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E-learning in "innovation, creativity and entrepreneurship": Exploring the new opportunities and challenges of technologies

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ABSTRACT

Companies and society demand professionals be able to provide creative solutions with added value as well as to implement them in order to face the arising challenges in the increasingly dynamic environment. Although the transversal competence "Innovation, Creativity and Entrepreneurship" is essential for engineers that should find innovative solutions to problems, teachers find many difficulties when training and evaluating their students in the scope of the regular courses: large groups, very adjusted time to technical contents. In this context, the School of Industrial Engineering (ETSII) at Polytechnic University of Valencia (UPV) is aware of the opportunities offered by new information and communication technologies to support teachers in this task while enhancing students' generic outcomes. For this reason, an e-learning platform has been created on this competence, that offers valuable resources to students to implement this competence throughout the assigned course tasks, and supports teachers prompted to train and evaluate this transversal competence. With this platform, the authors aim to contribute to the still neglected educational aspect of entrepreneurship and address for the first time in an e-learning system its relationship with innovation and creativity.

Introduction

To remain competitive in the markets, to grow and to lead, companies should be able to identify challenges and opportunities, as well as to explore, define and implement new solutions in the increasingly dynamic environment. This dynamism forces firms to improve their ability to meet current and future problems in a creative way with added value, that is, to innovate. Due to the increased pressure to innovate, organizations have become more interested in exploring new, collective ways to gain access to creative ideas (Parjanen & Hyypiä, 2019).

Gumusluoglu & Ilsev (2009) state that innovation through creativity is an important factor in the success and competitive advantage of organizations, as well as for a strong economy. Recently, Castillo-Vergara et al. (2018) pointed out that the importance of creativity is related to the impact on the competitiveness of business, having shown a positive correlation between teams with the best results in creativity tests and their success.

Creativity should be differentiated from intelligence, sometimes called divergent thinking, in contrast to convergent thinking related to the known common intelligence (Esquivias, 2004). However, strong relationships between creativity and innovation have been identified (Valaei et al., 2017), as well as between creativity and entrepreneurship (Ludvig et al., 2016). Indeed, creativity is identified as a root of innovation (Amabile & Pratt, 2016). Individual creativity supplies the base for organizational creativity and innovation, and results thereof have been linked with business performance and survival (Castillo-Vergara et al., 2018; Shalley & Gilson, 2004). For this reason, creativity is considered to belong to the individual level, whereas innovation is linked to the organizational one (Oldham & Cummings, 1996).

Besides, creativity is also considered a characteristic of entrepreneurial success (Ludvig et al., 2016). Entrepreneurs

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combine resources with the goal of creating something new that can be an organization, product and/or service. Only when converting their ideas into reality can entrepreneurs bring about a future state (Honig & Hopp, 2019). Entrepreneurship is, thus, a field of growing interest for economic research, because of its active contribution to economic growth (Crecente-Romero et al., 2016).

The relationship among creativity, innovation and entrepreneurship is pointed out by (Castillo-Vergara et al., 2018) who stresses that creativity is an important drive for the entrepreneurial process and innovation supporting the identification of new business opportunities. Along these lines, Boza et al. (2014) states that creativity, innovation, and entrepreneurship deals with the mind-sets and skills associated with creativity and innovation as well as the qualities and practices associated with successful entrepreneurship. For example, entrepreneurship is the individual's ability to translate ideas into action. It encompasses creativity, innovativeness, and risk taking, as well as the ability to plan and direct action towards the achievement of goals. It is necessary to consider how to apply these mind-sets and skills in their organization/business (Boza et al., 2017). Within this context of permanent change and growing turbulence, creativity, innovation and entrepreneurship have become a vital value for the survival and development of the organisations (Cuenca & Boza, 2015).

Integrated Development of the Innovation, Creativity and Entrepreneurship Competence in the Higher Education

For the reasons mentioned above, it is not surprising that there is a growing interest in the integrated innovation, creativity and entrepreneurship competence from both the professional and formative perspective. In the particular case of the engineering labour market, there is an increasing demand by companies of generic competences such as "critical and thinking out of the box capacity" and "innovation and creativity" (IIE-APD, 2017).

To develop these competencies in students will contribute to improve their access to the labour market and to adapt to their future unpredictable changes in jobs (Cuenca & Boza, 2015). One of the main University's functions is to prepare students for the professional activity by training them in those demanded competences by firms. In this context, in order to improve its graduates' employability, the Universitat Politècnica of València (UPV, Spain) has defined 13 transversal competences (TCs) for all their masters and bachelor's degrees (http://www.upv.es/contenidos/COMPTRAN/) particularly the fourth being "Innovation, Creativity and Entrepreneurship". In developing this competency, it is expected that students will be able to innovate in order to effectively respond to personal, organizational and social needs and demands with an entrepreneurial attitude (UPV, 2015). Although this competence is essential for engineers to find innovative solutions to problems, teachers find it difficult when training and evaluating their students in the scope of regular courses. In particular, the large groups and time needed for the technical contents pose a challenge to integrate this complex competence in the higher education system.

This difficult question raised to the School of Industrial Engineering (ETSII) at UPV is the question of which methodological approach allows maximizing time in the class dedicated to perform the competence. Is there any previous experience from other Universities to learn from? How can entrepreneurship be linked with creativity and innovation? This work sets the framework of action in the following section and presents a proposal to overcome these limitations. Furthermore, future research should be aimed at the analysis of creativity studies in terms of training future professionals in various areas (Castillo-Vergara et al., 2018).

