguientes fases:

1.- Ponerse de acuerdo por consenso sobre qué idea y tema quieren trabajar, así como qué quieren mejorar en la sociedad. Esta fase pone en juego principalmente la competencia de toma de decisión, escucha activa y mirada profunda.

2.- Llevar a cabo la decisión tomada, de modo que se produzca una verdadera mejora en la realidad. Han de medir también el impacto real (cuantitativa y cualitativamente). Esta fase pone en juego principalmente las competencias de proactividad, búsqueda de sentido, gestión del tiempo y proyecto, comunicación, resolución de conflictos y trabajo en equipo.

3.- Presentar una memoria escrita de su trabajo y la defensa oral del mismo ante un tribunal experto tanto en competencias técnicas (profesores y miembros de la dirección de su grado) como en competencias transversales (profesor de HCP y mentores). Esta fase pone en juego principalmente las competencias de proactividad, gestión del tiempo, comunicación y trabajo en equipo.

El trabajo que realizan en el aula computa un 75% de la nota final de HCP.

En cualquier caso, en HCP (aula-mentoría) es importante poder generar un encuentro con el alumno para poder acompañarle adecuadamente, como individuo o como miembro de un equipo de trabajo, en su propio desarrollo personal y búsqueda de la excelencia y plenitud a la que están llamados.

### 3. Resultados

La siguiente tabla nos muestra los resultados cuantitativos de la evaluación de HCP, aula y mentoría, en relación a los resultados globales de la UFV, para el año académico 2018-2019.





**Tabla 1. Resultados del CEDA: cuestionario sobre la actividad docente**

Núcleo	Ítem	MEDIA AULA HCP				MEDIA MENTORÍA HCP				MEDIA UFV	
		N: 1.489				N: 1.443				N: 63.377	
		Núcleo	Ítem	D.T.	Moda	Núcleo	Ítem	D.T.	Moda	Núcleo	Ítem
Programación-Organización de la Enseñanza	1 "Tengo suficientemente claro la planificación inicial de la asignatura (actividades, criterios evaluación)".	4,53	4,55	1,35	5	5,11	5,15	1,09	6	4,67	4,73
	2 "La metodología de enseñanza de la asignatura favorece mi aprendizaje".		4,5	1,41	6		5,07	1,11	6	4,67	4,60
Dominio de Contenido	3 "Las explicaciones sobre el contenido de la materia me resultan claras".	4,79	4,68	1,32	6	5,27	5,21	1,05	6	4,84	4,70
	4 "Las dudas planteadas me son resueltas".		4,91	1,25	6		5,34	0,99	6	4,84	4,97
Innovación Docente. Motivación	5 "Puedo conectar la asignatura con situaciones de la vida real".	4,55	4,76	1,35	6	5,00	5,19	1,18	6	4,72	4,83
	6 "Mi deseo de aprender se ve propiciado".		4,34	1,51	6		4,81	1,32	6	4,72	4,61
Interacción con el grupo clase	7 "Las actividades desarrolladas fomentan la interacción con el grupo en clase".	4,71	5,07	1,18	6	4,97	4,88	1,31	6	4,63	4,63
	8 "Los temas tratados me hacen plantearme preguntas".		4,34	1,47	5		5,05	1,23	6	4,63	4,62
Atención Individual al Alumno	9 "Me siento respetado en mis opiniones".	4,94	5,04	1,18	6	5,40	5,44	0,98	6	4,95	5,07
	10 "Me siento acompañado por el profesor".		4,85	1,37	6		5,35	1,10	6	4,95	4,83
Evaluación	11 "Me he sentido exigido adecuadamente por este profesor".	4,59	4,68	1,34	6	5,04	5,20	1,12	6	4,67	4,77
	12 "El método de evaluación permite reflejar lo que he aprendido".		4,5	1,43	5		4,87	1,32	6	4,67	4,60
Resultados	13 "Recibo feedback significativo que me permite mejorar".	4,51	4,67	1,38	6	5,00	5,14	1,15	6	4,71	4,64
	14 "Aprendo cursando esta asignatura".		4,35	1,57	6		4,86	1,40	6	4,71	4,78
Cumplimiento obligaciones	15 "El profesor es puntual en sus compromisos (asistencia a clase, entrega de notas...)".	4,95	4,91	1,34	6	5,28	5,22	1,24	6	5,04	5,06
	16 "Es accesible en la atención al alumno (tutorías, correos, etc...)".		5	1,24	6		5,34	1,09	6	5,04	5,02
Ítems-Criterio	17 "Desde una consideración general, evalúa globalmente: La labor docente de este profesor como facilitador de tu aprendizaje".	4,63	4,75	1,3	6	5,12	5,20	1,09	6	4,73	4,81
	18 "Si pudieras, en qué grado te volverías a matricular en otra asignatura impartida por este profesor".		4,49	1,58	6		5,03	1,37	6	4,73	4,64
MEDIA GLOBAL		4,69	4,69	1,37	5,83	5,13	5,13	1,17	6,00	4,77	4,77

Fuente: Crespi, 2018, p. 222 y 228.

Observando los datos de la tabla anterior, podemos decir, que esta asignatura, resulta, en términos globales muy bien valorada por los alumnos. Si observamos la media de la evaluación de todas las asignaturas de la universidad que es de 4,77, y la de las mentorías que es de 5,13, podemos decir que estas superan la valoración media de la universidad en 0,36 puntos. No obstante, los alumnos parecen valorar mejor la parte de mentorías que la del aula, que tiene una media global de 4,69.

Por otro lado, la evaluación cualitativa nos indica que los alumnos valoran y agradecen especialmente el espacio de desarrollo personal que se les facilita a través de la asignatura de HCP.

En términos de significatividad, y a través del estadístico "t de student", (alpha 0,05) pudimos comprobar que las valoraciones de los alumnos de la docencia recibida en el aula, en la asignatura de HCP eran altas y no diferentes de las valoraciones de otras asignaturas, mientras que si resultaron significativamente superiores las valoraciones de la mentorías, como parte de la misma asignatura.

## 4. Conclusiones

Dentro de la misión de la universidad en general y en particular de la UFV, y aludiendo a la necesidad detectada tanto del EEES como del ámbito empresarial, hemos propuesto la asignatura HCP.

Asignatura cuyo objetivo es el de acompañar a sus alumnos de primero en su respuesta a su vocación, aquí y ahora; de modo que puedan responder a ser quiénes están llamados a ser. Para lograr dichos objetivos, y ponerles en su propio camino de madurez, excelencia y plenitud, HCP articula el desarrollo de las competencias personales. Competencias transversales fundamentales en su desarrollo personal: cognitivas, intra e interpersonales.

Por tanto, HCP pretende que el alumno pueda reflexionar acerca de quién es y de quién está llamado a ser, desarrollando las competencias personales que le permitan dar lo mejor de sí mismo en cada momento. Para ello, el alumno es acompañado en el aula por sus compañeros y profesor; y en la mentoría, por su mentor.

Por último, la valoración de esta asignatura, y muy especialmente la de las mentorías, como espacio de desarrollo personal, es muy positiva, tanto cuantitativa como cualitativamente.

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## La importancia de la información documentada. Caso de actualización documental de un Sistema de Gestión de la Calidad para certificación bajo la norma ISO 9001:2015

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### Resumen

*La documentación de una empresa representa su capital intelectual, ahí se plasma el “saber hacer” que se ha adquirido con la experiencia y el paso de los años. Si no se preserva adecuadamente ese conocimiento se podría perder y provocaría retrabajos y deficiencia en las operaciones. El objetivo de este trabajo es compartir el resultado de un proyecto de intervención en una empresa para lograr la transición de la norma ISO 9001:2008 a la ISO 9001:2015, desarrollando una a una las cláusulas y requisitos solicitados para lograr la certificación.*

*Se describe cómo se desarrolló el sistema nombrado “Matriz de los procesos” el cual incluye de manera completa los requisitos en orden solicitados por la norma, así como los documentos, archivos y formatos asociados. Se elaboró una matriz de procesos que incluye información anterior proporcionada por el antiguo sistema nombrado “Matriz de correlación” la cual cumplía con la norma ISO 9001:2008. La matriz de procesos se desarrolló con el objetivo de identificar de manera rápida y sencilla que documentación de la empresa cumple con determinados puntos de la norma. Además, esta incluye de manera breve y concisa las entradas correspondientes en los procedimientos de la empresa y las salidas que se generan de dichos procedimientos. La transición de la norma ISO versión 2008 a 2015 generó que se debiera crear nueva información y realizar modificaciones y/o actualizaciones a documentos e información con la que la empresa ya contaba, dichos cambios se muestran explicando las etapas de cambio de estos y las consideraciones o recomendaciones propuestas por la norma. Se diseñó un mapa general de procesos con ayuda de hoja de*



*cálculo (Excel), tomando como base el ciclo PHVA (Planear, Hacer, Verificar, Actuar) incluido en la norma ISO 9001:2015.*

**Palabras clave:** *Documentación, Gestión de la Calidad, ISO 9001:2015, Matriz de procesos, Organización.*

## **1. Introducción**

Hoy en día las nuevas necesidades y requisitos de los clientes obligan a las empresas a realizar cambios en sus sistemas y estructura de organización para poder satisfacerlos. Sin embargo, esto no es algo que deba preocupar, al contrario, dichos cambios y actualizaciones generan numerosos beneficios a las empresas que van desde aumentar la calidad de los productos o servicios que ofrece hasta aumentar la competitividad y la cantidad de clientes. La calidad ha sido un tema de interés creciente para las empresas y clientes desde hace más de 30 años. La transición de la norma ISO 9001 posee varios beneficios entre los cuales destaca la integración de otras normas de la familia ISO, un enfoque hacia el ahorro económico de la empresa, formas más efectivas de evaluar la eficacia de los cambios que se llevan a cabo en la empresa y proporcionar un mejor estatus, ya que al poseer una certificación en ISO 9001, se genera una mayor confianza tanto en clientes como en proveedores (Organización Internacional de Normalización, 2015b).

Actualmente existen normas ISO que regulan desde procedimientos hasta productos a nivel nacional e internacional. El objetivo de estas normas es controlar y mejorar la calidad y procesos de producción de las empresas, es por ello que las empresas buscan lograr estas certificaciones, ya que les posibilita ampliar su mercado y prepararse para ser más competitivos (Miletić, Jovanović, Jovanović y Buha, 2017).

En este contexto, este trabajo presenta una breve descripción del proceso de transición de la norma ISO 9001:2008 a la ISO 9001:2015, realizado para la empresa TIHSA EM S.A. de C.V., que es una empresa mexicana, ubicada en el Municipio de Tulancingo, estado de Hidalgo. La generación de la nueva norma ISO 9001:2015, provocó que gran parte de la información, documentación, procesos y sistema llamado “Matriz de correlación ISO” que utilizaba la empresa fueran obsoletos al estar basados en la norma ISO 9001:2008. Lo anterior, representó una problemática de gestión documental en la empresa, por lo que fue necesario plantear un proceso integral para actualizar la documentación que respondiera a la pregunta: ¿Qué aspectos estratégicos eran necesarios para la transición de la norma ISO 9001: 2015? Se planteó así la necesidad de analizar los factores críticos de operación de la empresa, lo que permitió detectar los cambios por desarrollar tanto en las áreas administrativas como en áreas de producción, que implicaba actualizar o diseñar todos

aquellos formatos, documentos, archivos y procesos que resultaban obsoletos o que ya no cubrían por completo con los lineamientos demandados por la nueva norma.

El objetivo del trabajo es compartir el resultado de un proyecto de intervención en una empresa para lograr la transición de la norma ISO 9001:2008 a la ISO 9001:2015, desarrollando una a una las cláusulas y requisitos solicitados para lograr la certificación. Como objetivos específicos de la intervención en la empresa se determinaron los siguientes:

- Diseñar la matriz de los procesos
- Elaborar el mapa general de procesos TIHSA EM.
- Participar en la actualización de la planeación estratégica de la empresa. De forma específica en lo relacionado con el sistema de gestión de la calidad.
- Conocer y familiarizarse con el anterior sistema empleado por la empresa.
- Determinar que documentos son útiles y cuáles no para la norma ISO 9001 2015.
- Descargar al nuevo sistema los documentos útiles para la nueva versión de norma.
- Descargar al nuevo sistema las evidencias y/o información obtenida del desarrollo de las cláusulas de la norma.

## **2. Marco de referencia**

### **2.1. Antecedentes de la empresa TIHSA EM**

La empresa TIHSA EM S.A. de C.V. surge en el año de 1972. El giro de la empresa pertenece al sector metal-mecánico, ya que es fabricante y maquiladora de partes componentes y productos para la industria automotriz, de construcción y minera, entre sus clientes cuenta con empresas distribuidoras en la República Mexicana en las ciudades de Querétaro, México, Guadalajara, Monterrey, Tamaulipas; Guanajuato y San Luis Potosí, así como en el extranjero. TIHSA EM, ha obtenido tres veces el premio Hidalgo de la calidad, la primera ocasión fue en el año de 1994, seguido por el año 1998 y por último en 2007. También logró la certificación QS-9000 en el año 2004, lo que muestra el fuerte enfoque hacia la calidad que ha tenido la empresa en las últimas tres décadas.

La gestión de la calidad no es un elemento rígido, requiere renovarse constantemente para poder satisfacer las nuevas necesidades de las empresas y de sus clientes. TIHSA EM ha logrado establecer un proceso de planeación estratégica que le ayuda a renovar su Misión, Visión, Objetivos empresariales, Política de Calidad, Filosofía y Valores de una forma

continua. Este enfoque le ha permitido un desarrollo importante como empresa en la región de Tulancingo, Hidalgo, México.

## **2.2. La calidad y los beneficios de la normalización**

La calidad se puede definir como el conjunto de características que posee un producto o servicio y que le otorgan la capacidad de satisfacer las necesidades y expectativas de un cliente (Nava, 2006). De acuerdo a Palafox (2005), citado por Martínez (2007), la calidad supone que el producto o servicio debe cumplir con las funciones y especificaciones para lo que ha sido diseñado y que deberán ajustarse a las expresadas por los consumidores o clientes del mismo.

Las normas son un modelo, patrón o criterio a seguir. Una norma tiene valor de regla y tiene el propósito de establecer las características que debe poseer un objeto y los productos que han de tener una compatibilidad para ser usados a nivel internacional. Por ejemplo, el problema que ocasiona a muchos usuarios los distintos modelos de enchufes que existen a escala internacional para poder acoplar pequeñas máquinas de uso personal tales como secadores de cabello, máquinas de afeitarse, cargadores de celular entre otros, cuando se viaja de un país a otro y que provoca el mal funcionamiento del aparato o que no se pueda usar se puede evitar al aplicar una normalización en especificaciones. La incompatibilidad repercute en muchos campos, por lo que la normalización de los productos cobra mayor importancia en un mundo más globalizado.

### *2.2.1. Las normas ISO*

Las normas ISO se establecen por el Organismo Internacional de Estandarización (ISO), que es una entidad formada por 81 organismos de normalización de varios países del mundo cuya función principal es editar y revisar normas internacionales para facilitar el intercambio de bienes y servicios (Nava, 2005; Organización Internacional de Normalización, 2015b). Las normas se componen de estándares y guías relacionados con sistemas y herramientas específicas de gestión que se aplican en las diferentes empresas productoras de bienes o prestadoras de servicios (Cruz, López y Ruíz, 2017). Las normas ISO son un conjunto de normas orientadas a ordenar la gestión de una empresa en sus distintos ámbitos. La alta competencia internacional acentuada por los procesos globalizadores de la economía y el mercado, así como el poder e importancia que ha ganado la figura y la opinión de los consumidores, propicia que dichas normas, pese a su carácter voluntario, hayan ganado un gran reconocimiento y aceptación internacional.

La finalidad principal de las normas es orientar, coordinar, simplificar y unificar los usos para conseguir menores costos de operación y efectividad. Tienen valor indicativo y de guía y en la actualidad su uso se ha extendido generando gran interés por parte de las

empresas en seguir las normas existentes, porque desde el punto de vista económico reduce costos, tiempo y trabajo (Retos Supply Chain, 2014). Lo que se pretende lograr es que las normas ISO sean un elemento rector en cuanto a la importancia que tienen las relaciones de confianza entre los clientes y los proveedores (Retos Supply Chain, 2014).

### **2.3 Evolución de norma ISO 9001**

En la década de los 80's del siglo XX, el control de calidad pasó a ser garantía de calidad. La calidad ya no se limitaba únicamente al producto, sino que englobaba todo el proceso y la cadena de producción que debían garantizar la conformidad del producto. Mediciones y pruebas de calidad del producto eran realizadas en la cadena de producción y era deber de la empresa demostrar la calidad del producto al cliente.

Al principio de los años 2000, la garantía de calidad que se realizaba únicamente en las cadenas de producción pasó a ser dirigida, gestionada, y mejorada bajo la forma de un sistema de gestión. El producto, así como los servicios creados y aprovisionados por la empresa pasan a estar bajo la responsabilidad del sistema de gestión. La empresa no solo tenía que garantizar la conformidad de sus productos y de sus servicios, sino que también debía satisfacer al cliente y brindarle la prueba de conformidad.

En el 2015, el sistema de gestión de la calidad se extiende y ya no solo abarca a los clientes, sino que también a toda parte interesada que sea pertinente para la empresa (stakeholders), partes que conformen el ecosistema de la organización. La nueva versión de ISO 9001:2015 promueve una mejor integración del estándar con otras normativas similares, lo que se sitúa en línea con el nuevo concepto de calidad, mucho más amplio e integrado con otros elementos corporativos como: la Gestión de los Riesgos, la Responsabilidad Social o la Gestión Medioambiental. Se gestiona, modifica y mejora el sistema de gestión de la calidad - que se encuentra bajo la responsabilidad de la alta dirección - con la ayuda de riesgos y oportunidades identificadas y juzgadas pertinentes para la empresa, teniendo en cuenta el contexto, los desafíos y a todas las partes interesadas pertinentes para la empresa (Rodríguez, 2017).

En la Figura 1 se muestra un esquema con los siete conceptos básicos que tiene la versión ISO 9001:2015 y que sustentan la “estructura de alto nivel” (Organización Internacional de Normalización, 2015a; Gobierno del Estado de México, 2016; Instituto Mexicano de Normalización y Certificación, s.f.).



## 2.4 La norma IAF 16949

En el ámbito de la industria automotriz la International Automotive Task Force (IATF) ha publicado el estándar IATF 16949:2016, el cual ha sustituido a ISO/TS 16949:2009 como referencia para el desarrollo de sistemas de gestión de la calidad en la industria automotriz (Prudencio, 2016). La empresa TIHSA EM requiere ajustarse también en el cumplimiento de esta norma por lo que su sistema de gestión de la calidad debe incluirla.

La norma IATF 16949:2016 ha sido desarrollada con base en la nueva estructura de alto nivel para los sistemas de gestión de ISO que fue publicada en 2012, bajo la cual todas las nuevas normas publicadas a partir de ese año y las normas que se han actualizado tienen la misma estructura, facilitando su implementación de manera integrada y optimizando los recursos e inversión que implica para las organizaciones (Prudencio, 2016).



Fig. 1 Siete conceptos básicos de la norma ISO 9001:2015

Fuente: Instituto Mexicano de Normalización y Certificación, A.C. (s.f.)

### 3. Metodología

Para el desarrollo del trabajo descrito se utilizó el enfoque sistémico, ya que ayuda a representar la secuencia de acontecimientos o actividades relacionadas para lograr un determinado fin. El enfoque sistémico tiene como punto de referencia el concepto de sistema, que es un conjunto de elementos interrelacionados con un objetivo común (Van Gigch, 2006).

En la Figura 2 se muestra un modelo de enlaces de cadena basado en Marquis (1969) para representar el esquema metodológico seguido en el presente trabajo.

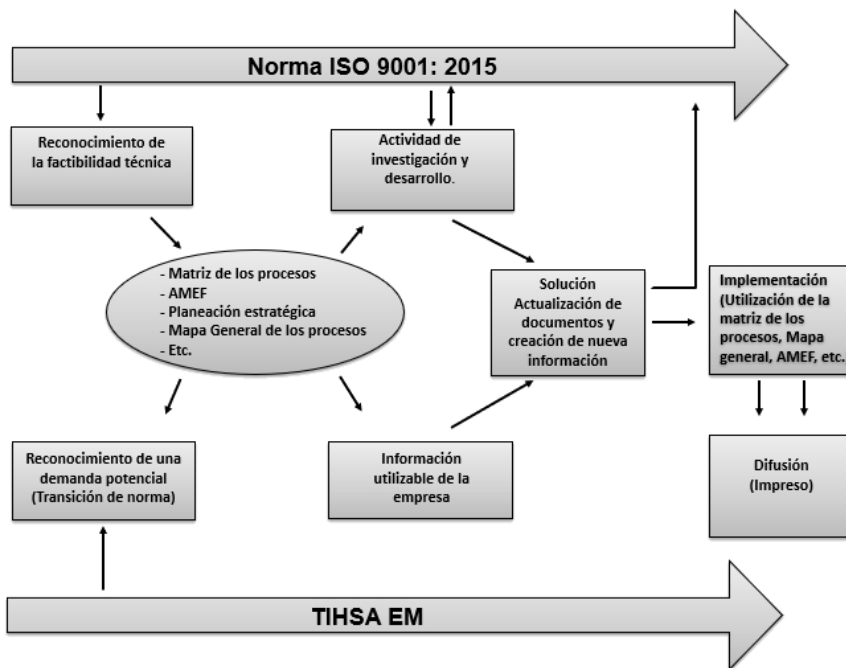


Fig. 2 Modelo de enlaces para la intervención en la empresa TIHSA EM con enfoque sistémico  
Fuente: Elaboración propia con base en Marquis (1969).

El periodo de realización del proyecto comprendió de julio de 2017 a noviembre de 2018. Las actividades realizadas como parte de la metodología de trabajo se indican a continuación:

1. Conocer y explorar el anterior sistema empleado para familiarizarse y realizar propuestas de sistema en el cual se incluyan los apartados correspondientes a los solicitados por la norma ISO 9001:2015.
2. Elaboración del mapa general de procesos TIHSA EM.
3. Descargar la información proporcionada por la norma ISO 9001:2015 y la norma IATF 16949 en el nuevo modelo de sistema "Matriz de los procesos" para dar una estructura, orden y seguimiento. Además, incluir la información, resultados y actividades obtenidos por el trabajo con el punto no. 4 de la misma.
4. Analizar y evaluar los documentos incluidos en el anterior sistema para determinar si aún son funcionales o no.
5. Seguimiento al sistema realizado. Asignación de nuevos códigos a los documentos y formatos.
6. Descargar al sistema la información y documentos obtenidos del avance y desarrollo de las cláusulas por parte de la norma ISO 9001 2015 y la norma IATF 16949.
7. Elaborar el informe final para su entrega y revisión del asesor empresarial y académico. Hacer las modificaciones correspondientes hasta lograr la autorización del reporte final.

#### **4. Resultados**

La transición que se realizó respecto a la norma ISO 9001:2008 a la 9001:2015, presentó un gran reto tanto para el personal administrativo como para los trabajadores y operarios. Los documentos identificados en la matriz de correlación enmarcada en la ISO 9001:2008 fueron 23 relativos a políticas, 56 de procedimientos, 22 instructivos, 3 manuales y 126 formatos. Los cambios implicaron modificaciones de gran alcance y otras de menor alcance en diferentes secciones de la empresa que abarcan desde la administración hasta la producción. Se generó una Matriz de Procesos que considera un mapeo de procesos (entradas y salidas) bajo la ISO 9001:2015. Tomando como base el mapa de procesos y el ciclo PHVA se dio inicio a la elaboración del mapa general de procesos de TIHSA. Dicho mapa debía contener de manera breve y concisa los procesos y sectores / áreas a los que pertenecen. La intervención realizada en TIHSA dio lugar a la propuesta de una "Matriz de alineación", que se realizó para incluir en la planeación estratégica de la empresa, la alineación de la visión, misión, Sistema de Gestión de Calidad, política de calidad y objetivos de la empresa, con la finalidad de poder evaluar que enfoque dan a características que poseen o que deberían de cubrir en común. Dichas características abarcan los clientes,

procesos productivos, industrias, productos, materiales, maquinaria y equipo, mano de obra y certificaciones.

Al continuar con el desarrollo de las cláusulas correspondientes a la ISO 9001:2015, se detectó que TIHSA EM no contaba con una lista de riesgos a considerar y con los que se debiera trabajar. Para poder cubrir las necesidades y requisitos que se solicitaban se creó un listado de riesgos el cuál posteriormente se trasladó a un diagrama de Ishikawa con el objetivo de identificar los riesgos críticos que eran más propensos a suceder, esto con el objetivo de trabajar con los mismos para poder controlarlos y de ser posible, eliminarlos. También se realizó una revisión de la descripción de los puestos de trabajo basados únicamente en las actividades que afectarían directamente la estructura o producción de la organización. Posteriormente, se procedió a asignar los nuevos códigos a los documentos y/o archivos que ya estaban listos o los que se identificaron de manera correcta dentro de la matriz de procesos, esto con la finalidad de poder identificarlos basados en las características y especificaciones de la nueva norma. Para la asignación de nuevos códigos se hizo uso de uno de los instructivos que se actualizó, el IN-7.5.2-01-R2-100318 ya que este es el que determina la manera correcta de asignar un código a un nuevo archivo o un archivo modificado.

La certificación del Sistema de Gestión de la Calidad se obtuvo en noviembre de 2018 por parte del organismo certificador American Trust Register, S.C. (ATR) con número de certificado 2496, al cumplir satisfactoriamente con lo requerido por el organismo. En el sistema creado, la matriz de los procesos, es la base estructural la cuál contiene gran parte de la información relevante de la empresa. Se realizaron cambios a información relevante de la empresa tal como la planeación estratégica que incluye la razón de ser, objetivos, políticas y organigrama, entre otros. También se realizaron propuestas de cambios a archivos que pudieran ser de ayuda en la justificación de documentos o en la creación de nueva información. La matriz creada ha resultado de mucha utilidad ya que permite identificar de manera clara y concisa los requisitos de la norma y los documentos que posee la empresa que cumplen con dichos requisitos. Anteriormente se contaba con un sistema llamado matriz de correlación, sin embargo, carecía de estructura y generaba algunas confusiones al tratar de saber con qué puntos específicos estaba cumpliendo cada documento contenido en ella.

## **5. Consideraciones finales**

La realización del proyecto de intervención en la empresa TIHSA EM surgió de la necesidad de actualizar su sistema de calidad para alcanzar la certificación en la norma

ISO versión 9001:2015. El enfoque de la nueva norma ISO 9001:2015 se basa en la gestión del riesgos, el Sistema de Gestión de Calidad (SGC) y la estructura funcional de la empresa, poniéndose especial énfasis en la interconexión y las relaciones existentes entre estos tres elementos. A partir del estudio de los cambios de la norma, se encontró que el análisis de riesgos, con una vocación preventiva, pasa a tener una importancia crítica en la filosofía de ISO 9001:2015. Se observó que ahora se pone el énfasis en la necesidad de identificar los riesgos para poder eliminarlos o minimizar sus consecuencias a través de la puesta en marcha de procesos de mejora continua del sistema.

Para lograr esta nueva certificación fue necesario realizar numerosos cambios al sistema de la empresa, que abarcó a la información, documentos y procesos, con la finalidad de cubrir las especificaciones que la norma solicitaba. El principal desafío que se presentó fue familiarizarse con el anterior sistema e identificar cada uno de los archivos, documentos y formatos que este contenía para así poder analizarlos y determinar si cumplían o no a las demandas solicitadas por la norma ISO 9001:2015. Fue necesario crear algunos nuevos archivos que las cláusulas de la norma solicitaban y para los cuales la empresa no contaba con ellos. Otros más como el mapa general de los procesos necesitaron una actualización obligatoria ya que al estar realizados en base a especificaciones pasadas, con la nueva versión quedaban obsoletos. La evaluación y análisis de documentos requirió de una gran cantidad de tiempo y el determinar los cambios o modificaciones a realizar se hizo con ayuda de un asesor académico.

Respecto a la matriz de los procesos y los documentos que contiene, la identificación de dichos documentos se puede realizar ahora de manera clara y sencilla. Con el nuevo sistema creado es mucho más fácil identificar qué documento cubre un punto específico de la norma, ya que se agregaron las cláusulas completas de esta para evitar tener que acceder a otro documento que especificara que es lo que se debía de cumplir. Se construyeron las bases y estructura general del sistema que serviría de apoyo para la certificación. En relación al sistema Matriz de los procesos, este contiene las entradas y salidas de los procesos correspondientes a las cláusulas de las normas. A las entradas y salidas se les mapeo, para generalizar las actividades que se realizaban. De igual manera, el mapeo de los procesos ayudó a identificar de forma más rápida los archivos y/o documentos que deben encontrarse para cubrir con determinadas cláusulas. Lo anterior, ayudará a que los documentos y archivos que se identificaron y añadieron se encuentren en constante actualización y modificación con la finalidad de volverlos útiles para las certificaciones correspondientes.

Finalmente, se recomienda analizar constantemente las oportunidades presentes y futuras para tomar acciones con la finalidad de mejorar los procedimientos dentro de la empresa. También es recomendable mejorar la comunicación y flujo de información dentro de la empresa para aumentar la respuesta ante situaciones no deseadas que pudiesen complicar

el ritmo de producción o la integridad de la empresa. Revisar y actualizar la información de la empresa es muy importante ya que se encontraron datos y archivos obsoletos que no generaban ningún aporte y que en cambio ocasionaban confusiones en la identificación de archivos e información que si era útil y de valor.

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## Propuesta de rúbrica para coevaluación de trabajos en asignaturas de máster

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### Resumen

*El presente trabajo presenta una propuesta para coevaluar trabajos mediante rúbrica. Se abordan en él los principales problemas que el docente debe afrontar y las soluciones propuestas.*

*La propuesta se muestra adaptada a una asignatura de corte tecnológico, con un peso muy concreto en la evaluación final, donde estos extremos, los más fáciles de adaptar, muestran al tiempo que la singularidad de la experiencia no lo es tal por la procedencia de los alumnos.*

**Palabras clave:** Rúbricas, Coevaluación, Innovación Docente.

### 1. Introducción

Todo docente se encuentra con una serie de limitaciones, siendo de las más comunes el escaso tiempo y la resistencia al cambio ante los cambios que las nuevas metodologías docentes imponen. (Viñas Pérez, 2015) (Viñao, 2006). Por otra parte, cuando se trata de estudios más allá del grado, de master o de tercer ciclo, entre los alumnos hay una casuística inmensa de la que suele destacar dos factores: la diferente titulación de partida y la mayor maduración intelectual del alumno frente a etapas anteriores (Peña, Gadañón, Crespo, & Sánchez, 2012) (Oltra Gutiérrez, Juan Vicente, 2018)

Con la siguiente propuesta tratamos de apoyarnos en esa distinta casuística para paliar las limitaciones docentes. La idea es hacer que “trabajen ellos”, como método, por una parte, que apoya su crecimiento intelectual, y por otra, rebaja la carga de corrección del profesor al facilitar un pre-filtrado de los trabajos a corregir, cada vez más con las llamadas metodologías activas. (Gallego Arrufat & Raposo Rivas, 2014)





## **2. Punto de partida**

En el plan de estudios del Master Universitario de Gestión de la Información se reciben alumnos de múltiples procedencias: Grado de Informática, Derecho, Periodismo, Ingeniería Industrial, Telecomunicaciones... gente de procedencia muy diversa no solo en titulaciones sino en nacionalidad (Rusia, Ucrania, Brasil, Colombia, Cuba, España, etc.) No se puede establecer un hilo común más allá del que da que se trate de personas en un momento vital que les ha llevado en su inmensa mayoría (la última encuesta realizada daba cifras superiores al 75%) trabajan mientras cursan los estudios.

Esa diversidad provoca que se deban buscar caminos comunes. Para ello, se disponen los trabajos de la asignatura en forma de entrega por grupos, para que exista la tan necesaria transfusión de conocimientos de unos a otros y, por otra parte, faciliten la corrección al docente, al reducirse el número de entregas y ser estas, obligadas a cubrir una serie de aspectos, homogéneas en su forma.

Esta diversidad afecta sobre todo a la asignatura MLD: Marco Legal y Deontológico de la información (Oltra Gutiérrez, 2019), pues el conocimiento de partida de la legislación Española y europea probablemente sea el más heterogéneo de todos los que conforman las distintas facetas de ese prisma que es el master.

Para reforzar ese intercambio no solo se realizan los trabajos en grupo, sino que antes de ser entregados al profesor, estos son coevaluados entre sí, por otros grupos de alumnos.

Eso permite una visión mayor de los conocimientos que realmente comparten y, por otra, sirve de criba para el docente, pues los que tienen una calificación muy baja son revisados de nuevo por los autores, evitando que sea el profesor quien les da esa vuelta de tuerca.

Para dar uniformidad y facilitar el trabajo (Ponce Morales & Rodríguez Mendoza, 2013) (Martínez-Azúa, Sandía, Rey, & Dios, 2016), se propone una rúbrica.

## **3. Pruebas a evaluar**

Siguiendo la guía docente, encontramos una serie de pruebas, que presentamos en la siguiente tabla.

Anticipemos que esos tres puntos, aun en distintos epígrafes, se corresponden al trabajo de la asignatura, en sus distintas fases. Estos tres puntos son realizados, como se ha anticipado,



en grupo, siendo divididos en cuatro bloques homogéneos en su nota de 0,75 puntos cada uno.

**Tabla 1. Elementos a evaluar.**

	Nº entregas	Peso (%)	Puntos
<b>Examen oral.</b>	1	7,5	0,75
<b>Mapa conceptual</b>	1	7,5	0,75
<b>Trabajo académico</b>	1	7,5	0,75
<b>Coevaluación</b>	1	7,5	0,75
<b>Caso</b>	7	70	7
<b>TOTAL</b>		100	10

*Fuente: elaboración propia*

El trabajo en sí consiste en la creación de un mapa conceptual sobre un asunto de interés para la asignatura, que ha de ir acompañado de una memoria descriptiva, de entre dos y cinco páginas.

¿Cuál es la división del trabajo? Veámosla repartida en el tiempo.

En una primera entrega, como borrador, se entrega la memoria descriptiva, que apuntará cómo será el mapa conceptual final. Esta entrega es la que se coevalúa y la que veremos con detalle a continuación. El peso de esta prueba será de 0,75 puntos. Hay que indicar que la nota en este caso no va asociada a la calidad de la entrega de cada grupo, sino a la calidad de las correcciones de los mismos por parte de otros grupos.

Una segunda entrega lleva dos partes asociadas: esa misma memoria descriptiva, ya en fase final, y el mapa conceptual en sí. Cada una de esas dos partes recibe una calificación máxima de 0,75 puntos.

Una tercera fase pasa por la presentación oral del mapa conceptual, de forma que al finalizar la misma, deben responder unas preguntas por parte del docente. Esta parte recibe así mismo una calificación de 0,75 puntos.

#### **4. Rúbrica propuesta**

La creación de una rúbrica es una de las más intensas que un docente puede realizar: esta debe ser legible por todos, debe decir exactamente lo que se pretende, ser clara y sin

ambigüedades y, además, adaptable según las circunstancias. (Picornell Lucas, 2014) (Chica Merino, 2011)

En el caso que nos ocupa, un borrador de poco tamaño, documento además asociado a un mapa conceptual y con una nota reducida (0,75 puntos) se propone una rúbrica de sencilla y rápida aplicación, basada en la simple comprobación de una serie de elementos distribuidos en tres categorías: elementos principales del mapa conceptual, relaciones principales del mapa conceptual y bibliografía y otros aspectos formales.

Cada una de esas tres categorías puede recibir una nota que va del rango de 0 a 0,25 puntos si se cumplen las condiciones asociadas (ver tabla 2). Para los aspectos formales y bibliográficos se ha preparado una lista breve de aspectos a considerar de forma que la nota será proporcional a la presencia (o ausencia) de los mismos.

Los elementos a revisar en esta última categoría serían:

1. El documento no presenta problemas de legibilidad
2. Es correcto sintácticamente y semánticamente
3. La bibliografía es adecuada extensión (mínimo, cuatro fuentes)
4. La bibliografía es adecuada en calidad (fuentes procedentes de artículos de investigación, libros... no Wikipedia o similar)
5. La bibliografía y está bien referenciada (emplea alguna norma como IEEE, APA o MLA)

Hay que remarcar que la nota que los alumnos indican no será la asociada al grupo que corrijan. Sirve para determinar su propia nota: de qué manera han corregido. Para esto será preciso que cada grupo evaluado indique (con una o dos líneas, no hace falta más) el porqué de cada decisión en la coevaluación.

Para el docente sirve además para establecer una retroalimentación a los alumnos sobre cómo va su propio trabajo. Esto agiliza mucho la tarea del docente, que evita una precorrección y, además, se asegura de mejorar el producto final del trabajo de sus alumnos, pues estos han corregido, al menos en los aspectos formales, aquellos aspectos con problemas.

Cabe añadir una nota un tanto subjetiva: a lo largo de los años que se ha venido experimentando en la asignatura con las técnicas de coevaluación, la nota que los alumnos se dan a sí mismos suelen ser mucho más bajas que las que el docente les daría. Esto es: sus criterios de corrección suelen ser mucho más duros.

Tabla 2. Rúbrica

<b>Elemento</b>	<b>Elemento principal: razón de su presencia</b>	<b>Elemento principal: Relaciones con los otros elementos que se señalan</b>	<b>Bibliografía y aspectos formales</b>
<b>0 puntos</b>	No aparece ninguno-	No se indica relación alguna	Carece de bibliografía. Párrafos ilegibles o documento mal estructurado
<b>0,05 puntos</b>	Aparece solo un elemento, y no se explica nada sobre él.	Se indica alguna relación, pero no otras, y no se explican	Cumple solo con uno de los elementos a revisar.
<b>0,1 puntos</b>	Aparecen de 2 a 5 elementos y al menos de uno no se explica nada.	Se indican las relaciones entre los elementos indicados, pero no se explican.	Cumple con dos de los elementos a revisar.
<b>0,15 puntos</b>	Aparecen más de 5 elementos, aunque algunos carecen de explicación.	Se indican algunas relaciones, algunas se explica, otras no.	Cumple con tres de los elementos a revisar.
<b>0,20 puntos</b>	Aparecen más de cinco elementos, con subelementos, aunque la aparición de algunos carece de explicación.	Se indican todas las relaciones, pero alguna no se explica.	Cumple con cuatro de los elementos a revisar.
<b>0,25 puntos (máximo)</b>	Aparecen más de cinco elementos, con subelementos, y los elementos aparecen explicados.	Se indican y explican todas las relaciones.	Cumple todos los elementos a revisar.

Fuente: elaboración propia

## 5. Conclusiones

En esta experiencia aunamos el uso de rúbricas, que permite una mayor claridad al alumno de cara a la eterna pregunta “¿qué espera de mí el profesor?” con la coevaluación, que permite una visión general, de forma que viendo los errores en el trabajo ajeno no solo se detectan mejor los propios, sino que con la necesaria retroalimentación, al ser corregidos por sus iguales, los alumnos tiene la percepción de que sus errores no han sido detectados por el ojo exquisito de un profesor, sino porque son evidentes.

Además, al formar grupos con alumnos de distinta procedencia, la tutorización inter-pares se enriquece y, aprovechando su mayor maduración al ser alumnos con una edad mayor y obligaciones vitales más intensas que las de los alumnos medios de grado, el aprendizaje se refuerza.

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## Análisis de la firma electrónica en el contexto de la Transformación Digital en la Unión Europea

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### Resumen

*El futuro profesional de la informática recibe una escasa formación en lo que respecta a su vinculación con el marco legal, político y económico del sector europeo. A pesar de que las implicaciones laborales son muchas, las más de las veces el parco acercamiento suele quedarse en un estado teórico y escaso.*

*Con la presente experiencia se busca acercar al alumnado al contexto europeo legal técnico y económico que rodea a la firma electrónica. Este elemento está vinculado con la autenticación e identificación electrónica de ciudadanos europeos en los servicios ofrecidos por el sector público y privado dentro del Mercado Único Digital. Esta estrategia es promovida por la Unión Europea como un paso más dentro de la teoría de la integración de mercados.*

*La involucración de los autores en este contexto es debido a su participación en el proyecto financiado por la Comisión Europea denominado 'Cross-border authentication in European cloud platforms according to the eIDAS Regulation (EUROLogin), de cuyos resultados se deriva información de interés para el seguimiento e investigación por parte del alumnado.*

**Palabras clave:** Firma electrónica, Reglamento eIDAS, Profesión Informática, Mercado Único Digital

### 1. Introducción

Vivimos en un mundo cada vez más pequeño. Los profesionales tienen cada vez más una movilidad geográfica mayor (EURES, 2019). Para los informáticos en particular esto





supone que no solo deben dominar sus materias y tener un conocimiento somero de la legislación que regula su trabajo, sino que deben ser conocedores del marco legal, político y económico en el que va a desenvolverse su actividad profesional.

El marco de la Unión Europea facilita esta movilidad por la tendencia a homogeneizar las leyes entre unos países de la Unión y otros, rompiendo barreras a la libre circulación de capitales y personas. Aun así, existen diferencias que pueden provocar problemas en su actividad laboral.

Dentro de la docencia de materias jurídicas para informáticos, uno de los elementos que no pueden soslayarse es el de la administración electrónica, con todo lo que ello conlleva: registros electrónicos, sedes electrónicas y, este es el caso que nos ocupa, la firma electrónica.

En la presente propuesta se muestra una actividad a desarrollar por alumnos de máster (MUGI, 2019) basada en el contraste de las distintas situaciones que pueden encontrarse en países de la Unión Europea. En concreto, partiendo de la ya conocida por ellos norma española (básicamente, (BOE [39/2015], 2015) y (BOE [40/2015], 2015) y el REGLAMENTO (UE) No 910/2014 DEL PARLAMENTO EUROPEO Y DEL CONSEJO de 23 de julio de 2014 relativo a la identificación electrónica y los servicios de confianza para las transacciones electrónicas en el mercado interior, se les solicitan trabajos comparativos con la situación en Italia, Bélgica y Chipre.

Para ello, en el presente trabajo, se describe someramente el proyecto y se establecen las principales definiciones, para a continuación enumerar los pasos dados por los alumnos en sus trabajos, así como la pequeña rúbrica de corrección establecida.

Los autores de la presente comunicación quieren agradecer a la Comisión Europea y a la Agencia Ejecutiva de Innovación y Redes (Innovation and Networks Executive Agency), así como, al programa marco de financiación Connecting Europe Facility (CEF Telecom).

## **2. Punto de partida**

La iniciativa “Connecting Europe Facility” (CEF) se creó mediante el Reglamento (UE) nº 1316/2013 del Parlamento Europeo y del Consejo (el «Reglamento CEF») (UE [1316/2013], 2013). Este Reglamento determina las condiciones, métodos y procedimientos para proporcionar asistencia financiera de la Unión a las redes transeuropeas a fin de apoyar proyectos de interés común, además de establecer el desglose de los recursos disponibles para el periodo 2014-2020 en los campos de transporte, telecomunicaciones (el que nos ocupa en esta ocasión) y energía.



En este trabajo nos interesan de forma específica las directrices para las redes transeuropeas en el área de infraestructura de telecomunicaciones (llamadas directrices CEF Telecom), que se adoptaron el 11 de marzo de 2014 (UE [283/2014], 2014), donde se marcan los objetivos específicos, prioridades y criterios de elegibilidad para la financiación prevista para las redes de banda ancha y las infraestructuras de servicios digitales

Como objetivo general figura la mejora de la infraestructura física y digital de nuestras redes facilitando, entre otros factores, el uso de infraestructuras interoperables para así favorecer el crecimiento económico y mejorar la competitividad del mercado interior. La consideración última es que así se logrará mejorar la vida cotidiana de los ciudadanos, las actividades de las empresas y administraciones. Todas estas interrelaciones, no está de más subrayarlo, son posibles gracias al trabajo de los ingenieros informáticos.

La estrategia del mercado único digital se revisó y, en la primavera de 2017 se evaluó el progreso realizado por la UE en términos digitales tras dos años del lanzamiento de la misma. La revisión indicó la necesidad de desarrollar un entorno ciberseguro, en el entorno de una economía de datos europea que maximice la digitalización de los sectores de servicios.

Para preparar este despliegue de ciberseguridad que apoya a la infraestructura y servicios interoperables y la modernización de la administración pública, en septiembre de 2017, la Comisión lanzó un paquete actualizado de iniciativas sobre ciberseguridad a través de la Comunicación conjunta "Resiliencia, disuasión y defensa: construcción de una ciberseguridad fuerte para la UE" (UE [2017/0450], 2017). Conviene tener esto presente, pues será uno de los elementos a considerar en la elaboración de los trabajos de los alumnos.

## **2.1. Definiciones.**

Las transacciones electrónicas seguras requieren absoluta certeza sobre las identidades de las partes que participan en ellas, así como la acreditación adecuada de su voluntad. Esto implica que tanto la identificación y autenticación electrónicas (eID) como las firmas electrónicas son, por tanto, elementos clave para las transacciones electrónicas seguras y para un mercado único digital.

En la Unión Europea, la prestación de servicios de identificación y firma electrónica se basa en el marco regulador establecido por el Reglamento eIDAS (UE [910/2014], 2014), gracias al cual se proporciona reconocimiento legal transfronterizo de eID, firmas electrónicas y servicios de confianza como eDelivery (CEF Digital, 2019), permitiendo así que la Unión Europea se beneficie de un entorno normativo predecible para permitir

interacciones electrónicas seguras y sin problemas entre empresas, ciudadanos y autoridades públicas.

Al respecto de la firma electrónica, eSignature, los programas de trabajo 2014-2018 apoyaron actividades de desarrollo, mantenimiento y actualización del software de la biblioteca de código abierto DSS (Servicios de firma digital), TL-Manager (Trusted List Manager) y el Trusted List Browser. Además, ayudó y capacitó a los organismos nacionales responsables del funcionamiento de las listas de confianza y los proveedores de soluciones que implementan firmas electrónicas avanzadas que dependen del DSS, y promovió la adopción del DSI de eSignature en los Estados miembros. La documentación está disponible en vía web y los alumnos pueden y deben consultarla (CEF Digital, 2019b).

Relacionado con la identidad electrónica, eID, los programas de trabajo 2014-2018 apoyaron la implementación de los nodos eIDAS, adaptados a las infraestructuras nacionales de eID, dentro de los estados miembros, así como la integración del componente básico de eID en los servicios/sistemas/plataformas en línea existentes en diferentes entidades del sector público y áreas del sector privado (como instituciones financieras o comunicaciones móviles). Esto permite realizar transacciones transfronterizas que cumplen con el Reglamento eIDAS. La documentación está disponible en vía web y los alumnos pueden y deben consultarla (CEF Digital, 2019c).

## **2.2. La firma digital en el contexto de los planes de estudio.**

En el plan de estudios del master la firma electrónica, desde un prisma legal, se ve en un tema de la asignatura MLD: Marco Legal y Deontológico de la información (Oltra Gutiérrez, 2019). Además, reciben nociones de ciberseguridad en el plan de estudios.

Se trata de una asignatura de primer semestre de primer curso, por lo que el alumno poco menos que cuenta tan solo con sus conocimientos previos al master, además del apoyo que el profesor le facilita.

## **3. Trabajo propuesto**

En grupos de cuatro alumnos deben elegir un país de los propuestos (dentro del marco del alcance de eIDAS) y con él:

- a) Localizar las normas que afectan a la firma electrónica en ese país
- b) Realizar una tabla comparativa con la normativa española, que conocen por la asignatura

- c) Crear un mapa mental con las relaciones de esa norma nacional con CEF, en particular con eSignature y eID, gracias a la información que se facilita vía web
- d) Localizar las alusiones a la ciberseguridad en ese aparato normativo y establecer las relaciones con las normas al respecto de la UE, en concreto con la directiva NIS (UE [2016/1148], 2016)
- e) Preparar una exposición pública.

### **3.1. Evaluación: rúbrica**

El trabajo tiene un peso total de dos puntos, siendo realizada la evaluación mediante la rúbrica que se presenta en la tabla 1.

En ella se descomponen los dos puntos de forma que pueda evaluarse cada elemento que se solicita de forma independiente. Para ello, cada elemento presenta tres o cuatro posibles estados, que van desde el no realizado (o con graves problemas) a un trabajo complete y fiel a las fuentes. Cada uno de estos estados alcanza un valor que puede ser de 0, 0,15 0,25 o 0,5, siendo el total, en el caso de que un grupo de alumnos alcance la excelencia, de dos puntos.

La rúbrica es conocida de antemano por los alumnos, de forma que en clase se les presentan ejemplos de distintas posibilidades de realización y la nota obtenida.

Una vez aplicada la rúbrica, se explica como ha sido aplicada a cada caso concreto, de forma privada a los interesados.

Tabla 1. Rúbrica

	0	0,15	0,25	0,5
Localización de normas nacionales				
<b>Graves errores / no se presenta</b>	X			
<b>Ausencias leves</b>			X	
<b>Relación complete</b>				X
Tabla comparative				
<b>No se presenta</b>	X			
<b>Comparaciones erróneas o incompletas</b>		X		
<b>Relación 1 a 1 de las normas fundamentales</b>			X	
Mapa mental				
<b>No se presenta</b>	X			
<b>Referencias erróneas a CEF Telecom</b>		X		
<b>Mapa completo en lo esencial</b>			X	
Localización de referencias a la ciberseguridad				
<b>Graves errores / no se presenta</b>	X			
<b>Ausencias leves</b>			X	
<b>Relación complete</b>				X
Exposición				
<b>No se realiza / problemas graves</b>	X			
<b>Se realiza cubriendo lo esencial</b>		X		
<b>Se realiza cubriendo lo esencial con elementos audiovisuales de calidad</b>			X	
<b>Se realiza cubriendo lo esencial con elementos audiovisuales de calidad y las preguntas posteriores son contestadas con éxito</b>				X

Fuente: elaboración propia

## 4. Conclusiones

La plataforma de servicios básicos de eID ofrece a los estados miembros apoyo para construir y operar sus nodos de interoperabilidad eIDAS. Este apoyo será clave desde 2019, ya que, de conformidad con el reglamento eIDAS, los estados miembros se vieron obligados a reconocer los esquemas de identificación electrónica notificados de los demás estados miembros antes del 29 de septiembre de 2018. Esto implica la necesidad de un conocimiento efectivo del mismo, no solo en lo referente al marco nacional de origen, sino en conjunto del entorno del alcance de eIDAS.

Con la realización del trabajo se persigue el aprendizaje autónomo y, además, gracias a la exposición pública, un conocimiento global del marco normativo que sería imposible alcanzar con el estudio individualizado de las leyes nacionales. Además, se facilita el conocimiento de la plataforma de servicios básicos de firma electrónica, eSignature.

