

INTED **2020**

14th International
Technology, Education and
Development Conference

2-4 March, 2020 - Valencia (Spain)

CONFERENCE PROCEEDINGS



Sharing the Passion for Learning

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**C O N F E R E N C E
P R O C E E D I N G S**

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An Author Index, a Session Index, and the Technical Program are included in HTML format to aid you in finding conference papers. Using these HTML files as a starting point, you can access other useful information related to the conference.

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1. Open the Search window, type the words you want to find, and then click Use Advanced Search Options (near the bottom of the window).
2. For Look In, choose Select Index.
3. In the Index Selection dialog box, select an index, if the one you want to search is available, or click Add and then locate and select the index to be searched, and click Open. Repeat as needed until all the indexes you want to search are selected.
4. Click OK to close the Index Selection dialog box, and then choose Currently Selected Indexes on the Look In pop-up menu.
5. Proceed with your search as usual, selecting other options you want to apply, and click Search.

For Acrobat 7 and earlier:

1. In the "Edit" menu, choose "Full Text Search".
2. A new window will appear with search options. Enter your search terms and proceed with your search as usual.

WEB BASED ON E-LEARNING OBJECTS AS SUPPORT TO THE DEVELOPMENT OF TRANSVERSAL COMPETENCES FOR ENGINEERING STUDENTS

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Abstract

Active learning methodologies stand out among the priority lines in the field of higher education, exemplified by flipped teaching or project-based learning (PBL). The latter is a methodological approach of marked complexity and close to reality, which favours learning experiences with high educational impact, knowledge integration, and the transfer of what has been learnt to professional reality. In this context, it becomes necessary to work and assess the students' performance related not only to specific competences (SC) as usual, but also to transversal ones (TC), previously and simultaneously.

The Universitat Politècnica de València (UPV), being aware of the increasing demand of TCs by employers and society, has defined 13 TCs whose training and assessment are integrated in their Bachelor's and Master's Degrees by means of the so called control point subjects. Based on the experience acquired in the School of Industrial Engineering (ETSII) since a number of subjects were appointed as control points of TCs in its 5 Degrees and 7 Masters, 6 of the TCs can be singled out for being the most difficult for teachers: Innovation, creativity and entrepreneurship; Teamwork and leadership; Ethical, environmental and professional responsibility; Knowledge of contemporary problems; Permanent learning; Time planning and management.

Unlike the instrumental TCs, which are intrinsic to the subjects taught, the (inter)personal and systemic ones are more complicated to fit in the subjects, because they require more complex or wider environments, or are very time consuming. That is why it has been proposed to use the flipped teaching methodology for the students' autonomous learning in TCs, through the development of an online educational platform. The website, with a section per TC, is accessible from <https://www.etsii.upv.es/competencias/index-es.php>. Its structure covers the definition of the TC, the aspects to enhance to acquire it, a performance level test, and resources to improve it (in-house produced and external).

The value of this initiative is double: on the one hand, it is a space designed for the training of students and not for assisting the teacher (the UPV already put material available to teachers), and, on the other hand, it will serve as a vertical coordination axis between the subjects of a Degree. Future actions of improvement include examples of application of the techniques proposed to engineering cases, organization of resources by domain levels, and experiences of UPV students.

Keywords: Transversal competences, industrial engineering, e-learning, educational platform, flipped teaching.

1 INTRODUCTION

In the field of higher education, the active methodologies, such as flipped teaching and problem- or project-based learning (PBL), are taking on a more leading role. In PBL environments, students learn primarily by building knowledge and creating meaning through iterative processes of questioning, active learning, exchange and reflection [1]. PBL organizes learning around projects close to professional practices and involves students in authentic situations [2]. It includes the ingredients of cooperative learning required for the development of both specific and transversal skills, as pointed out by diverse authors. For instance, De Miguel *et al.* [3] state that transversal competencies developed by PBL are: Planning and organization, Analysis, Synthesis, Research, Knowledge transfer, Critical thinking, Individual and group responsibility, Management of different disciplines and sources of information, Oral expression and writing, Teamwork, leadership and decision making. On the other hand, these active methodologies are in line with the learning outcomes related to practical application of engineering and design and project competences required by international accreditation

agencies such as ENAEE (European Network for Accreditation of Engineering Education) or ABET (Accreditation Board for Engineering and Technology; Baltimore, USA).