For this purpose, the use of new Information and Communications Technology (ICT) tools embedded in e-learning systems can be very useful, even more in the framework of the current pandemic situation originated by COVID-19. Indeed, the provision and usage of online and e-learning systems are becoming the main challenges for many Universities during the COVID-19 pandemic (Almaiah, 2020).

Alhabeeb & Rowley (2018) defines e-learning as: "an approach to teaching and learning, representing all or part of the educational model applied, that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction and that facilitates the adoption of new ways of understanding and developing learning"(p. 1). On his part, Rodrigues et al. (2019) states that e-learning is an innovative web-based system based on digital technologies and other forms of educational materials supporting and enhancing the learning processes. The advantages of e-learning systems are that it provides learning opportunities without the typical constraints of place and time, and supports new teaching and learning approaches involving a mix of traditional learning methods and e-learning (Alhabeeb & Rowley, 2018). The internet and the increasing growth of open educational resources (digitized materials, free and open) for teachers and students are challenging the assumptions of traditional teaching methodologies attempting to affirm 'openness' as a necessary default (Ponti, 2014).

Three elements are identified to integrate e-learning systems (Fee, 2009): technology, learning content and e-learning design. Ghiringhelly and Quacquarelly (2003)

considered the e-learning design a complex process integrated by four stages: identification of training objectives, detection of training needs, creation of design team and selection of learning content.

Islam et al., (2015) and Urh et al. (2015) pointed out that Universities have paid very little attention to e-learning design connected to the educational aspect, especially for courses on entrepreneurship. Gentile et al. (2020) identify that e-learning systems in Universities has been strong on technology and learning content, whereas e-learning design has not been studied. After a deep literature review, they state that there is a scarcity of research on e-learning design and more specifically on the didactic dimension in Universities. After their empirical investigation to find out the way in which Universities perform the learning design, they conclude that their attention was focused on the different professional figures involved in the construction of the course, rather than on the e-learning design process across the four phases (Ghiringhelly & Quacquarelly, 2003).

In addition to the above, despite the strong relationship of entrepreneurship with innovation and creativity, there is not to date any e-learning system linking these three competence dimensions. For the case of UPV, some material on TC04 has been developed to assist teachers, but there is no material oriented to students.

To fill the commented gaps, the School of Industrial Engineering (ETSII) at UPV has created an e-learning platform with digital resources on the TC04. Innovation, creativity and entrepreneurship mainly oriented to students (https://www.etsii.upv.es/competencias/innovacion.php). In this paper the application of an e-learning design methodology for the didactic dimension of the TC04 is reported. The resulting e-learning platform is also described. To the best of the authors' knowledge there is no other web containing e-learning material with these characteristics -or structured in a similar way being, therefore, a relevant contribution.

Theoretical Framework Foundations

The incorporation of key competences in academic curriculum frameworks has been evident for some time (Boza et al., 2017,). Indeed, the Royal Legislative Decree 1393/2007, of 29th October 2007 proposes as a priority objective to achieve the acquisition of skills by students without excluding the content-based approach. Figure 1 shows the structural model of competences which becomes the theoretical foundation of the web design and which is aligned with the UPV strategy. The goodness and validity of this model has been demonstrated by the results obtained in the context of five institutional Innovation and Educational Improvement Projects (PIMEs) at UPV and published in several papers as reported below.

As it can be observed in Figure 1, it is assumed that the degrees' curriculum is defined in terms of the student's