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## Gamification & Education: Una Revisión Bibliométrica

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### Resumen

*La Gamificación es una creciente area de investigación en la literature de Educación, debido a la necesidad y relevancia de nuevas metodologías innovadoras para enfrentar el nuevo entorno de aprendizaje. Sin embargo existe una carencia de investigación sobre la importancia y el desarrollo de la literature de Gamificación en el campo de la Educación (GE). Este artículo realiza una relevante contribución a la literature de Educación, al revisar esta literature, a través de un análisis bibliométrico y gráfico de la misma. El documento presenta una descripción bibliométrica de la investigación sobre Gamificación y Educación. El trabajo estudia 635 referencias recopiladas de la Web of Science (WoS), analizando específicamente 483 trabajos de la base de datos de la WoS Core Collection. Además, el documento utiliza el programa de visualización de similitudes (VOS)viewer para mostrar gráficamente el material. El estudio realiza una revisión amplia de esta literatura, una co-ocurrencia de palabras clave y un análisis de las principales revistas y los artículos más relevantes. Los resultados muestran el estado y las principales tendencias de esta literatura, identificando los temas principales y el análisis principal, que puede ser significativo para que los investigadores comprendan mejor la situación y el estado del arte de la Gamificación en el campo de la Educación*

**Palabras Clave:** Gamificación, Educación, Bibliométrico, Visualización.





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### **Abstract**

*Gamification is a Growing research topic in the literature of Education, due to the necessity and relevance of new innovative methodologies to face the new learning environment. However, there is a lack of research about the importance and development of the literature of Gamification in the Education field (GE). This paper makes a relevant contribution to the literature of Education by reviewing this literature, through a bibliometric and visualization analysis. The, the paper presents a bibliometric overview of Gamification and Education research. The work studies 635 references collected from the Web of Science (WoS), analyzing specifically 483 works from the WoS Core Collection database. Moreover the paper uses the visualization of similarities (VOS)viewer program to graphically map the material. The study does a broad review of this literature, a co-occurrence of keywords, and an analysis of the main journals and the most relevant papers. The results show the status and main trends of this literature, identifying the main topics and the leading analysis, which can be significant for researchers to better understand the situation and state of the art of Gamification in the field of Education.*

**Keywords:** *Gamification, Education, Bibliometric, Visualization.*

## **1. Introducción**

La gamificación, en el actual entorno educativo, se ha consolidado como un importante y creciente recurso educativo, hecho que se a traducido en un creciente análisis de su estudio en la literatura de Educación. Definida por Dominguez et al (2013) como el uso de elementos de diseño de juegos y mecánicas de juego en contextos de no-juegos, su uso y popularidad se ha extendido en diversos contextos y áreas, como es en nuestro caso el ámbito de la Educación o el área del aprendizaje en general. Debemos observar que la aplicación de la Gamificación en diversos ámbitos ha evolucionado y consolidado, debido en primer lugar al creciente desarrollo de las tecnologías de la información, y con ellas la abrupta y amplia extensión y difusión de la industria de los video juegos, a todos los estratos de la sociedad, A ello se añade la propia dinámica de la sociedad actual y del propio contexto educativo, así como el desarrollo de los dispositivos móviles, junto con la creciente relevancia específica de las tecnologías de información aplicables a educación (Garrigós et al., 2019). Finalmente, debemos sumar la propia transformación y cambio del sistema educativo, el cual ha conducido a forzar a una amplia transformación de los

métodos de aprendizaje, requiriendo con ello nuevos mecanismos o métodos, de los cuales la Gamificación se ha mostrado como uno de los más relevantes.

El nuevo marco de la sociedad, unido al nuevo ambiente educativo, obviamente requiere de un cambio en el proceso de aprendizaje, y con ello de la aplicación de importantes cambios en el proceso de enseñanza, con una mayor profusión de metodologías activas (Garrigos et al., 2015, Estelles et al. 2016). En este ámbito, los juegos pueden proporcionar no solo una diversión y mayor motivación que ayude al proceso de aprendizaje, sino que además los estudiantes pueden jugar y sentirse libres para expresar sus puntos de vista, consiguiendo a través del juego una mejora en la socialización del conocimiento, un incremento de la satisfacción, la mejora de la creatividad o la apertura de mentes (Montesa et al., 2014).

Siguiendo recientes trabajos que utilizan el uso de estudios bibliométricos en el desarrollo de las universidades (Cetto et la., 2012) o concretamente para observar el desarrollo de nuevas metodologías en la docencia o el entorno educativo (eg. Oltra et al., 2019), y observada la carencia de revisiones sobre la literatura de Gamificación en el área de la Educación (GE), y concretamente la falta de estudios bibliométricos o de visualización sobre esta literatura, pese a su importante relevancia de este tipo de análisis tanto para investigadores como usuarios (Garrigós et al., 2018), este trabajo pretende realizar un breve análisis bibliométrico y de visualización de la literatura. Para ello el artículo estudia 635 referencias recopiladas de la Web of Science (WoS), analizando específicamente 483 trabajos de la base de datos de la WoS Core Collection. Además, el documento utiliza el programa de visualización de similitudes (VOS)viewer para vislumbrar gráficamente el material. Los resultados muestran una relevante expansión de la literatura de Gamificación en Educación, así como el estado del arte y las principales tendencias de uso e investigación en este campo. El trabajo puede ayudar a investigadores y usuarios a comprender mejor el área de Gamificación y su uso en Educación, así como a observar el estado del arte y descubrir nuevas tendencias,, ofreciendo explicaciones e ideas útiles planificar nuevas investigaciones y nuevos usos en el contexto de la Educación y el aprendizaje.

Las siguientes sesiones describen las Fuentes de datos y los métodos bibliométricos utilizados. Posteriormente se presentan los resultados bibliométricos y análisis gráfico de los datos, explorando la relevancia de los mismos. Finalmente la última sección observa las conclusiones del trabajo

## **2. Metodología**

Los datos de investigación utilizados en el trabajo fueron recopilados de la base de datos de la Web of Science,, la cual incluye las fuentes más influyentes y con mayores estándares,

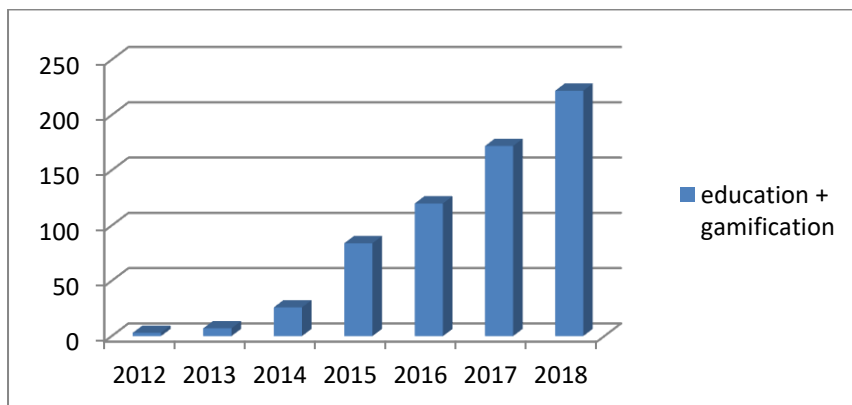


siguiendo siguiendo previos estudios (Garrigos et al., 2018; Garrigós, Narangajavana y Narangajavana, 2019). Con objeto de eleccionar la literatura sobre GE, utilizamos las palabras clave “education” y “gamification”. La poblacion incluye todos los articulos hasta el 31 de diciembre de 2018. La recopilacion de los datos se desarrollo en junio de 2019. La muestra total se redujo considerando solamente “articles”, reviews”, “letters” y “notes”, con una muestra total de 635 en toda la Wos, que se redujo a 483 para el analisis especifico, observando solo la “Core Collection” o coleccion principal.

Tal y como sealamos previamente, el trabajo utiliza los indicadores bibliometricos clasicos como metodo de analisis, metodologia que es un mecanismo apropiado para analizar y representar los datos utilizados, utilizando por ejemplo el numero total de articulos para medir laproductividad, el numero total de citas para representar la incidencia de un autor, el indice H para analizar la influencia de un articulo, el factor de impacto provisto por la WoS para cuantificar la influencia de una fuente, y el ratio de citas/articulos para medir el impacto de cada articulo. A su vez, observamos el programa VOS viewer para mostrar graficamente el mapa de datos. Este mecanismo puede mostrar la estructura y redes de los autores o revistas. Sin embargo, nosotros nos centramos en le analisis de co-ocurrencia de palabras clave de autor (las palabras clave que aparecen debajo de un abstract) siguiendo la metodologia de previos estudios (Garrigos et al., 2018; Garrigós, Narangajavana y Narangajavana, 2019),

## 2. Resultados

En este trabajo hemos desarrollado diversos analisis.



*Fig. 1 Publicaciones anuales sobre GE en la WoS*

*Fuente: Datos de la WoS*

En primer lugar observamos la situación y progreso de la literatura de Gamificación y Educación, analizando para ello los 634 documentos de toda la base de datos (restricción de artículos revisiones, notas y cartas, pero no restringido a la “Core Collection”. Ello incluye la estructura de citas de los documentos (Tabla 1). Aunque el primer artículo sobre GE apareció en la WoS en 1880, es a partir de 2012 cuando se inicia una publicación regular de la literatura, con un crecimiento exponencial en los últimos años, pasando de 2 artículos publicados en 2012 a 222 en 2018 (Figura 1). Atendiendo a la estructura general de citas, debemos observar que el artículo más citado en la literatura de GE es el de Dominguez et al (2013), con más de 400 citas en la Web of Science y más de 1200 en Google Scholar

**Tabla 1. Estructura General de Citas de GE.**

<b>Gamification + Education</b>					
<b>Number of Citations</b>	<b>Number of Articles</b>	<b>Accumulated N. of Articles</b>	<b>% Articles</b>	<b>% Accumulated Articles</b>	
≥300	2	2	0,31		0,31
≥200	2	4	0,31		0,63
≥100	3	7	0,47		1,10
≥50	8	15	1,26		2,36
≥25	21	36	3,31		5,67
≥10	61	97	9,61		15,28
<10	538	635	84,72		100,00
Total	635				

*Fuente: Elaboración propia con Datos de la WoS*

En segundo lugar el estudio se concentra en la observación de los trabajos en la literatura de GE más citados, con objeto de identificar los artículos más influyentes en el área de GE. No obstante a partir de aquí el estudio se concentra en el análisis de la “core collection” de la WoS, con una población restringida a 483 trabajos. La Tabla 2 muestra los 10 trabajos con más citas. Aunque el trabajo de Dominguez et al (2013) es el que más citas recibe, es el trabajo de Seaborn et al (2015) el que más citas tiene por año.

Tabla 2. Top 30 artículos con más citas en GE.

Artículos en GE con Más Citas						
R	Journal	TC	Article	Authors	Year	CY
1	CE	416	Gamifying learning experiences: Practical implications and outcomes	Dominguez, Adrian; Saenz-de-Navarrete, Joseba; de-Marcos, Luis; et ál..	2013	69,33
2	IJHCS	316	Gamification in theory and action: A survey	Seaborn, Katie; Fels, Deborah I.	2015	79,00
3	ETS	210	Gamification in Education: A Systematic Mapping Study	Dicheva, Darina; Dichev, Christo; Agre, Gennady; et ál..	2015	52,5
4	CHB	208	A social gamification framework for a K-6 learning platform	Simoes, Jorge; Diaz Redondo, Rebeca; Fernandez Vilas, Ana	2013	34,67
5	CHB	187	Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning	Hamari, Juho; Shernoff, David J.; Rowe, Elizabeth; et ál..	2016	62,33
6	CHB	167	Demographic differences in perceived benefits from gamification	Koivisto, Jonna; Hamari, Juho	2014	33,40
7	IEEETLB	95	Gamification for Engaging Computer Science Students in Learning Activities: A Case Study	Ibanez, Maria-Blanca; Di-Serio, Angela; Delgado-Kloos, Carlos	2014	19,00
8	EIT	85	Digital badges in education	Gibson, David; Ostashewski, Nathaniel; Flintoff, Kim; et ál..	2015	21,25
9	JCAL	84	A mobile gamification learning system for improving the learning motivation and achievements	Su, C-H.; Cheng, C-H.	2015	21,00
10	CE	71	Gamification in assessment: Do points affect test performance?	Attali, Yigal; Arieli-Attali, Meirav	2015	17,75

Fuente: Elaboración propia basada en WoS. R: ranking; TC: total citations; CY: citations per year.. CE: Computers & Education; IJHCS: International Journal of Human-Computer Studies; ETS: Educational Technology & Society; CHB: Computers in Human Behavior; IEEETLT: IEEE Transactions on Learning Technologies; EIT: Education and Information Technologies; JCAL: Journal of Computer Assisted Learning;



En tercer lugar observamos las revistas líderes en GE. La mayoría de las publicaciones con casi el 70% de los trabajos publicados están en el área de Education Educational Research, de la WoS. Destacan también las áreas de Computer Sciences (casi el 40% de trabajos están en esta área), Psychology, o Behavioral Sciences (con sobre del 17% en cada una de estas dos áreas). Vislumbramos que la revista con más publicaciones y citas es Computers and Education, aunque la revista con más índice H es Computers in Human Behaviour. Tabla 3 muestra las revistas con al menos 6 trabajos publicados en el área de GE.

**Tabla 3. Revistas Top en número de publicaciones en GE**

R	Journal	APGE	H-GE	TCGE	ACGE	PCGE	IF	≥200	≥100	≥50	≥20
1	CE	16	9	731	593	45,69	5,63	1	1	2	6
2	CHB	16	11	718	643	44,88	4,31	1	3	3	5
3	IJEE	15	4	64	59	4,27	0,61				1
4	CAEE	8	3	30	30	3,75	1,44				0
5	IJETL	8	3	46	45	5,75	-				1
6	JLKS	8	4	32	32	4,00	-				0
7	AGBL	7	2	7	6	1,00	-				0
8	EJMSTE	7	3	32	32	4,57	0,90				0
9	E	6	3	16	14	2,67	-				0
10	GLEELLG	6	2	7	6	1,17	-				0
11	RIED	6	3	22	22	3,67	-				0

Fuente: Elaboración propia en base a WoS. R: ranking; H-GE: indicates the h-index in the area of Gamification and Education; APGE: articles published in GE; TCGE: total citations in GE; ACGE: articles in which GE is cited; PCGE: average of citations by articles in GE.; IF: impact factor; ≥200, ≥100, ≥50, and ≥20: articles with more of 200, 100, 50, and 20 citations. CE: Computers & Education; CHB: Computers in Human Behavior;IJEE: International Journal of Engineering Education; CAEE; Computer Applications in Engineering Education; IJETL:International Journal of EmergingTechnologies in Learning; JLKS: Journal of E-Learning and Knowledge Society; AGBL: Advances in Game Based Learning; EJMSTE:Eurasia Journal of Mathematics Science and Technology Education; E: Educar; GLEELLG:Gamification in Learning and Education Enjoy Learning like Gaming; RIED: Revista Iberoamericana de Educación a Distancia.

Finalmente estudiamos el análisis de Co-ocurrencia de las palabras clave de autor. Con ello estudiamos la distribución de las palabra clave más frecuentes, investigados a través de la co-ocurrencia de palabras clave (palabras clave que aparecen juntas en el mismo artículo), El objeto es subrayar los tópicos de investigación más relevantes en el área de GE.



**Tabla 4. Principales co-ocurrencias de palabras clave de autor de las publicaciones relacionadas con GE.**

R	Palabra clave	Ocurrencia	Fuerza de Relación
1	Gamification	294	335
2	Education	45	67
3	Motivation	33	60
4	higher education	31	53
5	game-based learning	29	54
6	Learning	24	46
7	e-learning	21	35
8	serious games	20	30
9	Engagement	17	32
10	Games	17	25

Fuente: Elaboración propia en base a WoS

## 4. Conclusión

Este trabajo ha analizado la relevancia de la gamificación en educación. De los resultados se extrae la creciente y amplia relevancia que está alcanzando la investigación sobre Gamificación en la literatura relacionada con la Educación. Esta literatura, aun reciente, dato que comienza en 2012 cobra un fuerte impulso en los últimos años, Esta relevancia se observa no solo en el número de artículos citados, sino en las numerosas citas recibidas por artículos que son de reciente publicación. En este sentido tres artículos observan más de 50 citas anuales en la WoS. Entre las principales revistas destacan dos sobre las demás, tanto en el número de publicaciones como sobre todo en el número de citas recibidas: *Computers & Education* y *Computers in Human Behavior*. Finalmente observamos diversos cuerpos de literatura, observando las palabras clave de autor. No obstante, una revisión de estas nos indica la sobresaliente relevancia de las palabras “motivation” y “engagement”, o de forma más secundaria “active learning”. Un análisis detallado también observa la relación de nuestra literatura con otras innovaciones relacionadas con las nuevas tecnologías (“simulation”, “video games”, “digital games”) y la educación a distancia (“mobile learning”, “flipped classroom” “blended learning” “digital badgets”, “augmented reality”). A su vez, observamos que si bien estas metodologías se han desarrollado sobre todo en la educación universitaria (“Higger Education”), su uso y extensión ea otros niveles y sistemas



y campos educativos también muestra una incipiente presencia (“engineering education”, “secondary education”, “elementari education”, “medical education”, “physical education”). No obstante, la incidencia en campos de conocimientos todavía es escasa, dado que aparte de “pedagogy”, o “engineering education”, la gamificación aplicada a campos concretos se observa de forma residual.

Debemos señalar las limitaciones de nuestro trabajo, al centrarnos en un área incipiente de literatura, que ha implicado un análisis solo de 483 trabajos publicados. No obstante, nuestro trabajo abre a nivel teórico las puertas a posteriores análisis, que seguramente serán más consistentes con la aportación relevante de datos en los próximos años. A su vez, El trabajo revela las amplias posibilidades que tiene tanto el el desarrollo teórico como la aplicación en el aula de la gamificación en diversas áreas de conocimiento, aunque su uso y estudio es todavía incipiente

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## **Análisis de la factura electrónica en el contexto de la Transformación Digital en la Unión Europea**

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### **Resumen**

*La adopción de un estándar de generación, comunicación e intercambio de factura electrónica es uno de los hitos de la Unión Europea (UE) dentro de los mecanismos de cohesión interterritorial. Su uso generalizado en los países Miembros debe favorecer el acceso efectivo de los ciudadanos a bienes y servicios ofrecidos por proveedores transfronterizos, lo cual debe redundar en un beneficio colectivo tanto por el ahorro en costes, tiempo, y materiales, como por la creación de un canal económica y medioambientalmente sostenible de intercambio de datos de facturación.*

*Dentro de los esfuerzos de la UE por crear redes transfronterizas de comunicación para eliminar fronteras a la libre circulación de bienes y servicios, el proyecto de facturación electrónica se ha llevado a cabo mediante varias acciones entre las que destaca el proyecto GOV2EU - Apoyo a entidades públicas para adoptar el Estándar de la UE sobre factura electrónica para transacciones transfronterizas. Este proyecto se ha llevado a cabo mediante la colaboración de entidades públicas y privadas, financiado con fondos públicos de la UE.*

*En este artículo estudiamos el contexto en el que se desarrolla el concepto y puesta en práctica de la factura electrónica, más en concreto a través del proyecto GOV2EU, partiendo de los componentes legislativos y técnicos necesarios para que la facturación electrónica sea una realidad. Las conclusiones muestran el éxito de la implementación de la comunicación efectiva entre las 15 entidades participantes (12 de ellas hospitales).*

*Se concluye pues que la facturación electrónica es una herramienta válida y viable entre entidades que proveen bienes y servicios de forma transfronteriza entre Estados Miembros de la UE.*



**Palabras clave:** *Factura electrónica, e-Invoice, GOV2EU.*

## **1. Introducción**

En el entorno globalizado en el que nos encontramos actualmente, las tecnologías y los sistemas de información son un factor competitivo, que permiten a las organizaciones tener la información disponible en el momento y forma adecuados. De este modo, las organizaciones pueden tomar mejores decisiones, y ser más eficientes en su gestión. Es evidente que, cuanto antes se disponga de la información, antes se podrá tomar la decisión que dependa de ella, o esta se tomará con más elementos de juicio, y, por tanto, de forma más adecuada.

En este entorno, la facturación electrónica mejora notablemente los tiempos de gestión de las facturas entre dos organizaciones (bien sean públicas o privadas) y con ello, mejora su eficiencia y los tiempos de respuesta en todo el proceso de transacciones comerciales. Esto reducirá drásticamente la carga administrativa en términos de tiempo, gasto y esfuerzo asociados con el uso de servicios públicos extranjeros en nuestro mundo cada vez más globalizado (CEF Digital, 2018). Por este motivo, desde hace ya unos años, el marco de la Unión Europea ha impulsado el desarrollo e implantación de la factura electrónica los países miembros, financiando proyectos de desarrollo y estableciendo un marco de referencia para la facturación electrónica. De hecho, el programa “Connecting Europe Facility” (CEF) tiene una línea específica para el desarrollo e implantación de la factura electrónica en los países miembros de la UE, el denominado “CEF eInvoicing building block”.

Por tanto, es indudable la importancia y la repercusión que la factura electrónica puede tener en la eficiencia de las organizaciones. Pero también en el entorno global, en el que, mediante la eliminación de documentos en papel, se dará un paso más en la búsqueda de la sostenibilidad en sus tres aspectos, no sólo en el económico, sino también en el social y el medioambiental.

Con ese objetivo surge el proyecto GOV2EU (CEF Telecom, 2016), que apoya a las entidades públicas a adoptar el estándar de la UE sobre facturas electrónicas para transacciones transfronterizas. Posteriormente se lanza, en la misma línea el proyecto HOSP&INVOICE, mediante el cual hospitales públicos de Bélgica, Austria, Hungría e Italia se prepararon para la norma de facturación electrónica.

## 1.1 Proyecto GOV2EU para que entidades públicas

Nos centramos en este estudio en el proyecto *GOV2EU - Supporting public entities to adopt EU standard on electronic invoice for cross-border transactions*.

En este proyecto ha sido clave la participación de los proveedores de servicios de intercambios electrónicos de datos (EDI providers) que han sido representados en este proyecto por EDICOM dentro del consorcio creado para este efecto. Ha sido también clave la participación de INNOVATION AND NETWORKS EXECUTIVE AGENCY (INEA) como la agencia de que se ha encargado de la ejecución del proyecto. Y finalmente ha habido un tercer actor clave como Academia de gestión y dirección del proyecto, en este caso la Universitat Politècnica de València (UPV).

El proyecto apoya la adopción de la plataforma de nube electrónica EDICOM B2B que cumple con el estándar europeo de facturación electrónica (EN) por parte de entidades públicas, a saber, 36 hospitales en Austria, Bélgica, Italia y Hungría. Esto permitirá que los hospitales públicos envíen y reciban facturas electrónicas que cumplan con la EN (compatibles con ambas sintaxis de EN OASIS UBL2.1 y UN / CEFACT CII).

Los hospitales públicos, con el apoyo de EDICOM B2B Cloud Platform, han desarrollado su software ERP (Enterprise Resource Planning) integrando el modelo semántico del estándar europeo de facturación electrónica. El desarrollo de ERP será seguido por el despliegue de la interoperación e intercomunicación automatizadas dentro de la plataforma B2B EDICOM utilizando su propio punto de acceso (AS2 y AS4).

El proyecto se ha basado en los resultados de las acciones financiadas anteriormente por CEF 2015-EU-IA-0058 y 2016-EU-IA-0096. El primero resultó en la actualización de las herramientas de facturación electrónica de la plataforma en la nube B2B EDICOM para cumplir con la Directiva de facturación electrónica (Directiva 2014/55 / UE) en el sector de la salud. Este último permitió que entidades adicionales del sector de la salud envíen y reciban Facturas electrónicas que cumplan con EN. Este proyecto reutiliza estas herramientas de facturación electrónica e las integra con los sistemas ERP de 36 hospitales de diferentes Estados miembros, utilizando recursos ya desplegados para reducir costos y amplificar el impacto en Europa.

El proyecto ha dado como resultado que 36 hospitales públicos (12 de Bélgica, 14 de Italia, 9 de Hungría y 1 de Austria) con el apoyo de EDICOM y ASSECO puedan intercambiar facturas electrónicas que cumplan con la EN (compatible con ambas sintaxis UBL 2.1 y CEFACT / CII)



## **2. Marco del Proyecto**

La iniciativa “Connecting Europe Facility” (CEF) se creó mediante el Reglamento (UE) n° 1316/2013 del Parlamento Europeo y del Consejo (European Commission, 2013). Este Reglamento determina las condiciones, métodos y procedimientos para proporcionar asistencia financiera de la Unión a las redes transeuropeas a fin de apoyar proyectos de interés común, además de establecer el desglose de los recursos disponibles para el periodo 2014-2020 en los campos de transporte, telecomunicaciones y energía.

En este caso nos interesa la parte aplicable a la factura electrónica (CEF Telecom, 2019a). La facturación electrónica es el intercambio de un documento de factura electrónica entre un proveedor y un comprador. Una factura electrónica (eInvoice) es una factura que se ha emitido, transmitido y recibido en un formato de datos estructurados que permite su procesamiento automático y electrónico, tal como se define en la Directiva 2014/55 / UE (CEF Telecom, 2019b).

Como objetivo general figura la mejora de la infraestructura física y digital de nuestras redes facilitando, entre otros factores, el uso de infraestructuras interoperables para poder favorecer las transacciones y las consecuentes facturaciones. Con todo ello se debería favorecer el acceso de los ciudadanos europeos a bienes y servicios sin importar el país desde el que se provisionan.

### **2.1. CEF eInvoicing building block**

El building block de la facturación electrónica de CEF, tiene como objetivo promover la adopción y acelerar el uso de la facturación electrónica con respecto al estándar europeo, tanto entre las entidades públicas y privadas establecidas en la UE, como en los países participantes del EEA (CEF Digital, 2019). Sirve para ayudar a las administraciones públicas a cumplir con la legislación de facturación electrónica de la UE, y ayuda a los proveedores de servicios y soluciones a adaptar sus servicios en consecuencia. Por lo tanto, el building block de facturación electrónica del CEF, se centra especialmente en el tipo de transacciones Business to Government (B2G), aunque también puede permitir la comunicación de gobierno a gobierno (G2G). Sin embargo, otro tipo de comunicaciones digitales, como Business to Business (B2B), Government to Citizen (G2C) o Business to Consumer (B2C) no se abordan en el contexto del building block de facturación electrónica.

## **2.2. La facturación Electrónica**

La facturación electrónica (CEF Digital, 2019a) es el intercambio de un documento de factura electrónica entre un proveedor y un comprador. Una factura electrónica (eInvoice) es una factura que se ha emitido, transmitido y recibido en un formato de datos estructurados que permite su procesamiento automático y electrónico, tal como se define en la Directiva 2014/55 / UE.

Una factura electrónica estructurada contiene datos del proveedor en un formato legible por máquina, que puede importarse automáticamente al sistema de Cuenta por pagar (AP) del comprador sin necesidad de ingresar manualmente.

Al comparar las facturas electrónicas con las facturas en papel, es útil tener en cuenta que las facturas en papel tienen tres características que están tan integradas que normalmente no nos damos cuenta de que pueden separarse. Las facturas en papel contienen detalles de datos, como los importes, descripciones y cantidades; proveen esos datos en un formato visual, en papel impreso, que puede leerse manualmente; y finalmente tienen una forma física que los permite ser manejadas e intercambiadas manualmente.

Las imágenes digitales (pdf y otras formas visuales digitales) de facturas eliminan el elemento físico y permiten que las facturas se manejen y archiven de una manera más eficiente que el papel. Sin embargo, estos formatos aún requieren que la factura se vea manualmente y que sus datos se lean e ingresen manualmente en los sistemas de información. Sin embargo, las facturas electrónicas solo contienen los datos en forma estructurada, y pueden importarse automáticamente a los sistemas de información, por lo que no incluyen una presentación visual de los datos de la factura, aunque se pueden procesar temporalmente durante el procesamiento o transponer a formatos visuales. Para las facturas electrónicas, el formato visual es secundario y el objetivo en la automatización no es ver la factura, excepto en casos irregulares. Evidentemente, sí que se puede crear una versión visual y legible por humanos de la factura electrónica, para fines de lectura y puede fluir dentro del mensaje estructurado, pero no se considera parte de la factura electrónica en sí misma.

De este modo, es importante tener claro que, pese a lo que en muchos entornos se piensa, las facturas electrónicas no son:

- Datos de factura no estructurados emitidos en formato pdf o Word.
- Imágenes de facturas como jpg de tiff.
- Facturas HTML no estructuradas en una página web o en un correo electrónico.
- OCR (facturas de papel escaneadas)
- Facturas en papel enviadas, como imágenes, a través de máquinas de fax

El uso de facturas electrónicas requiere dos funciones clave:





- La factura electrónica debe crearse con la estructura correcta.
- La factura electrónica debe transferirse del sistema del vendedor al sistema del comprador.

Para ello, existe una norma europea sobre facturación electrónica, EN16931, que define la estructura de una factura electrónica y varias opciones para la transmisión de la factura entre los diferentes actores que la deben gestionar.

### **2.3. Beneficios de la factura electrónica**

La adopción masiva de la facturación electrónica en la UE genera importantes beneficios económicos y un aumento de la competitividad empresarial europea. Con el respaldo de la legislación europea, la aceptación de las facturas electrónicas por parte de los gobiernos facilitará las actividades comerciales con el sector público (CEF Digital, 2019b).

Los beneficios de reemplazar las facturas en papel por facturas electrónicas se pueden alcanzar en dos etapas:

- Reemplazar el formulario en papel físico con un formulario digital permite que la factura se maneje y se archive de manera más eficiente. Esto proporciona importantes ahorros en impresión, franqueo, enrutamiento y archivado dentro de la oficina. Estos beneficios se pueden lograr con imágenes digitales de la factura, como pdf, jpg y html, así como con facturas electrónicas estructuradas.
- Hacer que los datos sean legibles por máquina elimina la necesidad de ver y leer manualmente una forma visual de la factura. También elimina el trabajo manual de ingresar la información de la factura en un sistema AP. Esto proporciona ahorros significativos en recursos humanos y reduce significativamente los errores en la entrada de datos. Esto no se puede lograr con imágenes digitales de la factura, como pdf.

La adopción de la facturación electrónica en el sector público puede generar beneficios:

- respalda las prioridades de las políticas públicas, como la reducción del déficit del sector público, la transparencia financiera y la promoción del desarrollo sostenible.
- específicamente hará una contribución importante a la reducción y eficiencia de costos del sector público.
- También proporcionará beneficios a los proveedores del sector privado y creará oportunidades para que el sector público actúe como un catalizador para la adopción más amplia de procesos digitales en común con el sector privado.

### **3. El Proyecto GOV2EU**

El proyecto GOV2EU nace de la necesidad de tener un sistema de facturación electrónica para las administraciones públicas, bajo las leyes europeas que cambian el proceso de facturación (UPV – ai2, 2019). Para hacer eso, el consorcio resolverá toda la complejidad relacionada con la intercomunicación y la integración de datos, coordinada por EDICOM, empleando la plataforma en la nube EDICOM B2B. Además, implementarán una solución de sintaxis múltiple capaz de manejar la facturación electrónica en múltiples estándares, de acuerdo con las necesidades de cada participante con sus propios sistemas ERP y las especificaciones detalladas en la regulación europea, para lograr documentos electrónicos semánticamente interoperables en El alcance de la UE.

El proyecto también se basa en las especificaciones PEPPOL considerando que todos los participantes utilizarán un punto de acceso Peppol para comunicarse con otros para intercambiar las facturas electrónicas.

#### **3.1. Objetivos**

El objetivo global de la acción era promover y acelerar la adopción de la facturación electrónica principalmente en el sector de la salud mediante la reutilización de las herramientas de facturación electrónica para la plataforma de nube B2B EDICOM que se desarrollaron como resultado de la anterior acción 2015-EU-IA-0058 hospitales y otras entidades del consorcio de diferentes Estados miembros, lo que permite el intercambio de facturas electrónicas de acuerdo con las especificaciones de interoperabilidad semántica establecidas en la Directiva de facturación electrónica 2014/55 / UE.

Los objetivos del proyecto GOV2EU son (GOV2EU – ai2, 2019):

- promover la aceptación y el uso de la factura electrónica
- facilitar a las empresas de la UE la facturación transfronteriza al NHS utilizando la facturación electrónica
- Respetar los requisitos legales europeos (Directiva 2014/55 / UE)

#### **3.2. Participantes**

En este proyecto participan 9 socios de 9 países diferentes: 4 universidades, 8 empresas privadas y 17 hospitales bajo la coordinación de EDICOM (proveedor de plataforma de facturación electrónica). En concreto, y por países:



- Belgium: Universitair Ziekenhuis Gent
- France: Hôpitaux Du Pays du Mont Blanc, Université de Besançon Franche-Comte
- Germany: HBS, Alfried Krupp, EKBG, Witten
- Hungary: Asseco HU, Borbála, BPK, MFTH, Soproni, Baja, Uzsoki, Péterfy, Hatvan, Margit, OORI
- Italy: LIMA
- Poland: ILIM, Suwalki
- Portugal: SUCH, SISCONSULT
- Slovakia: Asseco SK, Comenius University, SKMBP,
- Spain: Universitat Politècnica de València (university); Valtiva, Edicom (enterprises)

### **3.3. fases del proyecto**

El proyecto ha constado de varias actividades o fases, con sus respectivos hitos de control, todas ellas realizadas con éxito a fecha de finalización del proyecto el 28 de febrero de 2019.

#### Actividad 1: Gestión de Proyecto. Finalizado 30/11/2017

- Proyecto lanzado: Basado en el inicio de la reunión del proyecto, presentación de las actividades a los socios y plan de trabajo para cada actividad.
- Directrices de gestión de proyectos: las directrices de gestión de proyectos comunicadas a todos los beneficiarios.

#### Actividad 2: Requisitos técnicos y legales y apoyo a la implementación. Finalizado 31/12/2017.

- Pautas de implementación de usuarios finales de salud pública: se prepararon las pautas técnicas para la implementación de facturación electrónica por parte de los usuarios finales beneficiarios.
- Inicio del despliegue técnico: análisis previo de requisitos técnicos y legales completado por cada participante.

#### Actividad 3: Implementaciones de usuarios finales de salud pública. Finalizado 28/02/2019

- Plan de implementación del usuario final de salud pública listo: el plan para implementar la solución e inscribir las pruebas de interoperabilidad estará listo para ser seguido por todos los usuarios participantes.



- Plan de prueba de plataforma y usuario completado: definición de planes de prueba para plataformas operativas.
- Facturación electrónica integrada en los sistemas de usuarios finales: sistemas de facturación electrónica totalmente operativos para todos los usuarios finales.
- Comienzo de las pruebas de integración.
- Validación de las facturas electrónicas por parte de la Plataforma de Servicio Central: la plataforma de prueba GITB (de EC-DIGIT) se utiliza para evaluar el cumplimiento de una factura electrónica dada a EN, y se corrigen errores.

#### Actividad 4: Plan de Comunicación, Difusión y Explotación.. Finalizado 28/02/2019

- Plan de comunicación listo: el plan de comunicación que deben seguir todos los beneficiarios y el sitio web del proyecto.
- Actividades de comunicación realizadas por todos los participantes, presentando evidencias y resultados de difusión.

## **4. Resultados Obtenidos**

### **4.1. Principales resultados**

Como resultado del proyecto GOV2EU, resultante de la Action 2016-EU-IA-0096, se han obtenido los siguientes resultados:

1. Mejorar la interoperabilidad de la facturación electrónica, a través de la incorporación de herramientas de facturación electrónica en EDICOM B2B Cloud Platform, por entidades públicas y privadas principalmente en el sector de la salud (12 hospitales, otras 3 entidades del consorcio) para facilitar la adopción de la Directiva de facturación electrónica. La plataforma incluye una solución multi-sintaxis para mapear y convertir las facturas siguiendo ambas direcciones: remitente de la factura (de un archivo de integración o sintaxis nacional en UBL 2.1 y CII) y receptor de la factura (convertir facturas en formatos UBL 2.1 y CII en cualquier otro formato e integración archivos).
2. Aumentar la conciencia del usuario y la adopción de la Directiva de facturación electrónica.
- 3.

### **4.2. Estado actual**

Con respecto al estado actual, la Acción se implementó completamente a tiempo para el 28 de febrero de 2019 y se alineó con el programa de facturación electrónica de CEF. Podría



proporcionar la solución específica de facturación electrónica para cada hospital y otras entidades del consorcio, cada una de ellas pasando el correspondiente Servicio de pruebas de conformidad de facturación electrónica CEF (plataforma GITB OF EC-DIGIT), alcanzando el Hito 10 definido por el Acuerdo de subvención. La difusión de la acción fue relevante. Utilizamos diferentes enfoques de marketing para informar al público que los hospitales y otras entidades del consorcio GOV2EU habían adoptado la Norma Europea sobre la factura electrónica, y también difundieron la Directiva de facturación electrónica 2014/55 / EU y el componente básico de facturación electrónica CEF en Europa.

El estado actual confirma que el proyecto está completamente implementado, alcanzando todos los hitos (todos los medios de verificación y algunas pruebas adicionales se presentan en varios informes preparados por los participantes), y los usuarios finales (hospitales y laboratorios / entidades) están completamente preparados para intercambiar facturas electrónicas, de acuerdo con la norma europea:

- Los 12 hospitales del consorcio:
  - o Szent Borbála Kórház (Borbála), Hungría
  - o Bugát Pál Kórház (BPK), Hungría
  - o Markhot Ferenc Teaching Hospital and Outpatient Clinic (MFTH), Hungría
  - o Soproni Erzsébet Oktató Kórház és Rehabilitációs Intézet (Soproni), Hungría
  - o Baja Szent Rókus Kórház (Baja), Hungría
  - o Uzsoki Utcai Kórház (Uzsoki), Hungría
  - o Péterfy Sándor utcai Kórház rendelőintézet és Baleseti Központ (Péterfy), Hungría
  - o Albert Schweitzer Kórház- Rendelőintézet (Hatvan), Hungría
  - o Szent Margit Kórház (Margit), Hungría
  - o Országos Orvosi Rehabilitációs Intézet (Instituto Nacional de Rehabilitación Médica) (OORI), Hungría
  - o Nemocnica svätého Michala (SKMBP), Eslovaquia
  - o Universitair Ziekenhuis Gent (UZ Gent), Bélgica
- Y otras 3 entidades:
  - o LIMACORPORATE SPA (LIMA), Italia
  - o Université De Besancon Franche-Comte (UFC), Francia
  - o Serviço de Utilização Comum dos Hospitais (SUCH), Portugal

## 5. Conclusiones

Al considerar tanto los objetivos como los resultados, la conclusión es que la implementación de la acción se logró por completo y todos los elementos de las actividades (actividades e hitos) se desarrollaron en el tiempo acordado establecido en el Acuerdo de lanzamiento de la acción. La implementación de eInvoice cumple con el estándar europeo, y las soluciones pasaron el servicio de pruebas de conformidad de la Comisión Europea (CEF eInvoicing Conformance Testing Service), validando los resultados alcanzados y haciendo que INEA / DIGIT valide el proyecto en todos sus hitos de control. Esta validación supone el logro de los objetivos principales de la acción, y el logro de tareas individuales y los objetivos generales del proyecto.

## Agradecimientos

Los autores de la presente comunicación quieren agradecer expresamente a la Comisión Europea y a la Agencia Ejecutiva de Innovación y Redes (Innovation and Networks Executive Agency), así como, al programa marco de financiación Connecting Europe Facility (CEF Telecom) por la financiación otorgada dentro de este marco al proyecto ‘*Supporting public entities to adopt EU Standard on electronic invoice for cross-border transactions (GOV2EU)*’ con el número de Acción 2016-EU-IA-0096 y número de Grant Agreement INEA/CEF/ICT/A2016/1333510.

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# Hacia un Mercado Único Digital: Caso práctico del Proyecto europeo: Promoting the AS4 between PEPPOL Access Points around EU

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## Resumen

*La Unión Europea está eliminando las barreras transfronterizas en las transacciones comerciales dentro del territorio europeo, fomentando así la economía digital. La estrategia del Mercado Único Digital busca que los ciudadanos europeos puedan acceder libremente a bienes y servicios en línea.*

*En esta comunicación se presentará la estrategia del Mercado Único Digital y se analizará como caso de estudio el proyecto 'Promoting the AS4EU between PEPPOL Access points around EU-AS4EU' financiado por la Comisión Europea dentro de su programa CEF Telecom.*

**Palabras clave:** *Intercambio electrónico de datos, AS4EU, Mercado Único Digital*

## 1. Marco del Proyecto

### 1.1. El Mercado Único Digital

Las tecnologías de la información y las comunicaciones se están convirtiendo en la base de los sistemas económicos modernos. Estos cambios están ocurriendo a una velocidad que ofrece muchas oportunidades para la innovación, el crecimiento sostenible y el empleo. La Unión Europea establece que un Mercado Único Digital es aquel en el que se garantiza la libre circulación de bienes, personas y servicios permitiendo a las empresas y ciudadanos acceder a las transacciones en línea en condiciones de competencia leal, y un alto nivel de protección de datos (EURLEX,2019).





Internet y las tecnologías de la información están cambiando el campo de la gestión, pero las barreras que existen pueden disminuir las oportunidades de negocio propio a un mercado integrado. El Mercado Único Digital tiene como objetivo reducir las barreras y ofrecer más oportunidades para realizar transacciones en línea de una forma segura y asequible en toda la Unión Europea, protegiendo al consumidor y fomentando la economía digital. Solo el 7% de las pequeñas y medianas empresas venden en el extranjero, pero esto puede aumentar con la implementación plena de la etapa de integración digital, en especial con la estrategia del Mercado Único Europeo (European Commission, 2019).

Según (European Commsision, 2019) el Mercado Único Digital tiene los siguientes objetivos:

- Impulsar el comercio electrónico en la Unión Europea eliminando el bloqueo geográfico, haciendo que la entrega de bienes y servicios transfronterizos sea más eficiente.
- Modernizar las normas de derechos de autor de la Unión Europea para adaptarse a la era digital, abordando el contenido digital en línea y protegiendo a los usuarios más vulnerables.
- Intensificar la respuesta de Europa a los ciberataques, creando una disuasión cibernética y de derecho penal de la Unión Europea, protegiendo así a los ciudadanos, empresas e instituciones públicas,
- Apostar por el potencial la economía de datos, facilitando su flujo e intercambio por todo el territorio europeo. Garantizando a su vez la protección de los datos personales
- Garantizar que todos los Estados Miembros de la Unión Europea tenga una buena conexión a Internet.
- Ayudar a las empresas, investigadores, ciudadanos y autoridades a emplear las herramientas digitales, garantizando que todos tienen las habilidades para ello.

En conclusión, la estrategia del Mercado Único Digital consiste en transformar la sociedad europea en base a la ola de digitalización que se está produciendo en todo el mundo.

## **1.2. eDelivery Building Block**

Denominamos eDelivery Building Block a una red de nodos para intercambio electrónico de datos a nivel europeo. Se basa en un modelo distribuido en el que cada punto de acceso se convierte en un nodo utilizando protocolos de transporte y políticas de seguridad estándar. El eDelivery eDelivery Building Blocl apoya a las administraciones públicas a

intercambiar datos y documentos electrónicos con otras administraciones públicas, empresas y ciudadanos, de manera interoperable, segura, confiable. Está por componentes basados en especificaciones, software y servicios reutilizables que formarán parte de una amplia variedad de sistemas de IT en diferentes dominios de políticas de la UE.

El componente básico CEF eDelivery se basa en el protocolo de mensajería AS4, abierto y gratuito para todos, desarrollado por la organización de desarrollo de estándares OASIS. Para facilitar su adopción en Europa, eDelivery utiliza las pautas de implementación de AS4 definidas por los Estados miembros en e-SENS Large Scale Pilot. Las organizaciones deben instalar un punto de acceso o utilizar un proveedor de servicios para intercambiar información con el protocolo de mensajería AS4 (CEF Digital, 2019).

El eDelivery Building Block está en relación directa con el Reglamento eIDAS UE 910/2014. En sus conclusiones el Consejo Europeo invitó a la Comisión Europea a contribuir al Mercado Único Digital mediante la creación de condiciones apropiadas para el reconocimiento mutuo entre los Estados Miembros, de herramientas electrónicas, tales como identificación electrónica, documentos electrónicos, firmas electrónicas y servicios de entrega electrónica, y para servicios interoperables de gobierno electrónico en toda la Unión Europea. De igual forma, el Reglamento eIDAS dio un paso muy importante, estableciendo que los datos enviados y recibidos utilizando un servicio de entrega registrado electrónico tendrán efectos legales y la admisibilidad como prueba en procedimientos judiciales (EURLEX, 2019).

Por lo tanto, el objetivo de CEF eDelivery es que aquellas administraciones públicas que hayan desarrollado su sistema IT de forma independiente puedan intercambiar cualquier tipo de documentos y datos de forma segura con otras administraciones públicas, empresas y ciudadanos (European Commission, 2019d).

### **1.3. Beneficios del Intercambio Electrónico de Datos**

Según (CEF Digital, 2019) las características del intercambio electrónico de datos, con los consiguientes beneficios que se ofrece al sector público, privado y al ciudadano, se pueden resumir de la siguiente forma:

1. Una de las características es la interoperabilidad, esto es, el intercambio electrónico de datos está basado en especificaciones técnicas comunes que permiten a diversas organizaciones intercambiar datos y documentos. Esto se traduce en los siguientes beneficios:
  - Se permite el intercambio de documentos y / o datos utilizando protocolos de mensajería estandarizados que no sean correo electrónico.



- Se permite el intercambio de archivos adjuntos además de mensajes (documentos XML)
  - Se permite visualizar fácilmente la dirección registrada de los nodos
  - Se permite ejecutar interacciones asíncronas de solicitud-respuesta.
2. La segunda característica es la seguridad. Los beneficios son:
- Los participantes están seguros de que los datos y documentos están protegidos contra cualquier modificación (integridad)
  - Están seguros de que los documentos se cifran durante la transmisión (confidencialidad)
  - Están seguros de que el origen y el destino de los datos y documentos son confiables
  - Tiene acceso a registros avanzados y configurables de eventos relacionados con el intercambio de datos y documentos.
3. La característica de escalabilidad y rendimiento, Permite que crezca el número de participantes en la red de intercambio de datos, así como el número de mensajes intercambiados.
4. Puede intercambiar documentos y archivos de datos de más de 50 Mb.
5. Garantía legal y responsabilidad: se promueve un alto nivel de transparencia y confianza entre todos los participantes en la red de intercambio de mensajes.
- Se tiene la garantía de que los datos y documentos se entregan una vez y solo una vez (reintentos, recibos, eliminación de duplicados)
  - Se está seguro de que los mensajes se entregan

## **2. El Proyecto AS4EU**

El proyecto "Promoting the AS4 between PEPPOL Access Points around EU (AS4EU)" se encaja dentro de los proyectos CEF eDelivery. El proyecto AS4EU fue coordinado por la Universitat Politècnica de València (UPV). En este proyecto, el consorcio AS4EU introducirá el protocolo AS4 en las soluciones de los EDI Providers participantes y desarrollará el SMP de acuerdo con la Plataforma de Servicios Centrales promovida por CEF Digital. En esta ocasión, el proyecto se presentó en forma de proyecto competitivo, y fue financiado por Comisión Europea a través de su instrumento de financiación

denominado Connecting Europe Facility (CEF Telecom, 2019), en especial, a través de la convocatoria denominada CEF Telecom– eDelivery 2017-2 (CEF-TC-2017-2).

Para llevar a cabo el proyecto, el consorcio está formado por cuatro proveedores de servicios electrónicos (SATA, Celtrino, DataInterchange y AdValvas) cuyo objetivo es convertirse en un Punto de Acceso gracias a la implementación del protocolo de comunicación AS4 que ofrece en abierto los eDelivery Building Blocks. Se pretende que con esta implementación se permitirá que los cuatro proveedores de servicios electrónicos puedan ofrecer al mercado un servicio de intercambio de documentos electrónicos más seguro y que opera a mayor escala, conectando administraciones públicas, empresas y ciudadanos. Este proyecto promueve el intercambio de datos electrónicos de forma segura y de acuerdo con los estándares europeos, cumpliendo con el Reglamento (UE) n° 910/2014.

## **2.1. Objetivos**

El objetivo principal de este proyecto es promover el uso del servicio DSI eDelivery en entidades públicas y privadas, implementando cuatro Puntos de Acceso e integrando el protocolo AS4 y los correspondientes SMP (Service Metadata Publisher).

## **2.2. Participantes en el proyecto**

1. Universitat Politècnica de València (UPV), España (Institución Coordinadora)
2. Leading Management Technology S.L. (LMT), España
3. S.A.T.A Applicazione Tecnologie Avanzate Srl (S.A.T.A), Italia
4. EDI FACTORY LTD (Celtrino), Irlanda
5. DATA INTERCHANGE PLC (Interchange), Reino Unido
6. AdValvas Europe NV (AdValvas), Bélgica

## **2.3. Fases del proyecto**

Las fases en las que se desarrolló el proyecto fueron las siguientes:

- Gestión administrativa y financiera del proyecto: los objetivos de esta actividad fue coordinar al consorcio, monitorizar el progreso del proyecto y la monitorizar que se conseguían los objetivos establecidos en el Grant Agreement. Dentro de esta actividad se incluyeron tareas de gestión financiera y administrativa para monitorizar los costes del proyecto y el cumplimiento de las relaciones contractuales con la entidad otorgante de la subvención, en este caso la Comisión Europea; tareas de gestión del conocimiento adquirido durante el periodo de implementación de los puntos de acceso; y tareas de



ejecución de auditorías internas garantizando el cumplimiento de los estándares de calidad establecidos en la propuesta original del proyecto.

- **Análisis de requisitos técnicos:** en esta actividad se desarrollaron tareas preparatorias para la implementación técnica, se incluyeron tareas de análisis de los requerimientos técnicos y tareas de creación de una estrategia de implementación.
- **Implementación técnica e integración del protocolo de comunicación AS4 en SATA, Celtrino, DataInterchange, y AdValvas:** esta actividad incluye tareas de configuración del protocolo de comunicación; tareas de implementación del protocolo y conexión con el SMP; y tareas relativas a las pruebas de interoperabilidad y conformidad.
- **Comunicación y difusión:** como parte del contrato de subvención se establece la obligación de difundir la financiación europea para el proyecto subvencionado a nivel nacional y europeo.

## **2.4. Principales resultados**

Los resultados alcanzados por el proyecto AS4EU ha generado un impacto positivo en las entidades implementadoras, en sus clientes B2B y B2G en particular, y en el mercado europeo en general. Los resultados alcanzados han sido:

1. La implementación exitosa de los estándares de CEF eDelivery Building Block en las plataformas cloud de los 4 proveedores tecnológicos, convirtiéndose en puntos de acceso AS4 interoperables entre ellos y con otras organizaciones. Una vez finalizado el proyecto distintas organizaciones podrán intercambiar datos y documentos de forma segura utilizando un protocolo de mensajería estandarizado en toda la Unión Europea.
2. La eliminación de barreras en las transacciones comerciales en la Unión Europea, promoviendo la integración económica y el Mercado Único digital.
3. La integración de SATA, Celtrino, DataInterchange y AdValvas en la red CEF eDelivery, convirtiéndose en proveedores de un servicio de confianza: un servicio de entrega electrónica certificada que garantiza la seguridad y la integridad de los datos a transmitir (los datos están protegidos contra cualquier modificación), la confidencialidad del mensaje, y la confiabilidad del origen y el destino de los datos.
4. Los datos que se intercambien a través de los nuevos servicios de entrega electrónica certificada tendrán el mismo efecto jurídico y probatorio que un documento en papel, ya que, disfrutarán de la presunción de la integridad de los datos, de que el envío de dichos datos se ha realizado por el remitente identificado, y la recepción por el destinatario identificado y la exactitud de la fecha y hora de envío y recepción de los datos.

5. Reducción de los costes de transacción y los errores administrativos en las cadenas de suministro de las organizaciones conectadas a los puntos de acceso (Gutiérrez, 2016). Esto aumentará la productividad, la eficiencia y la escalabilidad de las organizaciones, haciendo crecer sus beneficios gracias a la tecnología y convirtiéndose en organizaciones más competitivas dentro del mercado europeo.

### **3. Conclusiones**

Con este proyecto se ha demostrado que los proveedores de servicios electrónicos están apostando por las infraestructuras digitales europeas y el mercado único digital, siendo la financiación europea un elemento motivador clave. Las políticas europeas están consiguiendo movilizar a distintos agentes económicos, que se unen en consorcios público-privados con el objetivo de gestionar eficazmente la innovación y el desarrollo tecnológico.