In this context, it becomes mandatory to develop and evaluate the students' performance related not only to specific (SC) competences, but also to transversal (TC) ones, previously and simultaneously to these active learning methodologies. That is, these integrative learning methodologies are not incompatible, but rather should be complemented and preceded with activities that allow knowledge and training in specific and transversal skills.

On the other hand, TCs are increasingly demanded by employers and the society from University graduates [4]. Therefore, engineers not only have to develop competences that are specific to their area of knowledge but must also know how to transmit their own ideas, to work in a team and to understand the impact of the major societal problems on their professional activity and vice-versa. It is, thus, time to bring value to TCs between the targets of our students before they graduate, to broaden the perspective to include the development of TCs in the University settings, and carry out the necessary actions to ensure that our students acquire them.

As Cano García points out [5], the fact of possessing certain innate intelligences is a good starting point but does not guarantee being competent. Thus, it is not enough for teachers to provide the scope in their courses so that students develop or enhance TCs, but also to train them in skills of this nature to guarantee their academic and professional success.

The Universitat Politècnica de València (UPV), concerned with this issue, picked out 13 TCs summarizing those listed by the Tuning project [6], whose training is integrated in their Bachelor's and Master's Degrees. The institutional project linked to them can be browsed on this website: <http://www.upv.es/contenidos/COMPTRAN/>. The aim is to boost the development of these TCs by students at different levels of performance, throughout their studies, mainly in the context of regular subjects. To ensure the acquisition of transversal competences, subjects at different courses of a Degree are designated as control points to train and evaluate some transversal competences.

Within Spain, different models can be found at the Universidad de Comillas in Madrid, where the training in TCs is located in its Diploma in Personal and Professional Skills, which runs parallel to the Degree and Master in Industrial Technology Engineering, or at Mondragon Unibertsitatea, where the learning and training in TCs fall within the development of engineering projects during a few weeks each semester. Outside Spain, Universities such as those of Edinburgh, Sussex, Sydney, Oxford or York, for example, include in their websites a site with academic support e-learning resources, mainly on time management or team working and advises on academic writing and exam-writing techniques. Support on other TC are, though, not covered by these websites.

The UPV staff has realised that fitting the 13 TCs singled out in the courses is not equally challenging. Unlike the instrumental ones, which are intrinsic to most of the subjects taught, the (inter)personal and systemic ones are more complicated. On the one hand they require (or are better implemented in) more complex or wider environments, such as the Bachelor's and Master's Theses, internships in companies or extracurricular activities. On the other hand, their learning and training implies time spent in class that is scarce in the framework of the subjects.

That is why it was proposed from the School of Industrial Engineering (ETSII) to use the flipped teaching methodology for the students' autonomous learning in TCs, guided by their professors, through the development of an online educational platform as a tool for e-learning. Boneu [7] estimates that e-learning can be classified in three ways according to technology: the CBT (computer-based training) or CAI (computer-assisted instruction), the IBT (internet-based training), and the WBT (web-based training) learning making extensive use of the web, which is our case. The objective pursued by the ETSII when developing this website for e-learning was to assist both students and instructors, providing students with friendly material for self-training in TCs, but with the assistance of their professors, who will lead them to specific resources depending on the level. In this sense, this will allow to take advantage of some of the most important characteristics of the e-learning pointed out by Area and Arell [8]: Increase student autonomy and responsibility in their own learning process; Overcome the limitations caused by the separation in space and/or time of the teacher-students; Flexibility in educational times and spaces; Access multiple sources and data different from those offered by the teacher at any time and from anywhere. In short, this e-platform is designed to be consulted by the students, guided by the teacher towards a specific resource, to next put it into practice jointly with SCs, by means of activities defined during active methodologies inside or outside the class.

The rest of the paper is structured as follows. The Section 2 describes the methodology followed to the development of the e-learning platform. The results obtained from the applied methodology are reported in the Section 3 where the general structure of the website for the 6 TCs and some of their contents are presented. In the Section 4, the final conclusions including the future work lines are outlined.