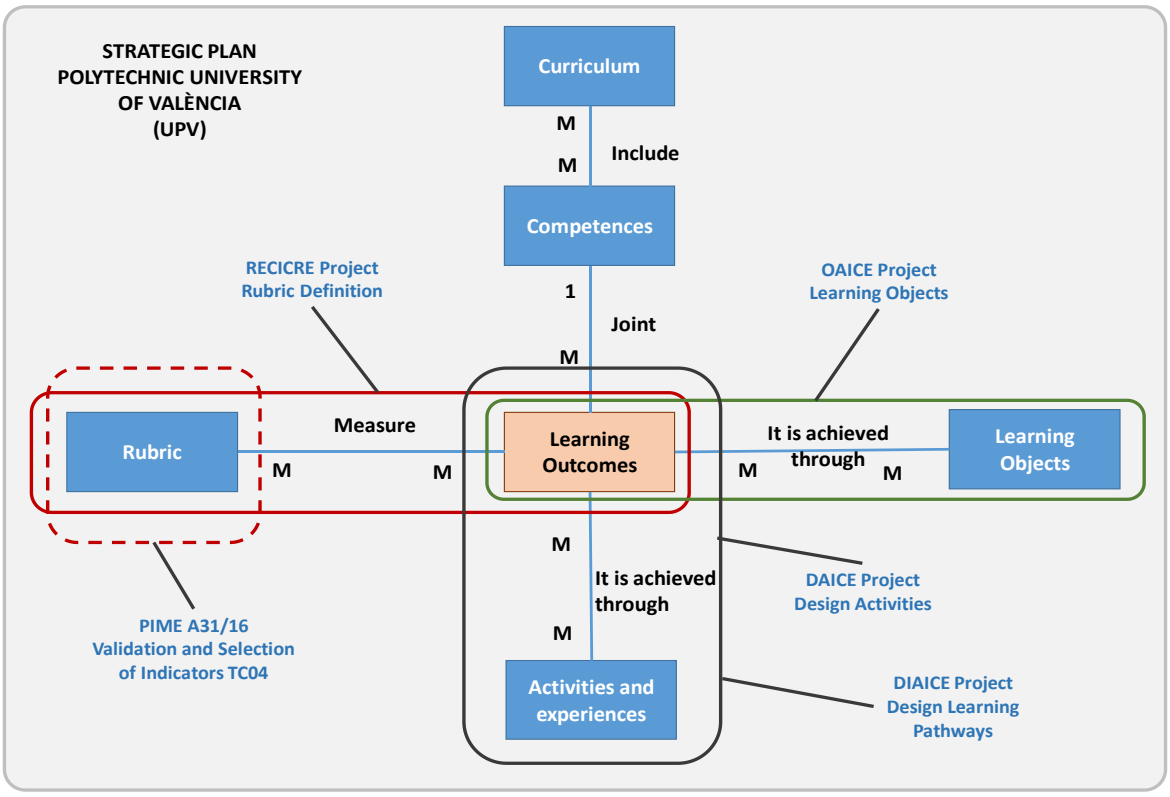

Figure 1. Structural Model of Competences and its Relationship with Five Institutional Innovation and Educational Improvement Projects (PIMEs) for the TC04 at UPV (adapted from (Alemany et al., 2016))

competences achievement. Competences can be defined as the complex knowhow resulting from the integration, mobilisation and adaptation of capacities and skills to situations sharing common characteristics (Incode, 2012, as cited in Cuenca et al., 2015c). Differentiation between specific competences (SC) and TCs has been done in the sense that the SCs belong to a certain field or degree and are aimed at achieving a specific graduate profile, while TCs are generic and transferable in a wide variety of contexts contributing to all the degrees of a University (Cuenca et al., 2016a).

According to ANECA (2013), it is considered that learning outcomes are concretions of the competences for a certain level and constitute the overall result of the teaching-learning process. Learning outcomes are statements of what a student is expected to know, understand and / or be able to do at the end of a learning period. Therefore, to acquire competences, certain learning outcomes are established, which must be met.

When assessing the level of achievement of the TCs, rubrics have demonstrated their validity. Rubrics facilitate the measurement of student performance in those areas that are complex to evaluate, through a set of graded criteria for assessing learning, knowledge and/or skills gained by the student. Rubrics present advantages from the teachers and students' point of view. Rubrics show the students the aspects to be met at different domain levels and allow for teachers an objective, fair and impartial evaluation by a scale that measures the skills and student performance (Alemany et al., 2016; Prats-Montalbán et al., 2016).

Along these lines, the aim of the RECICRE project was to develop a tool for assessing the TC04 in bachelor and master degrees, by the definition of different levels of mastery and aspects that should be taken into account when evaluating this competence. The results of this project can be consulted in Cuenca et al. (2015a, 2015b, 2015c, 2016a). The A31/16 project continues the work of RECICRE by means of the proposal of a methodology to objectively select the items related to a specific competence, from a set of potentially related ones (Prats-Montalbán et al., 2016). Furthermore, the weights associated to the items are determined in order to assess the level of achievement of the competence. This was carried out by applying a multivariate statistical projection method such as Partial Least Squares (PLS), embedded in a cross-validation process and was applied to the TC04.

To achieve the learning outcomes, access to appropriate learning resources is crucial that, in turn, could be reused and adapted to the different educational needs of students (Alarcón et al., 2015). With this aim, learning objects can be adopted to assist different teaching-learning methodologies. The vast majority of definitions identify a learning object with an entity, atom, building block, learning unit or resource. An underlying concept of an independent and minimal element that can form part of bigger ones is behind (Cuenca et al., 2016a). In this context, the objective of the OAICE project was, on one hand, to clarify the learning object definition and its classification to define the main elements associated to the learning objects, such as metadata, repository and different methodologies, and on the other hand, to propose learning objects associated to the TC04. The extended results of this part of the project can be found in Alarcón et al. (2015); Fernandez-Diego et al. (2015).

To complement the learning objects, the DAICE project designed activities to be developed in the classroom with the purpose of promoting the acquisition of the learning outcomes associated to the TC04 (Cuenca et al., 2016b; Ruiz et al., 2015). The diversity of student levels detected in the classroom for the transversal competences, in general, and for the TC04 in particular, led to the proposal of an itinerary of appropriate activities for each level in the DIAICE project. In this project, Boza et al. (2019) built a map of learning activities where each activity is appropriate to cover a specific level of the TC04 (Figure 6).

The structure of the rest of the paper is as follows. Based on the previous theoretical framework, section 2 reports the methodology application for the e-learning design of the platform for the TC04. In section 3, we describe the resulting e-learning platform for the TC Innovation, creativity and entrepreneurship and its contents. In section 4, we report the discussion and implications of the e-platform and its use. Finally, in section 5 we provide the main conclusions as regards to the key findings, the advantages and limitations of the e-platform and the future research agenda.

Methodology for the E-Learning Design of TC04

The methodology of Ghiringhelli and Quacquarelli (2003), in Nacamulli adapted by Gentile et al. (2020) was applied for the e-learning design of the platform with asynchronous material. This methodology consists in four phases: 1) identification of training objectives, 2) detection of training needs, 3) creation of a design team and 4) selection of learning content.

Identification of Training Objectives

The training objectives of the e-platform are strongly related with the strategic challenges and opportunities detected in the educational innovation context at UPV, in general, and at ETSII, in particular. Along with these lines, during the last years, the UPV has launched several initiatives to align with the approaches of the European Higher

Education Area (EHEA) and remain at the forefront in terms of Educational Innovation. The actions currently being carried out at the UPV can be framed in four dimensions as seen in Figure 2: competences, assessment, active methodologies and technological resources.