Desde el punto de vista de los resultados del proyecto, la estandarización técnica es la vía más eficaz para establecer una ruta óptima hacia la interoperabilidad de los diversos agentes económicos. El mantenimiento de un único estándar en el intercambio electrónico de datos facilita el avance hacia una mayor seguridad y eficiencia en los procesos económicos, burocráticos y digitales. Los CEF Building Blocks actúan como una base y pilar para promover un crecimiento paralelo de los distintos proveedores de tecnología, permitiéndoles mejorar su propia plataforma en un ambiente interconectado.

### **Agradecimientos**

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## Uso de ecuaciones alométricas sobre ArcGis para el cálculo de biomasa: Aplicación para la medición de la biomasa del *Pinus Halepensis* Mill de la Comunidad Valenciana

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### Resumen

*La medición de la biomasa es clave para la planificación, gestión y estimación de los recursos biológicos de una determinada zona. Éstos se encuentran relacionados directamente con los aspectos medioambientales de la zona analizada. En la actualidad el proceso de estimación o medición de la biomasa se realiza a partir de los datos recogidos en campo, sumado a una serie de operaciones posteriores que consumen una gran cantidad de tiempo y recursos manuales pese al uso de herramientas como las hojas de cálculo. En este trabajo precisamente se integran las experiencias y procedimientos de cálculo de biomasa de autores como Ricardo Ruiz-Peinado dentro del conocido software ArcGis.*

*Se ha desarrollado una herramienta en el entorno de este software para la automatización de la estimación de biomasa del *Pinus halepensis* Mill a partir de ecuaciones alométricas y datos del Inventario Forestal Nacional (IFN), ya que es una especie muy representativa de la Comunidad Valenciana, figurando como especie dominante en el 62 por ciento de la superficie arbolada de la misma.*

*Esta herramienta, permitirá un ahorro de tiempo considerable para la obtención del dato, y su adaptación para el cálculo de biomasa de otras especies. El resultado de ésta herramienta es una tabla base de datos, cuya unidad mínima es la parcela forestal (según el IFN) de la cual obtenemos los datos de: recuento de Pinos carrascos de la parcela, pies por hectárea, alturas máximas y medias, área basimétrica, índice de Hart-Becking y biomasa en kg por hectárea y toneladas por hectárea.*

**Palabras clave:** biomasa, *Pinus halepensis* Mill, automatización, alometría, IFN.



## **1. Introducción**

La biomasa es la cantidad de materia viva, y se encuentra directamente relacionada con el secuestro de carbono en el ámbito forestal, es por tanto de gran importancia cuantificar este parámetro para una mejor evaluación y control de la problemática medioambiental.

Uno de los grandes problemas a los que se enfrenta la sociedad de hoy en día es el cambio climático. Según los expertos del IPCC (Grupo intergubernamental de Expertos sobre el Cambio Climático) “para limitar los riesgos del cambio climático es necesario reducir de forma sustancial las emisiones de gases de efecto invernadero” uno de éstos gases es el dióxido de carbono, responsable al 50 % del calentamiento global.

Los árboles mediante la fotosíntesis absorben dióxido de carbono y expulsan oxígeno a la atmósfera, por lo que en el proceso de crecimiento del árbol existe un acto de secuestro de este gas. Por lo tanto el conocimiento del dato de biomasa puede ser muy útil para estudios atmosféricos, de calidad o medioambientales entre otros.

Para calcular la biomasa total de un árbol así como de cada fracción del mismo hay una gran diversidad de modelos aunque todos ellos derivan de funciones lineales o logarítmicas (Parresol, 1999). Los modelos más utilizados hoy en día son los alométricos, con forma potencial, y se calculan a partir del diámetro medio y de la altura total del árbol.

Existe una base de datos gratuita de donde extraer estos datos (diámetros y altura) llamada Inventario Forestal Nacional. Hasta la fecha el dato de biomasa no es un dato directo consultable dentro de la base de datos del IFN, pero sí deducible a partir de los datos tomados en él, mediante ecuaciones alométricas.

Aplicando las ecuaciones alométricas desarrolladas por Ruiz.Peinado et al (2011) se ha calculado la biomasa por fracción arbórea (fuste, ramas gruesas, ramas medias, ramas finas y raíces) para cada uno de los individuos de una parcela.

Esta tarea podría realizarse mediante hojas de cálculo o de forma manual, no obstante la organización de la base de datos del Inventario forestal nacional, reparte la información en diversas tablas y se debe ir buscando los datos necesarios en cada una de ellas, lo cual, resulta un trabajo agotador e incluso molesto.

Por ello y aprovechando las nuevas funcionalidades de los SIG de escritorio, se ha elaborado una herramienta en entorno ArcGis para la automatización de todo este proceso y agilizar así la obtención del dato y su georreferenciación, que tanta importancia tiene para la gestión forestal y por ende para el medioambiente.

## 2. Metodología

### 2.1 Estructura del Inventario Forestal Nacional

El Inventario Forestal Nacional es un proyecto llevado a cabo por el Ministerio de Agricultura Pesca y Alimentación, para la obtención de la máxima información sobre los montes españoles. Se trata de un inventario continuo de todo el territorio español y se realiza cada 10 años. La unidad de medida es la parcela forestal, la cual está georreferenciada para poder comparar en inventarios posteriores la evolución de la misma.

La información tomada campo se estructura en una base de datos, que después es manipulada en gabinete para la obtención de otros parámetros derivados de los originales y su integración en un Sistema de Información geográfica. Existen pues dos bases de datos diferentes, la de campo y la de datos SIG.

Estas bases de datos son de acceso gratuito y se dividen por provincias. Cada una de estas bases de datos consta de las siguientes tablas:

**Tabla 1. Tablas de la base de datos SIG del Inventario Forestal Nacional**

Nombre tabla	Descripción
<b>CambioEspecie</b>	Grupo de especies para elaborar las tablas de existencias
<b>CambioEspecieReg</b>	Agrupación de las especies para los gráficos de generación
<b>EspDominante</b>	Códigos para identificar la especie dominante en la tabla de Estratos
<b>Estratos_exs</b>	Existencias por Estratos. Datos dendrométricos procesados por estrato
<b>Mayores_exs</b>	Datos d existencias procesadas por pie
<b>Parcelas_exs</b>	Datos de existencias procesadas por parcela
<b>ParcPoly</b>	Parcelas de la provincia, tesela y estrato al que pertenecen y fisiología de las mismas
<b>Poligon</b>	Teselas de la provincia, estrato al que pertenecen, superficie niveles de clasificación del suelo, especies principales con su ocupación y Fcc
<b>Tarifas IFN3</b>	Ecuaciones utilizadas en el proceso de datos

*Fuente: Elaboración Propia*

**Tabla 2: Tablas de la base de datos de campo del Inventario Forestal Nacional**

Nombre tabla	Descripción
<b>Listado definitivo</b>	Listado definitivo de parcelas de campo a apaar en el IFN3.
<b>PCDatosMap</b>	Tabla referente a los datos de las parcelas de campo.
<b>PCDefTabla</b>	Codificación de diversos campos del estadillo, leyenda de PCParcelas
<b>PCEspMapa</b>	Tabla que detalla la posición especie, ocupación y estado de masa de las 3 especies arbóreas principales presentes en la tesela a la que pertenece la parcela según el MFE
<b>PCEspParc</b>	Tabla en la que se resumen los datos de ocupación, estado de masa, origen y tipo de tratamiento de las tres especies principales presentes en las parcelas de campo.
<b>PCMatorral</b>	Principales especies de matorral encontrado en las parcelas de campo, con su fracción de cabida cubierta y altura media...
<b>PCMayores</b>	Características dendrométricas de los pies mayores medidos en las parcelas de campo en el IFN3
<b>PCMayores2</b>	Características dendrométricas de los pies mayores medidos en las parcelas de campo en el IFN2.
<b>PCNueEsp</b>	Listado de especies presentes por parcela según lo observado por el capataz responsable del apeo de la misma.
<b>PCParcelas</b>	Resumen de la información tomada en cada parcela de campo (usos de suelo, tratamientos del vuelo y del suelo, tipo de suelo...)
<b>PCRegenera</b>	Pies de regeneración por categoría de desarrollo, nº y altura media de los de categoría 4 y densidad de los de categoría inferior a 4.
<b>PCTabla Esp</b>	Parámetros límite por especie y para esta provincia, aportados por la Dirección General para la Biodiversidad.
<b>Uso2Nivel1</b>	Equivalencias entre los códigos de uso de suelo utilizados en el IFN2 y el IFN3

*Fuente: Elaboración propia*

## 2.2 Proceso de cálculo

Para el cálculo de biomasa se han utilizado las ecuaciones alométricas de Ruiz-Peinado et al (2011)). Para los valores de altura total y diámetro medio del Pinus halepensis (extraíble de la tabla Mayores\_Exs de los individuos con código 24, pino carrasco) , separa la biomasa en fracciones para el fuste con corteza ( $W_s$ ) (ec.1), las ramas gruesas de más de 7 cm de diámetro( $W_{b7}$ ) (ec.2), dependiendo de su importancia según los pies sean de más de 27,5 cm de diámetro o de menos, las ramas medias entre 2 y 7 cm ( $W_{b2-7}$ )(ec. 3) y las ramas

finas de menos de 2 cm junto con las acículas ( $W_{b2+n}$ )(ec.4), e incluyendo la biomasa de las raíces ( $W_r$ )(ec .5) (tabla 3).

**Tabla 3. Ecuaciones alométricas empleadas**

Ecuaciones alométricas		
Fuste	$W_s = 0,0139 * d^2 * h$	(ec. 1)
Ramas gruesas	Si $d \leq 27,5$ cm: $Z= 0$ ; si $d > 27,5$ cm: $Z = 1$	(ec. 2)
	$W_{b7} = [3,926 * (d-27,5)] * Z$	(ec. 3)
Ramas medias	$W_{b2-7} = 4,257 + 0,00506 * d^2 * h - 0,0722 * d * h$	(ec. 4)
Ramas finas y acículas	$W_{b2+n} = 6,197 + 0,00932 * d^2 * h - 0,0686 * d * h$	(ec. 5)
Raíces	$W_r = 0,0785 * d^2$	(ec. 6)
TOTAL ARBOL	$W_s + W_{b7} + W_{b2-7} + W_{b2+n} + W_r$	(ec. 7)

Fuente: Ruiz-Peinado et al. (2011)

Aplicando estas ecuaciones a cada individuo de la parcela obtenemos la biomasa de cada árbol. La suma de la biomasa de todos los arboles de la parcela será la biomasa total de la parcela, que después se extrapola a la cantidad de biomasa por hectárea y se almacena en una tabla intermedia para la posterior generación de la tabla resultado.

Para georreferenciar este dato, es necesario la utilización de una de las tablas de la base de datos de campo del Inventario Forestal Nacional (PCDatosMap) donde se pueden encontrar las coordenadas UTM y el huso de las mismas.

Por tanto, es necesario la generación de otra tabla intermedia con el código de estadillo (identificador de la parcela forestal) y coordenadas, operación muy sencilla a partir de la funcionalidad *Table to Table* de ArcGis que nos permitirá relacionar la biomasa de una parcela con su posición espacial.

La implementación de éstas ecuaciones se ha realizado en la aplicación Model Builder en entorno ArcGis.

Además de las ecuaciones de la tabla 3, se han implementado también los siguientes cálculos para cada parcela:

- Área basimétrica (relación entre la sección normal de un árbol y la superficie de terreno que ocupa)

$$G = \pi * \left( \frac{D_{medio}}{2} \right)^2 \quad (ec.8)$$

- Densidad de pies (por hectárea)

$$Densidad = \frac{10000 * N_{pies}}{Superficie} \quad (ec.9)$$

- Índice Hart-Becking (relación entre el espaciamiento medio del arbolado y su altura dominante<sup>3</sup>)

$$HB = \sqrt{\left(\frac{10000}{\frac{Densidad}{H_{max}}}\right)} * 100 \quad (ec.10)$$

- Alturas media y maxima

### 2.3 Resultados

El resultado es una aplicación eficaz y veloz para el cálculo de biomasa. Esta herramienta minimiza el tiempo de cálculo, de hacerlo de mediante hojas de cálculo (4 horas para el caso de 32 parcelas a 18 segundos, llegando incluso a poder calcular la biomasa de 1100 parcelas en 43 segundos).

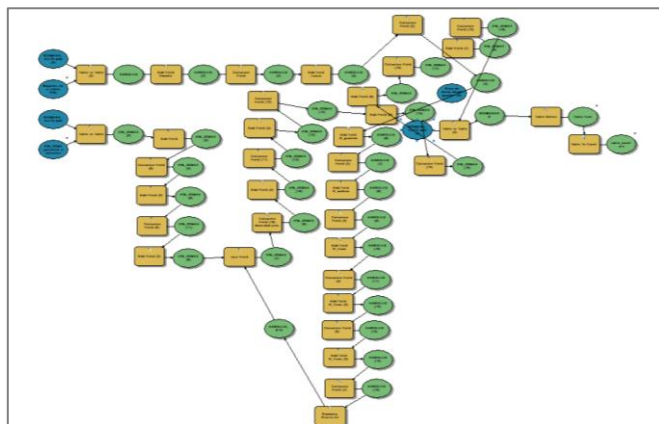
La aplicación genera una tabla de resultados que consta de los siguientes campos:

**Tabla 4. Campos calculados con la herramienta**

<b>Campo:</b>	<b>Descripción</b>
<b>Estadillo</b>	Identificador de la parcela forestal
<b>X,Y</b>	Coordenadas UTM en huso 30 de la parcela forestal
<b>Radio y Superficie</b>	Radio y superficie de cada una de las parcelas
<b>Pies por hectárea</b>	Número de individuos por hectárea.
<b>Frecuencia</b>	Número de individuos por parcela
<b>SUM_TotalArbol</b>	Suma de la biomasa de todos los árboles de la parcela
<b>MAX_Ht y MEAN_Ht</b>	Altura máxima y Altura media
<b>SUM_G</b>	Área basimétrica
<b>MEAN_Dmedio y MAX_Dmedio</b>	Media de los diámetros medios y Máximo de los diámetros medios
<b>G_m2_ha</b>	Área basimétrica en m <sup>2</sup> por hectárea
<b>W_kg_ha y W_t_ha</b>	Biomasa en kg /ha y en t/ha
<b>H_B</b>	Índice Hart-Becking

*Fuente: Elaboración propia*

La herramienta realizada (Figura 1) podrá ser modificada para el cálculo de biomasa de otras especies simplemente con el cambio de ecuaciones alométricas para especies como el abeto común, el pinsapo, sabinar, pino canario, pino negro, pino piñonero, pino rodeno, pino silvestre o *Pinus uncinata*.



**Figura 1. Flujo de trabajo de la herramienta.**

*Fuente. Elaboración propia*

Además al incorporar el resultado las coordenadas UTM es posible su conversión a capa cartográfica (capa de puntos) para su utilización en análisis forestales, entre otros.

Otra aplicación del dato de biomasa sería la obtención del carbono presente en la misma: aplicando el factor de 0,5 kg de carbono por kg de biomasa (0,5kg C/ kg) para la parte aérea y de 0,481 (0,481kg C/kg) para la subterránea (Ritson y Sochacki 2003).

Estos porcentajes son para el pino piñonero pero el contenido de carbón en la biomasa se encuentra la mayoría de las veces entre el 45 y el 50% de biomasa en materia seca. En muchas aplicaciones el contenido de carbón en la vegetación se estima a partir de una simple fracción de la biomasa, multiplicándola por 0.5 (Schlesinger, W .H. 1991).

El carbono presente a su vez se puede utilizar para la estimación del dióxido de carbono retenido utilizando la relación estequiométrica entre el carbono y el dióxido de carbono: 3.67 kg CO<sub>2</sub>/kg.

### 3. Conclusiones

Esta herramienta supone un ahorro de tiempo en el cálculo de la biomasa para la especie *Pinus halepensis* Mill a partir del Inventario Forestal Nacional.



Permite a su vez el cálculo de otras variables importantes para la gestión forestal como el índice de Hart-becking o el área basimétrica.

Como sub-producto de esta herramienta se obtienen datos interesantes, como la biomasa por fracción de árbol (ramas finas, ramas gruesas, etc...) recuento de individuos o alturas máximas.

El dato obtenido se puede utilizar para la estimación del CO<sub>2</sub> retenido en función de la biomasa en la zona donde se aplique la herramienta para un mejor estudio de problemas de la contaminación entre otros.

Por último, esta herramienta puede ser adaptada para otras especies, y permite la utilización del producto final en un Sistema de Información Geográfica, ya que puede ser transformado en capa cartográfica, para posteriores análisis SIG.

El proyecto podría ser ampliado y automatizado mediante el reconocimiento de áreas combinado con el reconocimiento de múltiples especies permitiendo la catalogación automática de cualquier área de manera interactiva. Esta capacidad permitiría a su vez facilitar los estudios de impacto relacionados con las modificaciones del territorio generadas por cualquier proyecto de obra civil, por cualquier alteración climática o por cualquier catástrofe medioambiental.

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**PORTUGUÊS**



## ***Active learning* – uma experiência com alunos do 1.º ano de Educação Básica**

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### **Resumo**

*O crescimento e expansão do ensino superior trouxe para as instituições de ensino superior públicos mais heterogêneos e diversificados relativamente ao passado. Esta heterogeneidade de públicos tem confrontado as instituições de ensino superior e os seus docentes com a necessidade do desenvolvimento de dinâmicas curriculares e pedagógicas capazes de captar a diferença e proporcionar com sucesso a inclusão destes novos públicos.*

*A reflexão que se apresenta resulta da experiência pedagógica, em que a autora esteve diretamente envolvida como docente, desenvolvida em contexto de ensino superior, com alunos do 1.º ano da Licenciatura de Educação Básica, com recurso ao active learning, assumindo-se como um estudo de caso. Defensora dos princípios da inclusão, ao nível do acesso e do sucesso académico<sup>1</sup>, é imprescindível desenvolver dinâmicas curriculares e pedagógicas que assegurem a todos os alunos a possibilidade de progredir de acordo com o seu ritmo de aprendizagem. Assim importa refletir sobre: até que ponto tenho posto este princípio em prática? Em que medida é que a minha prática de ensino e de avaliação ajuda os alunos a aprender, a pensar, a estudar ou a construir o conhecimento? Que oportunidades promovo, dentro e fora da sala de aula, para que os meus alunos aprendam a pensar, raciocinar, colocar e a resolver problemas?*

**Palavras-chave:** *active learning, diferenciação pedagógica, inclusão, prática reflexiva.*

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<sup>1</sup> Sucesso académico, no sentido de que vai mais além do mero rendimento escolar, por quanto engloba o desenvolvimento e a formação humana e social dos alunos.

## 1. Introdução

A presente comunicação resulta de uma reflexão sobre uma experiência pedagógica, desenvolvida em contexto de ensino superior pela autora durante a lecionação da unidade curricular de Metodologia de Investigação Educacional, com alunos do 1.º ano da Licenciatura de Educação Básica, durante o 1.º semestre, com recurso ao *active learning*. Provenientes de diferentes percursos formativos, esta é uma unidade curricular que os alunos, na sua generalidade, têm algumas dificuldades em compreender a pertinência, a utilidade da mesma na sua formação inicial, bem como em se apropriarem da linguagem específica. Acreditando nos princípios da inclusão considero ser imprescindível empreender por dinâmicas curriculares e pedagógicas que assegurem a todos os alunos a possibilidade de progredir de acordo com o seu ritmo de aprendizagem e tornando essas aprendizagens significativas. Assim, propus-me fazer uma reflexão, sobre a minha prática pedagógica, no âmbito do curso onde lecionei e apliquei o *active learning*. Deste modo, espero também contribuir para as futuras práticas destes estudantes destacando como podemos captar a atenção dos alunos para as aprendizagens, recorrendo às novas tecnologias de informação e comunicação.

Na presente comunicação, dá-se conta de dimensões da experiência em causa e de reflexões proporcionadas pela mesma. Assim, centrar-me-ei, sucessivamente, nos seguintes pontos: Licenciatura em Educação Básica e a unidade curricular de Metodologia de Investigação Educacional - conteúdos, objetivos; algumas notas em torno da diferenciação pedagógica; e por último, algumas notas de índole mais reflexiva suscitadas pela experiência vivenciada.

## 2. Licenciatura em Educação Básica (LEB)

Ao ensino superior (universitário e politécnico) chegam, cada vez mais, estudantes bastante heterogéneos ao nível de bases de conhecimentos, de capacidades cognitivas, de motivação e de projetos de formação ou carreira profissional (Almeida, 2002; Correia & Mesquita, 2006).

O Instituto Politécnico de Leiria (IPL) na sua oferta formativa oferece a Licenciatura em Educação Básica (LEB) que tem como objetivo proporcionar conhecimentos e competências teóricas, práticas e metodológicas ao nível da docência para o ensino básico com o intuito de promover o saber e a motivação dos profissionais. O plano curricular e as experiências de formação que estruturam o curso permitirão ao estudante, entre outros objetivos: participar de forma crítica e construtiva em projetos de investigação

desenvolvidos em contexto escolar e/ou não escolar; desenvolver a curiosidade e o gosto intelectual pelo saber e pela investigação. Este curso tem como saídas profissionais: acesso aos cursos de Mestrado que habilitam profissionalmente para a docência na Educação Pré-Escolar e nos 1.º e 2.º Ciclos do Ensino Básico; desempenho de funções de técnico de educação em contextos diversos; integração em equipas multidisciplinares para promoção de projetos educativos em contextos diversificados; conceção, produção e desenvolvimento de recursos didáticos com aplicação a contextos de educação formal e não formal.

### 2.1. Um estudo de caso

A unidade curricular Metodologia da Investigação Educacional (MIE) faz parte do plano curricular da LEB, no 1.º ano, 1.º semestre. No ano letivo 2017/2018 ingressaram no curso 56 estudantes encontrando-se divididos em dois turnos para que existisse uma maior aproximação entre aluno-professor e aluno-aluno. Esta unidade curricular propõe-se trabalhar os instrumentos conceptuais e metodológicos que são necessários à elaboração de conhecimento científico em educação. Visa a aquisição de competências necessárias ao estudante para a aquisição e produção de conhecimento sobre a educação através da elaboração de projetos de investigação relacionados com o ensino, aprendizagem e o desenvolvimento dos alunos.

O desenho do ensaio investigativo traçado consistiu na realização de uma reflexão crítica e fundamentada sobre a prática profissional, tendo por base as notas de campo, a observação participante e as produções escritas dos estudantes, assumindo-se como um estudo de caso. Insere-se num paradigma interpretativo (Coutinho, 2013) seguindo uma metodologia qualitativa (Pardal & Lopes, 2011) que postula uma conceção global fenomenológica, indutiva, estruturalista, subjetiva e orientada para o processo.

## 3. Diferenciação Pedagógica

A escola é um lugar onde as diferenças entre os alunos, de uma maneira geral, sempre se fizeram sentir. Contudo, fruto de uma filosofia educativa que não tinha em linha de conta o conceito de inclusão, a escola tentou geri-las e solucioná-las, mas, em virtude da escolha de estratégias desadequadas, acentuou mais as diferenças aumentando a exclusão e a discriminação (Grave-Resendes & Soares, 2002).

A diferenciação remete-nos, desde logo, para a ideia de romper com a homogeneidade, isto é, para a existência de alternativas diferentes (Tomlinson, 2008; Perrenoud, 2000). De acordo com Perrenoud (2000, p.9), “[d]iferenciar o ensino é fazer com que cada aprendiz

vivencie, tão frequentemente quanto possível, situações fecundas de aprendizagem”. Portanto, de acordo com o mesmo autor, adaptar a ação pedagógica ao aluno não é nem recusar-lhe a instrução, nem abdicar dos objetivos essenciais. Neste sentido, diferenciar é, antes pelo contrário, a luta para que as desigualdades face à escola se atenuem, e concomitantemente, para que o nível de ensino se eleve.

Provavelmente, o primeiro professor que, no seio de um grupo de alunos, ficou surpreso e intrigado perante as diferenças existentes entre eles, terá sido, o primeiro a adotar práticas pedagógicas diferenciadas nesse grupo. Neste sentido, as pedagogias diferenciadas inspiram-se, essencialmente, na luta contra o fracasso escolar e contra as desigualdades, sendo imprescindível esforços no sentido de recentração no currículo como referência básica da ação educativa para todos os alunos (Gomes, 2011).

Segundo Tomlinson e Allan (2002, p.14), entende-se por diferenciação pedagógica “uma forma de resposta proactiva do professor face às necessidades de cada aluno” (Tomlinson & Allan, 2002, p.14). Nesta ordem de ideias, pode-se considerar que um professor que diferencie, compreende a necessidade que os alunos têm de por exemplo: expressar humor; trabalhar com um grupo; beneficiar de ensino supletivo numa área/domínio específico; aprofundar mais um dado aspeto.

Portanto, segundo a opinião dos mesmos autores (idem: ibidem) “[a] diferenciação pedagógica resume-se simplesmente à prestação de atenção às necessidades de aprendizagem de um aluno em particular, ou de um pequeno grupo de estudantes, em vez do modelo mais típico de ensinar uma turma como se todos os indivíduos nela integrados tivessem características semelhantes”.

A diferenciação pedagógica tem como principal finalidade o crescimento máximo de cada aluno e o seu sucesso individual. Para tal, é necessário que o professor considere as características próprias de cada aluno. Pois, cada indivíduo possui pontos fortes, interesses, necessidades e estilos de aprendizagem singulares.

Neste sentido, será de esperar que os alunos aprendam melhor se o professor respeitar a individualidade de cada um e ensinar de acordo com essas diferenças. Grave-Resendes & Soares (2002) fazem referência a algumas das mais relevantes diferenças individuais que devem ser tomadas em consideração no processo da ação educativa: diferenças cognitivas, linguísticas e socioculturais. Destas, daremos somente destaque à primeira, em virtude de no nosso caso concreto as restantes não se verificarem de forma expressiva.

Foi através dos estudos de Gardner (1983, 1996), citado por Day (2006, p.138), sobre o desenvolvimento cognitivo das crianças que se reconheceu que o indivíduo possui vários tipos de inteligência (oito). No entanto, nem todos os tipos de inteligência têm a mesma

força no indivíduo. Por outro lado, tanto o contexto como o ambiente influenciam o seu desenvolvimento.

Em síntese, pode-se dizer que os professores podem proceder à diferenciação a três níveis distintos: conteúdos, processos e produtos. No entanto, esta diferenciação deve ser realizada de acordo com: a recetividade dos alunos, os seus interesses, bem como os seus perfis de aprendizagem.

As estratégias pedagógicas são, no fundo, as ferramentas da “arte” do professor. Contudo, por si só, não são tudo, isto é, podem não ser eficazes, pois isso depende em boa medida da forma como são utilizadas. Existem numerosas estratégias pedagógicas que valorizam a recetividade, o interesse e os perfis de aprendizagem dos alunos, a salientar: os centros e grupos de interesse, a investigação em grupo, os contratos de aprendizagem, as atividades e os produtos diferenciados, o trabalho cooperativo, o *ative learning*, ou, entre outras, o uso de formas alternativas de avaliação. De uma maneira geral, todas estas estratégias assumem a heterogeneidade como um recurso fundamental da aprendizagem.

Neste sentido, o aluno é parceiro intelectual do professor na aprendizagem e no ensino invertendo o sentido do ato pedagógico e a forma de gerir o currículo escolar. Logo, trará implicações na cultura profissional dos docentes, no que à gestão do currículo e organização diz respeito.

#### **4. Prática reflexiva e construção do conhecimento acerca da prática...**

Muitas das vezes os estudantes quando ingressam este curso vêm com a ambição de serem professores estando muito focados/canalizados para as questões práticas e dos contextos de ensino. Unidades curriculares menos ligadas com aquilo que ambicionam ser, são consideradas pelos mesmos de aborrecidas e sem grande utilidade no imediato, como é o caso de MIE. Assim motivar, envolver e comprometer este alunos é uma tarefa exigente.

Dada a multiplicidade de proveniências dos alunos em termos de percursos formativos, a sensibilização e a tomada de consciência da importância desta unidade curricular nem sempre é entendida pelos estudantes, que durante o semestre acabam por faltar às aulas, ou quando estão presentes adotam posturas passivas e de desinteresse que depois se refletem no baixo aproveitamento. Por outro lado, o facto da linguagem específica desta área científica ser complexa acaba também por provocar esse mesmo alheamento.

Assim, a prática reflexiva é algo que se assume como preponderante na atividade profissional do professor/educador, na medida em que, é através dela que a manutenção de um bom ensino pode (ou deverá) ser assegurado. Portanto, exige-se que os professores



revisitem e revejam com regularidade a forma como estão a aplicar os seus princípios de diferenciação, coerência, progressão, continuidade e equilíbrio, não só no “quê” e no “como” do seu ensino, mas também no “porque” em termos dos seus propósitos “morais” centrais (Day, 2006).

A prática reflexiva, para além de ser imprescindível para que o professor/educador não caia em rotinas (modelos de trabalho, respostas rápidas e intuitivas a determinadas situações e acontecimentos que ocorrem na sala de aula e pressupostos tidos como válidos, de uma forma subjetiva, que estruturam a prática e o discurso na sala de aula), requer tempo. Tempo este tão necessário para a realização de uma reflexão crítica que, conseqüentemente, terá reflexos no planeamento de algo que visará obter um progresso e uma melhoria.

Ao longo das sessões de trabalho, fui por diversas vezes confrontada com dúvidas e inseguranças, próprias de quem está pela primeira vez a utilizar uma metodologia de trabalho diferente da habitual numa disciplina importante no futuro próximo de qualquer professor/educador que se quer simultaneamente reflexivo e investigativo, com o intuito de conseguir chegar de igual modo a todos os alunos.

Neste momento, considero que consegui, de uma forma geral identificar os principais constrangimentos que me acompanharam e que mais se evidenciaram nesta caminhada: uma certa solidão, conhecimento mais aprofundado sobre cada aluno, falta de tempo e o excesso de trabalho.

Mais nenhum docente, a lecionar a este grupo de estudantes, tivera enveredado por esta metodologia de trabalho, pelo que não tinha com quem pudesse partilhar as minhas dúvidas, nem pensar conjuntamente outras estratégias, porventura, mais eficazes e que no fundo permitissem e levassem a uma melhor auto-capacitação dos alunos.

O tempo foi outro dos grandes constrangimentos, na medida em que, o recurso ao *active learning* implica ter-se muito tempo para a preparação das aulas, o que no meu caso não abundava dado acumular para além de funções de docência, as coordenações de mestrado e de departamento. Assim (re)preparar as aulas, selecionando o vídeo mais eficaz, o texto mais adequado e acessível, construir *quizzes* e fazer *brainstorming*, foi uma tarefa árdua e morosa. As estratégias recaíram essencialmente: na visualização de vídeos curtos (sempre acompanhados com perguntas tanto em sala de aula, como vistos previamente em casa e discutidos em sala de aula; na realização de *quizzes online*; *brainstorming* com recurso à ferramenta *mentimeter*<sup>2</sup>; e a realização de *MindMapping* tanto no *coggle*<sup>3</sup> ou no *goconqr*<sup>4</sup>.

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<sup>2</sup> <https://www.mentimeter.com/>

<sup>3</sup> <https://coggle.it/>

<sup>4</sup> <https://www.goconqr.com/pt/>

Em virtude de ter o tempo demasiadamente ocupado, não tive muita disponibilidade para refletir acerca do que estava a fazer e como o estava a fazer, no sentido de poder, de alguma forma, reestruturar as sessões de trabalho. Para planear aquilo que se irá ensinar a seguir, é fundamental avaliar o ensino anterior. Por outras palavras, para planear algo de forma a obter um progresso e uma melhoria é, absolutamente, imprescindível que haja tempo para uma reflexão crítica.

Este tempo foi demasiado curto, igualmente, para conhecer em profundidade os alunos. Senti que alguns conheci melhor, do que outros. Alguns eram mais espontâneos e transparentes e mesmo num período de tempo, consideravelmente curto, foi possível conhecê-los um pouco mais.

## 5. Considerações finais

A reflexão suscitada pela prática e experiência, de que aqui, sinteticamente, dei conta, permitiu-me tomar consciência, por um lado, da distância que existe entre os pressupostos teóricos que defendo e acredito e a minha prática docente, até então. Por outro lado, pude tomar, igualmente, consciência da importância que o conhecimento sobre os alunos tem, na condução, na organização e na gestão dos programas curriculares, com vista a que todos alcancem o sucesso académico.

Verifiquei que, apesar das propostas de trabalho, que valorizo no decorrer das sessões de trabalho, estimularem os alunos, no que diz respeito a pensar, raciocinar, colocar e resolver problemas, aquelas nem sempre estiveram adequadas às suas características, existindo por vezes um desfasamento entre as suas capacidades e as minhas exigências.

Interessantemente, senti que aderiram bem às propostas, tendo-lhes agradado em especial as tarefas que implicavam o recurso ao *smartphone* e/ou *tablet*, no decurso das aulas, deixando de ser um objeto proibido. Foi também gratificante verificar que sempre que tinham de ler um pequeno texto em casa para depois esclarecer as dúvidas em sala de aula, o fizeram com agrado, tirando proveito da situação. O mesmo já não se pode dizer relativamente à leitura de textos mais extensos e complexos, em sala de aula, ainda que a pares e /ou pequenos grupos, sentindo que era mais cómodo ouvir.

Considero que houve da minha parte um esforço em perceber as diferentes sensibilidades, tentando ser empática com todos e tendo uma postura proactiva face à mudança e às novas realidades. Pois, estes alunos têm características diferentes dos alunos que habitualmente chegavam ao ensino superior e com quem tenho vindo a trabalhar na formação inicial.



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## **Evolução do campo das dificuldades de aprendizagem específicas em Portugal: Das implicações nacionais às internacionais**

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### **Resumo**

*Este artigo tem por finalidade fazer sobressair o conjunto de eventos, de perspetivas e de influências que têm promovido o aparecimento e o aperfeiçoamento do campo das dificuldades de aprendizagem específicas em Portugal. Começamos por traçar o historial do campo e refletir sobre a situação portuguesa, referindo e problematizando as ações do governo e dos pais ao longo dos tempos, olhando com especial atenção para a legislação portuguesa atual sobre educação inclusiva. De seguida apresentamos resultados de um estudo influenciado pelo paradigma naturalista que contou com a participação de sete Professores Doutores. Os dados foram recolhidos através de entrevistas parcialmente estruturadas, de resposta aberta, e de análise de documentos. O conhecimento adquirido relativo ao cruzamento das perspetivas sobre a evolução do campo das dificuldades de aprendizagem específicas em Portugal mostra que, segundo os participantes: a) a evolução do campo não tem sido muito visível nos últimos 40 anos; b) as razões que têm estado na origem desta evolução pouco significativa são a ausência de envolvimento governamental, a supremacia das teorias de ensino maturacionistas e construtivistas, e a existência de um padrão cultural de permissividade. Terminamos lançando o desafio de fazer emergir a importância do tema para o contexto educativo, social e político nacional e internacional.*

**Palavras-chave:** *Dificuldades-de-aprendizagem-específicas, qualitativo, investigação.*



## **1. Introdução**

Desde o início do século XIX que as dificuldades de aprendizagem específicas têm vindo a intrigar e a captar o interesse de vários profissionais dos campos da medicina, psicologia e educação. A investigação tem evidenciado que a problemática das dificuldades de aprendizagem específicas é universal, ou seja, ocorre em todas as línguas, culturas e nações do mundo (Lerner, 2000). A literatura produzida na Austrália, no Canadá, na Alemanha, na Inglaterra, nos EUA, no Japão, na Holanda, na Suécia, na Finlândia, na Noruega ou em Portugal (ver em Martins, 2006, por exemplo, Bravo-Valdivieso & Muller, 2001; Correia, 2004b; Elkins, 2001; Fonseca, 1996; Gunther, 2001; Klassen, 2002; Lundberg & Hoiem, 2001; Masayoshi, 2001; Stevens & Werkhoven, 2001; Vianello & Moniga, 1996; Vogel, 2001; Wedell, 2001; Wong & Hutchinson, 2001), em conjunto com a investigação comparativa tem, igualmente, mostrado que existem muitas diferenças na forma como cada país compreende o fenómeno das dificuldades de aprendizagem específicas, na terminologia usada e no modo como a escola se organiza para responder às necessidades e características dos alunos. Adicionalmente, tem revelado que, mesmo quando a terminologia utilizada coincide, as definições conceptuais e operacionais podem ser diferentes. Tem, igualmente, revelado que, num mesmo país, existem diversas definições utilizadas em simultâneo e que há alguma similaridade na história inicial do campo em alguns destes países (Vianello & Moniga, 1996). Em Portugal o conceito de dificuldades de aprendizagem específicas aparece, em 1984, num livro de Vítor da Fonseca intitulado *Uma Introdução às Dificuldades de Aprendizagem* (Correia, 2002). Passados mais de 30 anos desde a primeira edição deste livro, o termo e o conceito estão presentes na comunicação de professores, médicos, psicólogos, investigadores, alunos, pais e população em geral, bem como em publicações do Conselho Nacional de Educação ou do Ministério da Educação. Assim, neste artigo caracterizamos e analisamos as percepções de sete profissionais no que respeita à evolução do campo das dificuldades de aprendizagem específicas em Portugal.

## **2. Metodologia**

### **2.1. Participantes**

Este estudo contou com a participação de sete professores que lecionavam em cinco universidades portuguesas, situadas nas regiões do Norte e Centro de Portugal, cujas idades estavam compreendidas entre os 45 e os 70 anos de idade. Quatro deles eram docentes e regentes de disciplina de dificuldades de aprendizagem específicas (com denominações diferenciadas) em cursos de formação inicial ou de mestrado e dois eram membros de

organizações ou redes nacionais e/ou internacionais relacionadas com a área. Todos tinham publicações e investigações feitas sobre o tema. Estes participantes foram intencionalmente selecionados porque se acreditava que seriam capazes de, compreensível e abrangentemente, abordar questões relacionadas com o fenómeno em estudo (Lincoln & Guba, 1985; Patton, 2002).

## **2.2. Instrumentos de recolha de dados**

Os dados foram recolhidos através de entrevistas parcialmente estruturadas, de resposta aberta, e de análise de documentos, considerando-se, desta forma, o que os participantes disseram, mas também o que tinham antes escrito. Todas as entrevistas foram gravadas e reproduzido por escrito, na íntegra, o discurso dos participantes, incluindo os silêncios, as interrupções, os risos e as entoações usadas durante as entrevistas, muitas vezes reflectindo os sentimentos e o pensamento daquilo que os participantes pretendiam transmitir. São exemplos de documentos públicos da autoria ou co-autoria dos participantes, teses de doutoramento, trabalhos no âmbito das provas de obtenção do grau de agregado, livros, artigos, brochuras e programas de disciplinas relacionados com o tema das dificuldades de aprendizagem específicas, bem como documentos pessoais. O acesso aos documentos públicos foi feito através de pesquisa efectuada em bases de dados das bibliotecas das universidades onde os participantes lecionavam, e os documentos privados foram gentilmente cedidos pelos participantes.

## **2.3. Análise da dados**

Neste estudo utilizou-se a análise de conteúdo como técnica de tratamento da informação contida nas entrevistas e nos documentos (Bardin, 1977). Esta técnica permitiu reduzir dados, encontrar ideias padrão ou temas e fazer inferências, válidas e replicáveis, dos dados para o seu contexto (Patton, 2002). O sistema de categorias foi elaborado segundo um misto de análise dedutiva (com categorias pré-determinadas de acordo com uma referência teórica) e de análise indutiva (com categorias que emergiram dos dados), à medida que se foram lendo e relendo os dados obtidos (Miles & Huberman, 1994; Patton, 2002). Os resultados apresentados nesta comunicação foram obtidos através da categoria denominada de “evolução do campo das dificuldades de aprendizagem específicas em Portugal”. O conhecimento adquirido foi sintetizado e discutido sob a forma de cruzamento de informação dos participantes e por fim é mobilizada a informação teórica em conclusões e recomendações, procurando-se dar voz própria à informação e ao conhecimento que se ganhou com o desenvolvimento e finalização deste projecto.



### **3. Resultados**

Os participantes neste estudo iniciaram as suas actividades profissionais nos anos 60, 70 e 80 e, de acordo com cinco deles, a evolução—vista como um processo de transformação gradual que se opera ao longo do tempo e que se substancia, nomeadamente, na alteração das características do campo das dificuldades de aprendizagem—, até 2006 não tinha sido muito visível em Portugal. Os factores que apontaram para que não tenhamos passado de um estado a outro, considerado mais avançado, foram diversos e podem ser sintetizados e caracterizados com base em três aspectos que estão, possivelmente, relacionados e recebem influências mútuas, e se caracterizam de seguida.

*1. Inexistência de envolvimento governamental:* Segundo três participantes a evolução pouco significativa no campo das dificuldades de aprendizagem específicas justifica-se pelo regime político não democrático que se vivia em Portugal antes da revolução de 25 de Abril de 1974 e, nos tempos mais recentes, pela ausência de uma política clara, prioritária, continuada e de qualidade. Um dos participantes refere:

Politicamente muitas coisas são vistas como algo que é temporário. Se todas as pessoas têm dificuldades e isto é mais uma; e se é mais uma não tem grande importância. Por isso, creio que não tem havido uma política continuada, diria até uma política séria, em relação a estas crianças, que representam a grande maioria dos alunos com necessidades educativas especiais. Também, os governos nunca tiveram o cuidado— e deviam tê-lo—, de produzir documentos que servissem de referência para os professores, porque [eles] são os grandes agentes [de mudança]. (Beta, E1, ¶30, citado por Martins, 2006)

Adicionalmente, estes participantes, mencionam a falta de advocacia como factor impeditivo de progresso.

*2. Teoria, organização e eficácia do ensino:* Um dos participantes menciona a importância da ideia transmitida pelas teses maturacionistas, ao nível das práticas do ensino da leitura, de que a aparente dificuldade na aquisição de determinada capacidade académica é, apenas, um atraso de maturação: “aquilo a que eu chamo, o triunfo das teses maturacionistas da leitura: a ideia de que [ao] sujeito que comece a ter dificuldades na leitura . . . bastar-lhe-á amadurecer, . . . [deixar] passar o tempo e, através de um ato mais ou menos milagroso, ele virá a aprender a ler e a escrever” (Zeta, E1, ¶34, citado por Martins, 2006).

Consequentemente, a imaturidade do aluno é assumida como a maior causa das dificuldades de aprendizagem e, portanto, o acto de esperar algum tempo para que o desenvolvimento ocorra na criança, é visto como natural. A ideia difundida pelas teorias construtivistas de que os alunos devem construir o seu próprio saber é, segundo um dos participantes, igualmente popular no seio dos profissionais portugueses e impeditiva de

progresso. São igualmente referidas, por um outro participante, ideias relacionadas com a forma como a sala de aula é organizada para dar resposta às necessidades dos alunos. Adicionalmente, um terceiro participante, considera que a falta de uma abordagem mais eficaz ao nível da intervenção específica, que é feita junto dos alunos, não tem promovido o desenvolvimento do campo das dificuldades de aprendizagem específicas.

3. *Padrão cultural*: Segundo dois dos participantes, algumas das características da população portuguesa, nomeadamente a permissividade, a tolerância, o desinteresse, o catolicismo, a pouca valorização da história, a pouca organização, ou a pouca valorização do que é científico, ao reflectirem-se no funcionamento da escola, impedem a evolução do campo das dificuldades de aprendizagem específicas.

Paralelamente à referência dos aspectos acima indicados, dois participantes lembram que, no entanto, o atendimento feito a alunos com necessidades educativas especiais, nomeadamente com, por exemplo, deficiência visual, auditiva, mental ou motora, tem sofrido algum progresso, chegando um deles a afirmar que em relação a estes grupos existiram muitas alterações a nível educativo. Tal foi justificado com a existência de legislação, com o seguimento das tendências que subsistem na Europa e noutros países, com a mudança, em 1974, do regime político português e com a oferta de formação especializada nas universidades portuguesas.

Referimos as razões que, segundo os participantes, têm estado na origem da evolução pouco significativa deste campo em Portugal. Segundo a literatura, internacionalmente o envolvimento governamental tem sido influente e decisivo para a fundação e a expansão do campo das dificuldades de aprendizagem específicas. Contudo, tal como se pode ver no Quadro 1, outras razões são igualmente indicadas pelos investigadores internacionais. De entre estas, salienta-se a existência de organizações de pais e de profissionais dedicadas à defesa dos interesses dos alunos, a escolha de um nome genérico que pudesse abarcar a variedade de problemas académicos que caracterizam as dificuldades de aprendizagem e que, ao mesmo tempo, fosse consensual (Ariel, 1992; Hammill, 1993; Kirk, 1981), a evolução da educação especial, a produção de investigação nas áreas da neurologia e da intervenção remediativa, o desenvolvimento da psicologia (Ariel, 1992), a aprovação de legislação que protege e apoia as crianças e os jovens em idade escolar, a existência de programas educativos ou de adaptações curriculares ao longo do percurso escolar dos alunos e a presença nas escolas de profissionais de diferentes áreas disciplinares (Hammill, 1993).



**Tabela 1. Eventos que segundo Ariel (1992) e Bender (2004) contribuíram para o desenvolvimento do campo das dificuldades de aprendizagem específicas**

Fundação
<ul style="list-style-type: none"><li>- Crescimento da consciência social em relação às crianças com necessidades educativas especiais.</li><li>- Origem do termo.</li><li>- Origem de definições.</li><li>- Envolvimento governamental.</li><li>- Existência de financiamento.</li><li>- Fundação de prestigiadas associações de pais e de profissionais.</li><li>- Formulação dos construtos das dificuldades de aprendizagem.</li><li>- Investigação e estudo das dificuldades de aprendizagem sob várias perspectivas (comunicação/linguagem/perceptivo-motora).</li><li>- Desenvolvimento de abordagens de diagnóstico e de intervenção.</li><li>- Formação de profissionais.</li></ul>
Expansão
<ul style="list-style-type: none"><li>- Proliferação de associações de pais e de profissionais.</li><li>- Aprovação de legislação que permite a elegibilidade e o apoio nas escolas regulares públicas.</li><li>- Investigação e proliferação de modelos de apoio nas escolas regulares públicas.</li><li>- Desenvolvimento de abordagens de diagnóstico e de intervenção.</li><li>- Formação de profissionais.</li><li>- Questionamento sobre a definição, os critérios, a formação, a avaliação e o ambiente de aprendizagem mais eficazes.</li><li>- Produção de investigação.</li></ul>

*Fonte: Ariel (1992); Bender (2004)*

Factores políticos, humanos e de funcionamento desempenham um papel fundamental na fundação e na expansão do campo das dificuldades de aprendizagem específicas. Olhando para o conhecimento produzido pela investigação internacional, e para as perspectivas dos participantes neste estudo, termina-se esta secção com a noção de que a fundação e o desenvolvimento do campo das dificuldades de aprendizagem específicas em Portugal depende de uma maior ação do governo e das associações de pais e de profissionais, da produção de investigação, da divulgação de informação e da existência de formação.

#### **4. Conclusões**

Tendo como referência o paradigma naturalista referido por Lincoln e Guba (1985), desenvolveu-se uma abordagem de investigação básica e exploratória que no final lança o desafio de fazer emergir a importância do tema para o contexto educativo, social e político, e de desenvolver um campo de investigação sobre o qual pouco se tem incidido em Portugal.

Segundo resultados do estudo, o campo das dificuldades de aprendizagem específicas em Portugal, visto através das perspectivas dos participantes, evidencia escassa progressão, devido à ausência de envolvimento governamental, à supremacia das teorias de ensino maturacionistas e construtivistas, e à existência de um padrão cultural de permissividade.

Assim, sublinha-se como conclusão que em Portugal o campo das dificuldades de aprendizagem específicas, visto através das perspectivas dos sete participantes, é mais teórico e científico, do que político e social. É teórico e científico no sentido em que se caracteriza de certa forma pelas tentativas que estes participantes têm levado a efeito, para formar e informar sobre o fenómeno das dificuldades de aprendizagem específicas. O fenómeno social é aqui entendido como a ação dos membros da sociedade portuguesa, especialmente dos pais, ou seja, ações e pressões sociais feitas junto do governo, no sentido de os alunos com dificuldades de aprendizagem específicas beneficiarem de uma educação que vai ao encontro das suas necessidades. O termo político é visto como o “envolvimento governamental”, na procura de estudar o estatuto e as necessidades dos alunos com dificuldades de aprendizagem específicas, de desenvolver políticas de educação adequadas que contribuam para a igualdade de oportunidades entre todos os alunos que frequentam a escola, de encorajar a implementação dos desenvolvimentos científicos sobre esta problemática, nas atividades do dia-a-dia da escola e da sociedade portuguesa. Foi unânime entre todos os participantes neste estudo que a falta de envolvimento do governo na formulação de políticas, coerentes e fundamentadas cientificamente, contribuiu ao longo dos anos para que o campo das dificuldades de aprendizagem específicas, na sua vertente de apoio aos alunos, tenha sido limitado no nosso país. Tendo por base a influência das ideias de vários investigadores internacionais (Kauffman, Hallahan, & Lloyd, 1998; Kavale & Forness, 1998), a leitura que se pode fazer aos resultados globais deste estudo conduz a que se sublinhe que se terá de procurar uma relação de equilíbrio entre o científico, o social e o político. Importa que esta relação maximize as oportunidades de avanço na compreensão do que são as dificuldades de aprendizagem específicas e a existência de uma educação eficaz para todos os alunos. A legislação de 2018 (Decreto-Lei 54/2018) sobre educação inclusiva poderá fomentar essa educação eficaz, ao permitir que as escolas incrementem um apoio pró-ativo baseado na implementação de um sistema integrado de deteção precoce e progressivos níveis de intervenção.

Assim, no contexto da abordagem multinível preconizada nesta nova legislação (Decreto-Lei 54/2018), é desejável a implementação de um modelo baseado no grau de resposta dos alunos à intervenção, um modelo educativo preventivo assente no pressuposto da prevenção das dificuldades de aprendizagem específicas, sob pena de estas se agravarem e de assim conduzirem os alunos que as possuem em direção ao insucesso (Vaz, 2015). Neste contexto propõe-se um sistema de triagem universal (uma vez em cada período letivo), feita com recurso a provas de realização breve, de fácil administração e cotação, que têm o nome de provas de monitorização com base no currículo para a leitura oral (fluência da leitura) e para a compreensão da leitura (provas Maze). Procura-se com este sistema a deteção precoce dos alunos que estão em situação de risco, o estudo aprofundado destes alunos e a implementação de programas de intervenção em diferentes níveis para os mesmos, bem

como a monitorização semanal da sua evolução (com recurso ao mesmo tipo de provas preconizadas para a triagem).

No presente artigo caracterizámos a evolução do campo das dificuldades de aprendizagem específicas em Portugal procurando conhecer o passado e o presente para melhor compreendermos e prepararmos o futuro quer ao nível escolar, quer ao nível da investigação.