2 METHODOLOGY

Currently, the ETSII is in charge at UPV of 12 academic diplomas (5 Degrees and 7 Masters). It has about 4100 students enrolled, relying on 534 teachers from 26 departments. A number of subjects were appointed as control points of each TC in each diploma, at different levels of domain, five years ago. Taking this experience as starting point, 6 of the TCs were singled out for being the most difficult for teachers: Innovation, creativity and entrepreneurship; Teamwork and leadership; Ethical, environmental and professional responsibility; Knowledge of contemporary problems; Permanent learning; Time planning and management. They are, indeed, among the 14 TCs most valued by Spanish companies demanded for engineers additional to the SCs [6].

Based on these most difficult TCs and after a first initial assessment with the teachers, it was observed that the development of these competences required, in some cases, prior preparation or a work by the students for their subsequent application in the course of the subject. Therefore, a working group was proposed by the ETSII to plan a strategy to be followed so that the development of such skills could be reasonably attained by students. The first stage planned in its strategy consisted of four major sequential phases (Figure 1) that constitute itself the methodology followed to construct the TCs e-learning platform at ETSII.



Figure 1. Methodology followed for the construction of e-learning TCs platform at ETSII.

The first phase was an extensive bibliographic search on how to work these competencies in different contexts and levels. The search has 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 materials provided by the Institute of Educational Sciences (ICE) of the UPV itself, an institute to assist teachers during their teaching learning process. Within the external materials that have been collected, we can find materials from other Universities, YouTube videos, videos relating students' experiences on these TCs, articles and congress papers. In this regard, it should be noted that not for all the competences identified there are available or of enough quality materials.

Once all this information was collected, the material was classified according to their recipient (student or professor) and typology (learning material, (auto)assessment, methodology/technique/activity) and discipline (generic, engineering, business) and level.

After the classification of the material achieved, a selection of the material of higher quality was carried out and that best suited the objectives pursued.

Finally, the selected material on the different TCs was classified in order to fit in a common structure of the website: fundamental or specialized material, online surveys to assess the level of proficiency, and links to books and complementary material from other Universities.

3 RESULTS

As a main result of the strategy followed has been the design of a website (<https://www.etsii.upv.es/competencias/index-es.php>, Figure 2) where we can find mainly the competences that initially have demonstrated major difficulties to be trained. In this first stage, the website has been developed in Spanish, but it is expected, once rethought and optimized, to translate it into English and Valencian. This first version is intended as a static page with infinite scrolling, although it may be subject to future changes in order to optimize the user experience.



Figure 2. Homepage of TCs ETSII e-learning platform (available at <https://www.etsii.upv.es/competencias/index-es.php>).

The website of the e-learning platform presents different sections for each of the TCs selected (Innovation, creativity and entrepreneurship; Teamwork and leadership; Ethical, environmental and professional responsibility; Knowledge of contemporary problems; Permanent learning; Time planning and management), presenting for each of them a similar structure whenever possible. This structure encompasses the following items (Figure 3), although not all the sections generated could be fitted to this organization.

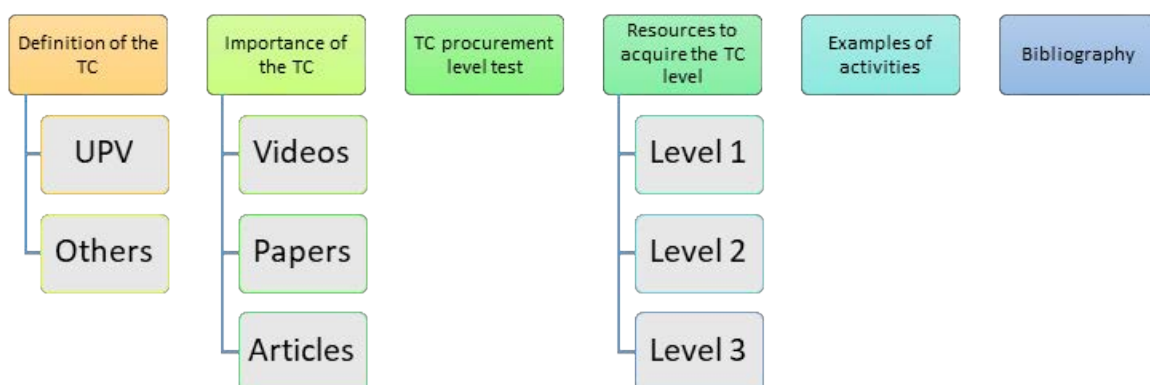


Figure 3. Generic structure of the TCs website.