The UPV strategic plan includes a project for master's and bachelor's degree being one of the main challenges to become a leader in high quality teaching and training oriented to the needs of the society. This strategy marked, among other objectives, to incorporate competences into all curricula (bachelor's and master's degrees), and increase the level of their internationalization (Alemany et al., 2016). In this context, one of the most relevant actions carried out by the UPV to adapt to the EHEA was the UPV Transversal Competences (TCs) Project. This TCs Project aimed to respond, on the one hand, to the feedback received from employers regarding the need to incorporate TCs into the profile of the graduates and, on the other hand, as a way to facilitate the process of accreditation of the degrees for obtaining international quality accreditation such as EUR-ACE, EUR-INF and ABET. In this institutional TCs Project, 13 transversal competences (also named generic competencies, generic outcomes or transferable competences) were singled out and listed: TC-01. Understanding and integration, TC-02. Application and practical thinking, TC-03. Analysis and problem solving, TC-04. Innovation, creativity and entrepreneurship, TC -05. Design and project, TC-06. Teamwork and leadership, TC -07. Ethical, environmental and professional responsibility, TC-08. Effective communication, TC-09. Critical thinking, TC-10. Knowledge of contemporary

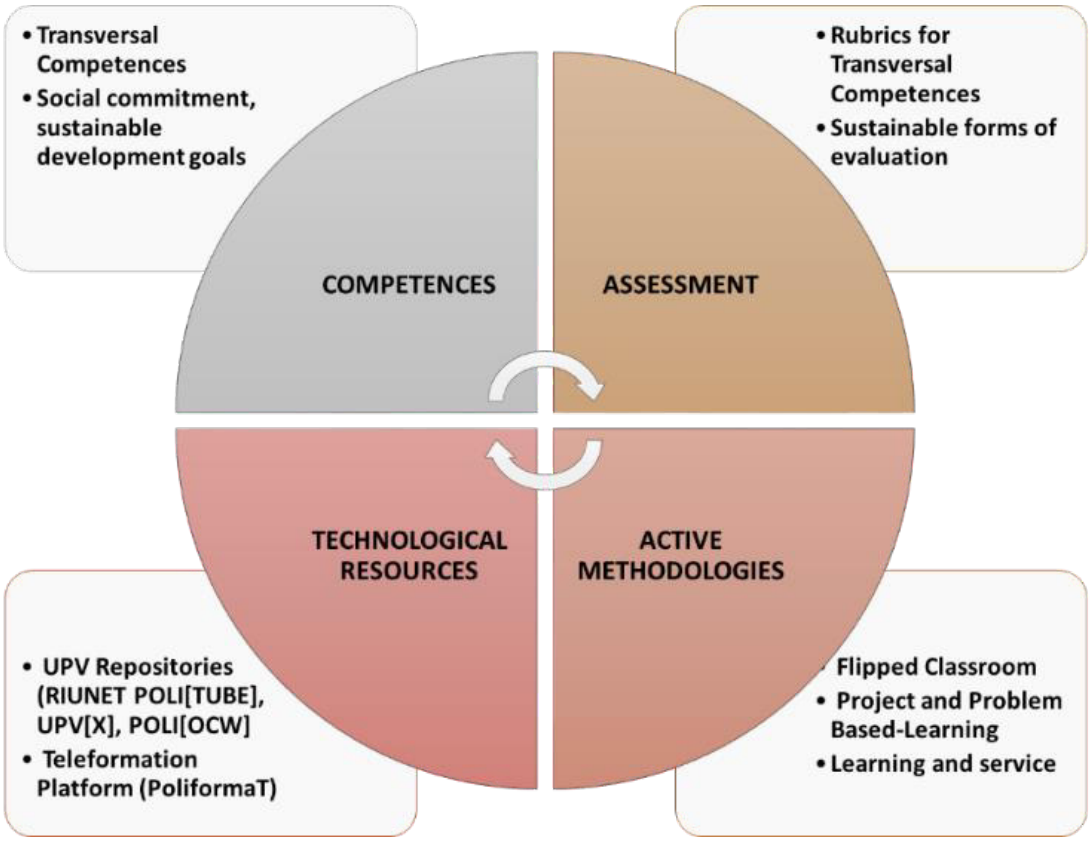

Figure 2. General Overview of the Current Educational Innovation Situation at UPV

problems, TC-11. Permanent learning, TC-12. Planning and time management, TC-13. Specific instrumental.

Figure 3 defines three ways to train and assess these TCs: through the curriculum, the thesis and extracurricular activities or specific courses. Through the curriculum way, each subject is designed to be control point of different TCs being in charge of training and assessing the achievement of them by students. Three domain levels are defined: level 1 for 1st and 2nd courses of bachelor's degree, level 2 for 3rd and 4th courses of bachelor's degree and level 3 for 1st and 2nd courses of master's degree. The grade is defined on the scale A (outstandingly achieved), B (satisfactorily achieved), C (partially achieved) and D (not achieved), and in levels 2 and 3 the grade obtained for in the Bachelor and Master Theses, respectively, is additionally included. The score obtained for each TC and level is reflected in the student record jointly with the grade obtained by the third way, which allows the students to accumulate points with each