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## A influência e a percepção das cinco forças competitivas de Michael Porter: um estudo no setor empresarial de Sobral – CE

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### Resumo

*Este trabalho aborda o estudo das Cinco Forças Competitivas de Porter no setor empresarial (panificação) da cidade de Sobral – CE, com o objetivo de analisar a percepção dos empresários com relação à atuação dessas forças no setor local. Como referencial teórico, o estudo inicia com uma abordagem a respeito das Cinco Forças Competitivas de Porter como instrumento para o planejamento estratégico e uma caracterização de cada uma destas forças. A parte dedicada ao estudo empírico traz os resultados de uma pesquisa de caráter quantitativo realizada com os empresários das padarias utilizando um instrumento estatístico que possibilita uma análise segura dos dados (Teste Qui-Quadrado), os quais revelam as percepções dos mesmos acerca da intensidade das Forças de Porter dentro do setor na cidade de Sobral. Com as informações obtidas, foi possível concluir que apenas uma delas possui forte atuação no setor. As demais, na visão dos empresários, apresentam uma atuação tímida. Essas forças com atuação tímida e pouca agressiva, atualmente podem não ser vistas como ameaças, mas a longo prazo elas podem reestruturar-se e atingirem fortemente o desempenho do setor.*

**Palavras-chave:** Forças competitivas, empresas, estratégias.



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### **Abstract**

*This work deals with the study of Porter's Five Competitive Forces in the business sector (breadmaking) of the city of Sobral - CE, with the objective of analyzing the entrepreneurs' perception regarding the performance of these forces in the local sector. As a theoretical reference, the study begins with an approach regarding the Five Porter Competitive Forces as an instrument for strategic planning and a characterization of each of these forces. The part devoted to the empirical study brings the results of a quantitative research carried out with the entrepreneurs of the bakeries using a statistical instrument that allows a safe analysis of the data (Chi-Square Test), which reveal their perceptions about the intensity of the Forces of Porter within the sector in the city of Sobral. With the information obtained, it was possible to conclude that only one of them has strong performance in the sector. The others, in the view of the entrepreneurs, present a timid performance. These timid, low-aggressive forces today may not be seen as threats, but in the long run they can restructure and strongly achieve industry performance.*

**Keywords:** *Competitive forces, interprise, strategies.*

## **1. Introdução**

Nos últimos anos, diversos estudos têm sido desenvolvidos com o objetivo de compreender o que leva determinados setores a obterem melhor desempenho no mercado, maior participação, reconhecimento e, conseqüentemente, maior lucratividade, e o que leva outros a falharem ou obter sucesso na adoção de um posicionamento estratégico. A Associação Brasileira da Indústria de Panificação e Confeitaria (ABIP), importante referencia brasileira de panificação, revela que o setor apresentou um índice de crescimento de 8,02% em 2014, o que representa um faturamento de R\$ 82,5 bilhões (ABIP, 2015). O estudo demonstra que este é o segundo ano consecutivo que o setor tem um crescimento inferior a 10%, apresentando a menor taxa dos últimos oito anos, contudo a taxa de crescimento continua positiva. Entretanto, como aponta o estudo, mesmo passando por esse momento de desaceleração, as panificadoras representam o segundo setor que mais cresce no país, ficando a sua frente apenas os supermercados. O Programa de Apoio à Panificação (Propan) mostrou que 66% dos brasileiros consomem pão no café da manhã e 98% da população são consumidores de produtos panificados. Essas informações constataam a forte presença das panificadoras no cotidiano das famílias residentes neste país, demonstrando a importância desse setor para a economia (SEBRAE, 2009; ABIP, 2015). Diante destas

informações, desenvolver estudos que constatem essa realidade e identifiquem as ações gerenciais que criam e mantêm um posicionamento estratégico que tornam o setor sustentável, é contribuir para o fortalecimento da economia do país e do setor. Diante desta contextualização prévia torna-se fundamental responder às seguintes questões: *De que forma os gestores percebem o impacto das Cinco Forças Competitivas do modelo de Porter no desempenho estrutural das panificadoras de Sobral? As estratégias genéricas de Porter são adotadas pelas panificadoras como ferramenta para posicionar-se estrategicamente e obter um diferencial competitivo? E, por fim, Qual (is) força(s) é (são) percebida(s) com mais influência pelos gestores?* Este trabalho tem como objetivo principal a análise e a percepção dos empresários com relação a influência de cada uma das Cinco Forças Competitivas de Porter no setor na cidade de Sobral-CE-Brasil.

## 2. Enquadramento

Michael Porter é um dos autores pioneiros no estudo da competitividade global e industrial. Os seus trabalhos têm sido recorrentemente utilizados nas ações de planejamento estratégico, que procuram identificar a competitividade das empresas a partir da análise de fatores ambientais. Este é intitulado de artesão da estratégia empresarial (Barney, 1997; Bignetti & Paiva, 2001; Bertero, Vasconcelos & Binder, 2003; Ramoz-Rodrigues & Ruiz Navarro, 2004; Mercês, 2009). O modelo das Cinco Forças de Porter pode ser compreendido como uma ferramenta que auxilia a definição de estratégia da empresa e leva em consideração tanto o ambiente externo como o interno, começando por ampliar o conceito de concorrência, sendo essa caracterizada por disputas por parcelas de mercado entre as empresas de um mesmo ramo de negócio que produzem produto e/ou serviços iguais ou semelhantes que satisfazem as mesmas necessidades dos clientes atuais ou futuros (Porter, 1990). Para o autor, a concorrência deve ser vista considerando-se as seguintes forças: Ameaça de novos concorrentes; Rivalidade em relação aos concorrentes existentes; Ameaça de produtos e serviços substitutos; Poder de compra dos clientes; e Poder de negociação dos fornecedores. O estudo de Porter (1990) assenta na seguinte premissa: quanto maior a força, menor a rentabilidade estrutural de setor e, conseqüentemente, da empresa. Assim, se um setor é caracterizado pela intensa concorrência; fornecedores e compradores com alto poder de troca, os quais conseguem impor com facilidade as suas condições; com forte concentração de produtos substitutos e no qual muito fácil entrar, inexistindo muitas barreiras de entrada, em longo prazo, dificilmente será um setor rentável (Fernandes & Berton, 2005). Ainda segundo esses autores, a presença dessas forças num setor, somada à intensidade de cada uma delas, estabelece o potencial de desempenho de um mercado. A análise isolada de cada uma dessas ameaças possibilita a identificação dos



elementos que compõem a estrutura de um setor, diagnosticando-o. Isso significa que identificando os fatores que favorecem ou depreciam um setor, é possível transformar as ameaças em oportunidades (Porter, 1990).

### **3. Metodologia**

O trabalho insere-se numa pesquisa de campo de natureza Quali-quantitativa e exploratória (Gil, 2008). Os instrumentos utilizados para a coleta de dados: observação atenta aos detalhes; aplicação de entrevistas semi - estruturadas a 11 proprietários do setor, e um questionário fechado aplicado a 27 gerentes e/ou proprietários de padarias da cidade de Sobral-CE - Brasil.

As entrevistas semi-estruturadas foram norteadas pelos tópicos relacionados às forças competitivas, permitindo que os entrevistados manifestassem livremente a sua opinião, (Alencar, 2009). A escolha do questionário deveu-se ao fato de ser necessária a obtenção das características da população estudada para perceber a relação entre as variáveis, confirmando, assim, nesse estudo a existência da pesquisa descritiva como um importante instrumento na aplicação e no sucesso da pesquisa quantitativa. O questionário contou com questões referentes à atuação das Forças Competitivas de Porter no setor que se caracterizaram como variáveis nominais do tipo Sim e Não e que serviram para acumular dados para uma análise mais aprofundada das forças, especialmente na identificação da relação existentes entre elas. Os dados qualitativos foram analisados através de “análise de conteúdo” que, segundo Vergara (2010, p.7) é uma técnica utilizada para se “analisar o que está sendo dito a respeito de determinado tema”. Esta técnica permitiu a construção de explicações com base nas interpretações de conteúdos categorizados previamente por meio da comparação. Os dados foram agrupados em cinco categorias analíticas que se referiam a cada uma das Cinco Forças Competitivas de Porter e permitiram o aprofundamento do que ficou obscuro na aplicação do instrumento quantitativo. Os dados quantitativos foram organizados em categorias analíticas de acordo com a relação que existia com as forças apontadas no estudo. A partir de então foi criada uma hipótese nula e uma hipótese alternativa para cada força analisada. Sendo denominadas H0 e H1 respectivamente. Nos métodos estatísticos, o uso de hipóteses trazem afirmações a respeito da população. A escolha por uma ou outra hipótese está condicionada ao que é chamado de *valor-p* trazido pelos dados e ao *nível de significância* pré-estabelecido pelo estudo (Agresti & Finlay, 2012). Segundo Agresti e Finlay (2012), se o *valor-p* for menor que determinado *nível de significância* (Sig.), passa-se então a rejeitar a hipótese nula e consequentemente aceita hipótese alternativa, em caso contrário, o inverso ocorre. Ainda segundo os autores, o *nível de significância* padrão deve ser 0,05 para a tomada de decisão. Ou seja, para  $p \geq 0,05$

aceita-se a hipótese nula ( $H_0$ ) e para  $p \leq 0,05$  aceita-se a hipótese alternativa ( $H_1$ ). Neste estudo, para chegarmos ao *valor - p* foi usado o programa SPSS. Os dados foram analisados pelo método *Qui-Quadrado*. Este método é caracterizado como não paramétrico que analisa a hipótese nula de não existência de discrepância entre as frequências observadas nas variáveis em estudo, ou seja, a não existência de associação significativa entre as variáveis (Bruni, 2012; Agresti & Finlay, 2012). A escolha deste método está associada às características da amostra, pois segundo Agresti e Finlay (2012) quando as amostras são numericamente pequenas ( $n \leq 30$ ) e não seja possível verificar a normalidade dos dados do universo, existe a possibilidade de as mesmas não representarem a população, impossibilitando a construção de suposições. No caso desta pesquisa, para cada força de Porter analisada (categorias) foi elaborado uma tabela com os resultados dos questionários e aplicado um teste *Qui-Quadrado* que buscou verificar se existia alguma relação entre as respostas encontradas (variáveis). O teste obedece ao seguinte padrão de hipóteses:

**Tabela 1. Relação das hipóteses com níveis de significância**

H0: São independentes	Não existe associação significativa entre as variáveis.	$p > 0,05$
H1: Não são independentes	Existe associação significativa entre as variáveis.	$p < 0,05$

Fonte: Agresti e Finlay (2012)

Caso o *valor-p* seja maior que o nível de significância (0,05) significa que as variáveis são independentes, portanto conclui-se que “não existe associação entre as variáveis” levando a aceitar a hipótese  $H_0$ . Vale ressaltar que, ao adotar o valor do nível de significância igual a 0,05, podemos afirmar com 95% de certeza que a escolha da hipótese está correta, ou seja, se esse teste for refeito 100 vezes, 95 delas dará o mesmo resultado (Agresti & Finlay, 2012).

#### 4. Resultados/Conclusões

*Ameaça de novos entrantes:* A grande maioria dos entrevistados (92,6%) afirmou que existem barreiras para quem está querendo entrar no setor de panificação em Sobral, fato percebido tanto por quem é novo no mercado quanto por quem já atua há mais tempo. Para analisar essa força através do teste *Qui-Quadrado*, consideraram-se “novos entrantes” aqueles estabelecimentos que tinham até 02 anos de existência no mercado e estabelecimentos “velhos” os que tinham acima de 02 anos de existência. Com a aplicação

do teste Qui-Quadrado, o mesmo apresentou um nível de significância igual a 0,512 significando a aceitação da hipótese H0. Isso mostra que os entrevistados não percebem uma relação entre as perguntas. Ou seja, independentemente do tempo de atuação no mercado, tanto os novos entrantes quanto os mais antigos percebem a existência de barreiras. O estudo demonstrou que dentre as “barreiras” apontadas, a maior e de mais representatividade tanto para os novos entrantes como pelos mais antigos é a “escassez de mão de obra qualificada” (51,9%). A explicação para esse fato é que em virtude dessa falta de profissionais qualificados, os gestores alegam que perdem competitividade, pois, necessitam treinar os funcionários recém-contratados, o que gera maiores custos e um período de tempo maior para que eles se adaptem à cultura interna da panificadora. Outra dificuldade, a ser superada pelos novos entrantes, é a “Legislação municipal” (14,8%). Para os gestores interrogados, o município impõe uma série de exigências legais que retardam e acabam desestimulando o empreendedor a prosseguir com seu projeto de negócio. Com a mesma relevância percentual da anterior (14,8%), a “necessidade de capital” também é um fator que dificulta a inserção no setor. Para os entrevistados, abrir uma padaria em Sobral<sup>1</sup> exige um investimento financeiro alto, para além do investimento na estrutura física

*Ameaça de produtos ou bens substitutos:* Para analisar a percepção a respeito desta força foi feito um cruzamento entre as perguntas “existem produtos substitutos?” e “O seu produto é vulnerável a esses produtos substitutos?”. Do resultado foi aplicado o teste *Qui-Quadrado* que verificou a hipótese de independência ou associação entre essas perguntas. A hipótese H0 prevê a existência de independência entre as variáveis, ou seja, a não existência de relação entre as mesmas. E a hipótese H1 prevê o contrário: a não existência de independência entre as variáveis, logo, a existência de relação entre as mesmas. O cruzamento dessas perguntas obteve um nível de significância igual a 0,302. Assim é possível aceitar a hipótese H0 de que não há uma relação significativa entre as variáveis, ou seja, segundo a percepção do empresário o fato de existir um produto substituto no mercado não significa que o mesmo irá influenciar na sua venda. Porter (1999) esclarece que os produtos substitutos impõem um teto nos preços de uma empresa, podendo diminuir seus rendimentos. Atentando-se para os números, podemos justificar a opinião dos que relataram que são afetados pelos produtos substitutos, 29,6% deles apenas, em virtude da existência de estabelecimentos que ofertam produtos iguais ou semelhantes aos das panificadoras..

*Poder de negociação dos clientes:* Para esta outra força foram cruzadas as perguntas “Seus produtos são iguais aos do concorrentes” e “Caso você aumente o preço do seu produto, o cliente deixa de comprá-lo?”. Do resultado do teste *Qui-Quadrado* resultou um nível de significância igual a 0,001. Desta forma rejeita-se a hipótese H0 e aceita-se a hipótese H1 de que existe uma relação entre as perguntas, mostrando que um pouco mais da metade dos

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<sup>1</sup> IBGE (2012); IPCE (2012).

entrevistados acreditam que o cliente pode deixar de comprar os produtos caso o preço dos mesmos venha a aumentar, significando que o poder de negociação do cliente, embora com baixa intensidade, é percebido pelos empresários do setor. O que explica a leve atuação dessa força no setor de panificação de Sobral é a alta concentração de padarias na cidade. Porter (1999) explica que, quando um setor é composto por inúmeras empresas que não apresentam grandes diferenciais competitivos, ou seja, seus produtos possuem atributos semelhantes aos do concorrente, os gestores possuem baixo grau de liberdade para impor aumentos de preços, exigir prazos ou recusar-se a dar descontos.

*Poder de negociação dos fornecedores:* A respeito desta outra força, teve-se em consideração as perguntas “Há facilidade na troca de fornecedores?” e “Há rigidez na alteração do preço do seu fornecedor?”. O resultado do teste analisou as hipóteses H0, que indica a não relação entre as variáveis por serem independentes, e a H1 que indica o contrário. O teste *Qui-Quadrado* apresentou um nível de significância igual a 0,040 mostrando a não aceitação da hipótese H0. Isso significa que os entrevistados percebem uma relação entre as perguntas, ou seja, para eles o fato de ter muitos fornecedores interfere na diminuição do poder de troca/negociação dos mesmos. Percebe-se que, se por um lado, o setor deve-se preocupar com o poder de troca/negociação dos compradores, a mesma atenção também deve ser dada ao poder de troca/negociação dos fornecedores, afinal essas forças ocupam as duas pontas da cadeia produtiva de um setor (Porter, 1999). A força poder de troca/negociação dos fornecedores possui baixa intensidade no setor, o que demonstra um baixo grau de dependência por parte dos atuais empresários na relação com seus fornecedores. Fernandes e Berton (2005), que aprofundaram o estudo de Porter no que refere à análise competitiva de um setor, esclarecem que um grupo fornecedor é poderoso quando um setor é dominado por poucos fornecedores, os quais impõem com facilidade suas políticas de preços, prazos, qualidade, dentre outros atributos. É possível, segundo os empresários, trocar de fornecedores sempre que estes estabelecem políticas desfavoráveis ou quando não cumprem os critérios das políticas atuais, tais como prazos, garantias, qualidade. Os empresários ainda relatam que existem disputas entre os próprios fornecedores, cada um tentando obter uma parcela maior de clientes, o que acaba por reduzir-lhes ainda mais seu poder de troca/negociação.

*Rivalidade entre os concorrentes:* A respeito desta outra força, foi levado em consideração as perguntas “Há muitos concorrentes no mercado de panificação?” e “Existe respeito entre os concorrentes?”. A hipótese H0 levantada alega a inexistência de dependência entre as variáveis, mostrando que não estão relacionadas e a hipótese H1 alega o contrário. Para esta força, o teste *Qui-Quadrado* apresentou um nível de significância igual a 0,434 significando a aceitação da hipótese H0. Isso mostra que os entrevistados não percebem uma relação entre as perguntas, ou seja, para eles o fato de ter muitos concorrentes não

interfere no respeito que existe entre os competidores. Segundo Porter (1999) a rivalidade tende a ser maior quando o setor encontra-se em recessão ou em baixo crescimento.

Porém, não basta conhecer e identificar a atuação de cada uma dessas Forças dentro do setor se esse conhecimento não for capaz de despertar o interesse dos empresários em desenvolver estratégias que possam melhorar o desempenho estrutural do setor. Foi com esse propósito que Porter (2008) desenvolveu as chamadas estratégias genéricas, sendo elas: a estratégia na Liderança do custo total; Diferenciação e Enfoque as quais são vistas como instrumentos capazes de responder às fragilidades diagnosticadas no estudo do setor, transformando-as em oportunidades que gerem um diferencial competitivo para o mercado. Pela análise dos resultados, foi possível concluir que apenas uma delas possui forte atuação no setor. As demais, na visão dos empresários, apresentam uma atuação tímida. Recorrendo ao raciocínio desenvolvido por Porter de que quanto maior a presença ou atuação das forças mais vulnerável torna-se o setor diante da ação da concorrência, podemos constatar que o setor de panificação não é vulnerável à forte pressão dos concorrentes. Isso significa que elas não impactam o desempenho estrutural do setor. Contudo, estas forças com atuação tímida e pouca agressiva, atualmente podem não ser vistas como ameaças, mas a longo prazo elas podem reestruturar-se e atingir fortemente o desempenho do setor.

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## Interdisciplinaridade no Ensino Superior: uma experiência na licenciatura em Educação Básica

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### Resumo

*Nesta comunicação, apresentamos resultados de uma experiência implementada no 2.º ano da Licenciatura em Educação Básica (LEB) de uma instituição de Ensino Superior do Nordeste de Portugal, que teve como objetivos: (i) promover a articulação e a interdisciplinaridade entre duas unidades curriculares (UCs) desta licenciatura e, consecutivamente, o desenvolvimento de competências transversais a ambas, através de um trabalho conjunto dos estudantes e dos docentes envolvidos; (ii) perceber de que forma os alunos envolvidos avaliam este tipo de articulação entre diferentes unidades curriculares. Tendo por base a obra literária de potencial receção infantojuvenil de Richard Zimmler intitulada: “Maria e Danilo e o mágico perdido”, os alunos envolvidos, num primeiro momento leram, interpretaram e transformaram em texto dramático o texto narrativo original. Posteriormente, encenaram-no e apresentaram-no à comunidade. No final os alunos da LEB avaliaram a sua perceção desta experiência de articulação entre as UCs. Apresentamos os resultados preliminares, obtidos a partir dos dados analisados, resultantes das ações reflexivas, exploratórias, formativas e expressivas trabalhadas com os alunos diretamente envolvidos.*

**Palavras-chave:** *Interdisciplinaridade, Licenciatura em Educação Básica, literatura infantojuvenil, expressão dramática.*





## **1. Enquadramento**

Os dados da literatura pesquisada demonstram que a interdisciplinaridade pode auxiliar na dissociação do conhecimento produzido e orientar a produção de um novo tipo de conhecimento, constituindo condição necessária para a melhoria da qualidade do Ensino Superior, mediante a superação da fragmentação, uma vez que orienta a formação holística do ser humano. Desenvolver a interdisciplinaridade no Ensino Superior requer profundas mudanças na vida académica, abrindo espaços efetivos para a prática da iniciação científica, da pesquisa e da interação. Essas mudanças passam pela articulação dos currículos das Unidades Curriculares (UCs) existentes a nível do plano curricular dos cursos de licenciatura, modificando de forma essencial o papel do professor no contexto educativo (Favarão & Araújo, 2004).

A vivência de aprendizagens interdisciplinares em artes, explorando diferentes formas de criação e realização de projetos, incluindo a prática de investigação, encontra-se referenciada no documento orientador das práticas artísticas no Ensino Básico-Competências Essenciais (2001), documento esse que destaca a importância das linguagens artísticas no desenvolvimento da criatividade, capacidade de expressão e comunicação, sendo necessário, para o efeito, que essa relação se estabeleça também em contexto.

As disciplinas artísticas são absorventes da cultura e posicionam-se criticamente sobre ela, o que leva que o artista crie representações de si e do outro. Por este modo, a arte ajuda a construir uma consciência da multiplicidade, da diferença e da liberdade individual, atitudes estas, benéficas à inclusão. É tácito afirmar que os vários campos artísticos defendem o pluralismo na busca da verdade do mundo pela expressão individual, assumindo a ideia dos múltiplos olhares sobre a realidade. Através da imaginação e da representação simbólica, o indivíduo recria a imaterialidade da vida em formas sensíveis, plausíveis de comunicabilidade e portanto, geradoras de significados. Esta dupla vertente da arte (reflexiva e comunicativa) ajuda à percepção e desenvolvimento da identidade por via da consciência da expressão pessoal aplicada na obra. Através dos métodos de concetualização, concreção e recepção da obra, gera-se um confronto entre o “eu” e o “outro” que se ameniza por meio da necessidade de exposição e pela possibilidade de contemplação da obra. Esta forma de respeito das partes, é em si uma forma de inclusão sócio-cultural.

A participação das comunidades educativas nas culturas locais, para além do estímulo às aprendizagens ativas, promove o interesse pela diversidade cultural (Roteiro para a Educação Artística, 2006), o que acentua a importância da preservação das identidades, dos valores pessoais e coletivos, através dum ensino criativo que desenvolva a percepção, a criatividade e a iniciativa, a reflexão crítica e a capacidade profissional.

Maréchal (1989) considera que no campo da formação de professores se deve promover o contacto com diferentes modelos de práticas dramáticas, criando condições para que os participantes possam experimentar diversas perspetivas de abordagem das mesmas, experienciando as particularidades de cada uma delas.

A «mise en action», de acordo com Maréchal (1989), é constituída por um grupo de práticas de natureza ludo-expressiva, que se caracterizam pelo incentivo à implicação individual e coletiva do participante (enquanto pessoa). A «dramatização» é um modelo que se refere às atividades dramáticas de jogo/improvisação que se orientam para a criação de uma ficção (verbal e não verbal), tomando geralmente a forma de um projeto espontâneo e imediato.

As práticas relativas à «teatralização», como refere Maréchal (1989), desenvolvem-se através da dinâmica que existe entre a criação de uma ficção e a sua realização (produção de um espetáculo), de acordo com diferentes contextos de representação, propostas de encenação e condições materiais de produção.

De natureza interdisciplinar (a decorrer no ano de 2019), resultando de uma articulação entre as UCs da Licenciatura em Educação Básica (LEB), Literatura Infantojuvenil e Expressão Dramática, e destas com a comunidade, mais concretamente, com uma IPSS da cidade de Bragança, o projeto “Literatura infantojuvenil na promoção de uma Educação Inclusiva” teve por objetivo trabalhar o tema “Diferenças(s)”, com vista à promoção de uma Educação Inclusiva, articulando diferentes instituições e cursos de Licenciatura da Escola Superior de Educação (ESE) do Instituto Politécnico de Bragança (IPB).

Partiu-se da obra de potencial receção infantojuvenil *Maria e Danilo e o mágico perdido* de um dos mais relevantes escritores da atualidade, Richard Zimmler, para desenvolver um conjunto de ações articuladas quer com os alunos da ESE-IPB dos cursos envolvidos, quer com a instituição parceira (para além da LEB também a licenciatura em Arte e Design foi envolvida).

Assim, entre outros, um dos objetivos centrais do projeto foi o de promover a articulação e a interdisciplinaridade entre Unidades Curriculares da LEB, e assim, o desenvolvimento de competências transversais a ambas as UCs, através de um trabalho conjunto quer dos estudantes, quer dos docentes envolvidos. Para além deste pretendeu-se perceber de que forma os alunos envolvidos avaliam este tipo de articulação entre diferentes UCs.



## **2. Procedimentos e opções metodológicas**

O trabalho desenvolvido teve início com a seleção, leitura, análise e reflexão crítica da obra literária, seguidas da sua adaptação à linguagem teatral e posterior apresentação a crianças do 1.º e do 2.º Ciclo do Ensino Básico (CEB), que durante alguns meses também trabalharam a obra e realizaram trabalhos escritos acerca da mesma. No dia da apresentação às crianças realizou-se um seminário aberto à comunidade, com a presença do ilustrador da obra selecionada, com a exposição em simultâneo dos trabalhos realizados pelos alunos do 1.º e 2.º CEB da IPSS. No contexto da unidade curricular de Expressão Dramática promoveu-se o desenvolvimento e a aplicação de conhecimentos no domínio da educação estética e artística, utilizando para o efeito a linguagem dramática como meio de expressão/comunicação e criação/produção, concretizando todo esse processo através da realização de peças de teatro dirigidas ao público infantil. No âmbito da unidade curricular de Literatura Infantojuvenil, os alunos leram, interpretaram e fizeram a transformação do texto literário de Richard Zimmler para texto dramático.

Para aferir o grau de satisfação dos discentes envolvidos no projeto e as suas sensibilidades, utilizou-se uma pesquisa de campo de cariz qualitativo e quantitativo, através do uso de um inquérito por questionário semi-estruturado, disponibilizado em suporte de papel. A amostra é constituída pelos vinte e dois alunos que frequentavam o 3.º ano da Licenciatura de Educação Básica e que frequentaram as unidades curriculares: Literatura Infantojuvenil e Expressão Dramática.

## **3. Apresentação e análise dos resultados**

Apresentamos, seguidamente, o resultado do questionário, com base nas respostas dadas pelos alunos dinamizadores do projeto.

Perante a afirmação a) “No Ensino Superior, normalmente, os professores não trabalham interdisciplinarmente”: 19% responderam concordo totalmente; 26%-responderam concordo, 40% responderam concordo parcialmente e 15% responderam discordo.

Relativamente à afirmação b) “É uma mais-valia para a construção de conhecimento desenvolver trabalho cooperativo, juntando-se duas ou mais áreas disciplinares”: 53,8% responderam concordo totalmente, 26,9% responderam concordo; 11,5% responderam concordo parcialmente e 7,7% responderam discordo.



Quanto à afirmação c) “O Projeto desenvolvido possibilitou um melhor conhecimento das artes cénicas da representação”: 57,7% concordaram totalmente; 34,6% concordaram e 7,7 concordaram parcialmente.

Na questão d) “ Teria sido mais fácil trabalhar a obra literária sugerida em Literatura Portuguesa, se não tivesse havido articulação com a área de Expressão Dramática?”: 15,4% discordaram totalmente, 57,7% discordaram, 19,2% concordaram parcialmente e apenas 7,7% concordaram;

Na pergunta e) “ Teria sido mais enriquecedor que a nível da Expressão Dramática, os alunos não tivessem tido sugestões de leitura em Literatura Portuguesa?” 19,2% discordaram totalmente; 69,2% discordaram e apenas 11,5% concordaram parcialmente.

À questão: f) “Acha que a experiência vivida lhe proporcionou condições para o desenvolvimento das capacidades de improvisação, dramatização e interpretação, de resolução de problemas”? 88,5% dos inquiridos responderam afirmativamente e apenas 11,5% deram uma resposta negativa.

À pergunta g) “O corpus textual de Literatura Portuguesa, que serviu como base de trabalho, foi-lhe apresentado pela docente. Concorda com esta forma de trabalho?” 88,5% dos questionados responderam afirmativamente, tendo respondido negativamente apenas 11,5%.

#### 4. Considerações Finais

Com base na apreciação final deste projeto, manifestada pelos alunos logo após a sua realização, com base no questionário disponibilizado concluímos que o projeto é referenciado como sendo uma experiência muito exigente e enriquecedora, dada a interdisciplinaridade e a complexidade das áreas abrangidas: interpretação e adaptação de textos, conceção estética e artística do espetáculo. Note-se que quase metade dos inquiridos referiu que no Ensino Superior, normalmente, os professores não trabalham interdisciplinarmente e cerca de 80% concordam/concordam totalmente que o trabalho cooperativo entre duas ou mais áreas disciplinares é uma mais-valia para a construção de conhecimento. Acresce-se o facto de 73,1% dos alunos discordarem/discordarem totalmente de que teria sido mais fácil trabalhar a obra selecionada sem a articulação interdisciplinar e de 88,5% considerarem que a experiência vivida lhes proporcionou condições para o desenvolvimento das capacidades de improvisação, dramatização e interpretação e de resolução de problemas.



Outro aspeto referido foi a dinâmica de grupo desencadeada com uma ação desta natureza, visto que, a realização de tarefas multifacetadas exige uma grande capacidade de organização, tendo gerado neste contexto uma interação acrescida entre os intervenientes, espírito de entretajuda e confraternização entre elementos do mesmo grupo e da turma em geral.

Destaca-se também por parte dos alunos da LEB o reconhecimento da importância de todo o processo intrínseco à apresentação de uma peça de teatro: os diferentes conceitos de espetáculo, a preocupação com os detalhes como essenciais à criação do todo e que é através dos ensaios que se percebe a união de todos esses elementos e entende a qualidade do que se apresenta, o que se nos afigura muito positivo em termos de experiência.

A capacidade de interpretação é considerada muito importante na medida em que se aprende a contar histórias, a desempenhar papéis de diferentes personagens, colocando-se o desafio na melhor forma de interpretação e adaptação da obra escolhida.

A capacidade de resolução de problemas é também considerada uma aprendizagem fundamental dado que os trabalhos foram realizados em grupo, o que exige esforço de cooperação. Os alunos revelaram-se mais motivados para próximas encenações e destacaram, neste processo, o apoio disponibilizado pelos docentes no conjunto dos trabalhos efetuados.

Como aparece referido pelos alunos, a experiência contribuiu para a construção de conhecimentos e habilidades que se vão repercutir futuramente na prática profissional, relacionando diferentes áreas do saber. Ficaram também sensibilizados com a possibilidade de desenvolver uma comunicação mais eficaz junto dos seus destinatários.

Não é alheio neste processo o que significa trabalhar em equipa, através da partilha de ideias e trabalhos conjuntos que se traduziram na construção de um objeto artístico comum. Foi, de fato, um fator de agregação de todos seus intervenientes e um exemplo de ensino/aprendizagem colaborativo.

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## Outros modos de ensinar a aprender no 1.º Ciclo do Ensino Básico: Escape Room

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### Resumo

*Nas últimas décadas as tendências globais do desenvolvimento social, económico, tecnológico e cultural trouxeram mudanças nos modos de vida que impõem um olhar atento para os modos de educar esta geração nascida na era digital (Prensky, 2001). A formação inicial docente assume uma responsabilidade elevada nos processos de inovação procurando responder aos problemas da atualidade (Flores & Ramos, 2016). Neste contexto, relevam-se os estudantes estagiários, também investigadores que atuam em contextos reais e interpretam o design inovador nas suas práticas educativas. Este estudo tem o propósito de determinar o impacto da abordagem Escape Room nas seguintes dimensões: desafios, satisfação, empenho, resultados. Também pretende compreender que mudanças ocorrem no perfil do aluno e do professor. A opção pela abordagem metodológica Escape Room visou promover o reforço de conhecimentos e de competências dos alunos, tal como estimular a motivação e interesse da criança, tornando o processo de aprendizagem mais atrativo, lúdico, interativo, conferindo sentido e significado ao conhecimento (Guigon, Humeau, & Vermeulen, 2018). Nesta experiência participaram 25 crianças, a frequentar o 3.º ano de escolaridade, uma professora titular da turma e duas professoras estagiárias. Seguiu-se uma metodologia qualitativa, de natureza descritiva e interpretativa, devido à “natureza aberta, globalizante e compreensiva” das questões orientadoras do presente trabalho (Martinho, 2011, p. 105). Para a recolha de dados foi aplicado um questionário às crianças, uma entrevista à professora titular e notas de campo resultantes da observação participada das estagiárias. Os resultados revelam que a abordagem Escape Room teve impacto na mobilização de conhecimentos para a construção de novos conhecimentos, no desenvolvimento de competências, nomeadamente, autonomia, capacidade de resolução de problemas e de decisão, na promoção de atitudes positivas face aos desafios propostos e na relação*





*entre pares. Além disso, observou-se um maior envolvimento das crianças, tal como ritmos de trabalho mais intensivos.*

**Palavras-chave:** *Renovação metodológica; Escape Room; Formação inicial docente; Tecnologias educativas.*

## **1. Introdução**

Enfrentamos hoje desafios sem precedentes provocados por um desenvolvimento tecnológico e social que tem alterado aspetos da vida humana, pelo que impõe novas competências para enfrentar um futuro incerto e imprevisível. No âmbito da educação, há necessidade de recriar pedagogias de modo a formar um cidadão com maturidade intelectual e moral, responsável, flexível e capaz de se adaptar neste mundo em mudança. Em Portugal, assistimos a impulsos de mudanças que envolvem um novo projeto político pedagógico que altera o que se ensina e como se ensina, mas ainda não são significativas as mudanças do que se avalia. Neste sentido, o Decreto-Lei n.º 55/2018, de 6 de julho, estabelece o currículo dos ensinos básico e secundário, os princípios orientadores, a operacionalização e avaliação das aprendizagens, realçando a necessidade dos estudantes adquirirem conhecimentos, desenvolverem capacidades e atitudes para alcançarem as competências do Perfil dos Alunos à Saída da Escolaridade Obrigatória (Oliveira-Martins, 2017). Deste modo, incita a escola a formar cidadãos competentes, com o conhecimento, as capacidades, as atitudes e os valores necessários para participarem e intervirem de forma consciente na construção do futuro.

Sabendo que as tecnologias emergentes proporcionam ambientes imersivos, interativos e conetivos, promotores de acesso fácil e direto à informação e comunicação a qualquer hora e de qualquer lugar, de criação de redes e de processos colaborativos que estimulam um novo tipo de sociabilidade e que impulsionam o crescimento de uma geração digital (Prensky, 2001), com competências inatas para a utilização inovadora das tecnologias, consideramos que a escola enfrenta um dos seus maiores desafios, o do digital. Este ambiente digital cria um fosso com o paradigma tradicional que impõe um registo diferente dos interesses desta nova geração. Assim, urge repensar o processo de ensino e de aprendizagem para encontrar soluções que cativem os estudantes desta geração digital. Este desafio levou-nos a criar uma nova abordagem estratégica sustentada no jogo em contexto de lazer, onde os indivíduos se esforçam para alcançar resultados, são envolvidos no processo e desenvolvem competências múltiplas para responder aos desafios do jogo. O *Escape Room* enquadra-se num subgénero de jogos denominados *adventures point and click*, pois espicaça o indivíduo a escapar de uma situação através da resolução de



puzzles/problemas, e está, ainda, relacionado com um género de jogo como o *Mystery of Time and space* lançado e desenvolvido por Jan Albartus em 2001 (Blanco, 2016). Este tipo de jogos foi bem recebido, nomeadamente no Japão, em bares, clubes ou outros espaços de lazer, reunindo um grupo considerável de adeptos. Mais tarde, começaram a construir-se as primeiras salas especializadas que se foram disseminando por vários países, desde a China aos Estados Unidos (Blanco, 2016), chegando a Portugal em agosto de 2014 (Durães, 2014). No âmbito da educação, este modelo, baseado na gamificação, visa desenvolver diversas competências por parte dos alunos no que concerne ao uso das suas habilidades sociais e emocionais, de raciocínio intelectual, criativo e dedutivo, tal como abordar conteúdos disciplinares em simultâneo, que caminham a par de um objetivo comum: “escapar da sala”. Esta designação significa que o desafio proposto foi cumprido com sucesso, pelo que o grupo de crianças deve avançar para a “sala” seguinte onde é proposto um desafio diferente e mais complexo. De entre os grupos participantes, o vencedor será aquele que, em primeiro lugar, ultrapassa os desafios de todas “as salas” com sucesso. O *Escape Room* enquadra-se num paradigma construtivista que centra o aluno no processo (Nicholson, 2018), sobretudo de modo colaborativo. O aspecto cooperativo e baseado em equipas dos jogos de fuga é um aspecto fundamental no *Escape Room* tornando-o uma abordagem poderosa para a sala de aula, como reforça o autor (ibidem). Acresce, ainda, o facto de fomentar uma maior probabilidade de reter conhecimento pela mobilização do mesmo no jogo, pelo que envolve o aluno de forma ativa, motiva-o na ação, apoia a compreensão e incentiva a curiosidade e a resolução de problemas (Vörös & Sárközi, 2017). Este artigo apresenta uma abordagem de *Escape Room*, aplicada no 1.º Ciclo do Ensino Básico (CEB).

## 2. Contextualização do modelo *Escape Room*

A estratégia educativa “*Escape Room*” visa desenvolver capacidades cognitivas, emotivas e sociais, estimulando a criatividade, o pensamento crítico e capacidade de decisão e liderança na resolução de tarefas, problemas e enigmas que se encontram relacionados com o conteúdo a abordar durante a aula. Como tal, sendo uma estratégia de aprendizagem que promove emoção e efeitos positivos na motivação das crianças e o desenvolvimento de competências múltiplas durante o processo de aprendizagem, propomos o *Escape Room* em ambiente virtual por forma a que as crianças ultrapassem labirintos de aprendizagem. A experiência vivida teve início com a organização das crianças em grupos para desenvolver o trabalho colaborativo, estratégia também implementada por Arnal-Palacián, Macías-García e Tosso (2019) e com uma história enigmática que alimentou a curiosidade das crianças ao longo do jogo.



A estrutura do *Escape Room* atende à autonomia das crianças, pelo que impõe regras e tarefas claras, estratégias viáveis e ajustadas ao seu nível e recursos disponíveis intuitivos e de fácil acesso. Permite a diferenciação pedagógica dado que se o grupo, ou a criança, sentir dificuldades na realização do desafio pode saltar para uma sala específica onde constam documentos com informações relevantes que lhe permite responder ao desafio. Neste sentido, o *Escape Room*, em ambiente digital, exige recursos tecnológicos disponíveis em sala de aula e espaço para a organização dos grupos.

Acresce que a preparação dos desafios atendeu às dificuldades e interesses das crianças da turma que foram ouvidas na realização de um *brainstorming*. Para a realização do *Escape Room* selecionou-se um *PowerPoint*, uma ferramenta de fácil utilização para as crianças, mas com alguns efeitos sonoros e de transição para criar um ambiente de aventura, tal como vídeos e narrativas relacionadas com o tema que foi explorado. No que diz respeito ao conteúdo educativo no *Escape Room*, este integrou diferentes áreas curriculares, de forma transversal, e envolveu questões de âmbito da realidade da vida e cidadania. No âmbito do mundo atual tratou-se, inicialmente, o habitat e deslocação dos animais, contudo à medida que os alunos ultrapassavam os desafios das salas, orientados por pistas, os níveis de complexidade aumentavam (Fig. 1), sendo que o primeiro nível, mais informativo e de desafio de menor exigência, dava lugar a outros níveis que impunham a mobilização de conhecimentos das anteriores salas para a realização do desafio. O nível 6 propõe a construção de um texto que exige a compreensão, reflexão crítica do tema e empatia, a mobilização de conhecimentos, competências e atitudes. Caso o desafio não seja superado, as crianças são convidadas a passarem para uma sala intitulada “explorar para saber” onde têm a oportunidade de rever os seus conhecimentos reforçando competências que lhes permitem retomar a sala e atingir a meta do jogo.

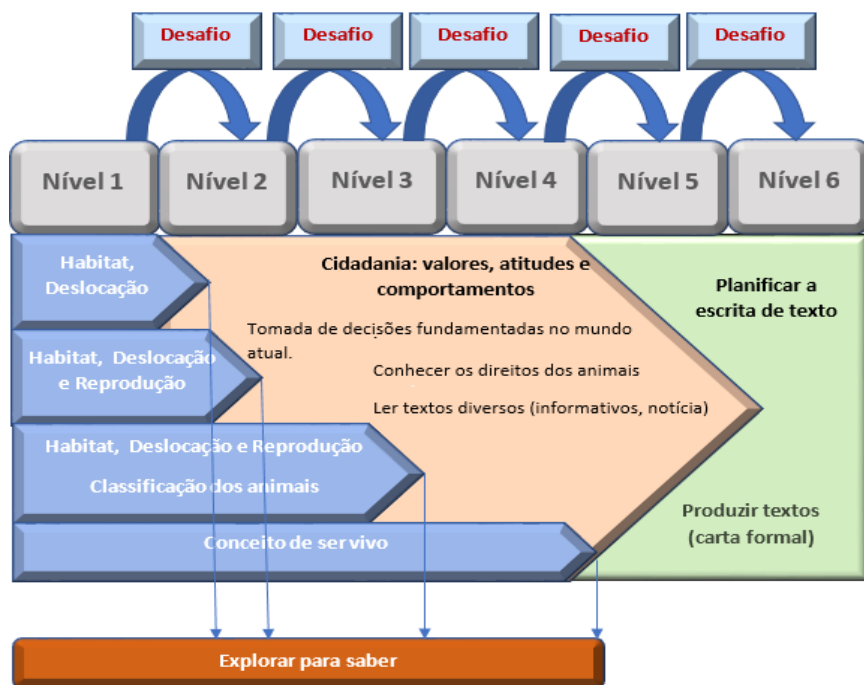


Fig. 1. Estratègia metodològica Escape Room

## 2.1. Metodologia

Tendo como objetivo a combinação de conhecimentos, competências e atitudes para motivar os estudantes no processo de aprendizagem e torná-los participantes ativos na sociedade, no âmbito da Prática Pedagógica Supervisionada, as professoras estagiárias planejaram um projeto de intervenção sustentado no modelo que anteriormente contextualizamos. A opção pela estratégia *Escape Room* visou promover o reforço de conhecimentos e de competências dos alunos, tal como estimular a motivação e interesse da criança, tornando o processo de aprendizagem mais atrativo, lúdico, interativo, conferindo sentido e significado ao conhecimento (Guigon, Humeau, & Vermeulen, 2018; Castro-García, 2018).

Nesta experiência participaram 25 crianças, a frequentar o 3.º ano do 1.º CEB, uma professora titular da turma e duas professoras estagiárias. As crianças eram curiosas e apresentavam desinteresse face a rotinas pedagógicas.

Seguiu-se uma metodologia qualitativa, de natureza descritiva e interpretativa, devido à “natureza aberta, globalizante e compreensiva” das questões orientadoras deste estudo (Martinho, 2011, p. 105). Para a recolha de dados foi aplicado um questionário às crianças, uma entrevista à professora titular e foram recolhidas notas de campo, resultantes da observação participada das professoras estagiárias.

## 2.2. Apresentação de resultados

A observação participante das professoras estagiárias permitiu revelar a dinâmica da aula que, quebrando a rotina, absorveu a atenção e estimulou a ação das crianças de modo saudável e prazeroso. Relevam, ainda, a estrutura da aula promotora de articulação e flexibilidade curricular, autonomia nos alunos e de trabalho cooperativo e colaborativo, a tecnologia digital que possibilitou toda a magia e emoção da aventura do jogo num só lugar, mas também que estimulou a participação e a construção do conhecimento de forma faseado, assim como o desenvolvimento de competências múltiplas numa aprendizagem significativa. Neste âmbito, referem a mudança de perfil de aluno e de professor neste novo paradigma, o primeiro muito mais ativo e construtor, o segundo mais promotor do ambiente educativo e orientador das aprendizagens.

No questionário aplicado às crianças (Fig. 2) verifica-se que 100% tem consciência de que aprenderam e mobilizaram conhecimentos na resolução dos desafios. A maioria também reconhece que desenvolve capacidades de cooperação, de literacia digital, decisão e autonomia.

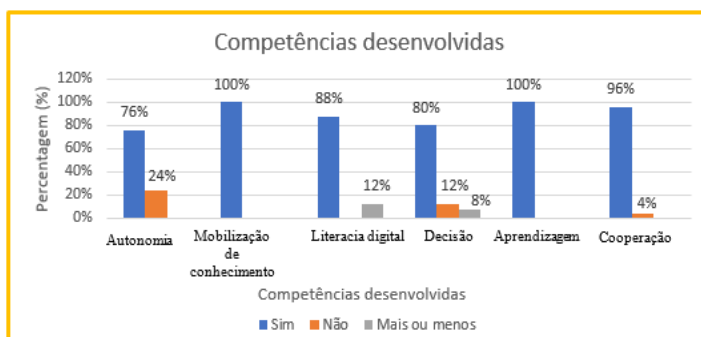


Fig. 2. Competências desenvolvidas

No que diz respeito às atitudes (Fig. 3), 96% das crianças considera que o *Escape Room* desafia-as levando-as a um maior empenho, mas 48% sentiu dificuldades na realização dos desafios. Segundo as professoras estagiárias, estas dificuldades tiveram mais enfoque nos conhecimentos curriculares e menos em conhecimentos técnicos no uso da tecnologia. Por essa razão o modelo de *Escape Room* utilizado não previa a “morte” na sala, mas a deslocação para uma nova sala, através de uma hiperligação onde os alunos dispunham de textos informativos relativamente aos conteúdos a mobilizar durante o desafio. Além disso, verificou-se a entreajuda das crianças pelo que apoiavam-se para ultrapassar dificuldades. Em questão aberta justificam a razão de gostarem dos desafios: “porque tudo o que é aprender a brincar motiva-me”; “apesar das dificuldades foi muito divertido”. Uma maioria significativa (84%) também é de opinião que esta estratégia é promotora de um aumento do esforço na tarefa.

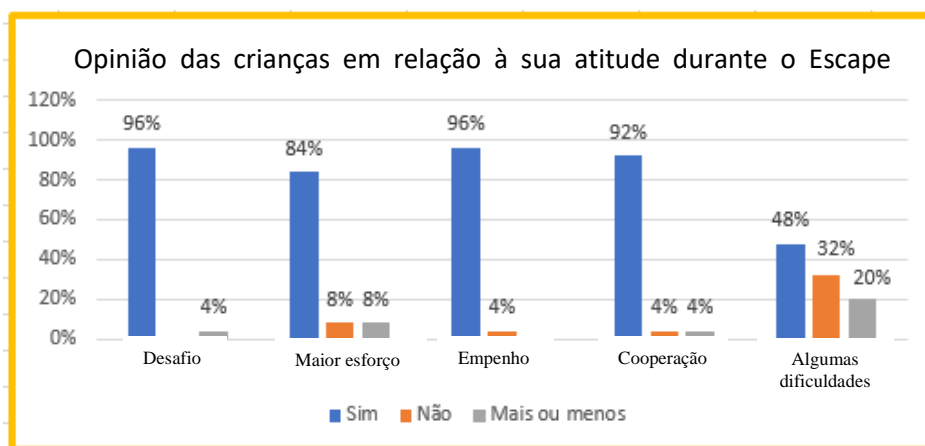


Fig. 3. Opinião das crianças em relação à sua atitude durante o *Escape Room*

Este resultado justifica a opinião das crianças relativamente ao *Escape Room* na educação que o consideram promotor de um maior empenho no processo de aprendizagem fomentando momentos de cooperação. Verifica-se, ainda, que 96% acreditam mesmo que esta abordagem lúdica de aprender melhora resultados, promove um ambiente de felicidade (88%), estimula o gosto pela aprendizagem (100%) e um ambiente personalizado que atende ao ritmo das crianças (100% e 88%) (Fig. 4).

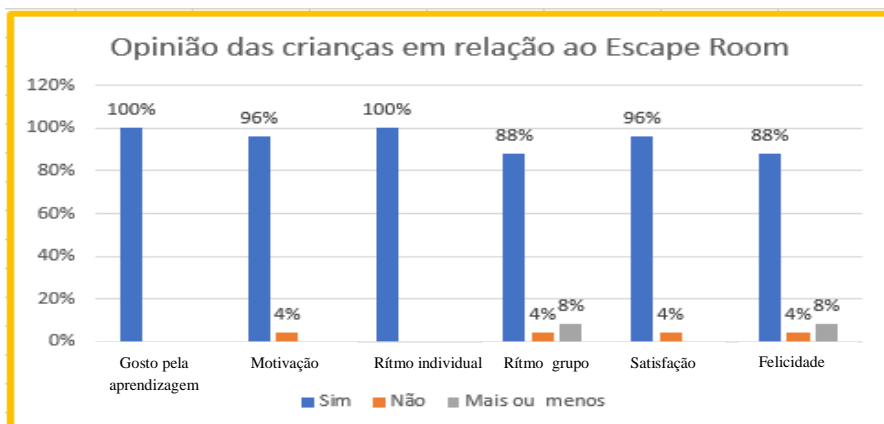


Fig. 4. Opinião das crianças em relação ao *Escape Room*

No que diz respeito à opinião da professora titular, constata-se na entrevista que esta gostou muito da aula e do impacto no trabalho desenvolvido, no empenho e criatividade estimulada.

[E1] “Usar os jogos pode ser a melhor estratégia para os professores estimularem os alunos a aprenderem, permitindo que os alunos resolvam questões a partir do conteúdo aprendido em sala de aula”.

[E1] “é uma forma de avaliar, de uma forma lúdica, o conteúdo aprendido, nas suas variadas vertentes, fomentando o trabalho cooperativo”.

[E1] “de facilitar o processo de aprendizagem, pois o jogo permite uma experiência vivencial que também trabalha competências como a atenção, a observação, o raciocínio lógico e abstrato, além de desenvolver competências comunicativas e linguísticas”.

[E1] “facilita a articulação curricular”.

[E1] “O professor do século XXI é, sobretudo, um profissional que deve adaptar-se às mudanças. Deve ser capaz de gerir o currículo e ensinar de forma criativa”.

### 3. Considerações finais

No âmbito da formação inicial docente é esperado que professoras estagiárias desenhem práticas educativas que relevem a criança e o seu processo de aprendizagem. O *Escape Room* é uma abordagem que responde aos interesses das crianças e pode, em simultâneo, promover momentos de aprendizagem e desenvolvimento de competências.

De acordo com os dados apresentados, pode concluir-se que o modelo de *Escape Room* proposto: a) permitiu quebrar a rotina das práticas educativas; b) estimulou comportamentos que cativam a atenção da criança no processo de aprendizagem; c) promoveu saberes, competências e atitudes; d) permitiu o trabalho colaborativo; e) estimulou um ambiente inclusivo, divertido e desafiante que respondeu aos interesses das crianças participantes.

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## Um olhar sobre as práticas docentes na avaliação de alunos com currículo específico individual

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### Resumo

*Uma incapacidade cognitiva, física, social ou emocional não pode constituir um impedimento à participação social e ao sucesso das crianças numa escola inclusiva e democrática. Este estudo centra-se na problemática da avaliação de alunos com necessidades educativas especiais do 2.º ciclo no ensino básico, concretamente dos alunos com currículo específico individual. O estudo analisa as práticas de avaliação docente destes alunos, assumindo como objetivos: (i) a identificação das práticas de avaliação dos alunos com currículo específico individual; (ii) a compreensão sobre o modo como o currículo específico individual é influenciado pelo desempenho dos alunos; (iii) o conhecimento das perspetivas dos professores face à avaliação destes alunos, bem como à inclusão dos mesmos na turma e na escola.*

*O estudo adotou uma metodologia qualitativa centrada no paradigma interpretativo, realizando um estudo de caso de dois alunos, João e Pedro (nomes fictícios), com currículo específico individual, incluídos numa mesma turma do 5.º ano, integrando, no estudo, seis professores do 2.º ciclo do ensino básico, do conselho de turma, de um Agrupamento de Escolas do distrito de Faro, Portugal. Os instrumentos de recolha de dados constituíram-se por entrevistas semiestruturadas, conversas informais e análise documental. Os dados recolhidos foram objeto de análise de conteúdo tendo por referência um sistema de categorias surgidos das opiniões dos professores entrevistados.*

*As conclusões apontam para a necessidade de realçar o contributo que a avaliação tem para o sucesso dos alunos, para a reestruturação do currículo específico individual e para o papel dos professores no desenvolvimento de práticas de avaliação formativas. Estas contribuem para as aprendizagens dos alunos com necessidades educativas especiais, em que as relações interpessoais, o reforço positivo e a autoestima são primordiais.*



**Palavras-chave:** *Avaliação, Necessidades Educativa Especiais, Currículo Específico Individual, Escola Inclusiva.*

## **1. Introdução**

A Educação deve ser encarada como um fator facilitador do desenvolvimento e da funcionalidade de todos os seres humanos. Este estudo tem como objetivo fundamental refletir sobre o processo de avaliação dos alunos com currículo específico individual, na realidade portuguesa, no que concerne a uma escola pública do 2.º ciclo do ensino básico.