In general, their structure covers the definition of the TC (Figure 4), why it is important to acquire this competence (Figure 5), a performance level test (Figure 6), the aspects to enhance to acquire it (Figure 7), and resources to improve it, in-house produced and external (Figure 8). Figures 4 to 8 are examples, for a particular TC (Time planning and management).

It is designed to be consulted by the students firstly as an initial approximation to the TC, and secondly to be examined guided by the teacher towards a specific resource, to next put it into practice jointly with SCs, by means of activities inside or outside the class.



UPV Institutional definition

Official definition of the competence by the UPV

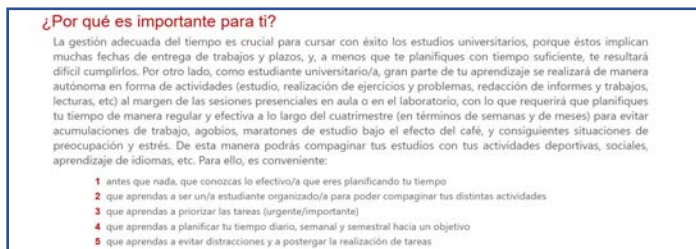
UPV Institutional video

Official video of the competence by the UPV

Figure 4. Screen capture of a video with a TC definition.

The first section, in addition to the institutional definition by the UPV, may include other definitions that are commonly used in different areas and help to better understand its meaning (Figure 4).

Once the definition is given, the following is the aim to show the importance that the development of this competence can bring to the student, the added value that is given to his/her training and what importance it may have in his/her future professional work (Figure 5).



Why is this TC important?

Reasons of the TC importance



Example of the importance

Video to exemplify the importance of this TC

Figure 5. Screen captures showing a text and a video to place value on a TC.

As a complement and as a starting point, it is interesting to have an initial assessment of the development of the TC in each of the students, which allows them to find their weaknesses and strengths, and to guide them on what aspects they should improve (Figure 6).

¿Sabes ya gestionar y planificar tu tiempo?

A continuación te proponemos un breve cuestionario que te puede ayudar a conocer tu nivel de desarrollo previo de esta competencia transversal, cuáles son los aspectos concretos por mejorar, y directrices para hacerlo:

- *How do you manage your time, University of Sussex*

How do you manage your time

Answer the following questions to receive feedback on your use of time.

Do you spend time cleaning your room, doing the washing up or playing on the computer before you start studying?	Yes <input type="radio"/>	No <input type="radio"/>
Do you have lots to do yet can't seem to say no when people ask you to do something else?	Yes <input type="radio"/>	No <input type="radio"/>
Does it take you ages to find your lecture notes?	Yes <input type="radio"/>	No <input type="radio"/>
Do you find that things always take twice as long as you thought they would?	Yes <input type="radio"/>	No <input type="radio"/>
Do you start lots of things and then struggle to finish them?	Yes <input type="radio"/>	No <input type="radio"/>
Do you find it difficult to know where to start with all the things you have to do?	Yes <input type="radio"/>	No <input type="radio"/>
Are you often the last to know about timetable changes or cancelled lectures?	Yes <input type="radio"/>	No <input type="radio"/>
Do you find yourself unable to concentrate when you try and study?	Yes <input type="radio"/>	No <input type="radio"/>
Do your friends complain that they hardly ever see you and you're studying too much?	Yes <input type="radio"/>	No <input type="radio"/>
Do you miss deadlines because of unexpected events (e.g. car running out of petrol, the printer running out of ink, the bus arriving late etc)?	Yes <input type="radio"/>	No <input type="radio"/>

submit

[Link to external Level Test](#)

Example of level test to evaluate the degree of acquisition of competence. For this example, it is an external link.

Figure 6. Example of a level test, retrieved from the University of Sussex website.

Once the starting point of the student is located, the aspects should be enhanced to acquire certain levels of competence are described, which for our case have been set to 3 (the first two for Bachelor's Degree and the highest for Master's Degree, Figure 7). These aspects are based on UPV institutional rubrics defined by domain-level for the control point subjects in order to assess the achievement of their assigned TC by the students.