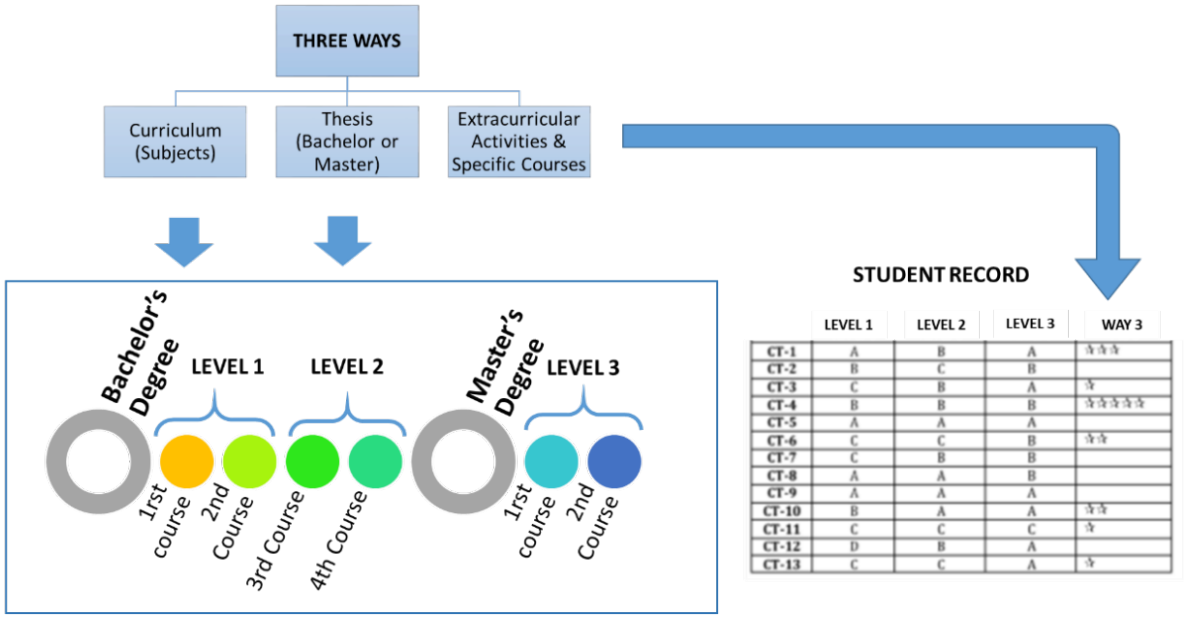

Figure 3. Three Ways of Training and Assessing TCs at UPV

extracurricular activity or course on the matter.

Other priority lines of the UPV are the active learning methodologies, understood as such those methodological approaches that cover both project-based learning, problems, or cases, and that include the necessary ingredients of cooperative learning to the development of both TCs and specific competencies (SCs onwards). Active methodologies are, therefore, complex and close to reality situations, which favor learning experiences of high educational impact, knowledge integration, transfer of learning to professional reality, etc. It is noteworthy that due to the pandemic situation provoked by the COVID-19, UPV has significantly boosted the use and development of technological resources and e-learning systems.

The ETSII at UPV was aware of these challenges and the need of teachers to train students in some TCs, considered by them as difficult to achieve or to work in the framework of a regular course, even before the pandemic COVID-19 situation. For this reason, from the Vice Dean of Educational Innovation of the ETSII a Teaching Innovation Team was formed that considered the possibility of using the flipped teaching methodology for autonomous learning of students in these TCs, particularly the one dealt with herein, TC-04. Innovation, creativity and entrepreneurship, guided by teachers and driven by the possibilities offered by ICTs, through the development of an educational platform related to TC04. The objectives pursued by the ETSII when developing this platform were manifold:

- To provide students with friendly material for self-training in TC-04 (e-learning).
- To assist teachers with resources that facilitate training and evaluation in this TC-04 for applying active methodologies in classrooms.
- To use the platform as a mean of methodologies coordination between subjects belonging to the same Degree.

Detection of Training Needs

The training needs on TC04 have been detected from different perspectives. As commented in previous sections, it was identified as an important requirement of employers, society and international quality accreditation agencies. Besides, instructors of Engineering Degrees find some obstacles for integrating the TC04 with SCs during their classes, being necessary to provide them with more support. Finally, the marks obtained by the students for the TC04 are lower than those obtained for other TCs. More specifically, the percentage of students with A and B mark for the TC04 is below 70% of the total students for eight of the thirteen bachelors' and masters' degrees at ETSII.

Therefore, it is necessary to continue training our students not only in SCs but also in this TC together. In this context, it will be necessary to have previously worked and evaluated knowledge related to both specific SCs and TCs that will subsequently be developed, expanded and integrated together, using active learning methodologies. That is why these active learning methodologies are not incompatible, but rather should be complemented with activities that allow knowledge and training in TCs and SCs in a comprehensive manner.

In fact, as Garcia (2008) points out, one of the three features that characterize competences is that they are also learned: the fact of having certain innate intelligences is a good starting point, but it does not guarantee to be competent. The competences must be developed with initial training, with permanent training and with experience throughout life. That is, it is not enough for teachers to put the framework in their subjects for students to develop or enhance their TCs, but training is also necessary, through methodologies with increasing complexity, in this type of competences to promote an adequate mastery of them that guarantees academic and professional success in our students.

In addition, the implementation of active learning methodologies such as PBL (Project-Based Learning or Problem-Based Learning) will almost certainly require a redistribution of classroom and seminar theory credits and even content revision, which could require combining the PBL with blended learning or flipped-classroom. In this sense, the flipped-classroom is a pedagogical model that transfers the work of certain easier learning processes outside the classroom and uses class time, together with the teacher's experience, to facilitate and enhance other processes of acquisition and practice of knowledge of greater complexity within the classroom (Monteagudo Fernández et al., 2017). During flipped classroom, the use of information and communication technologies (ICT) are combined with didactic strategies that substantially increase the main role of students and the applied aspects of the training curriculum. Through the flipped classroom, the bridge between the methodological aspect and technological resources is established.