## **2. Educação Inclusiva**

A educação inclusiva deve alterar o sistema educativo para que este se ajuste ao aluno e não o contrário, criando assim, um ambiente onde a paz, a tolerância, a justiça social, as necessidades básicas e os direitos sejam uma realidade para todos. Esta premissa levanta questões muito concretas que Reis e Neves (2011) realçam ao salientarem que importa refletir sobre a prioridade da inclusão na educação e sobre o caráter universal da educação inclusiva. Não nos podemos esquecer que o benefício da inclusão não é só para crianças com deficiência, mas sim para toda a comunidade escolar, originando impactos, no sentido da cidadania, da diversidade e da aprendizagem.

A inclusão torna as escolas lugares acolhedores e estimulantes, tanto para os professores e os assistentes operacionais, como para os alunos. A inclusão em educação implica: (i) a valorização de todos por igual; (ii) a redução da exclusão de alunos e o aumento da sua participação; (iii) a resposta à diversidade dos alunos, reorganizando as políticas, culturas e práticas nas escolas; (iv) a redução das barreiras à aprendizagem e à participação de todos; (v) a utilização de estratégias adequadas para que todos possam beneficiar e utilizar as diferenças entre os alunos como recurso de apoio à aprendizagem (Booth & Ainscow, 2002).

A flexibilidade e a diversidade participam de igual modo na definição de escola inclusiva, uma vez que a educação deve permitir às crianças e aos jovens atingirem o seu máximo potencial em termos das capacidades cognitivas, emocionais e criativas. Um olhar inclusivo sobre a qualidade da educação visa a necessidade de assegurar que as oportunidades de aprendizagens contribuam para uma inclusão na sociedade, deseja-se por isso a participação de todos (UNESCO, 2005). Esta qualidade nas aprendizagens pode ser melhorada pela



flexibilidade curricular, através de mudanças de metodologias e na avaliação, uma vez que os alunos necessitam de seguir caminhos diferentes para todos atingirem o sucesso educativo.

### 3. Avaliação dos Alunos com currículo específico individual

A avaliação refere-se essencialmente à avaliação das aprendizagens, envolvendo “interpretação, reflexão, informação e decisão sobre os processos de ensino e aprendizagem, tendo como principal função ajudar a promover ou melhorar a formação dos alunos” (Abrantes, 2001, p.46-47). A avaliação é a “recolha sistemática de informação sobre a qual se possa formular um juízo de valor que facilite a tomada de decisões” (Peralta, 2002, p.24).

De salientar que a avaliação engloba a dimensão cognitiva, que integra conhecimentos e capacidades, e a dimensão atitudinal, integrando o comportamento, atitudes e responsabilidade. Colôa Dias (2014) refere a avaliação como sendo um instrumento indispensável à monitorização do progresso dos alunos e à qualidade educativa dos estabelecimentos de ensino. Menciona ainda que “o processo de avaliação pedagógica (...) [pode ser] encarado como processo de avaliação para as aprendizagens, mais do que como [o] processo de avaliação de aprendizagens” (p. iii).

O objetivo da avaliação é facilitar a intervenção mais adequada para potenciar as aprendizagens, redundando numa melhoria dos resultados de todos os alunos, através de uma eficaz utilização da informação recolhida dos diferentes instrumentos de avaliação. A avaliação inicia-se com o processo de avaliação de diagnóstico, progride com a avaliação contínua ou continuada e finaliza com a avaliação sumativa. No caso de alunos com currículo específico individual, após a recolha das informações resultantes da avaliação diagnóstica, será necessário efetuar um currículo específico para o aluno, onde constem os conteúdos a abordar, as estratégias a utilizar, as competências a adquirir, o local da realização das atividades propostas (funcionais ou não), os recursos a utilizar e os instrumentos de avaliação.

O professor de educação especial tem um papel essencial na dinamização da mudança que a escola inclusiva reclama, em consonância com os normativos legais em Portugal: “uma aposta decisiva na autonomia das escolas e dos seus profissionais, designadamente através do reforço da intervenção dos docentes de educação especial, enquanto parte ativa das equipas educativas na definição de estratégias e no acompanhamento da diversificação curricular” (Decreto-lei 54/2018). O professor de educação especial deve motivar os restantes professores a quererem saber sempre mais e a estarem abertos à inovação e à

mudança, terem um conhecimento abrangente das crianças, das suas capacidades em cada fase do seu desenvolvimento, dos seus interesses, competências e necessidades, bem como da forma como estruturam o pensamento.

#### **4. Enquadramento Metodológico**

A questão de análise prende-se com a avaliação de alunos com currículo específico individual (Roque, 2018), mais concretamente com as práticas pedagógicas utilizadas na avaliação destes alunos. Tendo em conta os objetivos, optou-se por metodologias qualitativas e interpretativas para compreender a realidade tal como é vivida e percebida pelos sujeitos (Bogdan & Biklen, 1994). Este estudo pretende responder à questão: Quais as práticas de avaliação dos alunos com currículo específico individual? E apresenta como objetivos: i) Identificar as práticas de avaliação dos alunos com currículo específico individual; ii) Compreender se este currículo específico é influenciado pelo desempenho dos alunos; iii) Conhecer as perspetivas dos professores face à avaliação destes alunos, bem como à inclusão dos mesmos na turma e na escola.

##### **4.1. Participantes**

Este estudo desenvolveu-se numa escola básica do 2.º e 3.º ciclos de um agrupamento de escolas do distrito de Faro, Portugal, com os professores (nomes fictícios) de Português e Cidadania e Desenvolvimento (Alice), Inglês (Isabel), História e Geografia de Portugal (Carolina), Ciências Naturais e Matemática (Ana), Educação Física (Luís), Educação Musical (Nuno) e Educação Visual e Tecnológica (segunda autora) e com dois alunos (João e Pedro, nomes fictícios) com currículo específico individual do 5.º ano de escolaridade. Aos participantes foi garantido o direito ao anonimato e à confidencialidade e assegurado que os dados não são utilizados por terceiros nem para outro fim que não seja este estudo.

A professora Alice tem 16 anos de serviço. Tem formação em dislexia. A professora Isabel tem 26 anos de serviço. A professora Carolina tem 25 anos de serviço. Não tem formação específica em educação especial, mas considera ter experiência com alunos com currículo específico individual. A professora Ana tem 22 anos de serviço. O professor Luís tem 8 anos de serviço. Tem formação específica em educação especial. O professor Nuno tem 6 anos de serviço. Estes professores assumem a sua experiência e o apoio dos docentes de educação especial como aspetos determinantes para o sucesso do seu trabalho com estes alunos.



A turma estava constituída por 20 alunos, 11 rapazes e 9 raparigas, com idades compreendidas entre os 9 e os 12 anos. O João tinha 12 anos. Foi referenciado no 3.º ano por revelar dificuldades continuadas ao nível da aprendizagem. No início do 5.º ano, o João não conseguia ler, apresentava alguma autonomia, contava até 20 com ajuda e realizava operações de adição muito simples, desenhava bem para a sua faixa etária. O Pedro tinha 11 anos. Foi referenciado no 2.º ano por revelar dificuldades continuadas ao nível da aprendizagem. No início do 5.º ano, o Pedro conseguia ler, mas não compreendia o que lia, era pouco autónomo, contava até 20 e fazia operações simples de adição e subtração, não conseguia contar de 10 em 10 e desenhava ao nível do pré-escolar.

O João e o Pedro acompanhavam a turma em 23 tempos letivos, sendo 9 tempos em Educação Visual e Tecnológica, Educação Musical, Educação Física e Cidadania e Desenvolvimento e 14 tempos em Português, Inglês, História e Geografia de Portugal, Matemática e Ciências Naturais, 6 tempos em atividades com a professora de educação especial e 2 tempos numa atividade desportiva, o Boccia.

#### **4.2. Recolha e análise de dados**

Os instrumentos de recolha de informação adotados foram a entrevista semiestruturada aos docentes, a análise documental, concretamente o Projeto Educativo do Agrupamento de Escolas e os documentos dos processos dos alunos, incluindo o currículo específico individual, e os registos complementares, notas retiradas depois das entrevistas, em conversas informais e observação de aulas de Educação Visual e Tecnológica e de Matemática.

Optou-se por efetuar duas entrevistas, uma no início e outra no fim do ano letivo (2017/18), aos professores participantes, com o propósito de conhecer as práticas iniciais e as eventuais reformulações em função do conhecimento concreto dos alunos. A primeira entrevista (com duração entre quarenta minutos e uma hora) foi estruturada em nove blocos, distribuídos da seguinte forma: (i) Apresentação do estudo; (ii) Conceito de avaliação; (iii) Elementos que constituem o processo de avaliação; (iv) Instrumentos de avaliação utilizados; (v) Função da avaliação nas aprendizagens dos alunos; (vi) Efeitos da avaliação nas aprendizagens dos alunos com currículo específico individual; (vii) Inclusão dos alunos com currículo específico individual na escola e na turma; (viii) Participação da instituição escola/departamento de educação especial; (ix) Agradecimentos e conclusão da entrevista. A segunda entrevista (com duração de sete a quinze minutos) com o objetivo de concluir a recolha de dados foi estruturada em três blocos divididos da seguinte forma: (i) Relembrar os objetivos do estudo; (ii) Mudanças do processo de avaliação; (iii) Agradecimentos e conclusão da entrevista. Esta segunda entrevista não foi realizada aos professores de Educação Física e de Educação Musical.

Neste estudo, o tratamento de toda a informação foi realizado através da análise de conteúdo (Bardin, 2009), sendo que todos os dados recolhidos foram organizados tendo por objetivo caracterizar os alunos e responder à questão de pesquisa.

## **5. Resultados**

Os resultados da análise dos dados recolhidos foram organizados, neste artigo, tendo em apreciação os objetivos deste estudo.

### **5.1. Práticas de avaliação dos alunos com currículo específico individual**

O processo de avaliação implica um clima democrático, participativo, humanizado e estimulante, em que o encorajamento do professor desempenha um papel muito importante no sucesso de cada aluno, “tu consegues” [Luís, Educação Física], e no *feedback*, “vamos andando pela sala e vamos dizendo, olha faz assim, não faças assim” [Alice, Português], numa perspetiva de uma avaliação para a aprendizagem. Na perspetiva destes professores, a avaliação dos alunos com currículo específico individual decorre da assiduidade, “para estes alunos já é difícil estar numa sala de aula, quanto mais estar atento” [Nuno, Educação Musical], do relacionamento interpessoal, “saber estar, o participar, a relação com os colegas” [Isabel, Inglês], da curiosidade e gosto pelo trabalho [Carolina, História e Geografia de Portugal], dos trabalhos realizados, traduzido num “faz ou não faz” [Ana, Matemática e Ciências Naturais], da capacidade de inserção na comunidade, “ensinar o essencial para uma vida futura” [Alice, Português], bem como das aquisições académicas funcionais.

As tarefas utilizadas para cada aluno são diferentes entre si e diferentes em relação à turma, “o trabalho é muito diferente” [Alice, Português], denotando-se uma preocupação geral na preparação para uma vida futura “vai-lhes ser exigido determinadas coisas que deveriam aprender na escola, autonomia, escrever, lutar para ultrapassar as dificuldades” [Ana, Matemática e Ciências Naturais], mas nem sempre se faz esse trabalho “existem conteúdos que eles não conseguiram concretizar” [Isabel, Inglês], apontando as causas para o comportamento da turma “nós não temos turmas tranquilas” [Isabel, Inglês] e para a falta de tempo do professor na sala de aula, “porque o professor não está só para eles” [Isabel, Inglês].

## 5.2. Influência do desempenho na reformulação do currículo específico individual

Os professores entrevistados demonstram reconhecimento das necessidades de adaptações de tarefas e materiais, bem como na avaliação efetuada aos alunos com currículo específico individual, e todos realizam estas ações com o propósito de facilitar e promover o sucesso dos alunos. Este sucesso é influenciado pelos novos desafios, apresentados pelos professores, onde se executam tarefas, se resolvem problemas, mesmo os mais simples e se amplia a capacidade de autonomia e interação com os outros. Todos juntos vão fazer a diferença e sem se aperceberem estes professores estão a influenciar o currículo destes alunos ao tomarem atitudes de preocupação e não de indiferença, “Isto incomoda-me” [Ana, Matemática e Ciências Naturais], havemos de “arranjar um outro caminho” [Alice, Português].

No entanto, a perceção da maioria dos professores é que a avaliação não influencia o currículo específico individual, sendo que este currículo é uma medida muito limitativa quanto ao futuro dos alunos. Só após uma avaliação rigorosa, ponderada e articulada, envolvendo professores, técnicos e família se deverá aplicar o currículo específico individual, sendo a sua alteração passiva de ser efetuada sempre que houver alterações significativas, no fim de um ciclo de estudo ou quando o próprio currículo específico individual prover.

## 5.3. Educação inclusiva na turma e na escola

A inclusão é vista como a forma de solucionar os problemas de integração dos alunos, sendo que o desejado seria que os alunos passassem o maior tempo possível junto da turma, “a verdadeira inclusão, para mim é tentar que estes alunos acompanhem os restantes” [Alice, Português]. Os professores apontam dificuldades de integração dos alunos no contexto da sala de aula, sem um apoio especializado, “estes alunos devem estar dentro da sala de aula, mas devidamente acompanhados” [Ana, Matemática e Ciências Naturais], por sentirem que não têm condições para os apoiar, “não consigo estar tão disponível para eles como seria desejável” [Isabel, Inglês].

A permanência destes alunos na sala de aula gera alguma incomodidade a alguns professores das disciplinas tidas por teóricas, “[existem] aulas minhas, em que eles se aborrecem bastante” [Isabel, Inglês], e aos restantes alunos, “eles [João e Pedro] estão bem integrados, mas (...) eles [restante turma] não os apoiam” [Carolina, História e Geografia de Portugal]. O professor Luís [Educação Física] considera que os alunos estão bem incluídos na turma e têm todo o apoio necessário. O professor Nuno [Educação Musical] acrescenta ainda, que a permanência dos alunos em sala de aula deve ser vista, caso a caso, sendo que as vantagens da inclusão são maiores nas disciplinas práticas.





## **6. Reflexão Final**

A diversidade de atividades e estratégias são uma constante nas práticas de avaliação dos professores, não esquecendo a afetividade que consideram incluída no processo. Contudo, o trabalho colaborativo, a partilha de experiência, bem como as discussões inerentes às práticas letivas, não são uma constante entre estes professores, embora alguns façam referência à importância da colaboração do professor de educação especial, considerado indispensável na concretização do currículo específico individual, quer no apoio direto e concreto quer na elaboração de materiais. As práticas de avaliação dos alunos com currículo específico individual podem ser condicionadas por essa dualidade de considerações assumidas pelos professores, contrariando as potencialidades do trabalho colaborativo entre profissionais.

Os professores apontam a falta de acompanhamento dentro da sala de aula, por falta de tempo do professor da disciplina e por ausência do professor especializado em educação especial, como um dos motivos do insucesso dos alunos. Todos falam de inclusão e todos sentem necessidade de aprender e articular tarefas e estratégias especializadas e se tornarem eles próprios professores especializados, no entanto não procuram formação nem a colaboração dos professores especializados. Acreditamos que uma avaliação adequada e correta é um fator importante de inclusão e constitui uma resposta adequada e necessária ao desenvolvimento de todos os alunos.

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## O Ser e o Trabalho: um estudo de avaliação de fatores indicativos de satisfação

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### Resumo

*A satisfação com o trabalho possui importante relevância para o bem-estar dos colaboradores e consequentemente proporciona melhor desempenho em suas atividades. Alguns autores consideram que para se ter noção adequada de como mensurá-la deve-se analisar a relação do colaborador com alguns fatores, dentre os quais sempre são estudados pela literatura da área e por isso escolhidos para compor esse trabalho: a natureza e condições do trabalho, salário, sistema de promoções de cargo, equipe de trabalho e o superior imediato. Neste sentido, o presente estudo buscou avaliar o nível em que os referidos fatores indicativos de satisfação estão impactando no trabalho de colaboradores de uma rede de padarias em um município do Estado do Ceará – Brasil. Para tanto, realizou-se uma pesquisa exploratória descritiva, referenciada com levantamento de dados em campo. Os principais autores pesquisados foram Sarathy e Barbosa (1981), Tamayo (1998), Bergamini (2000), Chiavenato (2002, 2003) e Martínez e Paraguay (2003). Os resultados demonstraram que quanto às dimensões natureza do trabalho, superior imediato e equipe de trabalho, no local pesquisado, a avaliação foi muito positiva, enquanto as dimensões ascensão de cargo e remuneração demonstraram uma média satisfação e, havendo neles a possibilidade de avaliação por parte da empresa. Os resultados das dimensões são coerentes com os dados encontrados na avaliação geral com os indicadores de qualidade de vida.*

**Palavras-chave:** Comportamento organizacional, satisfação no trabalho, gestão de pessoas.



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### **Abstract**

*The satisfaction with the work has important relevance for the well-being of the employees and consequently provides better performance in its activities. Some authors consider that in order to have adequate understanding of how to measure it, one should analyze the relation of the collaborator to some factors, among which are always studied by the literature of the area and therefore chosen to compose this work: the nature and conditions of the work, salary, job promotion system, work team and immediate superior. In this sense, the present study sought to evaluate the level at which these factors indicative of satisfaction are impacting the work of employees of a bakery network in a municipality of the State of Ceará - Brazil. For that, a descriptive exploratory research was carried out, referenced with data collection in the field. The main authors searched were Sarathy e Barbosa (1981), Tamayo (1998), Bergamini (2000), Chiavenato (2002, 2003), and Martinez and Paraguay (2003). The results showed that, in terms of the nature of the work, the immediate superior and the work team, in the local searched, the evaluation was very positive, while the ascension of positions and remuneration showed an average satisfaction and, having in them the possibility of evaluation by the company. The results of the dimensions are consistent with the data found in the general evaluation with the indicators of quality of life.*

**Keywords:** *Organizational behavior, job satisfaction, people management.*

## **1. Introdução**

Nos tempos que decorrem, o ser humano passa a maior parte de seu tempo em organizações, onde, de acordo com Chiavenato (2002), o ambiente caracteriza-se por condições físicas e materiais e também psicológicas e sociais. Esta afirmação reforça a compreensão da importância de perceber o comportamento do ser humano nas organizações, em especial os aspectos relacionados a satisfação do colaborador em as suas responsabilidades no trabalho (Marqueze & Castro Moreno, 2005). Neste sentido, este trabalho teve como objetivo, avaliar o nível em que os alguns fatores indicativos de satisfação interferem no trabalho. Foram utilizados os fatores definidos por Tamayo (1998) e Sarathy e Barbosa (1981) como referência para o estudo em campo, nomeadamente: satisfação com o salário, colegas de trabalho, superior imediato, ascensão de cargo e trabalho em si, e também o modelo de qualidade de vida proposto por Walton (1979 *apud*

Alves, 2010, p. 7), tendo como objeto de estudo uma empresa no segmento de panificação na cidade de Sobral, Estado do Ceará- Brasil.

## **2. Enquadramento**

No campo da Teoria Geral da Administração, o comportamento humano nas organizações tem sido estudado desde a escola de Administração Científica, fundada por Frederick W. Taylor, que procurou conhecer formas de maximizar a produção industrial no menor tempo, ignorando a essência humana e social, definindo que a única fonte motivacional do trabalhador centrava-se na concessão do salário, criando a definição de “homo economicus” (Chiavenato, 2003). Tentando corrigir a forte tendência de desumanização no trabalho defendida pelo pensamento taylorista, o psicólogo Elton Mayo desenvolveu a Teoria das Relações Humanas, definindo o “homem social” ao reconhecer que os trabalhadores possuem sentimentos, temores, desejos e singularidades sociais que são motivadas por certas necessidades, e só alcançam sua satisfação através dos grupos com os quais interagem. (Carvalho, 2002). Após os estudos de Taylor e Mayo foram desenvolvidas diversas teorias que reforçaram a ênfase dada às tarefas e às pessoas, analisando os impactos da estrutura, do ambiente e da tecnologia para as organizações. Com esta evolução teórica nasceram novas concepções sobre o ser humano, tais como Homem Organizacional e Administrativo durante a Teoria Neoclássica, Homem Organizacional nas Teorias da Burocracia e Estruturalista, Homem Administrativo na Teoria Comportamental, o Homem Funcional na Teoria de Sistema e o Homem Complexo na concepção da Teoria da Contingência (Chiavenato, 2003).

### **2.1. O Trabalho dignifica o homem. O Trabalho significa para o homem**

O trabalho abrange grande parte da vida do ser humano e pode ser visto como fonte de significado pessoal, reconhecimento, gratificação econômica, meios de conseguir autorrealização e autodesenvolvimento (Pereira, 2006). Martinez e Paraguay (2003) afirmaram que o trabalho é uma das melhores formas de o homem expressar a sua singularidade, algo que o completa e dá sentido a vida, por este motivo, é visto como uma das fontes da felicidade humana, onde a felicidade no trabalho é alcançada através da satisfação plena e necessidades biopsicossociais, da sensação de bem-estar e do sentido de utilidade no exercício de suas responsabilidades no trabalho. De acordo com Frankl (2003), o homem só se torna homem e só é completamente ele mesmo quando fica absorvido pela dedicação a uma tarefa, quando se esquece a si mesmo no serviço a uma causa ou no amor a uma pessoa. Em trabalhos desenvolvidos sobre a Psicodinâmica do trabalho, Dejours e



Abdoucheli (1994) extraíram aquilo que era potencialmente desestabilizador para a saúde mental dos trabalhadores, identificaram que todas as pressões aparecem como decorrentes da organização do trabalho.

## **2.2. Satisfação no trabalho**

De acordo com Martinez e Paraguay (2003, p. 61) “A satisfação no trabalho é um fenômeno amplamente estudado, e esse interesse decorre devido à influência que ela pode exercer sobre o trabalhador, afetando sua saúde física e mental, atitudes, comportamento profissional, social, tanto com repercussões para a vida pessoal e familiar do indivíduo como para as organizações”. Spector (2003, p. 241) refere que “a satisfação deve resultar do desempenho”, ou seja “o desempenho deve resultar da satisfação”. Pereira (2006, p. 20) salienta que “a satisfação no trabalho é o resultado dos sentimentos positivos e negativos que uma pessoa apresenta em relação ao seu trabalho, ou seja, é uma resposta emocional determinada pela interação das tarefas desempenhadas, das condições físicas e sociais do local de trabalho”. Moretti (2010, p. 15) descreve que “é estudada como uma das mais importantes variáveis da área de comportamento organizacional”. Outro assunto relacionado com a satisfação e motivação que também congrega para o bom desempenho do colaborador é Qualidade de Vida Extensiva ao Trabalho ou a conhecida QVT. A QVT é uma ferramenta indispensável para perceber a importância dos funcionários. Os seus programas têm o objetivo de proporcionar espaços de trabalhos mais agradáveis, condições melhores nos aspetos: saúde, físico, emocional, social, além de buscar preparar as equipas, integrar os setores com seus superiores, entre outras vantagens que melhorem o nível de satisfação dos envolvidos com a instituição (Ribeiro, 1993). Alves (2010) relata que inúmeros instrumentos para avaliar a QVT têm sido criados e utilizados, sendo que parte deles apresentam a satisfação profissional como definição principal.

## **2.3. A Importância das dimensões da satisfação no trabalho**

Considerando que a satisfação do profissional com o trabalho é um estado emocional advindo da interação com outros profissionais, suas peculiaridades pessoais, valores e expectativas com o ambiente e a organização do trabalho torna-se necessário para o empregado estar satisfeito com o trabalho. Assim como estar igualmente satisfeito com o trabalho em si, com o seu superior imediato. Pelo que as relações interpessoais devem ser positivas no ambiente profissional (fatores intrínsecos), com uma remuneração salarial digna e seguida com políticas de promoção e ascensão justas (fatores extrínsecos). Este ajustamento pode ser considerado como normal, quando as necessidades humanas são satisfeitas dentro das exigências impostas pela própria natureza humana. Havendo

descompasso entre os objetivos individuais e organizacionais ocorrerá o conflito e, conseqüentemente, ao estresse, que quando enfrentado adequadamente, representa um terreno fértil ao desajustamento individual (Bergamini, 2010).

### 3. METODOLOGIA

A investigação caracteriza-se como qualitativa, tendo como método o estudo de caso. A interpretação dos dados por meio destes *softwares* SPSS versão 22.0 e Excel 2010, permitiu obter conhecimentos sobre o perfil dos participantes, nível de satisfação em relação às dimensões estudadas e avaliar o nível de QVT geral da organização. O universo desta pesquisa englobou os colaboradores das duas unidades de uma empresa do setor de panificação em Sobral, sendo composto por 59 colaboradores com contrato formal de trabalho. A amostra correspondeu a 49 servidores, correspondendo a 83% da população, tendo caráter do tipo não probabilístico por aceite.

Na recolha de dados usou-se um questionário dividido em 3 partes: (1) Pesquisa sociodemográfica; (2) pesquisa com afirmativas sobre fatores de satisfação no trabalho; e (3) pesquisa de avaliação dos indicadores de Qualidade de Vida no Trabalho. Os dados principais foram obtidos através de questionário adaptado de um instrumento desenvolvido por Sarathy e Barbosa (1981), apresentado como Escalas para Medir Satisfação com o Emprego - EMSE, adicionado de complementos para análise do perfil dos colaboradores e de um questionário adaptado pelos autores desse estudo baseado em seis dos oito indicadores de QVT propostos por Walton (1974, apud Alves, 2010, p. 79). No total o instrumento possui 78 questões (6 perguntas para análise do perfil do entrevistado, 66 questões com afirmativas da EMSE e 6 afirmativas sobre os indicadores de QVT). Para avaliar as afirmativas sobre satisfação e QVT optou-se pelo uso da escala Likert tendo em vista que o modo mais comum de se aferir a satisfação no trabalho se dá por meio de escalas deste tipo. Foram utilizadas as seguintes variáveis: ordinal, para as afirmativas das escalas de satisfação com o emprego, e com os indicadores de QVT, tipo Likert. Nas afirmativas com as variáveis intrínsecas e nos indicadores de QVT variou de 1 a 5 (de discordo totalmente a concordo totalmente) e de 1 a 3 nas variáveis extrínsecas (tendo o mesmo parâmetro, porém sendo o número 2 a opção “nem concordo nem discordo”); variável nominal (sexo, estado civil e posição ocupada na instituição), variável numérica intervalar (tempo de trabalho na instituição, faixa etária e salarial mensal). O instrumento foi aplicado *in loco* pelos pesquisadores.



#### **4. Análise dos resultados**

**Análise do perfil dos respondentes:** 51% dos entrevistados são homens e 49% mulheres. A faixa etária a maioria dos colaboradores, 43%, tem entre 21 e 29 anos e a segunda está entre 30 a 34 anos (24,5%). A maior parte são solteiros (59% do total). Em relação à faixa salarial mensal, constatou-se que todos os colaboradores recebem de 1 a 2 salários mínimos. Ao que tange a posição ocupada na empresa (88% está no nível operacional e 12% em nível tático especializado). Nenhum colaborador do nível estratégico respondeu. Quanto ao tempo de serviço na organização, constatou-se que a maioria dos servidores, com 55%, está na organização há menos de 1 ano. Em seguida, aparecem os funcionários que possuem de 2 a 4 anos e 11 meses no ambiente (24,5%).

##### **Análise de cada dimensão:**

*Satisfação com a natureza do trabalho:* a média 4,22 obtida das 12 afirmativas de satisfação, e pela média de 2,66 das 5 de insatisfação, onde a última caracteriza que os colaboradores discordam em partes que determinadas condições ocorram, levando a deduzir que neste caso há equilíbrio nos polos satisfação e insatisfação. Os índices empregados como medidas para conhecimento com esta dimensão de satisfação foram relacionados aos fatores respeito, onde a primeira refere-se ao cargo e atividades realizadas para a organização e a segunda para as condições humanas e de identidade pessoal. Houve destaque para a afirmativa que aquele trabalho era de natureza “exaustiva”. Com as menores médias nas afirmativas de insatisfação, ficaram que “o trabalho era frustrante e enfadonho”, sugerindo coerência com as médias positivas relacionadas as condições humanas e de identidade, ou seja, os maiores índices foram de “encantamento, satisfação, prazer, uso de criatividade e realização pessoal e profissional” no ambiente de trabalho e com as atividades realizadas.

*Satisfação com o superior imediato:* neste índice os servidores demonstram ampla satisfação com o seu superior representado pela média 4,39, a maior média de satisfação por dimensões da pesquisa, considerando-se as 13 afirmativas de satisfação. Com pontuação 1,52, discordaram quase que totalmente das afirmativas que sugerem insatisfação. Nesta dimensão as afirmativas são: que os superiores expressam respeito e buscam proporcionar bem-estar aos colaboradores (coerente com a dimensão anterior), mostrou influência do líder na organização, repassam informações às suas equipes, demonstram a inteligência e tratamento igualitário, sem favoritismos.

*Satisfação com a equipe de trabalho:* a média das 12 afirmativas que demonstraram insatisfação são de 2,16. As 5 afirmativas que sugerem satisfação tiveram pontuação acima de 4, tendo como média geral 4,27. Destaque entre as afirmativas com teor de insatisfação,

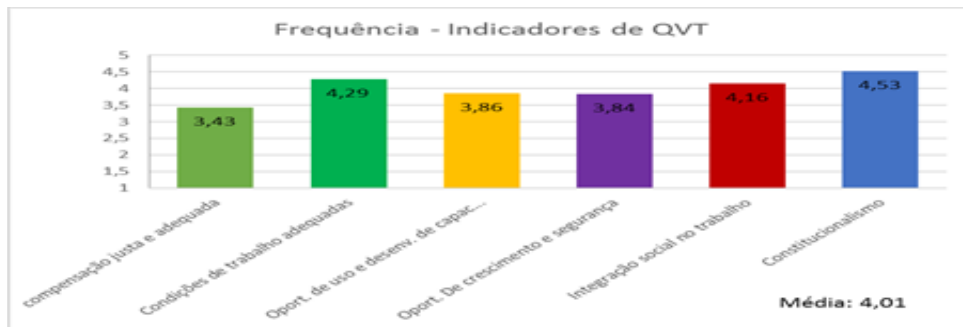
o índice “intrrometem-se na minha vida”, obtendo a menor média, 1,45. Dois índices com médias acima de 2,5 chamaram a atenção: “membros da equipe insatisfeitos” e “conversam muito durante o trabalho”. Mesmo que ambas estejam no nível de discordar em partes, indica que a prática de conversar muito durante o expediente existe. Neste caso deve-se recordar que isso pode expressar àquele indicativo, já apresentado, como um início de ataque contra a empresa, como mencionado por Ribeiro (1993, p.38) ao listar possíveis ações de um funcionário insatisfeito.

*Satisfação com a possibilidade de promoção/ascensão de cargo:* na presente e na última dimensão de satisfação no trabalho, a quantidade de afirmativas para análise é menor que nas dimensões anteriores, bem como é reduzida a escala Likert de 5 para 3 alternativas. Isso deve-se por conta destas dimensões representarem variáveis extrínsecas ao colaborador que requerem respostas objetivas do tipo sim, não sei e não. Com média 2,43, a maioria dos colaboradores afirmam que na organização existem oportunidades de promoção. Com média 1,53, de teor insatisfatório, os respondentes defendem que as políticas de ascensão da empresa não são injustas.

*Satisfação com a remuneração:* obteve média 2,07, este dado aponta que os funcionários não concordam nem discordam em estarem satisfeitos com seu salário. A média mencionada, de insatisfação pontuou em 1,77. Num contexto abrangendo as dimensões de satisfação com pontuações pouco acima de 2, os respondentes não concordam nem discordaram quanto aos índices: salário suficiente para despesas básicas como alimentação e contas da casa, proporciona uma vida confortável, salário bom e salário justo para o cargo. Destaque para o item que questionou se os respondentes consideram que a empresa distribui os seus lucros de forma justa, que foi a única afirmativa de satisfação a ficar abaixo do nível 2, indicando discordância parcial com média 1,69. Esta dimensão apresentou-se como a de menor nível de satisfação aos colaboradores.

*QVT:* os resultados das dimensões de satisfação, foram analisados a partir do Gráfico 1, onde constam 6 das 8 dimensões propostas pelo modelo de Walton para avaliar o nível de QVT, comparando com os resultados das dimensões de satisfação estudados. O termo constitucionalismo está ligado a existência de regras, normas de convívio no ambiente. Este foi o indicativo que mais se destacou na pesquisa, obtendo média 4,53. Em termos de coerência com os dados analisados nas dimensões de satisfação pode-se comprovar que nas 3 dimensões de fatores intrínsecos esta característica foi a que mais se destacou. Quanto ao segundo indicador com melhor avaliação destaca-se, as condições de trabalho adequadas com média 4,29, Integração social no trabalho foi o terceiro indicador mais bem avaliado com média 4,16.

Gráfico 1. Médias dos indicadores de Qualidade de Vida no Trabalho



## 5. Conclusões

Numa análise geral, os participantes mostraram-se satisfeitos com as condições que caracterizam o seu trabalho, o que pode significar que estejam designados nas áreas e setores baseados nas suas habilidades e conhecimentos, além de estarem num ambiente adequado ao seu bem-estar. Também se mostraram satisfeitos com o seu superior imediato e equipe de trabalho. Esta satisfação pode ser vinculada ao relacionamento interpessoal, já que a ênfase maior se deu nas afirmativas que indicam respeito. Pode-se inferir que a instituição possui um bom ecossistema de trabalho. Foi possível identificar uma certa indiferença em relação às afirmativas de ascensão na organização. Essa consideração pode ser resultado da grande quantidade de funcionários com menos de 1 ano na organização, equivalendo a 55% dos entrevistados, o que sugere pouco conhecimento sobre esta dimensão. Na última dimensão, a escala de remuneração recebeu a menor média, porém figurando na alternativa que equivale a “não concordo e nem discordo”. Neste caso, sugere-se que, diante destas condições, a empresa reveja o seu plano de remunerações, observando detalhes como esforço físico, periculosidade, responsabilidade auferida aos cargos de trabalho, entre outros, e que realize ajustes, se necessários. Comparando-se todas as médias e algumas afirmativas dispostas nas dimensões estudadas com os índices de QVT, concluiu-se que há coerência no cruzamento de dados, indicando satisfação com a maior parte das condições.

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## A inclusão no 1.º ciclo do ensino básico através da literatura para a infância

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### Resumo

*O trabalho que agora se submete à apreciação é o resultado de uma parceria com a Fundação Caixa CA de Bragança, Portugal, iniciada em outubro de 2017 e concluída em junho de 2018. Essa parceria teve como finalidades educar para a inclusão, através da leitura de potencial receção infantil com alunos 1.º Ciclo do Ensino Básico a frequentar os 3.º e 4.º anos de escolaridade, fora do ambiente proporcionado pela sala de aulas, sem, no entanto, sair do contexto escolar; aprender a brincar com as palavras sem que as ideias de construção e desafio se perdessem; pôr à prova a capacidade de interpretação de cada aluno em trabalho de grupo; englobar e incluir diferentes ideias e formas de trabalho entre os alunos participantes sem olhar a raças, cores, credos, línguas, questões cognitivas ou meios financeiros, visto que a língua é de todos e todos devem ter os mesmos direitos na hora de enriquecer a sua literacia. O projeto de promoção da leitura e da escrita denominado “Cozinha (com) as tuas Palavras” abrangeu seis agrupamentos de escolas pertencentes aos distritos de Bragança e Vila Real num total de novecentos alunos. Após a leitura do conto infantojuvenil Maggy, a Fada, os alunos foram divididos em equipas constituídas, não só por crianças da escola frequentada, mas, também, por crianças oriundas de outras escolas do 1.º Ciclo localizadas no meio rural daqueles distritos. As equipas realizaram provas em que as palavras foram o mote para os desafios propostos em ambiente culinário. Depois de uma fase de apuramento, chegaram à fase final uma equipa do 3.º ano e outra do 4.º ano de escolaridade a representar cada um dos Agrupamentos de Escolas que aceitou integrar o projeto.*

**Palavras-chave:** *Inclusão, leitura, escrita, desafios.*



## **1. Introdução**

O trabalho que nos propomos apresentar resultou das ideias de partilha e inclusão aliadas à literatura para a infância no âmbito do 1.º Ciclo do Ensino Básico Público Português (1.º CEBPP). O projeto foi, pois, proposto à Fundação Caixa CA de Bragança, que se tem vindo a dedicar a causas de grande amplitude, incluindo o desenvolvimento da literacia junto de crianças, neste caso concreto, a frequentar os 3.º e 4.º anos de escolaridade no ano letivo de 2017/2018.

Assim sendo, o projeto designado “Cozinha (com) as tuas palavras” surgiu da necessidade de incentivar a descoberta e o gosto pela leitura e pela escrita junto de crianças do 1.º Ciclo do Ensino Básico e da necessidade de incentivar todas as crianças participantes a saber incluir todos os elementos do grupo como um todo coeso sem olhar às possíveis dificuldades linguísticas, de aprendizagem ou de outra natureza. Neste sentido, e tal como afirma Leonardo (2008), apesar de ainda se verificar uma supervalorização da capacidade intelectual, da competitividade, da produção e até da beleza física, há que empreender tentativas no sentido de protelar estas ideias preconcebidas, evitando “que pessoas portadoras de alguma limitação ou que fujam aos padrões estabelecidos como normais sejam vistas como problemas e altamente desvalorizadas pela sociedade” (p. 432). E o autor citado anteriormente não é o único a manifestar-se em relação a este assunto. Também Rodrigues (2014) defende que “só podemos verdadeiramente falar em diferenças quando formos capazes de abolir a desigualdade” e acrescenta dizendo que “muito do que se chama atualmente “diferença” é uma mistura de diferença e de desigualdade e esta mistura leva a legitimar atitudes de discriminação que não são devidas à diferença, mas induzidas pela desigualdade” (p. 6).

Por que razão promover a igualdade e a equidade em ambiente educativo? Se a falta de igualdade e de inclusão alimenta necessariamente o insucesso escolar, então, de acordo com Rodrigues (2014) “promover a equidade em educação é antes de mais tomar consciência das faltas de equidade que a nossa educação pratica” (p. 8). No ponto de vista de Ainscow et al. (2012) a desigualdade deve ser pensada em três espaços diferentes: a) dentro da escola; b) entre escolas; c) para além das escolas.

Ora, o alinhamento do projeto “Cozinha (com) as tuas palavras” assenta precisamente na ideia de que a inclusão não se faz apenas num sentido. Por isso, quisemos iniciar o nosso trabalho no interior da sala de aulas, alargá-lo às diferentes escolas do 1.º CEBPP dentro de cada agrupamento de escolas e estendê-lo para lá desses agrupamentos com a deslocação de todos os grupos num outro ambiente que, embora se tratasse de um recinto escolar,

proporcionou aos alunos, na fase final do projeto, vivências de verdadeira confraternização e criação de novas amizades entre os grupos.

Por outro, se ler bem é, certamente, sinónimo de interpretar com correção e até alongar perspectivas, escrever bem é, sem dúvida, a capacidade que todos deveríamos possuir de manifestarmos os nossos pensamentos, opiniões, anseios em qualquer circunstância da vida escolar ou profissional.

Contudo, nem sempre é fácil introduzir novas ideias na exploração de um conto, ultrapassar metodologias já sobejamente exploradas, contudo, ainda assim, preferidas em relação a outras. Tal como acredita Alonso (2007) “la literatura para niños y jóvenes no es El País de Nunca Jamás. Aunque, algunas veces, pueda parecerlo debido a su invisibilidad”. Nós sublinharíamos, com as palavras do mesmo autor, que também a sua exploração junto de qualquer idade é um desafio a tomar muito seriamente com “unos ojos desprovistos de factores circunstanciales que condicionen la mirada y, así, encontrar un punto de vista diferente” (p. 32).

## 2. Enquadramento

É importante retermos neste enquadramento, como já mencionámos, que, o projeto em causa, pretende englobar e incluir diferentes ideias e formas de trabalho entre os alunos participantes sem olhar a raças, cores, credos, línguas, questões cognitivas ou meios financeiros mais/menos favorecidos porque a língua é de todos e todos devem ter os mesmos direitos na hora de enriquecer a sua literacia. Pretende-se, acima de tudo, uma leitura participada da obra pertencente à denominada literatura de potencial receção infantil *Maggy, a Fada*. Pretende-se ir além do texto, pondo em marcha duas das muitas características da literatura para a infância com que melhor, no nosso ponto de vista, se identificam as crianças: a imaginação e a criatividade, usualmente em grande destaque nas obras para pequenos leitores.

Essas características foram fundamentais para proceder à exploração das personagens da obra, bem como ao cruzamento da vertente do “fantástico/maravilhoso” com o quotidiano de qualquer criança dos nossos dias – neste caso, o mundo das personagens Joana e da sua avó Mimi – personagens principais da obra mencionada no parágrafo anterior.

Por que razão recaiu a nossa escolha sobre o primeiro volume da coleção *Maggy, a Fada*? Antes de tudo, devemos ter presentes os valores sociais e morais que este ‘novo’ conceito veicula. Como refere Silva (2011), com quem nos identificamos, no que toca à sua definição, poderá abordar-se a questão da ‘nova literatura’ quando nos referimos a





narrativas com “responsabilidade acrescida que lhe cabe na formação dos jovens porque ela aborda questões e temáticas de teor filosófico, abarcando uma visão humanitária e cívica do ser” (p. 216). Tais características conferem-lhe lugar de destaque no enriquecimento do património axiológico e cultural da criança/pré-adolescente e contribuem para a sua formação enquanto ser globalizante. O mesmo autor (Silva, 2011) afirma que por ‘nova literatura’ “apenas entendemos os livros de carácter literário que integram o ‘Fantástico Contemporâneo’ (a denominada “Modern Fantasy”), mais precisamente o fantástico maravilhoso” (p. 217).

## **2.1 Trabalhar em equipa para incluir**

Um projeto com estas dimensões possui algumas prioridades consideradas cruciais no momento em que a palavra de ordem é “incluir”. E, efetivamente, todo o projeto foi pensado com esse intuito – incluir; sentar à mesma mesa de trabalho crianças da mesma turma, mas também crianças de outras escolas do agrupamento e acreditar que as equipas seriam capazes de incluir e valorizar o trabalho e as ideias de cada membro do grupo (após os alertas em sala de aula sobre o que esperar do trabalho em equipa), criando um ambiente de desafio através do jogo, de interação, de responsabilidade, de partilha/cooperação, de amizade e confiança no outro na divisão e concretização das tarefas de forma a conseguir harmonizar todo o trabalho no tempo previsto. E foi possível ver tudo isso em grupos com crianças portadoras de algum tipo de Necessidade Educativa Especial; em grupos com elementos oriundos de outros países e falantes de outras línguas; em grupos com elementos provenientes de outras etnias, em grupos com crianças portadoras de necessidades económicas.

Para um maior e melhor envolvimento entre os alunos, a leitura, a escrita e a exploração do conto e todos os responsáveis pela formação da criança, o projeto foi apresentado à direção dos agrupamentos de escolas, a professores titulares de turma e de apoio, auxiliares de ação educativa, comissões de pais e encarregados de educação, bibliotecas escolares (que colaboraram ativamente na sua concretização), Rede de Bibliotecas Escolares e meios de comunicação social (que estiveram presentes no lançamento do projeto e no seu encerramento).

## **3. Objetivos**

Atendendo à explanação acima exposta, cabe-nos dar conta dos objetivos tendo em mira todas as fases do projeto, bem como o público alvo e suas necessidades no que à literacia e



à inclusão respeita: a) promover o gosto pela leitura silenciosa e em voz alta; b) fomentar o trabalho de interpretação em grupo, em pares e individualmente; c) incentivar a interpretação dialogada da leitura; d) contribuir para o desenvolvimento da semântica e da sintaxe; e) promover a inclusão social e escolar através da leitura; f) contribuir através da leitura e da escrita para a inclusão de alunos com diferentes necessidades - educativas, afetivas, financeiras; g) fomentar valores de conduta social/cultural através da leitura; h) promover entre os alunos a noção para questões fundamentais como a importância do livro e da leitura e do relevo que ambos devem assumir na consciência fonológica no contexto da Educação Básica; i) desenvolver nos alunos a capacidade de aplicar novo vocabulário (oral e escrito) em novos contextos situacionais; j) promover a articulação entre alunos dos diferentes concelhos/agrupamentos de escolas participantes; k) fomentar o trabalho em equipa através do jogo.

#### 4. Metodologia

Após a discussão e verificação de todas as etapas do projeto, bem como o seu financiamento por parte do conselho administrativo da Fundação, o projeto avançou para o terreno dividido em três fases: a) reunião com todos os diretores dos agrupamentos de escolas que fazem parte do âmbito de ação da Fundação, ou seja, os distritos de Vila Real e Bragança para apresentação dos objetivos do projeto, das suas duas fases, alunos e docentes envolvidos; b) leitura da obra de literatura para a infância escolhida, todo o trabalho de exploração com os alunos em contexto de sala de aula, formação das equipas e primeiras eliminatórias; c) segundas eliminatórias durante a fase final de apuramento.

Na conceção do projeto optou-se por uma metodologia faseada sem, no entanto, perder de vista que todas as etapas girariam em torno de uma ideia fundamental: a literacia para a infância e o ensino pela descoberta e, além disso, a aprendizagem pela descoberta. Ou seja, após a exploração da obra, os alunos juntar-se-iam a outros alunos (do seu agrupamento de escolas) e seriam confrontados com uma situação de jogo em equipa, durante o qual deveriam resolver tarefas.

As equipas foram totalmente constituídas pelas professoras titulares das turmas participantes no projeto, num total de dez alunos por equipa. Contudo, percebeu-se que pelo facto de o número de alunos nas turmas não ser uniforme, o número de elementos nas equipas também não o seria. Optou-se, assim sendo, por estabelecer um número uniforme entre as equipas em jogo para que não houvesse desequilíbrios em termos de participantes e que isso não prejudicasse o desenrolar dos seus trabalhos.



Era fornecido um desafio relacionado com a obra anteriormente explorada que as equipas deviam cumprir em trinta minutos. Desse desafio faziam parte a elaboração de um texto escrito tendo em conta o desafio proporcionado e a sua ilustração com utilização de gravuras diversas fornecidas para o efeito. O desafio era considerado válido pelo júri para avaliação se cumprido dentro do tempo e se apresentado com as duas partes que o compunham coladas no prato de cartolina facultado: o texto e as respetivas ilustrações.

Depois de entregue o trabalho pelo porta-voz de cada equipa, o júri, (que contou sempre com um elemento da Fundação Caixa CA e dois professores de cada um dos agrupamentos de escolas participantes), reunia-se e fazia a avaliação dos trabalhos e a seriação das equipas sempre com o intuito de apurar aquela (quer do 3.º, quer do 4.º ano) que representaria o agrupamento na etapa final juntamente com as demais apuradas nas mesmas circunstâncias nos restantes agrupamentos de escolas.

Na fase final, (a segunda), as equipas apuradas reuniram-se numa das escolas participantes e estabeleceram-se regras para que aquelas pudessem cumprir os desafios propostos em simultâneo perante um júri que, dessa vez, nada teria em comum com o júri estabelecido para a etapa anterior. Ou seja, não foi incluído qualquer elemento proveniente das escolas participantes, mas elementos externos (como a presidente da Fundação Caixa CA, docentes da Escola Superior de Educação de Bragança com formação académica no 1.º CEBPP e a Vereadora da Cultura da Câmara Municipal de Bragança).

Nesta fase foram introduzidas algumas alterações, embora a ideia principal do jogo, respetivas regras e conselhos sobre a inclusão de todos os elementos se mantivessem: a) os desafios não estavam projetados, mas encontravam-se em cima de cada uma das mesas de trabalho para que o porta-voz abrisse o respetivo envelope e com a ajuda da equipa delineasse a estratégia de trabalho; b) no início de cada jogo as equipas deveriam resolver dois desafios relacionados com a leitura do conto *Maggy, a Fada* sem cuja resolução não poderiam avançar; c) em caso de empate (e tal como sublinhado na primeira fase) o júri fez questão de mencionar a necessidade de as equipas organizarem o seu trabalho de acordo com as potencialidades de cada elemento, ou seja, de trabalharem a “uma só mão”; d) foram atribuídos quarenta minutos para o desempenho de todas as tarefas do jogo ao contrário dos trinta designados para a primeira fase; e) não foram distribuídas quaisquer gravuras de forma a permitir alargar a imaginação dos alunos, estreitando também a cooperação no seio da equipa.

## 5. Discussão dos resultados

Sobre a avaliação dos desafios para as equipas vale a pena esclarecer os critérios utilizados. Trata-se de uma grelha de registo cujos onze parâmetros se apresentam iguais para todas as equipas, independentemente do ano de escolaridade. Esses parâmetros pretendem abranger não só o cumprimento dos itens relacionados com a elaboração do texto (número de palavras, adjetivos, nomes, correção ortográfica, acentuação, coesão e coerência do texto, organização, pontuação, assim como o cumprimento da temática proposta, o cumprimento do tempo, o preenchimento da folha de rosto do texto com os dados solicitados (nome, número de elementos da equipa, designação do agrupamento de escolas, data) e a apresentação da ilustração (coerência em relação ao conteúdo desenvolvido no texto, utilização adequada das cores de acordo com os parâmetros que são transmitidos aos alunos nas aulas de Educação Artística e Dramática).

A cada item foi atribuída uma pontuação de forma a que o total não ultrapassasse os cem pontos e assim se conseguisse proceder à avaliação de ambas as equipas em jogo, uma vez que se tratava de uma atividade em que as equipas estavam duas a duas em jogo, simultaneamente.

No que respeita aos desafios elaborados, houve o cuidado de apresentar uma estrutura semelhante quer para as equipas do 3.º ano, quer para as equipas do 4.º ano, ou seja, a) um pequeno texto introdutório no qual se fazia a alusão ao tema retirado da obra *Maggy, a Fada* que dominava o desafio (a amizade, a alimentação saudável, o ambiente, a música); b) duas questões diretas para situar o tema na obra; c) o desafio propriamente dito, ou seja, a elaboração do texto e as respetivas instruções como o número de palavras permitido, o vocabulário que deveria estar incluído (nomes, verbos, adjetivos e preposições), estrutura (por exemplo, com ou sem diálogos, com ou sem personagens), apresentação do produto final conseguido por cada uma das equipas. Esta estrutura manteve-se ainda na segunda fase, exceptuando as alterações já mencionadas.

## 6. Conclusões

Chegados a este ponto parece-nos meritório referir que, a leitura é a grande vencedora deste projeto, visto que o tempo investido da leitura e promoção do conteúdo de um livro trará, certamente, a curto prazo benefícios importantes para a formação cívica dos nossos alunos. Acreditamos, também, que todos os envolvidos perceberam a multiplicidade de formas existentes para trabalhar uma obra e que saber incluir todas as ideias dentro de um grupo poderá fazer toda a diferença na hora de desempenhar com rigor as tarefas propostas. Não é



necessário que o impulso para a leitura parta sempre do professor e que seja este o principal motor da sua desconstrução, defendemos nós.

Na verdade, em “Cozinha (com) as tuas palavras” o nosso objetivo consistiu em lançar o mote e munir os alunos das ferramentas consideradas essenciais para que estes fizessem o seu próprio caminho no interior da narrativa e, mais tarde, no seio da equipa, com a qual trabalharam e cujos elementos nem sempre se conheciam.