¿Qué aspectos debes potenciar para adquirirla?

A nivel de Grado y Máster, y en el marco de distintas asignaturas, se realizarán una serie de actividades académicas encaminadas a desarrollar o potenciar esta competencia, que te será muy útil en el ámbito personal y profesional.

Si estás en 1º o 2º de Grado (nivel I), dichas actividades irán encaminadas a que seas capaz de desarrollar la planificación sugerida por el/la profesor/a a corto plazo:

- Identificar las actividades a cumplir a corto plazo.
- Jerarquizar las actividades a desarrollar a corto plazo en función de su importancia.
- Realizar las actividades en el tiempo asignado y con el formato requerido.
- Analizar el desarrollo de las actividades a partir de las sugerencias marcadas.

Si estás en 3º o 4º de Grado (nivel II), dichas actividades irán encaminadas a que seas capaz de dichas actividades irán encaminadas a que seas capaz de planificar las actividades a realizar a corto y medio plazo:

- Definir los objetivos a cumplir a corto o medio plazo.
- Determinar las actividades a desarrollar a medio plazo, jerarquizándolas en función de su importancia.
- Asignar tiempos a las actividades y realizarlas con el formato requerido.
- Analizar el desarrollo de las actividades.

Si estás en 1º o 2º de Máster (nivel III), dichas actividades irán encaminadas a que seas capaz de planificar y gestionar temporalmente los proyectos individuales o grupales:

- Definir los objetivos generales y específicos del proyecto a realizar.
- Determinar las diferentes fases del proyecto, integrando las actividades individuales y grupales para alcanzar el objetivo.
- Asignar tiempos a las actividades individuales y/o grupales para alcanzar el objetivo del proyecto y cumplir la planificación.
- Evaluar la planificación y los resultados alcanzados individuales y/o grupales del proyecto.

Aspects to enhance

Aspects to enhance the TC for different domain levels (according to courses)

Figure 7. Aspects to enhance to acquire the TC.

The next step is to present different resources that students can use, either self-taught or guided by the teacher. This last option allows a coordination between different subjects so that the student reaches the necessary level in a progressive and varied way throughout the curriculum of the Degree (Figure 8).

¿Quieres conocer algunas pautas que te ayudarán a mejorar esta competencia?

En los siguientes enlaces te proporcionamos información general que te ayudará a mejorar tu grado de competencia en planificación y gestión del tiempo:

Y aquí encontrarás información específica sobre aspectos concretos que puedas necesitar mejorar:

Pautas para hacer listas de tareas y priorizar

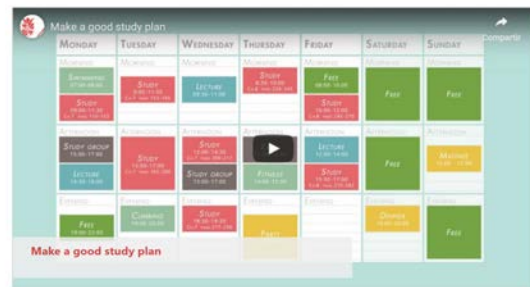


- Manual sobre gestión del tiempo para estudiantes, F. Pérez González y R. García Ras, Fac. de Psicología de la Universitat de València (PDF)
- Managing your time: time management tips and tools for organising your studies, Institute for Academic Development, University of Edinburgh



Metodología para planificar tu tiempo
¿Cómo organizar la agenda semanal?

Consejos para encontrar más tiempo (identificar y evitar los ladrones de tiempo y evitar postergar tareas)



- ¿Cómo organizarte para realizar tu TFG o TFM?
- Gestión eficaz del tiempo para el desarrollo de un trabajo académico, L. Candó Dorás, C. Santandreu Mascarell y P. Vidal Carreón (PDF)

- Yo procrastino, Universidad del País Vasco (PDF)
- Common Time Wasters, UNSW de Sydney

Figure 8. Example of different resources to enhance the TC.