In this context, new opportunities but also new challenges appear because the implementation of active methodologies will require, in turn, the development of material for students' autonomous work. This material can be written or audiovisual through the network (e-learning) to make possible the integration of TCs and SCs in the context of developing each degree. Although some material on TCs has been developed by UPV to assist teachers, there is no material oriented to students trying this e-platform to cover these detected training needs.

Creation of the Design Team

The design team was created by the Vice Dean of Educational Innovation of the ETSII to cover the different aspects of the e-learning system, and the professional figures involved in the design team come from different fields. The Dean of the ETSII jointly with the Vice Dean of Educational Innovation at ETSII and two teachers with recognized expertise in innovation projects form the innovation team. The implementation of the e-learning platform and the technologies adopted were carried out by the Innovation and Communication Vice Dean jointly with computer technical staff. Throughout the process, support was received from the Institute of Education Sciences (ICE) at UPV.

Selection of Learning Content

The learning content of the e-platform was selected according to its defined structure. Taking as a basis the structural model of competences presented in Figure 1, the e-platform was first designed by structuring it in different sections (Figure 4). Second, learning objects were searched for each of the web's sections and third, the ones of most interest were selected in order to include them in the platform.

Searchers for information included an extensive bibliographic search on the topics of each section in different contexts and levels. The search included both UPV-owned materials (e.g. the UPV institutional repository, Riunet) and external materials. Among the own materials are all those previously generated by teachers from the same University, as well as those provided by the Institute of Educational Sciences (ICE) of the UPV itself. The ICE is an Institute to assist teachers during their teaching-learning process. Within the external materials that were collected, we can find materials from other Universities, YouTube videos, videos relating students' experiences on these TCs, articles and congress papers, both theoretical and practical. The selec-

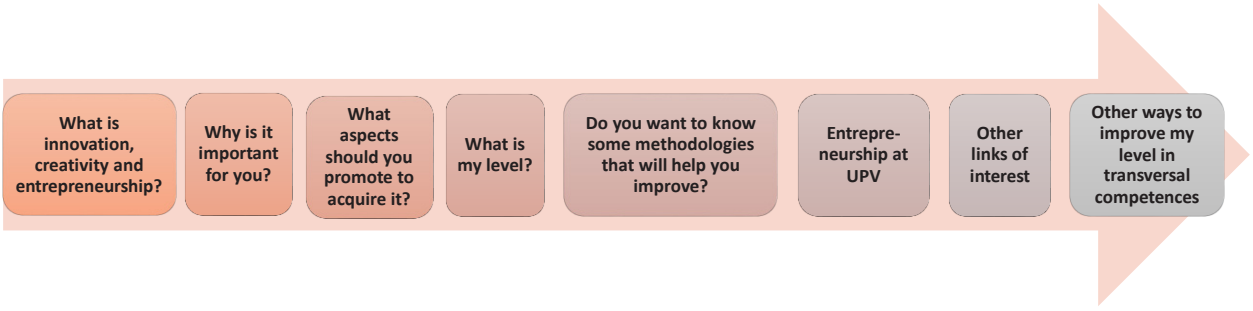

Figure 4. Structure of the E-Learning Platform in Innovation, Creativity and Entrepreneurship

ted material was intended to be friendly for students. For this reason, audio-visual learning objects were prioritized.

The result is a collection of learning objects properly arranged and structured taking into account the three levels of achievement for the TC04 in higher education at UPV. As described below, these three levels are based on the UPV institutional rubrics for this competence. These learning objects are expected to be applied and reused in different activities and experiences in the subjects integrating the bachelors' and masters' degrees.

Results

The resulting e-learning platform for the TC04 can be consulted at https://www.etsii.upv.es/competencias/innovacion.php. This platform presents eight different sections (Figure 5) to structure and guide the student learning process. Provided is the following brief description of each section.

In the section "What is innovation, creativity and entrepreneurship?" the UPV institutional video presenting this competence has been inserted. Then definitions for each of the terms of innovation, creativity and entrepreneurship is provided accompanied by different videos defining them and providing essential relationships among them. The section "Why is it important for you?" aims to show students that this transversal competence is one of the most valued by Spanish companies, additionally to the SCs required from engineers (IIE-APD, 2017).

The section "What aspects should you promote to acquire it?" is based on the dimensions defined by the UPV in institutional rubrics designed for each domain level for this TC (http://www.upv.es/contenidos/COMPTRAN/info/956667normalc.html). This section contains by level the following information:

Level 1: If you are in a 1st or 2nd Grade course, you should be able to question reality, identifying improvement needs and ideas that can add value.

- Question reality.
- Come up with ideas.