Depois das duas fases de apuramento, e analisando as grelhas de avaliação preenchidas não só através da análise do trabalho final conseguido por cada equipa, mas também pela observação *in loco* efetuada pelos diferentes júris da primeira fase e pelo júri da fase final, verifica-se que foram muitos os aspetos que deram azo à eliminação das equipas. De entre esses aspetos destacamos não só os que se prendem com uma leitura fraca da obra infantojuvenil *Maggy, a Fada* e consequente interpretação deficiente, mas todos os aspetos diretamente relacionados com a interpretação dos desafios, cumprimento do tempo estipulado, apresentação do trabalho final ao júri e, sobretudo, os aspetos intrínsecos ao funcionamento das equipas, enquanto um todo que deveria apresentar-se coeso.

Mais do que trabalhar e educar para a literacia, aos alunos foram fornecidas também ferramentas sobre como trabalhar, incluindo. Queremos com isto dizer que foram seguidas de perto as dificuldades que as várias professoras, que abraçaram esta iniciativa, há muito haviam detetado e há muito trabalhavam, promovendo o trabalho em equipa, quer através de jogos, por exemplo, quer através de trabalho efetivo relacionado com os conteúdos das disciplinas do currículo do 1.º CEBPP. Ora, entendemos por instrumentos para difundir a inclusão entre os alunos, por exemplo, fichas de trabalho sobre a interpretação da obra infantojuvenil selecionada com atividades para desempenhar conjuntamente. Para a elaboração dessas fichas de trabalho todas as ideias deveriam ser anotadas como resposta às tarefas, apelando, desse modo, ao trabalho cooperativo e à técnica de “brainstorming”, bem como a uma pedagogia participativa, uma vez que ao longo da correção dessas fichas de trabalho, todos os elementos deveriam igualmente participar e manifestar-se criticamente sobre as principais dificuldades sentidas.

É ainda importante referir, no momento em que procede a um balanço alargado do projeto, que, também através da correção de todos os textos e observação do desempenho das equipas, quer da primeira, quer da segunda fase, os objetivos acima mencionados foram amplamente cumpridos, embora tenhamos consciência de que alguns deles continuarão a ecoar (acreditamos nós) na consciência dos alunos participantes e as ferramentas resultantes desse cumprimento continuarão a ser-lhes úteis dentro e fora do contexto escolar. Falamos, sobretudo, de objetivos como a) a promoção pelo gosto pela leitura silenciosa e em voz alta; b) o desenvolvimento do trabalho de interpretação em grupo, em pares e individualmente; c) o desenvolvimento da interpretação dialogada da leitura; d) o

crescimento de valores de conduta social/cultural através da leitura. O cumprimento dos demais objetivos ficou bem visível na evolução verificada na redação dos textos (na passagem da primeira para a segunda fase), principalmente através da aplicação de novo vocabulário em novos contextos situacionais; na leitura e interpretação dos textos fornecidos e na sua importância no desenvolvimento da consciência fonológica dos alunos; na articulação e competição saudável que se estabeleceu entre os diferentes membros no seio das equipas.

*Ler e incluir* são verbos que quisemos ver conjugados em simultâneo pelos nossos alunos. Estamos cientes, perante os resultados, que ambos os caminhos serão longos, quer através deste projeto, quer através de outros. Necessário é, certamente, não cruzar os braços e continuar a alertar, independentemente da estratégia utilizada.

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## A gestão escolar inclusiva, cosmopolita e multicultural

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### **Resumo**

*A presente comunicação é fruto da tese em construção intitulada *O cidadão do mundo e a organização ética da escola que analisa as relações sociais estabelecidas nas instituições educativas como responsáveis pela sustentabilidade e manutenção das culturas organizacionais. Objetiva-se demonstrar que o gestor escolar pode liderar um currículo inclusivo, cosmopolita e multicultural com dinamismo e democracia apoiando práticas docentes autónomas que combatam a discriminação e incluam os stakeholders no processo de elevação educativa e de coesão social. A mobilidade demográfica é uma realidade no planeta e a escola está plural. Um dos instrumentos de pesquisa utilizados na investigação de doutoramento é o Projeto Jovem Em Cena da Escola Estadual Professor António José Leite, localizada na Cidade de São Paulo-Brasil que difunde uma prática inclusiva e inovadora. O projeto de teatro apresenta musicais com releituras de obras cénicas mundiais e obras originais. Os participantes com as professoras criam o argumento, roteiro, cenário e figurino. Os stakeholders que são: pais, alunos, patrocinadores, artistas e a comunidade em geral trabalham juntos num processo coletivo de responsabilidade social.**

**Palavras-chave:** *Multiculturalismo, coesão social, qualidade de ensino, cosmopolita, responsabilidade social.*

### **1. Introdução**

Esta comunicação é parte integrante da tese de doutoramento que corre a termos *O cidadão do mundo e a organização ética da escola* que na educação comparada entre Brasil e Portugal analisa o fluxo migratório presente no globo como difusor de escolas multifacetadas e multiculturais, mas que enfrentam sérios problemas relacionais em sua





cultura organizacional com a discriminação a essas populações e às diferentes identidades nelas presentes.

Existem pesquisas significativas em Portugal e no Brasil que denunciam nas diferentes identidades presentes nas escolas violações causadas por discriminações, xenofobias e preconceitos. Não compreendidas, repelidas e esquecidas essas populações desenvolvem o sentimento de inferioridade e exclusão, por consequência, a nacionalidade, a etnia, a religião, a opção sexual e o género corroboram como *fatores interferenciais* negativos ao insucesso académico desses alunos. A base de interpelação deste *paper* traz a *school leadership* como impulsionadora de um contexto educativo intercultural. Na investigação identifica-se a gestão, a liderança escolar e o corpo docente preocupados com a emancipação humana e com a garantia da autonomia dos professores. As ações dos diretores de escola desses objetos (Brasil e Portugal) e de seus professores defendem a coesão social, a justiça, a inclusão, o cosmopolitismo de resistência e o multiculturalismo interativo (Benavente, 2004; Estêvão, 2011; Souza Santos, 2007; Luck, 2010; Lima, 2011 e Candau, 2008).

As populações educativas discriminadas nas diferentes pesquisas existentes são vítimas das desigualdades socioeconómicas, autoestima e inserção social. São diferentes constructos identificados pela Academia que contribuem à vulnerabilidade dessas pessoas carentes de proteção social: a falta de oportunidade de empregos, baixo rendimento *per capita*, ausência de moradia e alimentação condignas (Ennes, 2018).

Por outro lado, os gestores escolares e os docentes enquanto responsáveis pelo avanço pedagógico-social desses alunos não podem esquecê-los ou deixá-los no anonimato. A escolarização de qualidade e o equilíbrio sustentável nas relações interpessoais dos *stakeholders* processam uma cultura democrática, equitativa e interativa que necessita de equipamentos adequados, famílias presentes, ações autónomas de professores e dos demais profissionais difundindo um espaço acessível e de pertencimento a todos/das (Formosinho et al., 2016, p. 49).

Portanto, *a escola para todos* não é homogénea atende pessoas de várias realidades, migrantes ou não, com fenótipos e genótipos diferenciados pertencentes às várias camadas sociais. Na metodologia bibliográfica exploratória da investigação a Academia identifica num contexto geral das escolas a ausência de um *gate* pelo diretor escolar para que todos adentrem e estejam presentes no processo educativo.

Dessa forma a construção coletiva da cultura organizacional escolar adir-se-á aos traços, às histórias e aos atos dos *stakeholders* na garantia do acesso e permanência de todos/das assegurados na dignidade humana e em seus múltiplos significados (Canário, 2005).

Neste *paper* objetiva-se demonstrar o apoio administrativo escolar incondicional na autonomia docente concedido pela equipa gestora de uma escola pública brasileira na criação de um dispositivo pedagógico diferenciado. A professora Denise Biella com o *Projeto Jovem Em Cena*, instrumento empírico - atraiu dezenas de jovens/ano como participantes e integrantes que conscientizam uma região em São Paulo, Brasil à tolerância, ao respeito e à ética na realidade cosmopolita e intercultural do mundo.

## 2. A elevação da qualidade educativa, a necessidade do currículo multicultural e o diretor de escola

A escola, organização social eficaz e prestadora de serviços, tem em sua ação a responsabilidade de atemperar objetivos, recursos, pedagogias, tecnologias em sua estrutura formal e informal à busca da elevação da qualidade de ensino. No fortalecimento do compromisso à comunidade garante-se a inserção de agentes transformadores da sociedade civil enquanto cidadãos do mundo dotados de competências e capacidades de aprendizagens dum saber que foi sistematizado e historicamente acumulado (Lima, 2011; Rios, 2011; Formosinho et al. 2016). É vital nessa escola cidadã constituir valores que viabilizem o respeito e a paz.

Contudo, as escolas devem garantir o desenvolvimento intelectual, procedimental e comportamental estabelecidos à emancipação e elevação das pessoas. As especificidades organizacionais e seus contextos, como salientam Estêvão[1998], Formosinho e Machado [2008], Lima[2011] e Batista[2017], sugerem mudanças na atuação dos sistemas políticos homogêneos: o controlo administrativo exagerado, a burocracia excessiva e punitiva, a visão unilateralista do sistema educativo, a autonomia organizacional falseada, a direção dos agrupamentos sobrecarregadas, os objetivos verticalmente estabelecidos, homogeneização dos currículos e a ausência de diálogos entre as organizações do sistema educativo (Batista, 2019, p. 115).

É na perspetiva social, histórica e ética da escola com suas interações sociais através dos símbolos, objetos, pessoas e acontecimentos externos (Bronfenbrenner 1977, 1996, 2011) que o desenvolvimento dos alunos e dos profissionais se constroem. As relações sociais estabelecidas na organização escolar possibilitam o *multiculturalismo interativo* (Candau, 2008) à construção dum ambiente saudável fortalecidos no respeito mútuo e na solidariedade. Desta forma, os *stakeholders* combatem toda forma de preconceitos, discriminações e xenofobias que destroem a manutenção e a globalidade da vida (Batista, 2019).

Recentes pesquisas em Portugal comprovam a existência de discriminações e preconceitos aos afrodescendentes e às populações provenientes dos Países Africanos de Língua Oficial Portuguesa. A investigação de Monteiro et al. (2009) identificam-se preconceito étnico-



racial entre crianças brancas e seus pares em idade infantil de 6 a 10 anos. Outros estudos denunciam a dificuldade das populações africanas e dos afrodescendentes acederem ao Ensino Superior, diferente da realidade dos jovens autóctones da mesma idade (Roldão, 2015; Seabra et al., 2016). As investigadoras Araújo e Maeso (2010) pesquisaram os manuais escolares de história e concluíram que os africanos são representados de forma inferiorizada e as lutas de libertação nacional em África são abordadas de forma despolitizada e sem importância.

No Brasil, investigação realizada pela Fundação do Instituto de Pesquisas Económicas a pedido do Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira para avaliar o grau de preconceito e discriminação no ambiente escolar trouxe uma revelação dura e assustadora. Essa pesquisa coordenada por Afonso Mazzon (2009) da Universidade de São Paulo concluiu que 96,5% dos entrevistados têm preconceito com relação a portadores de necessidades especiais, 94,2% têm preconceito étnico-racial, 93,5% de género, 91% de geração, 87,5% socioeconómico, 87,3% com relação orientação sexual e 75,95% têm preconceito territorial. Descreve a pesquisa que as escolas são ambientes fomentadores de discriminação inexistindo alguém que não tenha identificação de três a cinco áreas de preconceito. Culturalmente o país é miscigenado e os dados do Instituto Brasileiro de Geografia e Estatística (2011) identificou que 84 milhões de brasileiros se autodeclararam pardos.

As Organizações das Nações Unidas decretaram a implementação da Década Internacional dos Afrodescendentes (2015-2024) de forma a conscientizar e expandir a tolerância, mas “em todo o mundo a população afrodescendente continua a ser alvo de discriminação a vários níveis, da habitação às escolas, do trabalho à representação política ou à justiça” (Zeid Ra'ad Al Hussein, 2017).

O rumo da instituição educativa é condicionado pelo diretor de escola que quando desempenha o seu papel através do projeto político educativo com eficiência, força, consistência e coerência à ação educadora emerge numa intrincada tarefa de harmonizar a estrutura complexa e moderna do espaço educativo. A investigadora dissemina a importância da liderança educativa nas escolas do século XXI como função nuclear no desenvolvimento da qualidade de ensino, da liderança do currículo interativo e na sustentabilidade da cultura organizacional que enfrenta burocracias cruéis, disputas de poder, arena política e o fracasso do sistema social (Lima, 2011, p. 155).

### 3. A mobilidade demográfica e a coesão social

A mobilidade populacional trouxe uma nova onda demográfica aos países e uma crise migratória sem precedentes ao globo com contingências humanas não esperadas e não planeadas. Aos seres humanos que buscam a mudança restam a indiferença e o não acolhimento. Segundo as Organizações das Nações Unidas (2017) estima-se que 258 milhões de pessoas vivam num país diferente do país em que nasceu.

Não é possível banalizar-se com mortes causadas pelos naufrágios no Mediterrâneo nem tão pouco ficar indiferente com a miséria que aflige a Venezuela e outros países em desenvolvimento. Contudo, nas escolas as comunicações e interações entre os atores sociais com diferentes identidades atropelam-se e conflituam-se. Alunos migrantes ou possuidores de variadas situações socioeconómicas, de etnias, de género, orientação sexual e de limitações de toda espécie não são aceites. Nascem territórios separados dentro da mesma unidade educativa que são os *guetos* impedindo a interculturalidade. Urge despertar a autoconsciência, a responsabilidade social, a sensibilidade, a tolerância e a *mudança de mentalidades* (Morin, 2001).

O corte transversal do currículo oculto e inclusivo deve ser liderado pelo diretor de escola ancorado na ética e no direito dos alunos de estarem, acederem e permanecerem àquele espaço (Batista, 2017). A democratização escolar é consciência ativa fonte geradora de projetos autónomos dos professores e alunos com a partilha de responsabilidades (Batista, 2018). A liderança educacional compete: motivar, autonomizar, confiar, unir, conectar, interagir e harmonizar a cultura organizacional com os colaboradores, alunos, personagens da comunidade e famílias fomentando a coesão e a justiça social.

Segundo Lück (2012, p. 35) a arte de liderar resume-se em: “(i) Motivar[todos]para uma atividade; (ii) Ter propósitos claros de orientação; (iii) Garantir processos sociais dinâmicos, interativos e participativos; (iv) Inserir na organização escolar valores educacionais elevados; (v) Possuir orientação para o desenvolvimento e aprendizagem de forma contínua.”

O líder é o espelho e suas atitudes coadunam com o desenvolvimento da visão e missão da instituição. Existem vários tipos de liderança e as escolas são avaliadas (OCDE, 2014) na complexidade: de elevação da cultura e do clima organizacional, aplicação de recursos, mobilização das famílias/comunidade e do grau de organização e disciplina. Consta-se a elevação local com o desenvolvimento intelectual da escola segundo pesquisas recentes, relacionados com o respeito na formação de um *ethos* próprio de valores, atitudes e comportamentos institucionais (Torres & Palhares, 2009, pp. 81-83).



#### **4. O instrumento empírico Projeto Jovem Em Cena**

Um dos instrumentos empíricos da tese de doutoramento em curso *O cidadão do mundo e a organização ética da escola* é o Projeto Jovem Em Cena. É um dispositivo didático-sociocultural inovador que acontece na Escola Estadual Professor Antônio José Leite no Brasil - Cidade de São Paulo. Configura-se em um teatro voluntário criado e liderado pela professora de Língua Portuguesa Denise Biella auxiliada pela sua filha professora Juliana Biella. Retrata-se nas obras cénicas versões originais e releituras de textos teatrais emancipatórios com diferentes abordagens: dos negros africanos, da mulher, dos portadores de deficiências, dos direitos humanos, clássicos literários e musicais dentre outros. Os alunos, pais, comunidade, empresários e patrocinadores todos voluntários participam na construção dos figurinos, roteiro, da cenografia, filmagem, marketing e apoiam todo o projeto. Hoje seus ensaios acontecem aos sábados.

A professora Denise Biella determinada em trabalhar a *interdisciplinaridade* entre Língua Portuguesa e Artes combatendo a discriminação revolucionou a escola, a Zona Norte da Cidade e a Rede de Ensino Estadual trazendo inovação pedagógica e cultura a uma região vulnerável do Brasil. O projeto teve início no ano de 2008 e permanece até os dias atuais.

#### **5. Análise dos resultados**

Apura-se que o projeto teve início no ano de 2008 com turmas da Educação de Jovens e Adultos que encenaram a releitura de Tristão e Isolda. Em 2009 o projeto atingiu o Ensino Médio e encena o clássico *Romeu e Julieta* de William Shakespeare. Em 2011 nasceu a *Trilogia Ritmo e Cultura* e a professora relata que com a inspiração de um trabalho anterior surge o próximo.

Na peça de teatro *Ritmo e Cultura 1* a idealizadora do projeto inseriu alunas portadoras de necessidades especiais de mobilidade (*cadeirantes de rodas*) que nas inscrições democráticas optaram por fazer parte do Projeto. Os espetáculos são apresentados em junho e novembro com reflexões sociais e de autoconhecimento. O senso crítico das coisas da vida e do mundo sensibilizam a comunidade.

Novembro de 2011, nasceu a obra *Tudo tem o seu tempo*. O aluno Wesley Nicolas quis mostrar à escola um trabalho que assistiu na *Internet* e a ideia saiu muito bem à professora. Surgiu a obra *Tudo* - com dança e dramatização sem falas. O título originou-se no decorrer dos ensaios em que a palavra *tudo* foi identificada como importante em situações experienciadas pelo grupo. Com a ideia do aluno o desafio da obra foi criar um figurino à abstração e personificação dos elementos água, terra, fogo e ar que compõem o mundo:



A criação de tudo que existe, tudo ao que o ser humano e tudo o que lhe acontece como consequência de suas escolhas(...). O Criador molda e dá vida à criatura que vai conhecer o que é bom e o que não é. Pensámos em mostrar além da criação do ser humano, a criação dos quatro elementos água, terra, fogo e ar.(...) Neste ponto faltava ainda algum quadro no qual as alunas com deficiência física pudessem participar da dança. Mais uma vez elas encerrariam o espetáculo: elas seriam os anjos da apresentação (Revista Jovem Em Cena 10 anos, 2018, p. 6).

À direção escolar entende que apoiar não é somente aderir a ideia. Peremptoriamente no *ato educativo* é acreditar, motivar, planejar, incentivar, confiar e autonomizar a escola proporcionando meios e insumos para que projetos se realizem. Foi o que fez e faz a gestão educativa ao Projeto Jovem Em Cena. Relata a professora Denise Biella há treze anos na escola o apoio incondicional da gestão escolar:

O que foi mais importante para mim e até hoje ainda que ajudou a fazer de mim a profissional que eu sou hoje foi a confiança e a liberdade. A confiança que a gestão o grupo gestor da escola teve em que eu fizesse o meu melhor e a confiança para que eu utilizasse todos os espaços da escola. Esta confiança e essa liberdade permitiram com que eu pudesse acompanhar os alunos em séries consecutivas.(...) Isto foi muito importante por dois motivos, foi possível dar conta, dar seguimento àquilo que ficou em aberto e acompanhar efetivamente o desenvolvimento do aluno, sem contar que o facto de estar com eles há mais tempo fez com que se estreitasse os laços, a relação professor-aluno com maior confiança entre as partes(...) diminuindo sensivelmente a indisciplina. A confiança e a liberdade na abertura incondicional da escola para que eu trabalhasse a Arte(...). Hoje colocamos no palco a releitura de um clássico *O Fantasma da Ópera*. Isto só foi possível porque tudo o que estava ao alcance da gestão foi feito (Denise Biella, setembro/ 2016).

A escola conta com uma realidade perversa, os alunos são constantemente perseguidos por traficantes de estupefacientes além de muitos possuírem problemas ligados à desigualdade socioeconómica da periferia violenta da Vila Nova Cachoeirinha. Mas, com as informações e o conhecimento disseminados pelo *Projeto Jovem Em Cena* expande-se a multiculturalidade e o cosmopolitismo na Comunidade Educativa com a mensagem de amor, respeito e reconhecimento à *pluralidade cultural*. As peças de teatro são compostas com: música, dança, figurino, imagens, efeitos digitais e sonoros com a abrangência histórico-cultural de vários países: Brasil, Japão, Índia, Marrocos, Nigéria, França, Áustria, Espanha, Inglaterra, Portugal, Estados Unidos na real interdisciplinaridade da Arte com o roteiro e o argumento da Língua Portuguesa.

## 6. Metodologia

Ao instrumento de investigação utiliza-se o método qualitativo da pesquisa bibliográfica na construção de uma hermenêutica explicativa dos fenómenos revelados. Salienta-se



interpretar a dialética entre os atores sociais e o meio na abordagem inicial compreendendo-se a significação do instrumento de pesquisa àquela realidade apreendida (Prodanov & Freitas, 2013). Realizaram-se várias observações no decorrer do projeto identificando o impacto transformacional na vida de seus participantes e na Região.

Para não interpretar equivocadamente o significado original, os intérpretes devem empregar algum tipo de método que lhes possibilite um afastamento de seus referenciais históricos. Quando corretamente empregado, o método é um meio que permite aos intérpretes alegar uma atitude puramente teórica de observador (Schwandt, 2006, p. 197).

Os dados do Projeto Jovem Em Cena foram recolhidos do público alvo integrantes do ano de 2008 até 2019. Aplicou-se entrevistas semiestruturadas do mês de setembro de 2016 a agosto de 2019, compondo-se em 30 relatos de integrantes, pais, patrocinadores, artistas e professores a respeito do Projeto, 03 narrativas de Ex-membros e 05 depoimentos de Ex-alunos. Dentre as perguntas mais significativas aos integrantes estão: *Qual a importância do Projeto em sua vida? O que mudou no seu percurso acadêmico ao ingressar no Projeto Jovem Em Cena?*

Quando eu entrei no projeto que a escola apoiava *Jovem em Cena*, projeto de alunos voluntários e eu era uma pessoa muito retraída para eu falar em público era muito difícil muito tímida (...) aprendi o trabalho em equipa aprendi a batalhar por um sonho (...) Eu sinto até falta do jeito que a diretora chamava a gente *de leiteanos e leiteanas* (...) quem faz a escola é o aluno mas se essa escola não tiver administração não tem como o aluno fazer a escola, porque para o aluno fazer escola tem que ter alguém que oiça, que nos oiçam, tem que ter alguém que creia na gente e a diretora acreditava. Acreditava que poderíamos fazer uma escola melhor e acreditava que poderíamos crescer sim! E acredito que muitos que estudaram ali e estudam pensam da mesmo forma que eu e vão crescer na vida pelo que a diretora representou... (Marina Rodrigues, outubro 2017).

Os depoimentos foram confrontados com os documentos oficiais da escola que é objeto de investigação e por diversos registos culturais que são públicos em vídeos disponibilizados na Internet via ferramenta do YouTube. Constantemente a investigadora mantém-se atualizada a respeito das inovações do Projeto e de seus integrantes interagindo com a idealizadora do Projeto em plataforma *on-line*.

## **7. Considerações finais**

Os alunos ligados ao projeto possuem um alto desenvolvimento de suas capacidades e competências cognitivas e académicas. Muitos que foram integrantes possuem inserção em Universidades Públicas com cargos importantes em distintas empresas com destacada



relevância social. Interagem uns com os outros, independente da religião, etnia, gênero, orientação sexual ou de serem portadores de necessidades especiais. Forma-se um emaranhado de histórias ricas e narrativas multiculturais que se complementam entre si originando um enredo coletivo e um puzzle de significados e sentidos (Goodson, 2007) na vida desses jovens e crianças. Nasce um orgulho natural e a elevação da autoestima dos integrantes do projeto e dos alunos daquela escola pelo reconhecimento local da importância do trabalho ali desenvolvido.

Há um misto na composição da comunidade educativa por miscigenados europeus, indígenas, africanos, árabes e asiáticos que convivem com respeito no mesmo espaço numa demonstração viva da interculturalidade (André, 2012). São onze anos do Projeto Jovem Em Cena adicionando a cultura cosmopolita e multicultural em uma região, potencializando a Arte que inspira as pessoas e transforma vidas. A infraestrutura do Projeto conta com um anfiteatro arrojado e equipado com novas tecnologias: projetor de vídeo profissional, iluminação, mesa de som, colunas com amplificadores, microfones sem fio, cortinas eletrônicas, máquinas fotográficas, computadores, instrumentos musicais e filmadoras. Esses equipamentos são confiados pela equipa gestora à professora idealizadora do Projeto. As gravações do *making of*, das apresentações e entrevistas do Projeto são realizadas por Andressa Tarquini que se tornou voluntária, sensibilizada pela iniciativa de responsabilidade social fazendo um investimento pessoal em outros equipamentos profissionais de imagem. Os demais professores da escola apoiam e contemplam o projeto.

Entende-se que as professoras são missionárias e militantes - pérolas da educação brasileira - comprometidas com a elevação humana, acadêmica, criativa e ética dos alunos apesar de receberem baixíssimos salários. A crise brasileira só fez aumentar as desigualdades e os alunos quando possuem um Projeto como o *Jovem Em Cena* transferem sentimentos e extravasam emoções. A atriz global laureada, cantora, compositora e versionista brasileira Alessandra Maestrini visita o projeto, faz uma palestra, realiza jogos dramáticos com os participantes do Projeto e relata:

O que vocês têm aqui é muito especial é importante que vocês saibam disto, uma energia, um talento, uma coesão, uma amorosidade que é muito importante e que faz muita diferença no resultado criativo porque quando a gente sai do amor, a gente sai da criatividade, entra no ego e não entra na relação isto é até difícil(...). A base da criação está na base da probabilidade das relações, então quando você fecha uma porta é menos um na criatividade.(...)É muito lindo o que vocês têm aqui, é muito espetacular!(...)Que vocês continuem porque eu sei que vão fazer um excelente trabalho, um lindo tudo, parabéns muitos parabéns a todos vocês!(Alessandra Maestrini, agosto/2016).

Conclui-se com a hermenêutica qualitativa do instrumento empírico que a realização desse projeto cultural-socioeducativo corrobora para uma consideração nova dos alunos, favorece as interações coletivas entre os stakeholders que trouxeram evidentes avanços nas





aprendizagens dos jovens. Identifica-se que as crianças e jovens quando conhecem outras culturas ampliam o próprio repertório de vida, reconhecem nas culturas diferentes outras histórias e possibilidades, melhoram as capacidades linguísticas e seus léxicos, aumentam as competências literárias e a criatividade validando o *proactivismo juvenil*.

Levar as famílias à escola é um outro feito louvável deste projeto que evidencia a conexão entre escola/comunidade numa objetiva possibilidade de democratização do espaço escolar com movimento e participação tão necessários às escolas neste novo milénio.

A metodologia da professora Denise Biella em ir além com seus alunos que são despertados na interdisciplinaridade das Artes/Língua Portuguesa transforma-os em cidadãos do mundo, agentes da sociedade civil dotados de tolerância, respeito, amor e reconhecimento da pluralidade cultural. Estimula-se com a prática docente o desejo dos alunos em aprender, em estar e em conviver.

## **Agradecimentos**

Infelizmente, vítima de xenofobia e violência urbana tragicamente uma das integrantes do Projeto que sempre combateu todas as formas de discriminação foi assassinada brutalmente, a *transsexual Gabriel Borges*, com o nome artístico de *Gabi Blak* em dezembro de 2018. A ela, às professoras Denise Biella, Juliana Biella e ao Grupo do Projeto Jovem Em Cena agradeço pela essência deste trabalho.

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## Tarefas matemáticas: interseção entre a avaliação e a comunicação

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### Resumo

*As tarefas matemáticas deverão ser criadas com a principal intenção de gerar momentos significativos de aprendizagem para os alunos. Estes serão parceiros ativos no processo de ensino e de aprendizagem, cabendo ao professor selecionar as tarefas, orientar a comunicação, organizar o trabalho dos alunos e avaliar as aprendizagens. No estudo que temos vindo a desenvolver, a interseção entre a avaliação, a comunicação e as tarefas matemáticas surge como fundamental para responder à questão de investigação: Quais as relações existentes entre a avaliação e a comunicação nas práticas dos professores de matemática? Nas fases concretizadas, foram analisadas as perceções e as práticas de quatro professores do 2.º ciclo do ensino básico, tendo sido possível compreender que as perceções se cruzam com as práticas. É evidente que a avaliação e a comunicação se relacionam através da utilização do diálogo, do questionamento e dos registos escritos, na interação e na partilha de ideias, em torno da realização de tarefas matemáticas em sala de aula. Dando seguimento à investigação em curso, neste artigo pretendemos avançar resultados da validação de uma tarefa matemática, construída com a intenção de cruzar os processos de avaliação e comunicação, numa turma de 5.º ano. O confronto entre as nossas expectativas e o desempenho dos alunos, constitui o ponto de partida para a reflexão conducente à validação da tarefa a desenvolver pelos professores participantes no estudo. Centrados no tópico “Capacidade de visualização e compreensão de propriedades de figuras geométricas e de sólidos geométricos”, a tarefa visa que o aluno seja capaz de explorar, analisar e interpretar situações em contextos variados, numa abordagem do espaço ao plano. Estes objetivos estão associados aos descritores do perfil dos alunos, no que respeita à utilização de linguagens verbais, não-verbais e simbólicas, à comunicação, ao raciocínio e resolução de problemas, ao pensamento crítico e sentido estético.*



**Palavras-Chave:** *tarefas matemáticas, comunicação, avaliação, geometria.*

## **1. Introdução e apontamentos teóricos**

Analisar, investigar e reconhecer padrões nas práticas de ensino e de aprendizagem suscita o desenvolvimento da atividade de investigação em educação matemática, do conhecimento profissional e das práticas docentes em sala de aula. É nesta linha de ação que temos vindo a fortalecer um estudo sobre as relações entre a avaliação e a comunicação, tendo por propósito responder à seguinte questão de pesquisa: Que relação existe entre a avaliação e a comunicação nas aulas de matemática no 2.º ciclo do ensino básico? Neste artigo pretendemos dar conta dos resultados da validação de uma tarefa matemática, construída com a intenção de cruzar os processos de avaliação e comunicação, numa turma de 5.º ano.

Ressalvamos que os processos de avaliação e comunicação, bem como a consideração das tarefas a desenvolver em sala de aula são partes estruturantes do nosso trabalho. Adotámos a avaliação na sua dupla função de avaliar a aprendizagem e para a aprendizagem (Fernandes, 2015), aceitando uma dinâmica interativa entre aquilo que o aluno já aprendeu e aquilo que se perspetiva para as novas aprendizagens. Consideramos que o ato de avaliar é interno a qualquer processo de ensino e de aprendizagem, não o encarando como uma avaliação justificada no ato de classificar (Ulleberg & Solen, 2018), mas como um real contributo para a aquisição e desenvolvimento de competências, integrando aptidões, conhecimentos e atitudes. A diversificação de ações de recolha, análise e registo da informação é fundamental e constitui a base para que as avaliações formativa e sumativa sejam rigorosas num contexto de interação social entre os alunos e entre estes e o professor (Santos, 2016).

A comunicação da aprendizagem decorre da narração, do conhecido dos alunos e do professor, enquanto que a comunicação para a aprendizagem aposta na aquisição de novas ideias matemáticas (Guerreiro & Martins, 2018). Uma comunicação da aprendizagem centra-se no discurso oral e escrito dos alunos, sem valorizar a discussão e os diálogos em confronto entre os alunos. A comunicação para a aprendizagem não se restringe ao discurso dos alunos, mas aposta em evidenciar o seu pensamento, com o propósito de partilhar ideias e aprofundar o entendimento matemático dos alunos. Para “perceber que ideias matemáticas têm os alunos, como estão a pensar e que eventuais erros e dificuldades estão a sentir” (Guerreiro, Ferreira Tomás, Menezes & Martinho, 2015, p. 287), os alunos precisam de “oportunidades para desenvolver pensamentos e ideias matemáticas em colaboração com



os outros” (Ulleberg & Solen, 2018, p. 18), numa atmosfera de sala de aula solidária e inclusiva.

A escolha das tarefas matemáticas a propor aos alunos é o aspeto central da planificação do processo de ensino e de aprendizagem. Os projetos, as investigações, os problemas e os exercícios são diferentes tipos de tarefas matemáticas (Ponte, 2005), exploradas na sala de aula, as quais promovem diferentes oportunidades de os alunos pensarem, numa variação entre a execução de procedimentos memorizados e a conceptualização das ideias e conceitos matemáticos (Stein & Smith, 2009). O professor é responsável não só por conduzir a aula, mas também por escolher as tarefas, orientar a comunicação, organizar o trabalho dos alunos e avaliar as suas aprendizagens, num ambiente em que sejam valorizadas as ideias dos alunos.

## 2. Apontamentos metodológicos e fases do estudo

Adotamos um *design* de investigação interpretativo, com o intuito de interpretar, compreender e explicar significados, num contexto específico (Bogdan & Biklen, 1994). O objetivo principal da investigação é estudar as relações entre a avaliação e a comunicação tendo em vista proporcionar significativas aprendizagens matemáticas dos alunos. Os participantes neste estudo, para além dos investigadores (autores deste artigo), são quatro professores do 2.º ciclo do ensino básico (dois do distrito de Bragança e dois do distrito de Faro) que lecionam matemática neste nível de ensino. Esta investigação contempla as seguintes fases: (i) construção do referencial teórico, através da revisão da literatura; (ii) perceção dos professores, através da realização de entrevista semiestruturada; (iii) práticas profissionais dos professores, através da observação de aulas de matemática de uma mesma turma; (iv) experimentação na aula, através do desenvolvimento de tarefas matemáticas que relacionem conscientemente a avaliação e a comunicação; (v) reflexão, através da revisitação do referencial teórico e da indicação de práticas de sala de aula em que se verifique a existência de relações entre a avaliação e a comunicação na aula de matemática.

Até ao momento, o estudo contemplou um olhar sobre as principais ideias a propósito da avaliação e da comunicação, através da construção do referencial teórico e da averiguação das perceções e das práticas letivas dos professores (Martins & Guerreiro, 2018). Na fase atual do estudo temos como principal objetivo desenvolver, em sala de aula, tarefas matemáticas que articulem intencionalmente a avaliação e a comunicação para a aprendizagem, perspetivando novas práticas profissionais dos professores de matemática. Com este propósito, optou-se por validar uma tarefa matemática com o objetivo de ratificar as diferentes questões, antes da sua implementação nas turmas dos professores deste estudo.



### **3. Validação da tarefa matemática: resultados**

A validação da tarefa matemática ocorreu numa turma do 5.º ano de uma escola do distrito de Bragança, com vinte e um alunos. Os professores desta turma, professora titular e professores estagiários, não integram os professores do projeto, disponibilizaram-se para testar a tarefa em contexto real, na presença do segundo autor como observador participante.

A capacidade de visualização e a compreensão de propriedades de figuras geométricas e de sólidos geométricos são conhecimentos matemáticos estruturantes no campo da geometria e medida. A planificação de um sólido geométrico requer o conhecimento das formas geométricas da sua superfície, as quais, no caso dos poliedros, são figuras geométricas planas. Uma mesma tarefa matemática poderá ter por objetivos a identificação de planificações de sólidos geométricos e a descrição de figuras no plano e no espaço, num contexto de resolução de problemas, em que se promove o raciocínio e a comunicação matemática.

A tarefa matemática assume uma vertente fechada com as características de problema (nomeadamente no respeitante à análise das características do sólido geométrico) e uma vertente aberta com as características de investigação (especificamente no respeitante à descoberta das planificações e da disposição das suas faces numa relação de duas cores), comportando diferentes etapas, as quais devem ser geridas pelo professor, mantendo uma dinâmica de apresentação, trabalho autónomo, discussão e síntese, sem quebras significativas, ao longo das distintas fases. Os alunos trabalharam em pares e tiveram por suporte fichas de trabalho e material didático (Polydron).

Com o apoio das questões apresentadas numa ficha de trabalho, o professor apresentou aos alunos a imagem de uma embalagem tetraedro (ver Figura 1), questionando-os: (i) Conhecem produtos embalados desta forma? Quais? (ii) Açam que se trata de um sólido geométrico? Porquê? e (iii) Conhecem o nome pelo qual é designado? O propósito destas questões foi trabalhar um conteúdo estritamente matemático a partir de um contexto não matemático.



*Fig. 1 Embalagem tetraedro*  
*Fonte: recolha de imagens na internet*

Após a discussão sobre o reconhecimento e as características da embalagem, o professor solicitou aos alunos que representassem as faces da embalagem. Com esta tarefa pretendeu-se que o aluno reconheça um objeto tridimensional pela sua representação bidimensional e seja capaz de representar, a partir da gravura, as quatro faces triangulares do tetraedro.

Os alunos apresentaram significativas dificuldades em associarem a imagem, totalmente descaracterizada, a alguns produtos do quotidiano. Para ultrapassar esta dificuldade, o professor recorreu a embalagens concretas, no caso embalagens de chá, para ilustrar a existência de produtos embalados neste formato. Desta feita, o objetivo de avaliar se os alunos reconhecem sólidos geométricos em embalagens do quotidiano só foi concretizado a partir de embalagens concretas no formato de tetraedro. Atendendo aos dados, na implementação desta tarefa, o professor deverá utilizar embalagens concretas, para associar uma forma geométrica aos contextos sociais, e questionar os alunos sobre a existência de outras embalagens com o mesmo formato e com formatos distintos. Em relação à questão (ii), verificamos que os alunos associam os sólidos geométricos a objetos 3D e a poliedros, identificando as faces, arestas e vértices. No que concerne à questão (iii), os alunos designam como pirâmide triangular, a designação tetraedro não foi referida em nenhum momento. Estas respostas revelam um conhecimento geral sobre os sólidos geométricos, sem uma abordagem dos casos particulares dos sólidos platónicos. Uma deficiente abordagem dos poliedros regulares poderá ter como consequência a dificuldade em identificar o cubo como um caso particular dos prismas quadrangulares ou o tetraedro como um caso particular das pirâmides triangulares. Todos os pares de alunos representaram um ou quatro triângulos como as faces do tetraedro. Os pares que desenharam apenas um triângulo referiram, oralmente, que as restantes faces eram a repetição da representada. Com o objetivo de clarificar a questão, deverá ser reformulada para: Desenhem todas as faces da embalagem.

Num segundo momento, o professor solicitou aos alunos que descrevessem as características das faces do tetraedro: (i) Caracterizem cada uma das faces em relação à sua forma, (ii) Caracterizem cada uma das faces em relação à medida dos lados, e (iii)



Caracterizem cada uma das faces em relação à medida dos ângulos. Pretendeu-se avaliar se os alunos eram capazes de identificar as faces triangulares e classificá-las quanto ao comprimento dos lados e quanto à amplitude dos ângulos, assumindo tratar-se de um tetraedro regular. Os alunos manifestaram alguma dificuldade em entender estas questões, revelando incompreensões no conceito genérico de medida para comprimento e para amplitude. No caso da forma, a maioria dos pares identificaram com triangular, mas dois pares associaram ao mesmo comprimento (dos lados), revelando uma incompreensão sobre a associação da forma com a superfície. No caso dos lados, a maioria dos pares identificou a figura com o triângulo equilátero. No caso dos ângulos, a maioria dos pares referiu triângulo acutângulo ou triângulo com ângulos agudos e iguais. Alguns pares trocaram os conceitos de classificação dos triângulos quanto ao comprimento dos lados e quanto à amplitude dos ângulos. Neste sentido, as questões deverão ser reformuladas com a designação concreta em cada caso, comprimento para os lados e amplitude para os ângulos.

Num terceiro momento, o professor solicitou aos alunos para identificarem quantas faces tem um tetraedro, quantos vértices e quantas arestas: (i) Quantas faces tem este sólido geométrico? (ii) E quantos vértices? (iii) E quantas arestas? Os alunos não revelaram qualquer dificuldade na resposta a estas três questões. Em relação à questão subsequente, Existirá alguma relação entre estes valores? alguns pares de alunos identificaram a relação de Euler, sendo que a mesma tinha sido abordada em aulas anteriores.

Em síntese, na primeira fase da tarefa, a que, pelas suas características, chamámos fase de resolução de problemas, as respostas dos alunos caracterizam o seu conhecimento e identificam algumas dificuldades relativas a conceitos matemáticos no campo da geometria e medida. Neste sentido, estas questões constituem uma possibilidade de avaliação da e para a aprendizagem com uma componente de comunicação matemática.

Na segunda fase da tarefa, a que chamámos fase de investigação matemática, o professor solicitou aos alunos que representassem as diferentes figuras que eram capazes de formar com quatro triângulos equiláteros iguais, recorrendo a material didático (peças triangulares do Polydron). Inicialmente, os alunos manifestaram dificuldade no entendimento da questão, alguns deles questionando se o que se pretendia era desenhar as planificações do sólido. Metade dos pares identificaram as planificações do tetraedro (ver figura 2) e dois pares identificaram a figura de quatro triângulos iguais que não é planificação (ver figura 3). Apenas um par identificou as três soluções.

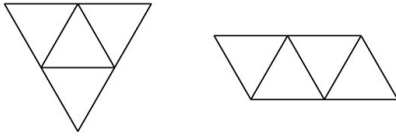


Fig. 2 Planificações do tetraedro  
Fonte: construção dos autores

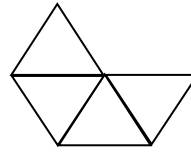


Fig. 3 Figura que não é planificação do tetraedro  
Fonte: construção dos autores

Os alunos manifestaram dificuldade nesta atividade de investigação matemática, revelando que estão muito condicionados pelas figuras que representam as planificações tradicionais dos sólidos geométricos. Ao serem questionados sobre quais das figuras eram e não eram planificações do tetraedro, os alunos identificaram as duas planificações que já tinham adiantado, na maioria, na questão anterior. Contudo, salientamos que questionados diretamente sobre a formulação da questão, consideraram que seria de mais fácil entendimento se lhes fosse pedido para desenharem as planificações do sólido. O propósito desta tarefa matemática foi levar os alunos a reconhecer que nem todos os arranjos de quatro triângulos são planificações do tetraedro.

Após esta etapa e seguindo o exposto na ficha de trabalho, o professor questionou os alunos sobre qual o número mínimo de cores necessário para colorir as faces de um tetraedro sendo que, cada face é de uma só cor e as faces que se unem na mesma aresta são de cores distintas. Esta descoberta foi, no geral, de fácil resolução para os alunos, nomeadamente porque a utilização das peças do Polydron veio dar-lhes a oportunidade de verificarem. Após a discussão sobre a inevitabilidade das quatro cores distintas, atendendo que cada face se liga com as restantes, os alunos compreenderam que cada face fica unida às restantes três.

No seguimento desta exploração, o professor solicitou aos alunos a construção de tetraedros de papel a duas cores. Distribuiu pelos grupos de alunos duas planificações, cada uma de sua cor, conforme apresentado na Figura 4. Sugeriu, então, aos alunos para construírem um tetraedro regular em papel, de duas cores distintas, a partir das duas planificações do tetraedro. O professor desafiou os alunos a construírem um único tetraedro com as duas tiras (planificações), sobrepostas (ver Figura 4).

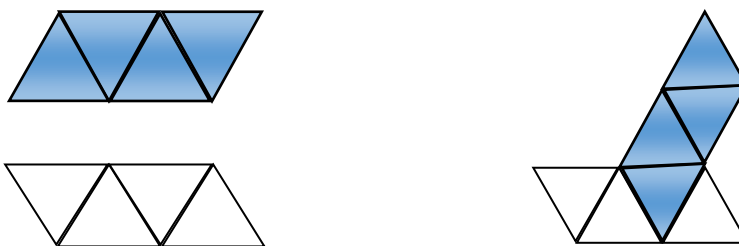


Figura 4: Planificações do tetraedro – duas cores (retirado de Gardner, 1992, p. 127) .

Os alunos insistiram, oralmente, que tinham sempre de sobrepor inicialmente duas faces para construir o tetraedro, não assumindo a possibilidade de entrelaçarem as fitas originando diferentes combinações de cores. Após a experimentação, o professor solicitou aos alunos que apresentassem um pequeno relatório com os diferentes sólidos geométricos, reforçando a ideia de se pronunciarem em relação à cor. Os relatórios limitaram-se a referir “concluimos que a cor da fase inicial é a que fica sobreposta na fase final”. A simplicidade dos registos escritos revela que os alunos entendem a comunicação matemática escrita restrita ao registo das resoluções sem uma natureza argumentativa de construção do conhecimento matemático. Atendendo ao exposto, os alunos devem ser incentivados a apresentarem registos escritos mais detalhados com uma natureza justificativa das afirmações apresentadas.

#### **4. Nota final**

Dando seguimento à investigação em curso, os resultados divulgados neste artigo vieram dar ênfase à formulação das questões escritas, à (dificuldade da) interpretação das mesmas, ao diálogo estabelecido na sala de aula para averiguação dos conhecimentos matemáticos dos alunos, à escuta das suas opiniões e a importância desta para a compreensão dos seus raciocínios, dúvidas, erros e dificuldades, à importância das representações e registos escritos e à utilização de recursos materiais no processo de ensino-aprendizagem-comunicação-avaliação. Desta feita, e na prossecução do nosso objetivo, podemos constatar que a tarefa é adequada à avaliação e à comunicação das e para as aprendizagens. Salvaguardamos, pois, a necessidade de reformulação de algumas questões, conducente a uma melhor explicitação do pretendido. Reafirmamos que o confronto entre as nossas expectativas e o desempenho dos alunos, constituiu o ponto de partida para a reflexão conducente a esta validação desta tarefa, contudo a sua exploração em sala de aula suplantou o esperado. O próximo passo é, pois, o desenvolvimento da tarefa pelos professores participantes neste estudo, acreditando que a comunicação, as tarefas e a avaliação são três (ou mesmo os três) elementos fundamentais numa aula de matemática.

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## Estratégias de Ensino Ativas e Desenvolvimento de Competências de Estudantes de Administração: proposta de uma escala de mensuração

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### Resumo

*Este artigo objetiva propor uma escala de mensuração para avaliar o uso de estratégias de ensino ativas no desenvolvimento de competências de estudantes de Administração. A pesquisa, de natureza quantitativa e descritiva, foi realizada com uma amostra de 369 alunos do curso de Administração da Universidade Federal da Paraíba, Brasil. A partir da utilização de métodos multivariados de análise, foi possível validar a escala de mensuração com cinco construtos (Consciência sobre a prática gerencial, Trabalho em equipe, Consciência social e emocional, Planejamento e resolução de problemas e Visão sistêmica) e 23 itens. Além disso, foi possível identificar que a estratégia de ensino de aprendizagem baseada em problemas foi a que mais contribuiu no desenvolvimento das competências dos estudantes.*

**Palavras-chave:** *estratégias de ensino, competências, estudantes, administração, escala de mensuração.*

### 1. Introdução

O ambiente de formação na educação superior demanda dos agentes responsáveis pelo planejamento acadêmico o estabelecimento de métodos de ensino mais inovadores e orientados para a ação. Os alunos precisam ser convidados a viverem experiências significativas por meio do estabelecimento de um ambiente de aprendizagem em que as dimensões físicas, sociais, emocionais e tecnológicas (Silva, Silva & Coelho, 2019) devem estar articuladas com o mundo do trabalho.

Wlodkowski (2004) destaca a importância de criar ambientes de aprendizagem motivadores



para que os estudantes sejam mais efetivos na construção de significados a partir da informação e da experiência. Em um ambiente de aprendizagem em que há um propósito e uma tarefa desafiadora, geralmente o aluno se sente motivado a aprender. Entretanto, o autor também indica que a motivação para aprender pode desaparecer em um milésimo de segundo quando fatores associados ao ambiente (sala quente, baixo desempenho no teste, discussão chata), além de fatores culturais que levam as pessoas a terem diferentes necessidades e perspectivas, tornam a atividade de ensino desafiadora.

Rinaudo, Chiecher e Donolo (2003) ressaltam que várias discussões teóricas e empíricas enfatizaram a importância de atender não apenas a dimensão cognitiva da aprendizagem, mas também os aspectos afetivos e motivacionais que estimulem os alunos a participarem de forma ativa e tornar os processos de aprendizagem mais significativos.

A utilização de estratégias de ensino ativas podem contribuir para o desenvolvimento de competências profissionais e promover o engajamento dos alunos, motivando-os a agir individualmente, em pares ou em pequenos grupos em discussões que sejam significativas e difundidas no ambiente da sala de aula (Wurdinger & Carlson, 2010).

Silva (2016) ressalta que o uso de estratégias ativas de aprendizagem aproxima o professor e os alunos, além de promover uma maior integração entre a teoria e a prática, a reflexão e a ação. Nesse sentido, Jennings (1996) destaca a efetividade do método de caso no desenvolvimento de habilidades de comunicação, habilidades interpessoais e de integração que são relevantes para a prática de gestão e o pensamento estratégico.

Outros estudos revelaram, em seus resultados, a contribuição do uso de estratégias ativas de ensino na aprendizagem e no desenvolvimento de competências de estudantes, tais como aprendizagem baseada em problemas (Silva, Bispo, Rodriguez & Vasquez, 2018), casos para ensino (Alberton & Silva, 2018), filmes (Schultz & Quinn, 2013) e história em quadrinhos (Silva, Santos & Bispo, 2017; Brandão & Silva, 2018).

Este artigo objetiva propor uma escala de mensuração para avaliar o uso de estratégias de ensino ativas no desenvolvimento de competências de estudantes de Administração. Além da proposta da escala, identificamos a contribuição de quatro estratégias ativas de aprendizagem (aprendizagem baseada em problemas, método de casos para ensino, filmes e história em quadrinhos) no desenvolvimento das competências identificadas na escala.

As principais contribuições do artigo são: (a) propor uma escala para avaliação da contribuição das estratégias de ensino ativas no desenvolvimento de competências dos estudantes; (b) auxiliar na identificação de competências para o planejamento de programas e cursos de desenvolvimento gerencial; e (c) reforçar a importância do uso de estratégias de ensino ativas para tornar o processo de aprendizagem mais significativo para os estudantes.

## **2. Método**

A pesquisa teve como objetivo propor escala de mensuração para avaliar o uso de estratégias de ensino ativas no desenvolvimento de competências de estudantes de Administração. Para alcançar o objetivo, foi realizado um estudo quantitativo com estudantes do curso de Administração da Universidade Federal da Paraíba (UFPB), Brasil.

### **2.1 Coleta de dados**

A coleta de dados foi realizada nos anos de 2016 e 2017 e ocorreu após a utilização das estratégias de ensino ativas pelos professores do curso de graduação em Administração da UFPB das disciplinas de Gestão do Conhecimento nas Organizações, Processo Decisório e Desenvolvimento Gerencial, Comportamento do Consumidor, Sistema de Informação e Decisão, Administração de Recursos Humanos.

O instrumento de coleta foi um questionário estruturado em duas partes. A primeira parte, com 29 questões, foi adaptada do estudo realizado por Pereira (2012) para avaliar os fatores determinantes para utilização de casos para ensino na percepção de alunos e professores. Para captar a percepção do aluno sobre a utilização de uma das estratégias ativas de ensino pelo professor (aprendizagem baseada em problemas, método de casos para ensino, filmes e história em quadrinhos), foi utilizada uma escala intervalar com 11 pontos (0 a 10). Quanto mais próximo de 0 o aluno indicasse a sua resposta, menor a contribuição da estratégia de ensino ativa na variável analisada e, quanto mais próximo de 10 se posicionasse, maior a contribuição da estratégia de ensino ativa na variável analisada. Por fim, a última parte do instrumento, com 7 questões, teve como objetivo caracterizar o perfil dos alunos que participaram do estudo.