Ayúdanos a mejorar

Crea tu propio video contando tu experiencia en lo que respecta a la planificación y gestión del tiempo en una asignatura, semestre o curso, durante la realización de tu TFG o TFM, o cómo te has organizado si has compaginado estudios y trabajo, etc. y háznoslo llegar a **competencias @ etsii.upv.es**

En estos videos puedes conocer las experiencias de otros estudiantes al respecto, que te pueden servir de inspiración:

En estos videos puedes conocer experiencias de otros estudiantes que te pueden servir de inspiración:

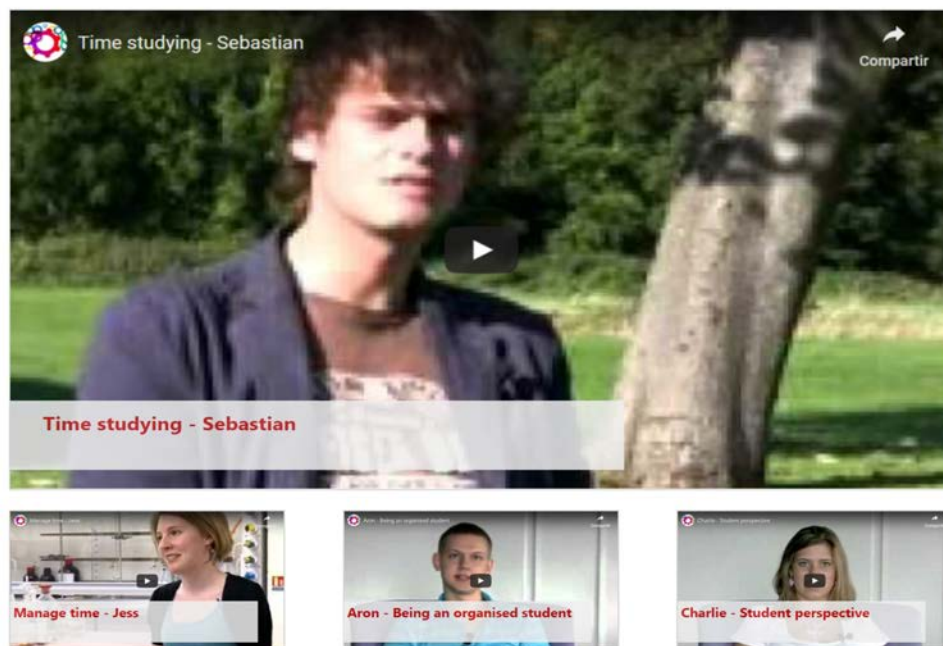


Figure 9. Examples of application by students of other Universities.

Finally, a section focused on showing different application experiences that serve as examples, including the option to make new contributions, especially by students, that exemplify different applications and uses, and that may be of interest to other users (Figure 9).

It is worth to point out that the need to have a platform of this nature was not detected, neither exclusively nor for the first time in the UPV. Indeed, some Universities' websites contain material for some time now for this purpose, as already seen.

Notwithstanding, the value of this initiative is double: on the one hand, it is a space designed for the training of students and not for assisting the teacher (the UPV already put material available to teachers), and, on the other hand, it will serve as a vertical coordination axis for methodologies to train and assess TCs competencies between the subjects of a degree.

The different subjects can be coordinated according to the activities and guiding the students among the different resources in such a way that they adapt to the levels of learning depth sought in each subject within the curriculum, increasing the complexity and level of elaboration for the higher courses. Through this initiative it is expected, on one hand, to improve the acquisition level of students in such TCs and, on the other hand, to assist teachers in the work of training and assessing these more difficult TCs for them.

4 CONCLUSIONS

As a main conclusion, it should be said that after assessing the importance of the acquisition of certain transversal competences and evaluating how to implement them in the curricular design of the different degrees, the ETSII has chosen to facilitate the learning teaching process both for students, and for the vertical coordination between subjects, through a website acting as e-learning platform that helps in such a process using also a flipped teaching learning.

A strategy has been followed for the design and structure of the different sections that has resulted in a first version of the TCs website that is now under revision study and optimization phase in collaboration with the teachers who have to work and grade them in their subjects. It should be noted that the majority of the material is of audio-visual character because it pretends to be friendly for students. Indeed, the students are the main users of this e-learning platform.

As a weakness, it should be pointed out that practical examples applied to engineering contexts are still very scarce, and the quality of some material can be improved. For these reasons, the next steps will focus on improving and optimizing the website, as well as generating new and of better quality resources for students such as: the development of application examples of the techniques to engineering cases, organization of resources by domain levels, and experiences of UPV students.

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