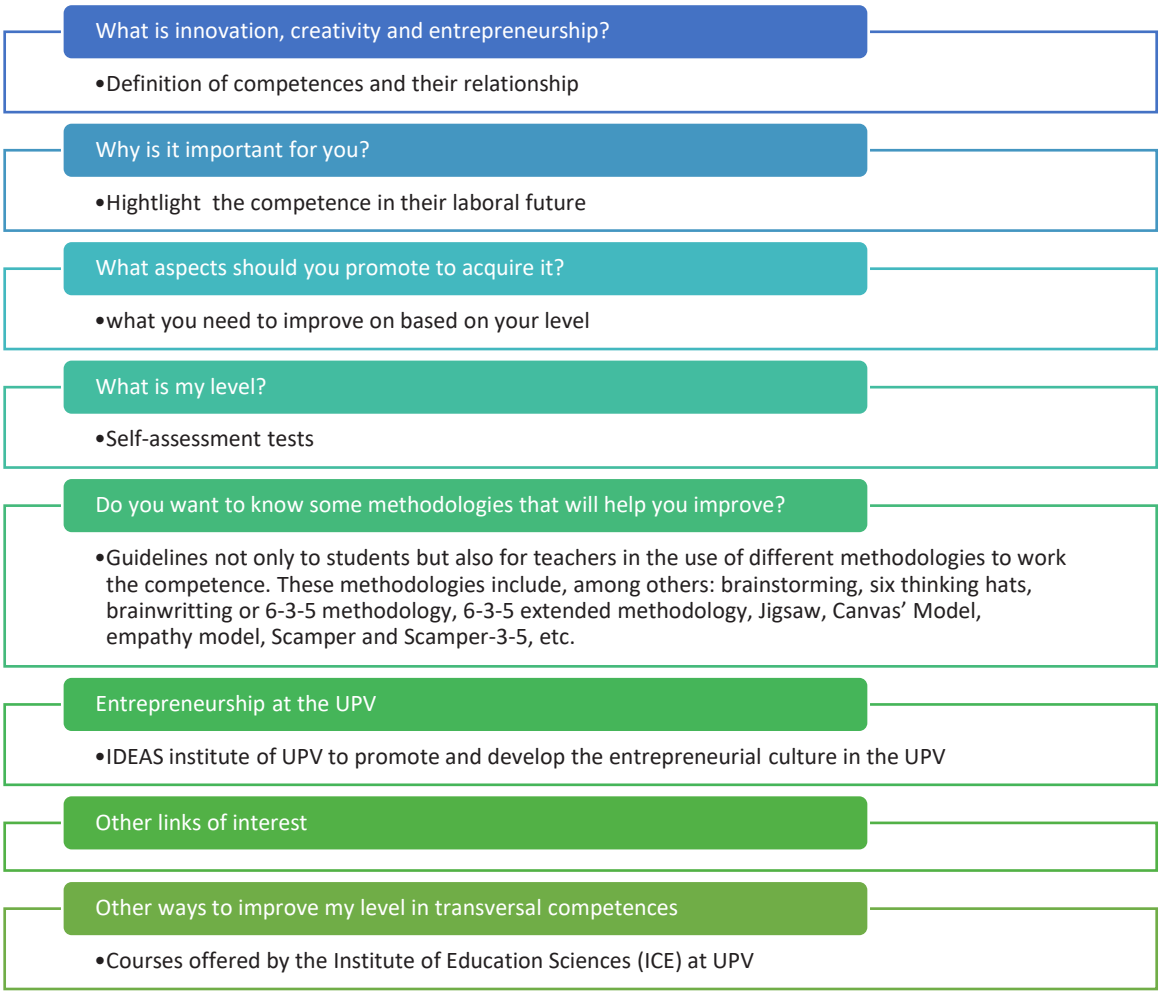

Figure 5. Structure and Sections of E-Learning Platform to Guide the Student Learning Process

• Formally capture those ideas using the appropriate tool and / or technique (Business Model Canvas -BMC-, mind map, a structure, model, drawing, canvas, etc.).

• Identify results to measure the value of your ideas.

Level 2: If you are in a 3rd or 4th Grade course you should be able to contribute to original ideas and approaches that add value through creativity strategies and techniques.

• Identify opportunities and / or aspects of improvement.

• Provide original ideas and approaches.

• Fluently use appropriate creativity methods / strategies / techniques in each case to generate and translate ideas and solutions.

• Analyze the results in depth and draw appropriate conclusions.

Level 3: If you are in a 1st or 2nd Master course you should be able to propose an action plan, including a global analysis of the value of innovation.

• Integrate knowledge of different disciplines that generate ideas that improve existing solutions to a given situation.

• Adopt original approaches, generate new divergent ideas from different perspectives and provide creativity in what you do, improving systems, procedures and processes.

• Formal and detailed planning of an action plan, executing some of its phases.

• Make a report with the value analysis, in which it indicates the tools and / or techniques that have been used (e.g. qualitative and / or quantitative methods; probability analysis; consequences analysis; multicriteria techniques; indicators of efficiency, effectiveness, economic, quality, impact ...).

In section "What is my level?" self-assessment tests for creativity, innovation and entrepreneurship are accessible. Then in section "Do you want to know some methodologies that will help you improve?" different methodologies are defined jointly with learning objects providing its description and one or several applications to different examples. The suitability of each methodology for training students depending on the domain level and dimensions or aspects to be trained appears on the e-learning platform in order to provide guidelines not only to students but also for teachers in the use of each methodology (Figure 6). These methodologies include, among others: brainstorming, six thinking hats, brainwritting or 6-3-5 methodology, 6-3-5 extended methodology, Jigsaw, Canvas' Model, empathy model, Scamper and Scamper-3-5, etc.

The section "Entrepreneurship at the UPV" presents initiatives around Entrepreneurship to students by the IDEAS' Institute of UPV. The IDEAS UPV's mission is to promote and develop the entrepreneurial culture in the UPV, to sensitize and energize the university community in the creation and support of new companies, and to support the creation and development of innovative and technologically based companies in the Valencian Community, Spain, mainly. In the section, "Other links of interest" additional information about this competence is provided by linking to other web pages. Finally, the section "Other ways to improve my level in transversal competences" shows the courses offered by the Institute of Education Sciences (ICE) at UPV to improve different TCs among which is TC04.