### **2.2 Caracterização da Amostra e Análise de Dados**

Após a coleta, foi realizada uma limpeza e posterior retirada dos dados faltantes. Desse modo, a base de dados foi composta por 371 alunos de graduação do curso de Administração, dos quais 81% já cursaram mais de 4 semestres, 52,6% estudam no turno matutino, 70,2% iniciaram o curso até 2013 e 43,6% trabalham com vínculo empregatício. A média e a mediana da idade dos alunos é de 25 anos e 23 anos, respectivamente, variando de 18 a 56 anos. Em relação ao sexo, 50% são homens e 50% são mulheres. O processo de análise dos dados envolveu uma análise estatística descritiva do perfil dos respondentes, análise fatorial exploratória (AFE) para identificação dos construtos e análise fatorial confirmatória (AFC) para validação da escala. Após o processo de validação da escala, foi realizada uma análise





de variância (anova) para analisar a contribuição das estratégias ativas de aprendizagem.

### **3. Resultados**

A primeira etapa foi submeter os itens à técnica de AFE para verificar quais construtos emergiriam. O método de rotação adotado foi o *varimax*, que aplica uma rotação ortogonal visando maximizar as cargas fatoriais da matriz fatorial (Hair, Black, Babin, Anderson *et al.*, 2009). Sobre o número de fatores, adotou-se a forma livre para que a técnica recomende a quantidade de fatores, utilizando o critério Kaiser, em que se seleciona a quantidade de fatores com os autovalores maiores que um (Hair, Black, Babin, Anderson *et al.*, 2009).

Ao executar a AFE com 29 itens, emergiram 7 fatores subjacentes. Foram removidos os itens com comunalidades abaixo de 0,4 e cargas fatoriais abaixo de 0,5. Depois dos ajustes, 23 itens foram submetidos novamente à AFE, por meio da qual 5 fatores foram sugeridos. A confiabilidade, por meio do *alpha* de Cronbach, apresentou índices satisfatórios ( $\alpha \geq 0,7$ ). Com o resultado, discutiu-se se os itens faziam sentido teórico em cada um dos seus fatores. Cada um desses foi denominado considerando o alinhamento teórico de seus itens. Portanto, os 5 fatores que emergiram são: Consciência sobre a prática gerencial (6 itens), Trabalho em equipe (4 itens), Consciência social e emocional (6 itens), Planejamento e resolução de problemas (4 itens), e Visão sistêmica (3 itens).

Em seguida, partiu-se para a aplicação da AFC com o objetivo de avaliar a qualidade de ajustamento do modelo de medida teórico à estrutura correlacional observada entre os itens da escala. Nesse caso, o número de fatores é estabelecido *a priori* de acordo com a teoria. Considerando que o resultado da AFE demonstrou um bom alinhamento teórico, foi utilizada essa estrutura para ser confirmada via AFC.

O resultado da AFC demonstrou uma boa qualidade no ajuste ( $\chi^2=692,33$ ;  $gl=213$ ; TLI=0,93; CFI=0,94; RFI=0,91; IFI=0,94; RMSEA=0,09; SRMR=0,06), dentro de índices de referência normalmente utilizados na literatura (Hair, Black, Babin, Anderson *et al.*, 2009). Além disso, foi analisada a confiabilidade por meio do *alpha* de Cronbach, Confiabilidade Composta (CC) e *Average Variance Extracted* (AVE). As referências são, respectivamente, 0,7, 0,7 e 0,5. A Tabela 1 apresenta os resultados de cada um dos fatores. Apenas o fator ‘Consciência social e emocional’ ficou abaixo da referência na AVE, mas bastante próximo dela. Considerando a relevância dos seus itens, decidiu-se mantê-los. A Tabela também apresenta as correlações entre os construtos.

Tabela 1. Índices de confiabilidade dos fatores analisados via AFC

Construtos	1	2	3	4	5
1. Consciência sobre a prática gerencial	1				
2. Trabalho em equipe	0,554	1			
3. Consciência social e emocional	0,706	0,813	1		
4. Planejamento e resolução de problemas	0,781	0,716	0,723	1	
5. Visão sistêmica	0,818	0,579	0,664	0,754	1
Alpha	0,893	0,865	0,834	0,842	0,759
CC	0,838	0,768	0,786	0,781	0,734
AVE	0,568	0,581	0,452	0,565	0,549

Fonte: Dados da pesquisa (2019)

Também foram verificados que os escores padronizados atingiram índices maiores que 0,6, e que suas respectivas significâncias apresentaram  $p < 0,05$ . Nesse sentido, a validade estrutural da escala foi validada, indicando sua confiabilidade. A ferramenta utilizada para executar as técnicas foi a linguagem R, juntamente com pacotes específicos como o *lavaan*.

A partir da validação da escala, foi possível avaliar a contribuição de quatro estratégias de ensino ativas no desenvolvimento de competências. A avaliação foi possível porque o questionário tinha como objetivo avaliar a utilização de estratégias de ensino ativas, como aprendizagem baseada em problemas, casos para ensino, filmes e histórias em quadrinhos pelo professor em sala de aula. Para cada atributo associado aos cinco construtos validados na escala, o aluno teria que indicar, em uma escala de 0 a 10, o nível de contribuição da estratégia de ensino no desenvolvimento da competência.

A Tabela 2, a seguir, apresenta as médias obtidas em cada uma das competências por estratégia de ensino. Foi realizada uma análise de variância (anova) para verificar se havia diferenças significativas entre as médias dos grupos. Como mostra a Tabela 2, houve diferença significativa, quando consideramos o p-valor menor do que 0,05, nas médias das competências *consciência sobre a prática gerencial*, *planejamento e resolução de problemas* e *visão sistêmica*.

*Tabela 2: Contribuição das estratégias de ensino ativas no desenvolvimento das competências*

	ABP	Casos	Filmes	HQ	Anova	
	N = 93	N = 144	N = 63	N = 69	F	p-valor
1. Consciência sobre a prática gerencial	8,86	8,19	8,65	7,69	21,02	p < 0,001
2. Trabalho em equipe	8,68	8,07	8,38	8,71	0,37	p = 0,54
3. Consciência socioemocional	8,04	7,30	7,90	7,74	0,16	p = 0,69
4. Planejamento e resolução de problemas	8,79	7,80	8,26	8,19	3,93	p < 0,05
5. Visão sistêmica	8,89	8,22	8,32	8,03	16,25	p < 0,001

*Fonte: Dados da pesquisa (2019)*

Os resultados indicam que a estratégia de aprendizagem baseada em problemas foi a que mais contribuiu no desenvolvimento das competências de *consciência sobre a prática gerencial*, de *planejamento e resolução de problemas* e de *visão sistêmica*. Para as competências de *trabalho em equipe* e de *consciência socioemocional*, os resultados indicam bons níveis de contribuição de todas as estratégias de ensino, tomando como referência a média.

#### **4. Considerações Finais**

Este estudo teve como objetivo propor uma escala de mensuração para avaliar o uso de estratégias de ensino ativas no desenvolvimento de competências de estudantes de Administração. Os resultados do processo de validação possibilitaram a identificação de cinco construtos, aqui definidos como competências, e 23 atributos associados a elas. A Tabela 3, a seguir, apresenta uma definição de cada competência e os atributos associados.

Tabela 3: Competências desenvolvidas a partir da utilização de estratégias ativas de ensino.

Competência	Descritores
<i>Consciência sobre a prática gerencial:</i> capacidade de aprender sobre a ação gerencial, por meio da percepção da relação entre teoria e prática, ampliando o conhecimento das atividades e do funcionamento de uma empresa.	<ul style="list-style-type: none"> <li>- Aprendizado sobre a ação gerencial.</li> <li>- Associação da teoria à prática gerencial.</li> <li>- Visão do gestor sobre o funcionamento da empresa.</li> <li>- Conhecimento de atividades pertinentes à prática profissional.</li> <li>- Novos conhecimentos sobre o funcionamento da empresa.</li> </ul>
<i>Trabalho em equipe:</i> capacidade de interação com os colegas visando à troca de informações, à resolução de problemas e à melhoria da motivação para trabalhar em equipe.	<ul style="list-style-type: none"> <li>- Capacidade de comunicação com os seus colegas.</li> <li>- Habilidade de fornecer informações para os colegas.</li> <li>- Eficácia na resolução de problemas em grupo.</li> <li>- Motivação para trabalhar em equipe.</li> </ul>
<i>Consciência socioemocional:</i> capacidade de compreender suas atitudes e a dos colegas para lidar com a insegurança, resolver conflitos interpessoais, trabalhar de forma independente, por meio da exploração de comportamentos individuais.	<ul style="list-style-type: none"> <li>- Consciência sobre as suas atitudes administrativas.</li> <li>- Consciência sobre as atitudes dos colegas.</li> <li>- Capacidade de lidar com a insegurança.</li> <li>- Capacidade de resolver conflitos interpessoais.</li> <li>- Exploração de um comportamento que conhecia, mas ainda não havia vivenciado.</li> <li>- Habilidade de trabalhar independentemente.</li> </ul>
<i>Planejamento e resolução de problemas:</i> capacidade de resolver problemas a partir do planejamento de operações do negócio, implantação de ideias e planos, utilizando o pensamento reflexivo.	<ul style="list-style-type: none"> <li>- Habilidade para resolver problemas práticos.</li> <li>- Capacidade de planejamento das operações de negócios.</li> <li>- Capacidade para implementar suas próprias ideias e planos.</li> <li>- Pensamento reflexivo.</li> </ul>
<i>Visão sistêmica:</i> capacidade de aprender a integrar as diversas áreas funcionais de uma empresa para identificar e analisar problemas a partir de diferentes perspectivas identificadas na interação com a equipe.	<ul style="list-style-type: none"> <li>- Integração da aprendizagem em diversas áreas: (Contabilidade, Finanças, Marketing, etc.).</li> <li>- Capacidade de identificar os problemas gerenciais.</li> <li>- Análise de um problema a partir de diferentes pontos de vista na discussão do grupo.</li> </ul>

Fonte: Dados da pesquisa (2019)

A escala proposta pode auxiliar na delimitação das competências que podem ser desenvolvidas em programas de formação, tanto em nível de graduação como de pós-graduação, uma vez que indica atributos associados ao contexto da prática gerencial. Garvin (2007) identifica algumas metas de programas de desenvolvimento gerencial e destaca a capacidade de levar os estudantes a compreenderem o negócio e adquirirem conhecimento sobre a empresa, além de ajudá-los a lidar com as pressões para a resolução de problemas e melhorar o seu desempenho no trabalho. Os resultados deste estudo

reforçam a relevância das competências propostas para a estruturação de programas de aprendizagem gerencial, por meio de ações que articulem a educação e o desenvolvimento gerencial, como preconizam Fox (1997) e Mintzberg (2006).

Os estudos realizados por Jennings (2000), Chang (2003) e Chang, Jennings, To e Sun (2005) para avaliar o uso de três estratégias de ensino (projetos de consultoria, simulação e método de caso) possibilitaram identificar que a utilização das estratégias promove uma experiência de aprendizagem mais significativa, sobretudo a simulação de novos negócios.

Uma das implicações práticas da escala de avaliação do desenvolvimento de competências a partir da utilização de estratégias de ensino ativas é a identificação da contribuição das estratégias de ensino utilizadas pelo professor na aprendizagem dos alunos. Este estudo revelou que a aprendizagem baseada em problemas teve a maior contribuição no desenvolvimento de três das cinco competências da escala validada, reforçando os resultados de Silva, Bispo, Rodriguez & Vasquez (2018).

Esse achado reforça o posicionamento de Jennings (2002) de que os métodos de ensino podem ter contribuições diferentes na aprendizagem dos estudantes. Por outro lado, a utilização de estratégias de ensino diferentes no processo de aprendizagem pode potencializar o desenvolvimento de competências diferentes. Assim, o mais importante é o resultado final alcançado por meio da participação no curso.

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*Estratégias de Ensino Ativas e Desenvolvimento de Competências de Estudantes de Administração:  
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## Corpus - possibilidade metodológica para o ensino da variação linguística na aula de PLNM

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### **Resumo**

*As diferenças entre o português europeu e o português brasileiro observam-se nos diversos módulos da gramática da Língua Portuguesa. Uma vez que o léxico é a parte da gramática que mais absorve os condicionamentos socio-históricos e culturais, é no léxico que se constata maiores divergências, ainda que o português europeu e o português brasileiro partilhem um fundo lexical comum. Graças a essa partilha lexical, opera-se uma comunicação eficaz entre falantes do português europeu e falantes do português brasileiro, embora os usos discursivos, convencionais e pragmáticos na interação linguística no Brasil e em Portugal sejam distintos. Na sequência das especificidades da Língua Portuguesa anteriormente referidas, colocam-se duas questões essenciais, a que procuraremos dar resposta com este trabalho: tendo em vista o ensino da diversidade linguística na aula de PLNM, que visão da língua deve apresentar o Professor de PLNM? No ensino da diversidade linguística na aula de PLNM, o “Corpus do Português”, disponível online em [www.corpusdoportugues.org](http://www.corpusdoportugues.org), poderá ser um recurso didático profícuo?*

**Palavras-chave:** *Corpus, variação linguística, ensino do PLNM.*

### **1. Introdução**

O trabalho que agora se apresenta pretende expor uma possibilidade metodológica para o ensino da variação linguística na aula de PLNM através de corpus. Nesse sentido, começa-se por apresentar evidências a propósito das diferenças entre o português europeu (PE) e o português brasileiro (PB), depois, no escopo da variação linguística e o ensino do PLNM, preconiza-se uma visão contrastiva português europeu/português brasileiro mediada pelo uso de corpora, destacando o “Corpus do Português”, de Mark Davies, e termina-se com a





apresentação de uma proposta didática para o estudo das variedades do português faladas em Portugal e no Brasil, no nível lexical, através da observação e análise de concordâncias no “Corpus do Português”.

## **2. Uma Língua com duas variedades nacionais: Português Europeu e Português Brasileiro**

A variação é uma característica intrínseca de qualquer língua, podendo observar-se quer no passado quer no presente e manifesta-se como diversidade dialetal ou sociolinguística (Segura 2013). O português europeu foi levado para as novas terras descobertas no início do século XVI, entrando em contacto com as diversas línguas indígenas brasileiras, as diversas línguas africanas dos falantes envolvidos no tráfico negreiro e as múltiplas línguas europeias e asiáticas dos emigrantes que chegaram ao Brasil, a partir de meados do século XIX. Segundo Silva (2013), este contacto entre falantes de línguas distintas “foi configurando, através de uma história longa e complexa, o que é atualmente a variedade brasileira da língua portuguesa: o português do Brasil, hoje falado por mais de cento e setenta milhões de pessoas.” (p. 145).

Os dados históricos demonstram que a maioria dos brasileiros adquiriu o português europeu, língua do colonizador e língua do poder e do prestígio social, por um “processo de transmissão irregular, favorecedora de uma aquisição imperfeita; [...] era adquirido na oralidade do quotidiano e, dada a escolarização praticamente inexistente, na ausência de uma normatização que só poderia ser veiculada pelo ensino” (Silva, 2013, pp. 147-148).

A investigação tem reunido evidências a propósito das diferenças entre o PE e o PB, veja-se, entre outros, Teyssier (1982, p. 78-88), Mattos e Silva (2004, p. 140-147), Castilho (2010, p. 171-195) e Silva (2014, p. 143-188).

Mateus (2003) apresenta exemplos de algumas das diferenças do PE e do PB patentes quer nos níveis em que as divergências são mais perceptíveis, ou seja, os níveis fonético, fonológico e lexical, quer nos níveis morfológico e sintático-semântico.

As diferenças entre o português europeu e o português brasileiro observam-se nos diversos módulos da gramática, no entanto, como se conclui em Mateus (2003), “a deriva das duas variedades utiliza processos gramaticais comuns, não podendo afirmar-se, portanto, que as variedades do português possuem diferentes gramáticas” (p. 51).

Uma vez que o léxico é a parte da gramática que mais absorve os condicionamentos socio-históricos e culturais, é no léxico que se constatam maiores divergências, ainda que o português europeu e o português brasileiro partilhem um fundo lexical comum. Graças a

essa partilha lexical, opera-se uma comunicação eficaz entre falantes do português europeu e falantes do português brasileiro, embora os usos discursivos, convencionais e pragmáticos na interação linguística no Brasil e em Portugal sejam distintos.

Na sequência das especificidades da Língua Portuguesa anteriormente referidas, colocam-se duas questões essenciais, a que procuraremos dar resposta nas secções seguintes: tendo em vista o ensino da diversidade linguística na aula de PLNM, que visão da língua deve apresentar o Professor de PLNM? No ensino da diversidade linguística na aula de PLNM, as ferramentas TIC poderão ser um recurso didático profícuo?

### 3. Variação linguística e ensino do PLNM

Efetivamente, a variação é uma característica intrínseca de qualquer língua, podendo observar-se quer no passado quer no presente. Sendo o português uma língua pluricêntrica (Silva 2014), ou seja, uma língua que possui diversas variedades e que duas delas, o português europeu e o português brasileiro, se encontram normalizadas, isto é, possuem normas padrão reconhecidas e descritas linguisticamente, em contexto de ensino-aprendizagem, o professor de PLNM deve apresentar uma visão contrastiva PB/PE (Duarte 2016), quer nos níveis de proficiência iniciais quer nos níveis avançados, em conformidade com o *Quadro Europeu Comum de Referência para as línguas* (QECR).

De acordo com Ellis & Shintani (2014, p. 26), nos objetivos do ensino da língua, não cabe apenas o desenvolvimento da competência comunicativa dos estudantes, deve caber também a promoção do saber ser e do saber estar no mundo, que permita aos alunos a reflexão crítica sobre os valores, as atitudes e crenças.

A aula de variação linguística deve favorecer essa competência existencial, facilitando “o desenvolvimento de “uma personalidade intercultural”” (Conselho da Europa, 2001, p. 153), que, inquestionavelmente, configura um fim educativo relevante.

A investigação tem revelado que o uso de corpus na sala de aula de línguas configura um contexto pedagógico-didático favorável à aprendizagem autónoma, exercendo um impacto especial na aquisição lexical (McCullough, 2001).

É importante realçar o corpus como ativador do papel do aluno no processo de aprendizagem da língua, isto é, o corpus constitui-se como um campo fértil para estimular a curiosidade do aluno, levando-o a fazer explorações e descobertas linguísticas (Sardinha 2011; 2016; 2017).

Com efeito, o enfoque indutivo subjacente à utilização de corpus na sala de aula sustenta que a observação dos dados linguísticos conduz o aluno a extrair as regras e os princípios gerais que regulam a língua. Tal como argumenta St. John,

using corpora and a concordancer can be motivating and rewarding not only for the learner but also for the teacher. For the teacher, these tools can provide contextualised examples to confounding lexical questions. Moreover, the learner can develop an ability to "learn how to learn" [...] This therefore assists the student in exploring the language in great detail and thereby gaining further insights into its grammar and vocabulary (St. John, 2001, p. 185).

Como recorda Mendes (2016), o uso de corpora é alvo de interesse por diversos domínios de estudos da língua. Nesse sentido, Mendes (2016, p. 224-251) problematiza a conceção de corpus quer como fonte de dados linguísticos quer como método de trabalho em estudos linguísticos que se ancoram em teorias linguísticas diversas. Além disso, a autora apresenta também uma lista com os endereços web de vários tipos de corpora disponíveis para o Português (Mendes, 2016, p. 244-247): corpora de fala, corpora de português não contemporâneo, corpora de variedades regionais de PE, corpora de variedades do português no mundo, corpora paralelos, corpora de aquisição e corpora de aprendizagem.

Efetivamente, na Web, deparamo-nos com bases diversificadas que divulgam e disponibilizam corpora que poderão ser recursos importantíssimos para o ensino da diversidade linguística na aula de PLNM. No âmbito dessas bases, começamos por destacar o “Corpus do Português”, que iremos utilizar na secção seguinte deste trabalho. Podemos encontrá-lo disponível em <https://www.corpusdoportugues.org/web-dial/>. Destaca-se também a Linguateca, que é um centro de recursos para o processamento computacional da língua portuguesa, onde se encontra disponível o “corpus CONDIVport”, em <http://www.linguateca.pt/acesso/corpus.php?corpus=CONDIV>. Os textos deste corpus pertencem aos domínios do futebol, do vestuário/moda e da saúde das décadas de 50, 70 e 2000 de jornais e revistas portuguesas, tendo sido criado com o objetivo de estudar a “CONvergência” e a “DIVergência” entre estas duas variantes do português.

Destaca-se de igual modo a base de dados do Instituto de Linguística Teórica e Computacional (ILTEC), resultante do projeto LUPo (Léxico Unisyn do Português), o RADbank (Regional Accent Databank), acessível em <http://radbank.iltec.pt/> (O RADbank pode ser consultado através da página do Portal da Língua Portuguesa ([www.portaldalinguaportuguesa.org](http://www.portaldalinguaportuguesa.org)), clicando em “RADbank” do lado direito do menu “Consultar”). Os utilizadores deste recurso podem seleccionar um país da CPLP. Ao seleccionar “país”, será apresentada ao utilizador da ferramenta a opção de pesquisar por informante ou por variedade regional (<http://radbank.iltec.pt/index.php?action=countries>; <http://radbank.iltec.pt/index.php?action=words>).



De facto, na Web, facilmente podemos aceder a uma panóplia diversificada de corpus. Não obstante, “o que vemos é uma escassez de materiais de ensino de língua materna e estrangeira baseados em corpora em todos os níveis.” (Sardinha, Delfino & Rampaso, 2017, p. 2), ainda que a investigação recente nos dê conta das potencialidades da utilização de corpus em sala de aula (Piñol, 2016; Finatto *et al.*, 2018).

Por conseguinte, a incorporação de corpus em sala de aula representa um poderoso instrumento ao serviço do desenvolvimento da competência lexical dos alunos que se encontram em situação de aprendizagem de uma língua estrangeira (Piñol, 2016).

De acordo com o QECR, a competência lexical traduz-se “no conhecimento e na capacidade de utilizar o vocabulário de uma língua e compreende elementos lexicais e gramaticais” (Conselho da Europa, 2001, p. 159). Na secção seguinte, apresenta-se uma proposta didática de estudo da variação linguística através do “Corpus do Português”, que constitui uma possibilidade metodológica ao serviço do desenvolvimento da competência lexical dos estudantes de PLNM.

#### 4. Proposta didática de estudo da variação linguística através do “Corpus do Português”

Tendo em vista o ensino-aprendizagem das variedades do português faladas em Portugal (PE) e no Brasil (PB), no nível lexical (Mateus, 2003, p. 50-51), o professor poderá apresentar aos estudantes alguns exemplos como os que se apresentam nos quadros a seguir.

**Quadro 1. Palavras idênticas com significado diferente**

Divergências - Palavras idênticas com significado diferente			
Nível	Lexical	PE	PB
		apelido	Sobrenome
	banheiro	salva-vidas	casa de banho
	camisola	t-shirt, blusa	camisa de dormir

**Quadro 2. Palavras diferentes com o mesmo significado**

Divergências - Palavras diferentes com o mesmo significado		
	PE	PB
Nível Lexical	Cunha	pistolão
	Adesivo	esparadrapo
	Betão	concreto

**Quadro 3. Palavras derivadas com a mesma base e diferentes sufixos mas com significado semelhante**

Divergências - Palavras derivadas com a mesma base e diferentes sufixos mas com significado semelhante		
	PE	PB
Nível Lexical	fumador	fumante
	prestável	prestativo

**Quadro 4. Palavras com bases diferentes e com o mesmo sufixo, mas que veiculam um significado idêntico**

Divergências - Palavras com bases diferentes e com o mesmo sufixo, mas que veiculam um significado idêntico		
	PE	PB
Nível Lexical	carnudo	polpudo
	canalizador	encanador

Apresentadas algumas variedades do português faladas em Portugal (PE) e no Brasil (PB), particularmente no nível lexical (palavras idênticas com significado diferente; palavras diferentes com o mesmo significado; palavras derivadas com a mesma base e diferentes sufixos mas com significado semelhante; palavras com bases diferentes e com o mesmo sufixo, mas que veiculam um significado idêntico), o professor poderá propor aos alunos de PLNM, a partir do nível B1, a extração de concordâncias no “Corpus do Português” (Davies 2018). Este corpus, criado por Mark Davies, possui cerca de um bilhão de palavras em Português, retiradas de aproximadamente um milhão de páginas web de quatro países lusófonos (Brasil, Portugal, Angola e Moçambique).

Deste modo, a utilização deste corpus, através da observação e análise das concordâncias das formas linguísticas do PE e do PB, como se ilustra nas figuras 1 e 2, permitirá a exemplificação das referidas variações linguísticas, confrontando os alunos com a multiplicidade das variações dos usos da língua portuguesa, não se limitando ao

conhecimento dos usos linguísticos que o professor possui, que é inevitavelmente fragmentário.

The screenshot shows the 'Corpus do Português: Web/Dialects' interface. The search results for 'sobrenome' are displayed in a table with columns for ID, source, frequency, context, and university. The context column contains various sentences where the word is used.

ID	SOURCE	FREQUENCY	CONTEXT	UNIVERSITY
1	G BR 102fmatat.com.br	A B C	o produto acima como "x Gillette"! Em a verdade, esse é o <b>sobrenome</b> do inventor das lâminas de barbear – o norte-americano King Camp Gillette	
2	G BR 4b-2013-01.blogos.com.br	A B C	Pietro Ferrero, um dos fundadores da gigante marca que leva o seu <b>sobrenome</b> . Pietro queria encontrar uma fórmula para criar um produto barato, e	
3	G BR 4cliques.com.br	A B C	região geográfica. Isso na maioria das vezes não é legal. Usar <b>sobrenome</b> , ou mesmo o nome do dono do negócio, pode ser legal	
4	G BR 4cliques.com.br	A B C	nome escolhido não tenha alguma relação histórica negativa. Imagine um açougue associado ao <b>sobrenome</b> Hitler. Mais detalhes Nomes descritivos	
5	G BR 4cliques.com.br	A B C	o Brasil, e talvez no mundo, as pessoas optarem por usar o <b>sobrenome</b> da família. Alguns poucos talvez não saibam, mas, a cervejaria Schincariol	
6	G BR 50anosdefilmes.com.br	A B C	o roteiro para Robert Wise ler. Wise tem inteligência até mesmo no seu <b>sobrenome</b> . Disse ao produtor que tinha adorado o roteiro, e que, claro	
7	G BR abcunitiba.com	A B C	bronze do Country Clube, como alguém nos fez perceber recentemente. Contraditório? <b>Sobrenome</b> por aqui também é mérito! Quando cunhou o ter	
8	G BR abordagempolicial.com	A B C	"x, não sou valentão, sou PM aposentado da PMPR, uso meu <b>sobrenome</b> . moro no litoral do Estado, não escondo o rosto com camisetas	
9	G BR acervo.revistabula.com	A B C	587639 A pior coisa que já escrevi na vida Tamburello... Narcisca tem <b>sobrenome</b> de curva assassina e – graças às vinte e três cirurgias plásticas realiz	
10	G BR acervo.camila.blogspot.com	A B C	respostas simples "x. "x Você acha que uma arma, um distintivo, um <b>sobrenome</b> fazem de você alguém? "x Toda glória é passageira "x. "x	
11	G BR apcurus.com	A B C	Segurança Pública, policiais do Delic realizavam buscas pelo rapaz e o <b>sobrenome</b> e a idade do suspeito não foram divulgados. O homem usou uma c	
12	G BR ad-mensagensdeamor.blogspot.com	A B C	amar fosse fácil. Não haveria tanta fome, Nem tantas guerras Nem gente sem <b>sobrenome</b> . Se amar fosse fácil. Não haveria tantas crianças nas ruas s	
13	G BR afetivagem.blogspot.com	A B C	tudo que é demais... * Se compulsoriamente os países devessem mudar de nome para <b>sobrenome</b> . os Estados Unidos e o Reino Unido seriam Smithi	
14	G BR afetivagem.blogspot.com	A B C	a Argentina. E o Brasil e Portugal seriam domínios dos Silva. O <b>sobrenome</b> da selva – presente em 8 % das RGS no Brasil --	
15	G BR agora.opsblog.org	A B C	o nordeste brasileiro, e a cara que não me era estranha ganhou nome e <b>sobrenome</b> bem na hora em que ele olhou de lado de olho para mim,	
16	G BR agora.opsblog.org	A B C	nome. Os elementos do sistema onomástico moderno comum no Ocidente são o <b>sobrenome</b> e o prenome. Não devemos esquecer que é recente o f.	

Figura 1 Concordâncias de “sobrenome”

The screenshot shows the 'Corpus do Português: Web/Dialects' interface. The search results for 'alculha' are displayed in a table with columns for ID, source, frequency, context, and overview. The context column contains various sentences where the word is used.

ID	SOURCE	FREQUENCY	CONTEXT	OVERVIEW
1	G BR 180graus.com	A B C	se destaca fisicamente em relação aos outros profissionais de arbitragem, mas dispensa a <b>alculha</b> de 'fortão' e alerta: "x eu quero ser conhecido po	
2	G BR a-partir-pedra.blogspot.com	A B C	o do Estado de São Paulo) e eu catarinense (ou barriga-verde. <b>alculha</b> dos nascidos em este maravilhoso Estado de Santa Catarina). Caro Rui,	
3	G BR acertodecontas.blog.br	A B C	. Em um país onde existe um tal de Paulo maluf, outro com a <b>alculha</b> de juiz lalau etc. ter o nome no serasa não é motivo de	
4	G BR acervo.revistabula.com	A B C	de o Petê, da Presidente Dilma ("= Aquela Sapata "x foi a <b>alculha</b> que elas utilizaram...), da ascensão social da classe Cê,	
5	G BR acervo.revistabula.com	A B C	enganações de Maria da Anunciação -- a iletrada (e desletrada) Emanuele -- cuja <b>alculha</b> foi a ela imposta, ainda nos primórdios da prostituição na cic	
6	G BR acervo.revistabula.com	A B C	). Léo assume que não gosta dos negros, embora não aceite a <b>alculha</b> de racista (!). Foi ao cinema, única e exclusivamente	
7	G BR acervo.revistabula.com	A B C	que pouquíssimo amo e ame!, além de não ser diabético, ainda considero a <b>alculha</b> deveras ridícula, além de hipercolérica. De a mesma forma, "x mi	
8	G BR acervo.revistabula.com	A B C	de Brás Cubas -- Machado de Assis "x Desde os cinco anos merecera eu a <b>alculha</b> de "x menino diabo "x; e verdadeiramente não era outra coisa: fui c	
9	G BR afetivagem.blogspot.com	A B C	as imperfeições deste mundo). E, logo, ele prontamente adota a <b>alculha</b> , como fórmula completa, comum entre os cavaleiros andantes e antes de s	
10	G BR afinsophia.com	A B C	se chama Manuel Mateus, mas não é parente de Sete-Sois, e tem por <b>alculha</b> Sarago, sabe-se lá que descendência a sua será, e que saiu penitenc	
11	G BR albertomurray.wordpress.com	A B C	Copa do Mundo, querem demonizar os críticos e colar-lhes sobre as testas a <b>alculha</b> de anti-brasileiros. Reparem como às portas da Copa das Confe	
12	G BR amalvos.uol.com.br	A B C	de Beauchamp e Childress, conhecida nos anos posteriores de sua publicação pela <b>alculha</b> de biológica principalista, discutia as questões morais sob	
13	G BR aorigemdosproverbios.blogspot.com	A B C	mundo. Se ele não se envergonhava de isso, o pior era mesmo a <b>alculha</b> que tinha pela aldeia, e para a qual muito contribuíam os dois factores	
14	G BR arautodofuturo.wordpress.com	A B C	Universidade Indiana e retomou uma atividade: a de "x cientista cantora "x. A <b>alculha</b> surgiu quando Jill iniciou uma campanha em prol da doação de	
15	G BR armonte.wordpress.com	A B C	idade madura -- entre André, um órfão que ganha, ainda pequeno, a <b>alculha</b> do título por ser antissocial e esquisito (feito de doer, caladão,	
16	G BR artepdfm.blogspot.com	A B C	Romano para identificar Papa Francisco que veio duma terra distante. Malcom Mc Flyer <b>Alculha</b> Caro Glauco: eu não estou achando nada, as especu	

Figura 2 Concordâncias de “alculha”

## 5. Considerações finais

As opções didáticas através de corpus rentabilizam as potencialidades que a Linguística de Corpus concede ao ensino das línguas.

De facto, os corpus que os recursos tecnológicos nos disponibilizam configuram uma possibilidade metodológica que permite aos professores e alunos desbravar novos horizontes no ensino-aprendizagem da variação linguística na aula de PLNM. Deste modo, no ensino da diversidade linguística na aula de PLNM, o “Corpus do Português”, disponível online em [www.corpusdoportugues.org](http://www.corpusdoportugues.org)., poderá ser um recurso didático prolífero, uma vez que concede aos alunos a possibilidade de observar e analisar a multiplicidade das variações dos usos da língua portuguesa e permite aos professores orientar os alunos de PLNM para a descoberta dos contrastes existentes entre o português europeu e o português brasileiro.

Nesta linha de pensamento, concluímos com as palavras de Tagnin (2018), dado que consideramos que o ensino tem muitíssimo “a ganhar em termos de objetividade e confiabilidade com o uso da Linguística de Corpus, principalmente porque a tecnologia avança a passos largos nesse setor, permitindo a criação de ferramentas que permitem análises cada vez mais específicas e direcionadas.” (p. 14).

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## Projeto EGID3: ensino da Geometria, investindo no diagnóstico, dificuldades e desafios

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### Resumo

*Neste artigo pretendemos apresentar e fundamentar as principais linhas orientadoras do projeto de investigação – EGID3: ensino da Geometria, investindo no diagnóstico, dificuldades e desafios. O diagnóstico das dificuldades dos estudantes, a valorização de um ensino do tipo exploratório, a averiguação dos raciocínios e das suas aprendizagens em Geometria são os aspetos centrais da sua ideiação. As perspectivas dos alunos sobre a Geometria e os seu ensino, bem como o diagnóstico das dificuldades apresentam-se como fundamentais para a planificação e desenvolvimento do processo de ensino e aprendizagem. A valorização do ensino do tipo exploratório prevê que os estudantes sejam chamados a desempenhar um papel ativo na interpretação das questões propostas, na representação da informação dada, na conceção e concretização de estratégias de resolução, na apresentação e justificação dos seus raciocínios. Neste, as tarefas matemáticas surgem com o intuito de conduzir os estudantes a construir ou aprofundar a compreensão de conceitos, representações, procedimentos e ideias ligadas à Geometria. Desta feita, os objetivos desta investigação, iniciada em fevereiro de 2019, são: (i) averiguar as perceções de alunos face à disciplina de Geometria e ao seu ensino; (ii) verificar o contributo das práticas de avaliação de diagnóstico para a aprendizagem da Geometria; e (iii) verificar o contributo da utilização de um ensino do tipo exploratório, envolvendo a diversificação de tarefas matemáticas. Encaramos este trabalho com características de investigação sobre a própria prática profissional, de natureza reflexiva e colaborativa. Tem como participantes a professora e os alunos de uma turma da Licenciatura em Educação Básica no contexto da unidade curricular de Geometria. A recolha de dados é efetuada com recurso a questionários, observação participante e produções*



*dos estudantes. A análise dos dados é focada na análise de conteúdo, de acordo com categorias definidas a priori e aprimoradas durante o desenvolvimento do estudo.*

**Palavras-chave:** *geometria, avaliação de diagnóstico, ensino do tipo exploratório, tarefas matemáticas*

## **1. Introdução**

O professor na concretização da sua missão tem necessidade de se envolver em investigação que o ajude a lidar com as situações problemáticas que constantemente surgem na sua prática (Ponte, 2002). O projeto de investigação “EGID3: ensino da Geometria, investindo no diagnóstico, dificuldades e desafios” surgiu do interesse comum dos investigadores sobre a prática letiva, concretamente no âmbito do ensino superior.

A prática letiva é um momento particular da vida profissional do professor. É compreendendo a sua prática que se torna possível saber não só como atua nos momentos de tomada de decisões, mas também como é justificada a sua atuação, pois, independentemente do nível de ensino, o processo de ensino e aprendizagem da Matemática, em geral, ou da Geometria, em particular, envolve alunos, professores, administradores e escolas em contextos que variam de um dia para outro de uma maneira que dificulta a criação de uma fórmula ou de um conjunto de práticas que os professores possam adotar (Franke, Kazemi, & Battey, 2007).

No contexto do projeto EGID3 damos particular importância às perspetivas dos alunos sobre a Geometria e o seu ensino, ao diagnóstico das dificuldades, à valorização do ensino do tipo exploratório e ao papel das tarefas matemáticas na condução da prática letiva. Neste artigo, além da apresentação sucinta do projeto, pretendemos interpretar os dados relativos às perceções de alunos face à disciplina de Geometria e ao seu ensino.

## **2. Abordagem teórica**

Ao contemplarmos o mundo que nos rodeia percebemos de forma clara e imediata que impera o sentido geométrico, com as ideias geométricas presentes na natureza, na arquitetura, nas artes, entre outras áreas do saber. Mas, apesar disso, reconhecem-se frequentes dificuldades com os conceitos e representações geométricas em contexto escolar dado que ensinar e aprender geometria são processos complexos e multidimensionais. Por

exemplo, para as organizações The Royal Society e Joint Mathematical Council (2001), uma das dificuldades menos óbvias no ensino de geometria está relacionada com as abstrações que fazemos quando “ilustramos pontos e segmentos de reta por meio de desenhos e diagramas e, no entanto, nenhum dos objetos pode ser visível, exceto no nosso ‘olho da mente’ (...)”, mas “frequentemente os professores desenharam esboços rápidos pretendendo representar objetos na sua própria imaginação que, na verdade, podem não ser reconhecidos como tal pelos seus alunos” (p. viii).

O estudo da Geometria é muito relevante (De Villiers, 2017) e deve contribuir para o “desenvolvimento do raciocínio geométrico, onde se incluem a capacidade de visualização, de formulação de conjecturas, de argumentação e de demonstração” (Santos & Oliveira, 2017, p. 6), tornando necessário seguir estratégias de ensino e aprendizagem que permitam compreender a real necessidade desse estudo e melhorar a relação com o saber geométrico.

É, então, essencial uma avaliação de diagnóstico e prognóstico que sustente as decisões, quer de seleção, quer de orientação em função de uma antecipação do futuro próximo do aluno em termos das suas competências para prosseguir determinados níveis de estudo subsequentes. Alguns autores particularizam a importância de ser sensível às ideias prévias dos alunos e utilizar as técnicas do conflito cognitivo para promover o progresso na aprendizagem (Godino, Batanero, & Font, 2003). Particularmente Del Puerto, Minnard e Seminara (2006) atribuem relevância à implementação de questionários para a deteção de erros e posterior classificação dos mesmos com base em alguma das categorias vigentes, considerando-a uma metodologia que permite obter uma “radiografia” do estado de conhecimento, constituindo uma valiosa ajuda na hora de reorganizar a prática pedagógica.

Um contexto de sala de aula adequado a esta perspetiva pode ser propiciado pela assunção de um ensino do tipo exploratório assente, segundo o National Council of Teachers of Mathematics [NCTM] (2017), em “práticas poderosas e [em] capacidades essenciais para promover uma aprendizagem profunda da matemática” (p. 9). Para tal, os estudantes devem envolver-se em “tarefas desafiantes que incluam uma elaboração ativa de significado e apoiem uma aprendizagem com sentido” (p. 9), de que são exemplo as tarefas de natureza mais problemática e investigativa. Tarefas deste tipo estimulam os estudantes na interpretação da informação, nos processos de resolução e justificação dos seus raciocínios, contribuindo para uma melhor compreensão dos conceitos, representações e procedimentos matemáticos, em geral, e geométricos, em particular.



### 3. Metodologia de investigação

Os objetivos deste estudo são: (i) averiguar as percepções de alunos face à disciplina de Geometria e ao seu ensino; (ii) verificar o contributo das práticas de avaliação de diagnóstico para a aprendizagem da Geometria; e (iii) verificar o contributo da utilização de um ensino do tipo exploratório, envolvendo a diversificação de tarefas matemáticas.

Encaramos este trabalho com características de investigação sobre a própria prática profissional, de natureza reflexiva e colaborativa (Ponte, 2012). Tem como participantes a professora e os alunos de uma turma da Licenciatura em Educação Básica no contexto da unidade curricular de Geometria. A recolha de dados recorre a questionários, observação participante e produções dos estudantes. A análise dos dados foca-se na análise de conteúdo, de acordo com categorias definidas a priori e a criação de categorias e subcategorias a posteriori mediante a leitura dos dados. Esta análise pressupõe a segmentação dos dados a partir da identificação de temas e padrões (Stake, 2009). A “frase e conjuntos de frase” é a unidade de análise considerada.

### 4. Primeiros resultados: percepções de estudantes face à disciplina de Geometria e ao seu ensino

De seguida, apresentam-se resultados relativos a quatro categorias sobre as percepções dos estudantes: (i) Palavras associadas à Geometria; (ii) Conteúdos e temas associados à Geometria; (iii) Estratégias/metodologias de ensino; e (iv) Materiais/recursos a utilizar.

Relativamente às respostas obtidas à questão: *Ao que associas a palavra “geometria”?* foi possível agrupar os dados e, assim, definir as seguintes subcategorias, conforme o explicitado na tabela 1.

**Tabela 1: Categoria Palavras associadas à Geometria**

Subcategorias	Evidências (Associo a Geometria...)
Matemática ou ramo da Matemática	À disciplina de Matemática. (E1); À Matemática. (E10, E11, E14); A um ramo da matemática. (E23, E24); À área da Matemática (E4)
Figuras geométricas	Ao estudo de figuras geométricas. (E3, E21); Às figuras geométricas. (E5, E6, E7, E8, E12, E20); A desenho de figuras geométricas. (E26)
Sólidos geométricos	Aos sólidos geométricos e a derivados componentes matemáticos. (E25); Aos sólidos geométricos. (E2, E6, E11, E16, E22)
Formas geométricas	Às formas de figuras. (E19); Às formas geométricas, a segmentos de reta, etc. (E18); A formas, tamanhos e posições (E13); Às formas geométricas. (E15); Envolve o estudo de diferentes formas, tamanhos e posições de várias figuras. (E24); A formas geométricas e aos seus tamanhos. (E17)
Ângulos e polígonos	Aos ângulos e polígonos. (E27)
Cálculos	Aos cálculos, medidas, estimativas. (E9); Trabalha com questões de forma e cálculo de superfícies (E4); Onde calculamos áreas, perímetros, ângulos entre outros. (E3); Aos respetivos cálculos das suas áreas. (E12); Cálculos. (E7); Medidas. (E2); Suas [formas] medidas e áreas. (E19)

Tendo em atenção a tabela 1, verifica-se que “figuras geométricas” é a ideia mais presente no contexto das palavras que os alunos associam a Geometria, havendo também uma referência significativa à Matemática ou ramo da Matemática, a cálculos, a sólidos geométricos e a formas geométricas.

Relativamente às respostas obtidas à questão: *Que conteúdos/temas gostarias que fossem abordados nas aulas da UC Geometria?*, criaram-se também várias subcategorias que, em conjunto com as evidências com elas relacionadas, se expõem na tabela 2.

**Tabela 2: Categoria Conteúdos e Temas associados à Geometria**

Subcategorias	Evidências
Conteúdos relacionados com sólidos geométricos	Problemas que envolvam sólidos geométricos. (E1); Planificação dos sólidos geométricos. (E11); As diferenças de alguns sólidos que podem ser semelhantes, mas que por pouco que seja há diferenças entre eles. (E15); As características dos sólidos. (E19); O desenho das figuras solidas com materiais adequados. (E26)
Conteúdos relacionados com figuras geométricas	Gostaria que fosse abordado as propriedades das figuras. (E23); Gostaria de entender mais sobre as suas formas e os seus nomes. (E25); Polígonos (E27); As figuras geométricas, (E8); Não relacionar apenas a figuras geométricas (E21)
Conteúdos relacionados com outros temas	Temas relacionados com o programa no ensino básico. (E7); As transformações (E8); Gostaria que fossem dados exemplos presentes na realidade para compreender melhor. (E4); Os conteúdos mais práticos e fáceis. (E17); O teorema de Pitágoras. (E2, E10); Ângulos. (E6); Medição de ângulos. (E2)
Referência à avaliação	A avaliação deve ser feita através de testes e trabalhos ao longo do semestre. (E5); Gostaria de fazer a avaliação com duas frequências, e um trabalho de grupo. (E24)
Assunção de não ter conhecimento	Não sei. (E3, E9, E12, E14, E18, E20, E22); Não faço ideia. (E16); Não tenho um [conteúdo] em concreto (E13)

Como se pode observar na tabela 2, há vários alunos que não têm uma opinião concreta sobre os conteúdos/temas que gostariam de ver abordados na UC de Geometria, eventualmente porque não é um assunto sobre o qual reflitam já que não é habitual terem

uma intervenção na escolha dos temas a abordar nas aulas. Dos alunos que manifestaram opinião o destaque vai para conteúdos relacionados com figuras ou sólidos geométricos.

A partir da análise das respostas obtidas à questão: *Que estratégias/metodologias de ensino gostarias que a tua professora desenvolvesse nas aulas da UC Geometria?*, foi possível agrupar os dados e definir as subcategorias, conforme o explicitado na tabela 3.

**Tabela 3: Categoria Estratégias/metodologias de ensino**

Subcategorias	Evidências
Aulas práticas	Aulas mais práticas. (E12, E14, E15, E18); Aulas práticas. (E17, E20); Gostaria que a professora desenvolvesse nas aulas estratégias/ metodologias práticas. (E23); Optar por exercícios mais práticos e lúdicos e menos teóricos, como por exemplo atividades fora da escola e fichas de trabalho. (E11); Fazer trabalhos de pesquisa. (E5)
Realização de exercícios	Exercícios práticos essencialmente. (E8); Aulas de exercícios. (E10); Exercícios de aplicação. (E27)
Aulas expositivas	Aulas expositivas com resolução de exercícios adequados à UC. (E1); Prefiro que a aula seja mais expositiva onde seja possível a resolução de muitos exercícios. (E3); Gostaria que a professora desse aulas expositivas, pois quando somos nós a fazer pesquisas acho que nos sentimos um pouco perdidos na matéria. (E24)
Associação de aulas expositivas com outras estratégias/metodologias de ensino	Com aulas pouco expositivas e que cada aluno procurasse obter o máximo de informação de uma determinada questão. (E4); Aulas dinâmicas, de pesquisa e expositivas. (E6); Trabalho em grupo; apresentação expositiva e exercícios. (E7); Junção de aulas expositivas com aulas práticas e pesquisa. (E9)
Estratégias para utilização futura em sala de aula	Trabalhos mais práticos em que nos ajudassem num dia mais tarde conseguirmos colocar em prática com os alunos. (E2); O que mais pudesse utilizar mais tarde. (E13); Gostaria que as aulas fossem uma mistura dos conceitos com exemplos concretos de reais que poderemos ter no futuro no ensino com as crianças. (E21)
Assunção de não ter conhecimento	Um [estratégias] que me fizessem entender de forma fácil a geometria. (E16); Não sei. (E22)

Conforme é possível verificar, as percepções dos estudantes originaram a criação de sete subcategorias. Vários alunos indicam a preferência por aulas práticas, ainda que nada adiantando sobre o significado do termo utilizado, sendo nosso entendimento que esta ideia se opõe a aulas expositivas, também indicadas por alguns (menos) alunos. A realização de exercícios consta também nas percepções dos alunos, embora surgindo numa subcategoria diferente pela referência concreta a exercícios. A associação de aulas expositivas com outras estratégias/metodologias de ensino faz também parte das percepções dos estudantes, referindo aulas dinâmicas, pesquisa, trabalho em grupo, exercícios, aulas práticas e pesquisa. Verificou-se particularmente a indicação de estratégias para utilização futura em sala de aula e a assunção da não existência de qualquer percepção, referindo: “Não sei”.

Em relação à análise das respostas obtidas à questão: *Que materiais/recursos gostarias de utilizar nas aulas da UC Geometria?*, foi possível agrupar os dados e definir as subcategorias apresentadas na tabela 4.

**Tabela 4: Categoria Materiais/recursos a utilizar**

Subcategorias	Evidências
Materiais de desenho e medição	Compasso, transferidor, esquadro, régua. (E3, E14); Compasso. (E13); Régua, transferidor, esquadro (E17); A régua, o esquadro. (E21); Régua, esquadro, compasso. (E26); Materiais relacionados com medições. (E27)
Modelos de figuras ou sólidos geométricos	Estudo de sólidos geométricos. (E5, E17, E24); Os próprios sólidos geométricos para uma melhor compreensão dos conteúdos. (E6); Objetos do dia a dia com a forma de sólidos geométricos. (E11); Os sólidos. (E15); Observar, tocar e entender mesmo bem os sólidos e o resto da matéria. (E25); As figuras geométricas [modelos] (E21); Todos os tipos de figuras geométricas. (E19)
Recursos digitais	Computador. (E1, E24); O computador e fazer exercícios on-line. (E4); Recursos digitais. (E20); Calculadora e, se possível, aplicações interativas. (E8); Calculadoras. (E6, E18)
Associação a exercícios	Recursos mais práticos, como exercícios em que possamos aplicar o que aprendemos. (E2); Objetos e exercícios em grupo. (E7)
Jogos e outros recursos	Alguns jogos que pudesse ser importantes para a aprendizagem da matéria. (E15); Gostaria que fossem utilizadas materiais práticos. (E23)
Assunção de não ter conhecimento	Não sei. (E9, E10, E12, E16, E22)

Da leitura das várias percepções expressas nestas respostas verificou-se a necessidade de criação de seis subcategorias. Salientamos a incidência na indicação de materiais de desenho e medição, como o compasso, a régua, o esquadro e o transferidor. Surge a indicação de recurso a modelos de sólidos geométricos sem qualquer exemplificação e a referência a recursos digitais, onde incluímos o computador e a calculadora. Houve ainda dois estudantes que associaram recursos especificamente à realização de exercícios e igual número a jogos e materiais “práticos”. Tal como na questão anterior, vários estudantes assumiram não saberem que recursos/materiais gostariam de utilizar.

## 5. Notas finais

Reconhecemos as percepções dos estudantes sobre a Geometria e o seu ensino como fundamentais no desenvolvimento da presente investigação, sobretudo pelo seu contributo para a tomada de decisões em sala de aula.

Assim, as percepções dos estudantes no que respeita ao significado da palavra Geometria tendem para a sua consideração como uma área da Matemática, ligando-a a figuras, sólidos e formas geométricas, bem como a ângulos e polígonos. O cálculo, mais característico do estudo das grandezas, é também expresso nas suas respostas. Deste modo, é perceptível que a Geometria é mais associada a conteúdos específicos do que a competências transversais, como o raciocínio geométrico ou a capacidade de visualização, de formulação de conjecturas, de argumentação e de demonstração (Santos & Oliveira, 2017).



Quanto às percepções dos estudantes sobre Conteúdos e temas associados à Geometria foi clara a ligação com as percepções apresentadas sobre a palavra Geometria: relação com sólidos geométricos, figuras geométricas e outros temas. Verificou-se até, imprevisivelmente, a referência ao processo de avaliação a considerar na unidade curricular de Geometria. Desta feita, é possível situar as suas percepções em questões ligadas à geometria das figuras planas e à dos sólidos geométricos (De Villiers, 2017).

Sobre Estratégias/metodologias de ensino, para além da possibilidade de utilização de estratégias passíveis de aplicar em sala de aula, é feita referência a aulas práticas, realização de exercícios, aulas expositivas, associação de aulas expositivas com outras estratégias/metodologias de ensino. É possível verificar uma forte tendência nas percepções dos alunos para aulas do tipo expositivo nas quais, segundo Ponte (2009), a comunicação tem por padrão fundamental a sequência I-R-F (iniciação-resposta-*feedback*). O professor coloca uma questão, recebe a resposta do aluno e fornece-lhe *feedback* imediato (resposta certa ou errada), situando-se longe do que se considera ser um ensino do tipo exploratório (NCTM, 2017).