Discussion and Implications

The resulting e-learning platform on the TC-04 offers the possibility to be used in multiple ways. One way is that students self-organize themselves around the e-learning platform, which enables expanding access to different types of educational resources on the TC04. Self-organized lear-

	Brainstorming	6 Thinking Hats	6-3-5 Methodology	6-3-5 Extended Methodology	SCAMPER 6-3-5	Jigsaw (Puzzle Aronson)	Empathy Model	Canvans Model	Lego Serious Play	DAFO	Ethical dilemmas	Data leakage role
LEVEL 1												
Question reality.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Come up with ideas.	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
Formally capture and represent those ideas			✓	✓	✓		✓	✓	✓		✓	
Identify results				✓					✓		✓	
LEVEL2												
Identify opportunities and/ or aspects of improvement.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Provide original ideas and approaches.	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
Fluently use appropriate creativity methods / strategies / techniques in each case to generate and translate ideas and solutions.			✓	✓	✓		✓	✓	✓		✓	
Control results.				✓					✓		✓	
LEVEL 3												
Integrate knowledge of different disciplines.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Adopt original approaches in contents and processes.	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
Propose and perform an action plan,				✓			✓	✓	✓		✓	
Analyze the innovation value				✓					✓		✓	

Figure 6. Contribution of some Methodologies for the TC04. Innovation, Creativity and Entrepreneurship per Domain Level (based on Boza et al. (2019))

ning can be defined as a learning method students undertake independently without following prescribed curricular requirements or without reliance on teachers (Ponti, 2014). In this sense, the platform can be considered as a mean to self-organized learning consisting in a form of self-directed informal learning.

Besides, the e-learning platform offers valuable resources to students to implement this TC throughout the assigned course tasks, and supports teachers prompted to train and evaluate this TC. For instance, in a flipped classroom, teachers can direct students to specific sections on the platform in order to train in certain methodologies or concepts previously to classes. Later, students will put in practice this TC through actively implement different active methodologies in classrooms or in course works integrating the application of this TC jointly with SCs of the corresponding degree. Acting in this way teachers can save time in training students in this TC alone and invest more time in activities that jointly develop SCs and TCs.

Another alternative of use is that students can be directed by teachers to target sections or methodologies on the platform in order to level the knowledge and capacities of students at the beginning of a course. When a teacher starts his or her activity with a new group of students, in some cases it is assumed that the students possess a determined domain level for each competence and they develop activities according to these "assumed" level (Cuenca et al., 2018).

Finally, the platform can be used as a tool for the coordination of methodologies among subjects of the same degree. Indeed, this is one of the current work lines at the Higher School ETSII at UPV.

In practice, the resulting e-learning platform offers valuable resources to students to implement the TC-04 throughout the assigned course tasks, and supports teachers prompted to train and evaluate this TC. As a result, it is expected to provide society with better-trained graduates on this competence, more capable to address future society and business challenges successfully.

Conclusions and Future Research

In this paper an e-learning platform for the detected need of training Engineering students in TC04: Innovation, Creativity and Entrepreneurship, jointly with the SCs of each degree, has been described after setting its framework in the contexts of the demand from skilled employees and higher education area. Different studies show that when developing e-learning systems, emphasis has been put on the technology and learning content more than on e-learning design. Indeed, the literature revised highlights the scarcity of research on e-learning design and more specifically on the didactic dimension in Universities. This applies even more for the TC04 where the integration of the entrepreneurship with creativity and innovation has not been found.

From the research point of view, this paper covers the previous gaps by the application of an e-learning design methodology for the didactic dimension of the TC04 and the resulting e-learning platform. Although the authors cannot be certain of having found all the existing material, they have no knowledge to date about other e-learning material with these characteristics or structured in a similar way. From the practical viewpoint, the resulting e-learning platform presents several advantages pointed out by students and teachers. It enhances the value of the TC04 in the labour context for students and links three competence dimensions that are strongly connected: creativity, innovation and entrepreneurship. It offers valuable resources to students to implement this TC throughout the assigned course tasks jointly with the specific competences. It supports teachers prompted to train and grade the students' performance of this TC and to coordinate the methodologies used to train the TC. In this way, teachers could focus on activities that are more practical during their classes, reducing the time spent in theoretical concepts and the description of methodologies. Its modular design integrated by learning objects allows their reuse in different contexts by instructors. Last but not least, this e-learning system intends to contribute to the achievement of the new challenges originated by the COVID-19 pandemic situation. As the main result, it is expected to provide society with better-trained graduates on this TC, more capable to address future society and business challenges with success, as well as more satisfied teachers.

In regards to the limitations of this study, it must be acknowledged that the e-platform design has been made taking into account the specific context of the UPV degrees and transversal competences. The authors cannot ensure that this design is the most suitable for other University contexts. Despite this, the modular design provided by the learning objects can be reused by other e-learning platform designs based on other structural models. As regards to the content of the web, the authors have noted a lack of suitability of audio-visual resources for this TC when applied to Engineering. Evidence is needed about the effectiveness of the e-platform in the achievement of the objectives pursued.

To address these drawbacks, future research lines are underway in the framework of Institutional Innovation and Educational Improvement Projects (PIMEs) to generate more Engineering-specific audio-visual resources for this TC, while organizing them by domain levels. Finally, the impact assessment of the e-platform on the level of acquisition of TC04, as perceived by students and faculty, should be made by conducting student activities and their corres-

ponding evaluation in different subjects and through questionnaires for students, faculty and employers.

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