Quanto a Materiais/recursos a usar nas aulas de Geometria, os alunos indicaram materiais de desenho e medição, modelos de figuras ou sólidos geométricos, recursos digitais, jogos e outros recursos. Para nós, foi inesperada a associação dos materiais à realização de exercícios, dado que um *exercício* é uma tarefa fechada e de desafio reduzido (Ponte, 2005). A este respeito, e em articulação com um ensino do tipo exploratório, realce-se que diferentes tipos de tarefas guiam os alunos a diferentes oportunidades de pensar (Stein & Smith, 2009). Stein, Engle, Smith e Hughes (2008) vincam que quando os professores propõem tarefas centradas no aluno enfrentam desafios que devem ir além da apropriada identificação e da aplicação adequada na sala de aula. Dado que nestas tarefas os caminhos para chegar à solução não são especificados, os alunos tendem a realizá-las de forma única e, por vezes, inesperada. Os professores devem esforçar-se para entender a forma como os alunos estão a interpretar a tarefa, mas também começar a categorizar as diferentes ideias e abordagens dos alunos de acordo com a natureza da Matemática (ou da Geometria).

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## Supervisão pedagógica de professores na Universidade Pedagógica de Moçambique: averiguando opiniões

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### Resumo

*Cientes que a supervisão pedagógica é um processo fundamental para o desenvolvimento profissional dos professores e futuros professores, surge a realização do estudo que envolve investigadores da Escola Superior de Educação do Instituto Politécnico de Bragança (ESE-IPB) e a Universidade Pedagógica de Moçambique – delegação de Manica (UP – Manica). Numa fase inicial, pretendemos conhecer a opinião dos supervisores da UP – Manica acerca do processo de supervisão pedagógica. Trata-se de uma investigação qualitativa, de natureza descritiva e interpretativa. O inquérito surge, nesta fase, como a técnica de recolha de dados principal, sendo um questionário constituído por questões abertas e fechadas, o instrumento utilizado. Neste, foi solicitado aos participantes a caracterização do processo de supervisão. Dos 16 supervisores que responderam, houve unanimidade na resposta no que concerne ao destaque que atribuem à importância deste processo, nomeadamente na formação dos alunos – futuros professores – e, particularmente, na sua integração nas escolas. Muito embora seja clara uma associação do processo à avaliação dos alunos, para a caracterização do processo descrevem atividades que desenvolvem, tal como o acompanhamento dos alunos na planificação e observação de aulas. Quando identificam os constrangimentos que sentem, o número excessivo de alunos, a dispersão geográfica das escolas e o tempo de que dispõem para realizar a supervisão, são os aspetos mais registados. Enumeram como sugestão para a melhoria do processo a formação dos supervisores, o número de alunos por supervisor e os recursos materiais. Desta feita, concluímos que é imperativo otimizar a qualidade do processo de supervisão pedagógica, o que cremos*



*seja facilitado, conforme perpsativamos, pela cooperação estabelecida entre parceiros e instituições..*

**Palavras-chave:** *formação de professores, desenvolvimento profissional, supervisão pedagógica,*

## **1. Contextualização da investigação**

O projeto em curso partiu dos interesses comuns de investigação de um grupo de professores/as do ensino superior, de dois países lusófonos. Neste, temos como objetivo principal idealizar um programa de formação contínua com e para os professores supervisores. Em termos teóricos situamos a nossa investigação no âmbito do desenvolvimento profissional de professores, especificamente numa das formas de o promover – a formação contínua de professores – e, especificamente, na supervisão pedagógica da formação inicial de professores.

É nosso entendimento e conforme sublinhamos numa publicação anterior (Marins, et al, 2019), que na formação inicial e contínua de professores, o processo de supervisão assume particular importância, dado que propicia o desenvolvimento profissional do futuro professor ou do professor em exercício. Este pressupõe a articulação de diferentes atores para a criação de um ambiente formativo em que a colaboração, a partilha de saberes e ideias, a interação, o apoio, a experimentação e a reflexão estão presentes. No processo de supervisão ressalvamos o papel do supervisor, como agente de mudança, facilitador e encorajador, numa escola em constante mudança e repleta de desafios. Para tal é necessário, pois, que analise, desenvolva, renove e atualize constantemente as suas competências, encarando a formação contínua numa perspetiva de desenvolvimento profissional e de aprendizagem ao longo da vida. Sendo que o sujeito fundamental do seu próprio desenvolvimento profissional é o professor/supervisor, conhecer as perceções dos supervisores sobre o processo em que estão envolvidos é um ponto privilegiado no nossa investigação. Reafirmando e conforme perspetivado desde o início, a ideia de criação de um programa de formação contínua com e para supervisores, que deverá partir das suas necessidades e expectativas, além de que o desenvolvimento profissional produz melhores resultados quando se organiza durante um período alargado de tempo, é centrado no trabalho colaborativo, na prática, na reflexão e valoriza a investigação (Marins, et al, 2019).

## 2. Abordagem metodológica

A investigação em curso é de natureza qualitativa e interpretativa (Bogdan & Biklen, 1994). Pretendemos reunir um conjunto de informação pertinente com a finalidade de a interpretarmos.

Nesta fase do estudo – averiguação das perceções dos professores/supervisores sobre o processo de supervisão – utilizámos o questionário, como técnica de recolha de dados. Neste contexto, consideramos que a formação continuada dos docentes deve assumir um papel decisivo e ir ao encontro das reais necessidades de formação dos intervenientes (Rodrigues e Vieira, 2018) e o professor deverá ter um papel ativo no seu próprio desenvolvimento profissional (Pires e Martins, 2010). O referido instrumento era constituído por 5 questões, com várias alíneas, organizadas em três secções: (i) caracterização pessoal; (ii) formação e experiência profissional; e (iii) Processo de supervisão no UPM - DM. Neste artigo, damos ênfase à secção Processo de supervisão no UPM – DM. Para o tratamento dos dados recolhidos através de questões fechadas recorremos à estatística descritiva. No respeitante às questões abertas, a informação foi sujeita a análise de conteúdo. Para o efeito, fizemos uma leitura prévia de todas as respostas, e criámos categorias de acordo com os aspetos mais relevantes de cada questão. Como refere Bardin (1995) a análise de conteúdo “aparece como um conjunto de técnicas de análise das comunicações, que utiliza procedimentos sistemáticos e objetivos de descrição do conteúdo das mensagens” (p. 38). Genericamente, as etapas de realização da análise de conteúdo são sequencialmente a descrição, a inferência e a interpretação (Carmo & Ferreira, 1998).

No que respeita aos participantes nesta fase do estudo – averiguação das perceções – responderam 16 supervisores, sendo 14 do sexo masculino e 2 do sexo feminino, destes, 10 têm entre vinte e cinco a trinta e cinco anos e 6 têm entre trinta e seis e quarenta e cinco. Relativamente à sua formação inicial, 6 são licenciados e 10 têm o grau de mestrado. Grande parte (8) assinala que tem de percorrer entre dez a vinte quilómetros desde a sua residência até ao local onde realizam a supervisão. Dada a variedade de formações existentes na UPM-DM, as áreas de formação dos supervisores são muito diversas, bem como realizam a supervisão em áreas muito distintas. No que respeita à sua experiência profissional, verifica-se que têm entre 2 a 15 anos de serviço enquanto professores e entre 2 a 9 anos de experiência em supervisão. Globalmente, verificamos, que o número de anos de serviço é superior ao número de anos que desempenham o papel de supervisores.



### **3. Processo de supervisão: resultados**

Na primeira questão deste grupo “caraterize o processo de supervisão na UP – Manica”, três docentes não responderam e dois apresentaram respostas que não consideramos válidas, pois não respondiam ao que se questionava. Assim, das onze respostas obtidas, sete fazem referência às atividades desenvolvidas durante o processo supervisorio, nomeadamente, a distribuição dos estagiários, a planificação do trabalho e a observação de aulas, tal como é evidenciado nos seguintes excertos:

O processo de supervisão na UP – Manica segue as linhas orientadoras constantes nos documentos normativos da UP, nomeadamente, o calendário académico, regulamento académico, plano curricular. No curso de ensino da Biologia, por exemplo, todos os docentes participam na supervisão/estágio pedagógico, orientando estudantes nas atividades inerentes à cadeira (S2)

O docente é alocado a um estudante em uma escola; o docente corrige os planos de aula antes de ser submetido à aula; o supervisor assiste à aula e avalia a aula (S5)

Os docentes supervisores têm que assistir pelo menos 5 aulas dos estudantes. Na escola o estudante trabalha com o tutor (professor da turma) durante no mínimo 10 semanas. Existe uma última aula em que o supervisor vai assistir para avaliação (S12).

Como é evidente nos discursos de S5 e S12 o processo de supervisão surge associado à avaliação dos estagiários. Esta mesma opinião é partilhada por S11 quando refere que “depois da distribuição dos alunos (DC) tem o momento de socialização dos horários, assiste-se às aulas onde é classificado o estudante mediante o seu desempenho. A classificação do estudante associa-se à avaliação do professor acompanhante”.

De salientar ainda que as respostas de alguns supervisores parecem referir a supervisão como um processo que decorre de uma forma agradável, como o S8 que menciona “ocorre de uma forma harmoniosa” e S13 “é organizado e tem fases distintas e sequenciadas”, no entanto outras parecem transparecer alguma preocupação. S7 escreve “tem sido uma atividade árdua, visto que o efetivo de docentes é insuficiente para o número de estudantes, e as escolas estão relativamente dispersas”. Esta opinião é partilhada por outros, sendo o número de estudantes que têm de acompanhar o aspeto mais referenciado e que, na opinião de alguns supervisores, pode comprometer a supervisão. Esta ideia é claramente expressa nos seguintes discursos:

Complexo e insuficiente. O supervisor não consegue supervisionar todos os estudantes com a qualidade que se espera (S6, S13).

Tenho constatado na maior parte dos cursos a falta de acompanhamento dos estudantes por parte dos docentes (supervisores) e conseqüentemente, o desempenho do aluno é muito baixo (S10)

Pelas respostas apresentadas verificamos que os supervisores não partilham a mesma opinião relativamente ao processo de supervisão, enquanto para uns é entendido como um processo organizado e até agradável, outros apontam as suas fragilidades e as principais dificuldades que, na sua opinião, caracterizam o referido processo.

No que respeita ao papel que os supervisores atribuem ao processo de supervisão para a formação de professores, três optaram por não responder e uma das respostas não a consideramos válida. Assim, das doze respostas analisadas sobressai o papel atribuído à supervisão enquanto processo de formação dos estudantes, visível na maior parte dos discursos:

auxilia o aluno no seu desenvolvimento no processo de formação (S1)

a supervisão em processos pedagógicos tem um papel central na formação de professores na medida em que garante a dinâmica e qualidade das atividades relacionadas com a formação, permite detetar e corrigir os erros/falhas cometidos, entre outros (S2)

Importante, pois possibilita auxiliar e ajudar os demais para que tenham uma formação de qualidade (S4)

Permite que o professor verifique se os seus formandos fazem a ligação entre a teoria e a prática; permite melhorar o conhecimento aprendido (S6)

Dar aos estudantes conhecimentos práticos e metodológicos no processo de ensino e aprendizagem; familiarizar no estudante o futuro meio que estará inserido no seu dia a dia” (S8)

O processo de supervisão para o professor tem um papel fundamental na concretização e alcance dos objetivos preconizados” (S9)

Fundamental na formação integral do professor(S13)

Alguns supervisores relevam o acompanhamento dos estudantes e a relevância do mesmo para o seu desenvolvimento, a este respeito S5 refere “[o processo supervisivo é] mediador entre o conhecimento adquirido e o transmissor”, na mesma linha S7 acrescenta que “[a supervisão dá] orientações para a melhoria da qualidade da prática na área da docência/educação”. Os discursos de S10 e S12 reforçam esta ideia quando mencionam, respetivamente, que “o acompanhamento do aluno durante o período da supervisão é muito fundamental visto que é a partir desse processo que o aluno poderá reduzir ou eliminar algumas lacunas que foi observando durante as práticas” (S 10) e “a supervisão se for bem feita é muito importante porque ajuda o aluno a melhorar profissionalmente, é o supervisor que vai lhe aconselhar sobre o que está bem e o que está mal na sua atuação como professor de forma a melhorar” (S 12). Já S14 destaca o papel do supervisor, indicando que o mesmo tem a responsabilidade de “verificar os planos de aula antes de ser dada a aula; assistir à aula do estudante praticante; avaliar cada aula assistida junto com o tutor local”, mais uma vez a supervisão surge associada à avaliação do estudante.



Nas respostas analisadas surgem, com menor frequência, outros aspetos relacionados com a supervisão, como por exemplo permitir a aproximação entre a universidade e a escola integrada, referido por S1, e promover a articulação entre vários saberes e a iniciação à pesquisa mencionado por S13.

Os supervisores, quando questionados sobre as fragilidades e os constrangimentos que sentem no desenvolvimento do processo de supervisão, apontam para os aspetos apresentados na tabela 1.

**Tabela 1. Fragilidades/constrangimentos**

<b>Fragilidades/constrangimentos</b>	<b>N.º de respostas</b>
Escassez de tempo do supervisor e do estágio	8
Elevado número de estudantes por supervisor	5
Ausência de transporte	4
Falta de comunicação entre a UP e a escola/tutor local	4
Fraca logística (liderança, pagamento)	3
Papel do tutor local	3
Distância do local de estágio	2
Falta de recursos	2
Falta de conhecimentos das atividades supervisivas	1

Verificamos que 8 supervisores indicam a escassez de tempo como constrangimento do processo supervisoivo. Esta ideia é clarificada nos seguintes discursos:

O não acompanhamento do estudante praticante do estágio num semestre (o estágio começa no meio de um semestre e não termina todo o semestre) (S5)

Muitas das vezes os alunos são colocados nas escolas fora do período estabelecido para o efeito. O aluno não tem muito tempo para realização do estágio/práticas (S10)

Falta de tempo para supervisionar visto que o docente tem que dar aulas a outras turmas no período em que o supervisando está a dar aulas; falta de comprometimento de alguns supervisores e tutores que deixam o estudante a estagiar sozinho (S12)

Pouco número de aulas para poder ser avaliado; o praticante apenas dá aulas na escola por um período curto e não há continuidade das atividades na mesma escola (S14)

Por outro lado, importa referir que esta opinião já tinha sido expressa pelos supervisores quando lhes solicitamos para caraterizar o processo de supervisão. Do discurso de S2 sobressaem outras preocupações que se prendem- com o número de estagiários por supervisor com a falta de transporte “a distância entre o local do estágio da supervisão em

relação ao de residência ou local de trabalho do docente; elevado número de estudantes por docente”.

Por último, destacamos que alguns supervisores demonstram algum descontentamento relativamente às interações com as escolas que recebem os estagiários e o seu respetivo acompanhamento, tal como evidencia a opinião de S8 “Recusa de algumas instituições (privadas) em receber os estudantes; abandono dos estudantes por parte do tutor local”.

Em articulação com a questão anterior solicitamos aos supervisores que indicassem sugestões para melhorar o processo de supervisão, as suas respostas estão expressas na tabela 2.

**Tabela 2. Sugestões**

Sugestões	N.º de respostas
Formação dos supervisores	4
Gestão do tempo	4
Redução do n.º de estagiários por supervisor	4
Organização do processo	4
Realização de seminários entre a UP e as escolas	2
Troca de experiências	2
Disponibilidade de recursos e transporte	2

São várias as sugestões que os supervisores indicam, designadamente, um maior investimento na sua formação, apontam a formação contínua como uma mais-valia para exercerem o papel de supervisores e também a partilha de experiências com outros docentes, como refere S2 “capacitação/troca de experiências em matéria de supervisão de processos pedagógicos, tais como: supervisão pedagógica, supervisão do estágio pedagógico e de práticas profissionalizantes e de práticas pedagógicas”.

Em concordância com os constrangimentos que enumeraram propõem mais tempo para a realização do estágio e para a permanência do estagiários nas escolas e a redução do número de estagiários por supervisor, a este respeito S12 sugere “que houvesse docentes que só se dedicassem ao estágio no semestre em que este ocorre; que o estudante ficasse pelo menos 6 meses no estágio”.

Sugerem, ainda, a organização mais eficaz do processo, como evidencia o discurso de S 10 quando refere ser fundamental “Preparar o expediente para colocação dos alunos com muita antecedência; os supervisores devem participar em todas as fases práticas nas escolas; e dar o parecer aos alunos de todas as aulas assistidas”.

#### **4. Sinopse conclusiva**

Os resultados apresentados demonstram que os supervisores atribuem importância ao processo de supervisão na formação inicial de professores, destacando a sua relevância do ponto de vista formativo, uma vez que, na sua opinião, contribui para o processo de ensino-aprendizagem e para o desenvolvimento profissional dos estudantes. Valorizam o acompanhamento que fazem dos estagiários, evidenciando o papel de cada um dos intervenientes no processo. É evidente nos discursos descritos que a supervisão surge associada à avaliação dos estudantes, o que nos leva a inferir que, de certa forma, os supervisores a valorizam do ponto de vista formativo, mas também a encaram como um processo regulador.

Apontam algumas dificuldades associadas à supervisão, quer do ponto de vista organizacional, quer da disponibilidade de recursos que têm à disposição. Sendo a supervisão um processo complexo, dinâmico e multidimensional implica a articulação entre todos os agentes envolvidos e a mobilização de recursos, o que em determinados momentos se pode constituir como um constrangimento ao seu desenvolvimento. No entanto, e no sentido de dar resposta aos problemas identificados elencam um conjunto de propostas para os minimizar. Entendem a formação contínua como fundamental, quer do ponto de vista concetual quer do ponto de vista didático-pedagógico. Sugerem também uma gestão mais eficaz dos recursos e a promoção de interações mais positivas entre a universidade e as escolas de acolhimento dos estagiários.

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## Reflexão sobre a prática: o que e como reflete uma futura professora de matemática

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### Resumo

*Esta comunicação apresenta aspetos do conteúdo das reflexões escritas por uma futura professora sobre uma experiência de ensino e aprendizagem em sala de aula. Esta experiência foi desenvolvida numa turma de matemática com dezanove alunos do 6.º ano de escolaridade, abordando uma unidade de ensino relacionada com tópicos estatísticos. A futura professora, assumindo características de ensino exploratório e de reflexão sobre a prática, propôs aos seus alunos um trabalho estatístico de natureza mais investigativa, que proporcionou uma organização e tratamento de dados apelando a diferentes modos de registo e representação da informação recolhida, como a construção de gráficos usando materiais de desenho ou um suporte digital. O estudo sobre as reflexões escritas foi orientado para a identificação do conteúdo em que incidiram as apreciações da futura professora. Começando com uma leitura flutuante do relato da experiência, foi evoluindo para leituras mais precisas e organizadas dos registos escritos, fazendo emergir sobre o que a futura professora refletia, que permitissem categorizar o respetivo conteúdo. A futura professora concentrou as suas reflexões escritas em diversas dimensões relevantes da prática letiva, revelando, por exemplo, as suas preocupações com a criação de contextos de aprendizagem estimulantes para os seus alunos, a relevância das práticas de avaliação dos desempenhos dos seus alunos, a diversificação dos modos de trabalho dos seus alunos, a importância do desenvolvimento de atitudes positivas relativamente à matemática ou a projeção do trabalho futuro a desenvolver.*

**Palavras-chave:** *educação básica, reflexão sobre a prática, reflexão escrita.*



## 1. Contexto do estudo

O estudo, que se apresenta neste texto, está contextualizado no Relatório Final de Estágio (RFE) elaborado e defendido publicamente por uma futura professora (Teresa, nome fictício) na conclusão do Mestrado em Ensino do 1.º e do 2.º Ciclo do Ensino Básico na Escola Superior de Educação de Bragança, concretizando o trabalho realizado na Prática de Ensino Supervisionada (PES) e relativo ao estágio profissional para a docência. O regulamento da instituição, que orienta a elaboração e redação do RFE, regista que os futuros professores devem “apresentar, de forma contextualizada, experiências de ensino e aprendizagem realizadas ao longo do estágio, abrangendo os vários níveis de educação ou ciclos de ensino e disciplinas do domínio de habilitação, e reflexão crítica sobre as mesmas. Esta reflexão deve ser sustentada na literatura científica, pedagógica e investigativa de referência e em dados da prática”. É, assim, visível a assunção do papel central que a reflexão ocupa na construção e desenvolvimento do conhecimento profissional, acompanhando as evidências da relevância dos processos reflexivos no pensamento e nas práticas de um professor largamente documentadas na literatura (Kwon & Orrill, 2015; Martins & Santos, 2012; Schön, 1983).

No seu relatório, Teresa apresentou e refletiu sobre experiências de ensino e aprendizagem realizadas nos dois ciclos de ensino e nas diversas disciplinas de docência, que foram enquadradas pelo tema integrador “recursos para a aula” que trabalhou ao longo da PES. Este texto centra-se na análise das reflexões escritas que a futura professora produziu sobre uma experiência de ensino e aprendizagem desenvolvida numa aula de matemática no tema “Organização e tratamento de dados (OTD)” em que os alunos recorreram ao *Excel*.

## 2. Enquadramento teórico

Embora possam ser associadas perspetivas e características diversas ao conceito de reflexão, entendemo-la como “um processo mental de tentar estruturar ou reestruturar uma experiência, um problema, ou o conhecimento existente, conduzindo à compreensão destes e constituindo-se como um processo contínuo de análise e refinamento da prática, em que o carácter recursivo e a natureza cíclica definem sumariamente a forma como se processa” (Martins, Pires, & Sousa, 2017, p. 411).

Na literatura em educação, há um grande consenso no reconhecimento da reflexão como um processo essencial para interpretar, compreender e dar sentido à atividade profissional de um professor (Eynon, 2009; Korthagen, 2012; Kwon & Orrill, 2015; Martins & Santos,

2012; Sellars, 2014), permitindo-lhe analisar as suas próprias práticas e atuações. Mas, como realça Korthagen (2012), “a reflexão sistemática e eficaz” é um processo que requer aprendizagem no sentido de “trazer os aspetos inconscientes do ensino para o nível da consciência” (p. 155).

Schön (1983) introduz três tipos de reflexão associados ao conhecimento em ação: a reflexão *na ação*, reflexão *sobre a ação* e a reflexão *sobre a reflexão na ação*. A reflexão *na ação* é um processo de diálogo do sujeito com uma situação problemática, sem a interromper, através do qual o professor aprende a partir da análise da sua própria atuação. A reflexão *sobre a ação* e a reflexão *sobre a reflexão na ação* correspondem a processos de análise que o professor realiza *a posteriori* sobre as características e o decurso da sua própria ação, relacionando o conhecimento na ação e a reflexão na ação com a situação problemática e o seu contexto. Todos estes processos, interligados e complementares uns dos outros, ajudam o professor a enfrentar as situações divergentes da prática, proporcionando-lhe uma intervenção prática racional.

É importante atender ao conteúdo da reflexão (Meireles (2005), que não pode nem deve ser relegado para um segundo plano. Igualmente importante é o papel da escrita no desenvolvimento das práticas reflexivas, potenciando o seu aprofundamento, pois “ao escrever, o professor toma consciência de seu próprio processo de aprendizagem” (Passos, Nacarato, Fiorentini, Miskulin, Grando, Gama, Megid, Freitas, & Melo, 2006, p. 202).

### 3. Enquadramento metodológico

O estudo segue uma abordagem de natureza qualitativa e interpretativa (Amado, 2014; Bogdan & Biklen, 1994), procurando compreender o que é único e particular para a futura professora na interpretação e reflexão que faz das diferentes experiências que foi vivendo e que significados lhes atribue.

A experiência de ensino e aprendizagem apresentada no relatório final de estágio assume características de investigação-ação e de investigação sobre a prática (Ponte, 2002). A futura professora suportou a escrita da experiência, realizada com os seus dezanove alunos de uma turma de matemática do 6.º ano de escolaridade, em notas de campo registadas num diário de bordo construído ao longo do estágio profissional, na observação direta da atividade dos alunos em sala de aula e na análise das respetivas produções e opiniões. A reflexão sobre a prática foi perspetivada para a compreensão da experiência de ensino e aprendizagem, dando-lhe consistência e coerência.



A análise das reflexões escritas pela futura professora foi orientada para a identificação do conteúdo em que incidiram as referências reflexivas apresentadas na experiência de ensino e aprendizagem. O primeiro contacto com estas referências reflexivas foi feito através de uma leitura flutuante (Amado, 2014) da experiência, que foi evoluindo para leituras cada vez mais sistematizadas do material escrito, procurando fazer emergir sobre o que a futura professora refletia e que aspetos de sala de aula mais valorizava

#### 4. A experiência de ensino e aprendizagem

A experiência corresponde ao final da unidade de ensino “Organização e tratamento de dados” em que foi valorizada a investigação estatística nas suas diferentes dimensões: (i) definição de uma questão a investigar; (ii) seleção dos tipos de variável a tratar e recolha de dados; (iii) organização e tratamento da informação recolhida; e (iv) apresentação da informação e estabelecimento de conclusões. Nesta aula os alunos trabalharam os tópicos “tabelas de frequências absolutas e relativas, gráficos de barras, diagramas circulares” e o objetivo “construir e interpretar tabelas de frequências absolutas e relativas, gráficos de barras, diagramas circulares” (Ministério da Educação, 2007, p. 43), recorrendo a diferentes formas de representação da informação. Teresa justificou as opções feitas, afirmando que “os alunos já tinham conhecimento das possíveis hipóteses de representação, tendo clarificado vantagens ou desvantagens de cada possibilidade. Na aula de conclusão do tema optei, então, por proporcionar aos alunos uma aula que recorresse a um meio distinto do habitual, em que fizessem a representação de dois gráficos [barras, circular] em *Excel*”.

#### 5. Reflexões sobre a experiência de ensino e aprendizagem

Nas suas reflexões, Teresa registou dimensões muito relevantes para uma melhor compreensão da dinâmica da sala de aula e dos papéis desempenhados pelos intervenientes, diversificando o respetivo conteúdo. Teresa refletiu sobre (i) aspetos de âmbito global, como os contextos de aprendizagem, a organização da sala de aula, a importância da OTD, das TIC ou as atitudes face à matemática; (ii) aspetos mais relacionados com o papel dos alunos, como as suas dificuldades, modos de trabalho, produções que realizam ou a resolução de tarefas de natureza mais investigativa; e (iii) aspetos mais relacionados com o seu papel de professora, como as práticas de avaliação dos desempenhos, a reformulação de estratégias em ação ou implicações no trabalho futuro. Apresentam-se cinco situações que realçam e evidenciam aspetos do conteúdo das reflexões escritas por Teresa no seu RFE.

### ***Situação 1: atitudes face à matemática***

Há então que focar o objetivo no sentido de influenciar os alunos na forma como eles vêem e encaram a matemática o que, a longo prazo, se torna um fator fundamental à sua compreensão e empenhamento. Para isso, é importante que o professor, ele próprio, entenda a matemática como “dinâmica, que engloba o estudo de padrões, [em que] as interações serão muito abertas e incluirão indubitavelmente explorações, discussões e expressões escritas dos processos de pensamento dos alunos e conclusões” (Matos & Serrazina, 1996, p. 167). Como era bem evidente a ideia dos alunos de que a disciplina de matemática era, essencialmente, um “conjunto de procedimentos ou algoritmos a seguir” (p. 167), não proporcionando um crescimento face à matemática, selecionei uma tarefa que se afastasse dessa mesma ideia e permitisse as explorações próprias ou a partilha de ideias e argumentos. (Teresa)

As atitudes que alunos e professores vão desenvolvendo sobre a matemática revelam-se uma preocupação para Teresa, dado que podem influenciar, decisivamente, o ensino e a aprendizagem desta disciplina. Apoiar a sua reflexão em literatura de referência, destacando a natureza mais estática ou mais dinâmica da maneira como se encara e vê a matemática. Partindo da percepção que tem das ideias dos seus alunos baseadas em perspetivas mais estáticas, realça a visão da matemática como um saber dinâmico ligando-o à exploração de situações e à partilha de opiniões. Neste sentido, prepara e propõe aos seus alunos uma tarefa matemática que lhes permita um envolvimento mais ativo e reforce as possibilidades de exploração e discussão dos diferentes pontos de vista.

### ***Situação 2: modos de trabalho dos alunos***

Numa primeira fase, a ideia que melhor me convencia seria o trabalho individual (...). Contudo, refletindo melhor acerca deste fator, vejo vantagens e concordo que a interação entre pares pode contribuir para o desenvolvimento pessoal do aluno, embora acrescentem novas exigências para o professor. Em trabalhos de grupo, existe uma maior preocupação por parte do professor, visto que todos os grupos apresentaram ritmos de trabalho bastante diferenciados, “tornando por vezes difícil encontrar um momento apropriado para se fazer uma discussão geral ao nível de toda a turma” (Abrantes, Leal, Teixeira & Veloso, 1997, p. 61), o que me exigiu uma mobilidade constante, um acompanhamento mais pormenorizado e individualizado, a maior parte das vezes para esclarecer pontos que já tinham sido referidos numa primeira explicação coletiva. Esta circunstância deve-se ao próprio facto do trabalho ser realizado em grupo, com questões não relacionadas com o trabalho em si que, desviando a atenção do aluno, o desconcentram do que realmente é importante. Mas a interação entre pares (...) promove a autoestima dos alunos, demonstrando-lhes que os seus argumentos e raciocínios são escutados e respeitados, aprendendo a modificar as estratégias consoante a necessidade e defendendo os pontos de vista. (Teresa)

A organização e gestão do trabalho dos alunos em sala de aula merece um destaque especial por parte de Teresa e, nesta transcrição, é visível a influência da reflexão na alteração das suas opções docentes, passando de uma proposta de trabalho individual para um trabalho em pares. Refletir sobre o modo mais adequado como os alunos devem resolver uma tarefa, permite a Teresa destacar o papel importante das interações na sala de aula e ter consciência que diferentes modos de organização exigem, ao professor, diferentes formas de gerir o



trabalho letivo. Mais uma vez, as suas reflexões suportam-se em bibliografia de referência, colocando em evidência que refletir é sustentar e dar mais sentido às opiniões que se vão formando e, por isso, é sempre um processo intencional.

### ***Situação 3: tarefas de natureza mais investigativa***

Seria de todo o meu agrado proporcionar aos alunos uma investigação livre, [pois] oferecer aos alunos uma abordagem investigativa “envolve uma mudança no poder do professor que deixa de ter controlo sobre as respostas” (Abrantes, Leal & Ponte, 1996, p. 31). [Também] ocorre no aluno uma transformação, dando-lhe a oportunidade de “dominar os conteúdos a tratar, as metodologias a utilizar e as soluções a aplicar” (p. 31), o que altera os processos de verificação do professor (...). No entanto, em grande parte devido à gestão curricular do tempo destinado ao tema, a opção não foi por um trabalho de investigação “integral” mas apenas por alguns aspetos importantes do trabalho investigativo. [Constato que] existe alguma rejeição por parte dos professores relativa às investigações, sendo vistas como uma perda de tempo, ocupando o lugar do “trabalho duro” que deve ser dedicado à matemática (p. 32). No entanto, torna-se fundamental aumentar o sentido de autonomia dos alunos, recusando a ideia de que o indivíduo apenas deve assimilar a informação mecanicamente. (...) Após uma reflexão mais aprofundada sobre esta opção, penso que é necessária uma aprendizagem mais completa que permita lidar com os erros tornando os alunos mais capazes de fazer novas reformulações e experimentações. (Teresa)

Teresa reflete sobre o trabalho matemático a desenvolver pelos seus alunos, em especial o trabalho de natureza mais aberta e exploratório, concretizado nas tarefas que resolvem em sala de aula. Ao pensar em propor uma investigação “livre”, a futura professora pretende proporcionar, aos alunos, momentos de uma maior autonomia na procura de caminhos e de soluções. No entanto, motivada por restrições de tempo, alarga a reflexão sobre a integração deste tipo de tarefas na aula de matemática relacionando-a com implicações na gestão e desenvolvimento curriculares e nos papéis desempenhados por alunos e pelo professor, nomeadamente, na validação de processos e resultados.

A atividade experienciada evidencia sobre os alunos uma receptividade e uma produtividade francamente positiva (...) tornando o aluno num indivíduo participante, crítico e argumentativo. Este tipo de atividades permite mudar a imagem “tradicional” da matemática que se enraíza nos alunos. Procura-se a mudança na forma como vêem a matemática, apelando à substituição de estratégias transmissivas por estratégias mais ativas, diversificando os instrumentos utilizados e evoluindo para processos que permitam partilhar e acrescentar novas informações. (Teresa)

Refletindo após a realização da tarefa, Teresa reconhece o bom envolvimento e desempenho dos alunos, que assumem papéis mais ativos nas suas aprendizagens, retomando a relevância do desenvolvimento de atitudes positivas face à matemática. Para Teresa, este maior protagonismo dos alunos na aula também tem consequências nas suas práticas de ensino, que devem ser mais orientadas para um ensino do tipo exploratório em contraponto a um ensino do tipo direto e essencialmente transmissivo.

#### **Situação 4: avaliação dos desempenhos dos alunos**

Todos os trabalhos foram identificados e (...) recolhidos, em suporte digital, para uma posterior avaliação. É necessário manter práticas de avaliação em todas as aulas e, neste caso, não se tratou de uma exceção. Esta avaliação esteve mais direcionada para aspetos do comportamento, da responsabilidade e da capacidade de trabalhar em grupo, enfatizando o esforço do próprio aluno. Também dei importância ao produto final das produções dos alunos, visto que informa se os passos seguidos durante o processo foram os corretos. Não os avaliei quantitativamente dado que a intenção principal foi proporcionar o primeiro contacto com diferentes instrumentos de cálculo, o que originou um auxílio bastante forte por parte de todos professores e, portanto, as produções foram muito apoiadas. Em termos gerais, os resultados finais também não tiveram grandes discrepâncias, não se evidenciando os diferentes níveis [habituais] de aprendizagem dos alunos. Aliás, se alguma distinção se pode fazer, os alunos considerados com desempenho mais fraco apresentaram gráficos mais “requintados” em termos estéticos. No final da aula pedi aos alunos que identificassem as principais dificuldades sentidas na utilização (...) do Excel, assim como a utilidade e os benefícios da utilização da folha de cálculo na organização e tratamento de dados. (Teresa)

As práticas de avaliação são muito valorizadas por Teresa, que as integra nas rotinas da sala de aula. Realça a sua dimensão formativa, refletindo quer sobre as atitudes ou os comportamentos e os processos que os alunos desenvolvem quer sobre os produtos que concretizam. Diversifica, igualmente, as fontes de recolha da informação, dando importância às opiniões e pontos de vista dos alunos, bem como às suas produções escritas.

#### **Situação 5: implicações para o trabalho futuro**

Se tivesse mais tempo, seria possivelmente mais significativo fornecer aos alunos não a ficha de trabalho mas um guião com os passos a seguir para a realização da atividade. Desta forma, cada aluno sentir-se-ia mais responsável (e mais autónomo) para concretizar as tarefas, visto que não teria que esperar pelos outros grupos para avançar nos procedimentos da atividade. Esta atuação favorece a concentração no trabalho, afastando momentos de dispersão, e o desenvolvimento da comunicação com o colega do par ou com o professor. [...] Embora o tempo destinado para a unidade de ensino não o tenha permitido, teria sido uma boa opção propor aos alunos a produção de um relatório escrito sobre o trabalho realizado. A atividade teria proporcionado o desenvolvimento da capacidade de interpretação e consequente comunicação matemática, através de uma análise escrita e individual das conclusões retiradas dos gráficos produzidos. (Teresa)

Por vezes, nas suas reflexões escritas, Teresa tenta colocar e fundamentar alternativas à opção seguida, especialmente quando a considera que não foi muito bem sucedida. Analisando a preparação e a concretização da tarefa, a futura professora pensa que teria sido mais útil para os seus alunos ter dado melhores orientações para o trabalho a realizar em pares e ter optado por solicitar a produção de um relatório escrito, pois permitir-lhes-ia melhores oportunidades para interpretar e comunicar as respetivas opiniões e produções.



## 6. A concluir: *projeção da vida profissional*

As suas considerações escritas sobre o trabalho que ia realizando evidenciam características associadas à reflexão, como sejam a estruturação, a intencionalidade, a continuidade, a interpretação ou a análise (Eynon, 2009; Schön, 1983). Teresa, enquanto futura professora, revela uma grande preocupação com os processos reflexivos e, através deles, procura compreender e dar sentido às suas práticas de ensino (Korthagen, 2012; Martins & Santos, 2012). Esta valorização, aliada à prática da reflexão, permite-lhe discutir e procurar outras soluções ou outros caminhos para resolver situações colocadas na sua atividade letiva, estar mais atenta à complexidade dos ambientes de aprendizagem dos seus alunos, ter uma visão mais articulada e global das suas práticas de ensino e reconhecer a importância da integração da reflexão na vida profissional (Kwon & Orrill, 2015; Sellars, 2014).

A concluir, como afirma Teresa na projeção da sua atividade profissional futura, todo o trabalho realizado “consciencializou-me para o facto de existir uma real necessidade do (futuro) professor refletir sobre as suas práticas profissionais e de que este facto deverá fazer parte do processo contínuo do que é realmente ser professor”. É, então, fundamental “adotar, ao longo da nossa carreira, uma postura flexível, autocrítica, reflexiva e autoavaliativa, tendo a plena consciência de que em todo o processo educativo os alunos aprendem com os professores e os professores aprendem com os alunos. Penso que este será o melhor caminho a seguir para nos tornarmos cada vez melhores profissionais”.

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## Um jogo de gestão de caos para aprendizagem informal

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### Resumo

*A aprendizagem ao longo da vida implica que as pessoas estejam disponíveis para alterar a atitude, a forma de pensar ou de agir, normalmente com base em algum objetivo. Seja com apoio empresarial, devido a requisito de empresa para formação ou informação, seja em ambiente letivo, a aprendizagem implica um contacto com conteúdos e metodologias que estimulam o desenvolvimento pessoal. Muitas vezes, a aprendizagem é estimulada por passagem de documentação, formação presencial ou a distância, b-learning, etc. Neste trabalho, pretende-se avaliar uma forma de aprendizagem informal com base em jogos. A aprendizagem com base em jogos permite experimentar diferentes papéis, correr riscos, errar e repetir sem receio, encorajando o aprendente a contactar e a experimentar os conteúdos. Assim, descreve-se o desenho de um jogo sério com foco na aprendizagem e tendo como principal forma de jogabilidade a gestão e tomada de decisões. O jogo foi desenvolvido para dispositivos iOS e Android, utilizando a ferramenta Unity.*

*A premissa do jogo coloca o jogador no papel de um gestor empresarial em que é lhe são colocadas diferentes situações que requerem uma decisão. O jogo apresenta uma mecânica baseada em cartas, fazendo com que o jogador escolha entre duas opções, deslizando a carta para direita ou para a esquerda, influenciando as finanças e reputação da empresa. Adicionalmente, o jogo prevê, também, conquistas e cartas colecionáveis, obtidas ao longo do jogo.*

*O jogo permite que sejam criados diferentes decks para diferentes conteúdos. No momento, foi criado um deck com foco na aprendizagem em cibersegurança e está sendo validado em quatro contextos diferentes. Por meio de questionários, exames antes e após a utilização do jogo e dados recolhidos por observação, é possível obter resultados da satisfação dos alunos e do impacto da utilização do jogo como contributo no processo de aprendizagem.*



**Palavras-Chave:** *Aprendizagem informal, jogos sérios, aprendizagem baseado em jogos.*

## **1. Introdução**

O termo aprendizagem informal, de uma forma geral, pode ser definido como o aprendizado obtido fora de classes organizadas e estruturadas (McCartney et al., 2011). Além desta definição geral, a aprendizagem informal pode contemplar vários tipos diferentes de aprendizado, como o aprendizado autodirigido, o aprendizado em ambientes informais e o aprendizado no local de trabalho (McCartney et al., 2011). A aprendizagem resultante da realização de atividades diárias e relacionadas a família, trabalho ou lazer (como jogos) também podem ser definidas como uma aprendizagem informal (European Commission, 2001).

A eficácia da aprendizagem pode ser aumentada por intermédio da motivação e do interesse pelo assunto, recorrendo a jogos (Protopsaltis, Pannese, Pappa, & Hetzner, 2011). Neste sentido, jogos sérios é o termo utilizado para se referir a jogos com intenções além do entretenimento (Deterding, Dixon, Khaled, & Nacke, 2011). A aprendizagem informal consiste na realização de atividades planejadas que não são explicitamente designadas para a aprendizagem. Assim, os jogos sérios explicitamente projetados para a aprendizagem, se bem planejados e a aprendizagem ocorrer como uma consequência do jogo, podem ser categorizados como experiência de aprendizagem informal (Protopsaltis et al., 2011).

A aprendizagem com base em jogos permite aos jogadores experimentar diferentes papéis, correr riscos, errar e repetir sem receio, encorajando o aprendente a contactar e a experimentar os conteúdos (Pivec, 2007). O objetivo deste trabalho é propor uma forma de aprendizagem informal baseada em jogos, mais especificamente um jogo sério com foco na aprendizagem e tendo como principal forma de jogabilidade a gestão e tomada de decisões. Este jogo tem como foco dispositivos móveis com os sistemas operacionais *Android* e *iOS*.

## **2. Jogos sérios para dispositivos móveis**

Em geral, os estudantes gostam de jogar e, geralmente jogarão constantemente (Kalloo, Kinshuk, & Mohan, 2010). Os professores têm dado atenção à utilização de jogos como forma de aprendizagem e como estes podem contribuir para melhorar e facilitar os processos de aprendizagem (Yue & Ying, 2017). Algumas características devem ser



estabelecidas no projeto de um jogo sério, como a mecânica. A mecânica é um elemento implementado de forma estratégica pelos desenvolvedores para uma experiência lúdica (mecânicas de jogo) ou atividade de aprendizagem (mecânicas de aprendizagem) (Patino, Romero, & Proulx, 2016).

A utilização de dispositivos móveis, como *smartphones* e *tablets*, é facilitada por alguns aspectos, como a conectividade, pois através do acesso à *internet* com telemóveis é possível ter uma ampla forma de comunicação e acesso a informações, e recursos, como textos, sons, imagens e vídeos (Fonseca, 2013). Os aspectos de mobilidade e portabilidade permitem ainda que os usuários levem os dispositivos móveis para qualquer lugar e possam utilizar a qualquer momento (Hamid & Fung, 2007).

Encontra-se pesquisas com jogos em dispositivos móveis aplicados em diversas áreas, por exemplo, no ensino de matemática, Chang e Yang (2016) apresentam um jogo com conceitos de perímetro, área, superfície da área, volume e capacidade e, nos quais, os resultados ao realizar um exame antes e após a utilização do jogo demonstram um progresso significativo na pontuação média dos estudantes. No ensino de cidadania, Chee, Tan, e Liu (2010) demonstram o jogo *Statecraft X* aplicado a estudantes de 15 anos. No ensino de história, Yue e Ying (2017) apresentam o jogo *History Learning Mobile Game* (HLMG), que tem como objetivo ensinar história na educação básica.

Outros contextos também podem se beneficiar dos jogos sérios em dispositivos móveis, como é o caso do ensino de primeiros socorros a indivíduos com Transtornos do Espectro Autista (TEA), em que Urturi, Zorrilla, e Zapirain (2011) desenvolveram um jogo para *smartphones* e *tablets*, em que os resultados apontam o jogo como tendo contribuído para enriquecer e aumentar o impacto da educação e terapia.

### 3. *Reigns* e a mecânica de deslizar cartas como decisão

Neste trabalho, o jogo será direcionado aos dispositivos móveis que, pela falta de um teclado físico, faz com que os desenvolvedores utilizem o toque na tela de diversas formas para interação com o usuário. Uma interação comum é o *swipe* (deslizar) para direita e para a esquerda, utilizado e popularizado no aplicativo de relacionamento *Tinder*. Inspirados pelo *Tinder*, diversos aplicativos utilizam a mesma abordagem como, por exemplo, o jogo *Reigns*.

O *Reigns* é um jogo desenvolvido pela *Nerial* e publicado pela *Devolver Digital*. Lançado em 2016, conta com suporte para as plataformas *Android*, *iOS*, *Linux*, *macOS* e *Microsoft Windows*. O jogo decorre num mundo medieval fictício, onde o jogador assume o papel de



um monarca e governa um reino tomando decisões. O objetivo é governar pelo maior tempo possível sem desequilibrar os pilares da sociedade: o clero, o povo, o exército e as finanças. Caso não consiga manter o equilíbrio, o rei é morto e um novo rei começa a governar, assim o jogador a cada novo rei tenta conquistar novos objetivos.

A principal forma de jogabilidade utilizada no *Reigns* é a tomada de decisões deslizando cartas para direita e para esquerda (Fig. 1). As cartas são exibidas de forma aleatória ao jogador, apresentando uma situação em que deve tomar uma decisão. Cada carta é composta de um personagem, um texto e duas opções para escolha. A cada escolha realizada pelo jogador, alterações ocorrem nos recursos como consequências, aumentando ou diminuindo os pilares do seu reino.



Fig 1: Reigns

Após o lançamento do *Reigns*, outros jogos também seguiram a mesma linha de jogabilidade, por exemplo o *Lapse: A Forgotten Future*, o *Nirvana: Game of Life* e o *Soccer Kings*. A principal mecânica utilizada na proposta de jogo neste trabalho baseia-se nesta mesma jogabilidade, cartas com situações apresentadas ao jogador e, no qual, deve deslizar para direita ou para esquerda como forma de tomada de decisão.

#### 4. Proposta de jogo

O jogo deste trabalho coloca o jogador no papel de um gestor empresarial e, no qual, deve tomar decisões e conciliar para que as finanças e a reputação com a comunidade de sua empresa não cheguem a zero. As situações apresentadas são contextualizadas de acordo com o conteúdo da aprendizagem, pelo que se o conteúdo é sobre cibersegurança, as situações apresentadas para as tomadas de decisões serão sobre o mesmo tema.

Sempre que o jogo começa inicia-se no dia 0 e, a cada decisão tomada, um novo dia surge. Se acontecer um fim de jogo, por ter ficado sem dinheiro ou reputação perante a comunidade, o jogo é reiniciado, voltando ao dia 0.

Como citado anteriormente, a forma de interação com o jogo é por meio de cartas em que cada carta apresenta uma situação ao jogador para que seja tomada uma decisão. Uma coleção de cartas, ou seja, um *deck*, compõem um conteúdo a ser aprendido pelo jogador. O jogo permite a criação de vários *decks* com conteúdos diferentes e, então, o jogador escolhe um para ser jogado, permitindo a troca de *decks* ao decorrer do jogo. O *deck*, além do conteúdo, também define o enredo, por exemplo, a área de atuação da empresa a ser gerida. O *deck* também define outros elementos, como os personagens, conquistas e as cartas colecionáveis (Fig. 2). A tela principal do jogo prevê dois botões, um para a troca de *decks* e outro para aceder à lista de conquistas. Adicionalmente, também é possível observar a percentagem referente à reputação perante a comunidade, o dia atual, as finanças em euros e, no centro, a carta atual com um texto na parte superior.

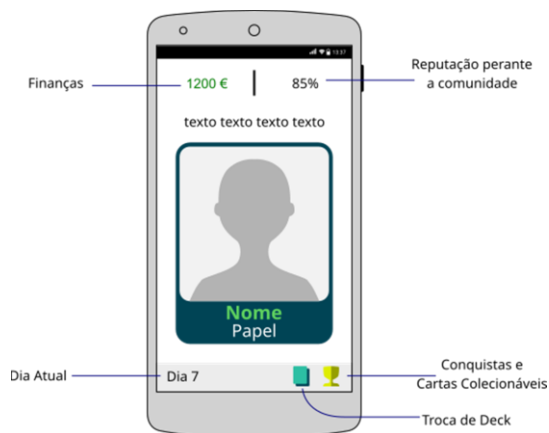


Fig 2: Tela Inicial

Um exemplo de uma jogada é exibido na Fig. 3, no qual a carta com o colaborador Mateus apresenta um questionamento sobre o destino da sobra de tintas. Se o jogador deslizar para a direita tem a opção de investir na reutilização. Se deslizar para esquerda, tem a opção de descartar no rio. Em algumas ocasiões, como neste exemplo, sem ter o real conhecimento das consequências, o jogador pode pressupor que ao investir ele terá um gasto, e ao descartar no rio, uma queda na reputação com a comunidade.

As conquistas e cartas colecionáveis são objetivos extras a serem conquistados pelo jogador ao decorrer do jogo, mantidos mesmo se o jogador perder. As cartas colecionáveis são cartas que não apresentam uma situação de escolha no contexto do *deck*, que podem representar recursos, benefícios ou vantagens. Atualmente as cartas colecionáveis

comportam-se apenas como colecionáveis, mas permitem explorar alguns potenciais no futuro.



Fig 3: Exemplo da Jogabilidade

As conquistas são objetivos definidos a serem obtidos ao decorrer do jogo, no qual podem ser dias passados no jogo, quantidade de cartas colecionáveis obtidas ou escolhas realizadas. Exemplificando, uma conquista pode ser obtida se o jogador alcançar 30 dias no jogo sem perder ou obter 3 cartas colecionáveis. As conquistas de acordo com escolha realizadas exigem mais percepção do jogador, por exemplo, uma conquista no qual ele deve investir na reutilização de tintas, sendo que o jogador deve estar atento quando vai ter disponível esta decisão ao decorrer do jogo. Na Fig. 4 são exibidas as telas de troca de decks e de objetivos extras, as conquistas e cartas colecionáveis.

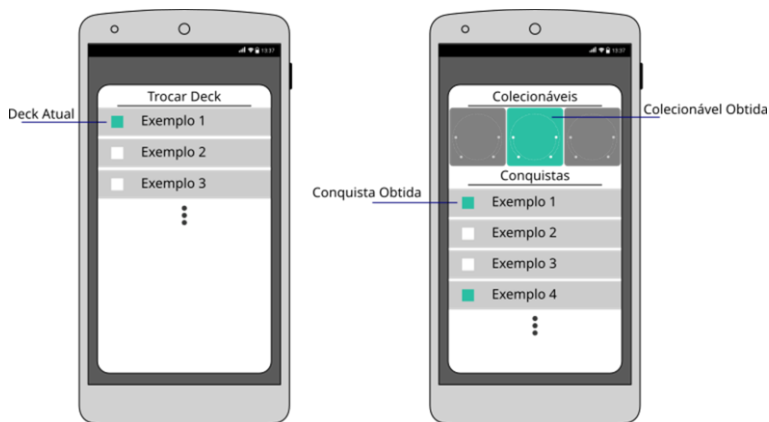


Fig 4: Troca de deck, Conquistas e Cartas Colecionáveis

A dinâmica do jogo ocorre da seguinte forma, um conjunto de cartas do deck escolhido pelo

jogador estarão disponíveis ao decorrer do jogo e, tais cartas surgem de forma aleatória para o jogador. O *software* deve, para cada jogada, escolher aleatoriamente uma carta a ser apresentada, e após o jogador tomar sua decisão, deve ser aplicado as consequências de sua escolha, e a carta será marcada como exibida. Cartas que já foram exibidas só voltaram a repetir se não houver mais cartas novas a serem apresentadas.

## 5. Conclusões e Trabalhos futuros

O jogo proposto pode permitir a aprendizagem de diferentes conteúdos, como trabalhos futuros se aplica a criação de *decks* em diferentes contextos e a realização de avaliações e testes a fim de verificar o impactado no aprendizado. No momento, avaliações com alunos do Instituto Politécnico de Bragança estão sendo realizadas com conteúdos de cibersegurança.

A proposta deste trabalho ainda há muitos aspectos para serem explorados. Com a adição de novos elementos e realização de testes avaliações, o jogo pode se tornar uma útil ferramenta para o aprendizado multidisciplinar.

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