ENGLISH AS A MEDIUM OF INSTRUCTION FOR ENGINEERING E-PORTFOLIO

INGLÊS COMO MEIO DE INSTRUÇÃO PARA E-PORTFÓLIO DE ENGENHARIA

INGLÉS COMO MEDIO DE ENSEÑANZA PARA PORTAFOLIO ELECTRÓNICO DE INGENIERÍA

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ABSTRACT: This paper tackles the importance of capacity-building and Industry 4.0. preparation in higher technical education where sustainable learning approaches start gaining a place. The primary study objective focuses on developing a combined curricular implementation of an applied didactic and career-promoting tool. A sequence of applied tasks related to the Mechanics of materials course and supported by English as Medium of Instruction (EMI) allowed to teach technical topics through the English Language. The transversal competences' framework strengthened training activities and created a meaningful connection to a professional e-portfolio artefact design. Quality task and presentation deliveries, remarkable e-portfolio contributions and student satisfaction questionnaires motivate applying this methodology to specialisation courses in engineering training. The findings help establish new models for higher education institutions' teaching and learning.

KEYWORDS: Competence-based education. Engineering education. Transversal competences. English as Medium of Instruction (EMI). Engineering e-portfolio.

RESUMO: Este documento analisa a importância do desenvolvimento de habilidades e preparação para a Indústria 4.0 no ensino técnico superior, onde as abordagens de aprendizagem sustentável começam a ganhar relevância. O objetivo principal do estudo é projetar e implementar curricularmente uma ferramenta pedagógica para a preparação profissional dos futuros engenheiros. Uma sequência de tarefas aplicadas relacionadas ao tema de Mecânica dos Materiais e suportadas pelo uso do inglês como meio de instrução (EMI) permitiu o ensino de disciplinas técnicas através da língua inglesa. A estrutura de competência transversal reforçou as atividades de treinamento e criou uma conexão significativa com o projeto de um portfólio profissional. A qualidade dos trabalhos de casa e apresentações, as notáveis contribuições do portfólio técnico e os questionários de satisfação dos estudantes motivam a aplicação desta metodologia a cursos de especialização em educação em engenharia. Os resultados ajudam a estabelecer novos modelos de ensino e aprendizagem nas instituições de ensino superior.

PALAVRAS-CHAVE: Educação baseada na competência. Educação em engenharia. Competências transversais. Inglês como Meio de Ensino (EMI). Portfólio de engenharia eletrônica.

RESUMEN: Este trabajo aborda la importancia del desarrollo de capacidades y la preparación para la Industria 4.0. en la educación técnica superior, donde los enfoques de aprendizaje sostenible comienzan a adquirir relevancia. El objetivo principal del estudio consiste en diseñar e implementar a nivel curricular una herramienta pedagógica a la preparación profesional de los futuros ingenieros. Una secuencia de tareas aplicadas relacionadas con la asignatura de Mecánica de materiales y apoyadas y uso del inglés como medio de enseñanza (EMI) permitió enseñar temas técnicos a través de la lengua inglesa. El marco de competencias transversales reforzó las actividades de formación y creó una conexión significativa con el diseño de un portafolio profesional. La calidad de las entregas de tareas y presentaciones, las notables contribuciones del portafolio técnico y los cuestionarios de satisfacción de los estudiantes motivan la aplicación de esta metodología a los cursos de especialización en la formación de ingenieros. Los resultados ayudan a establecer nuevos modelos de enseñanza y aprendizaje en las instituciones de educación superior.

PALABRAS CLAVE: Educación basada en competências. Formación en ingeniería. Competencias transversales. Inglés como Medio de Instrucción (EMI). Portafolio electrónico de ingeniería.

Introduction

Executing a digital transformation in modern society is no easy task. The Industrial Internet of Things poses sustainability challenges related to technical integration, data, information, and public context (BONILLA *et al*., 2018; REIS *et al*., 2018). Furthermore, this may imply that new management strategies applied to processes and operations must be adjusted for a new digital reality or the creation of an intelligent industry (KIEL *et al.*, 2017; VOGELSANG *et al.*, 2018). In line with this description of a modern work environment, the question arises regarding specific university preparation and engineering pedagogy. Can we identify some fundamental skills for future experts in the Higher Education system?

Specific authoritative reports have emphasized the relevance of capacity-oriented training and learning. The Organization for Economic Cooperation and Development (OECD, 2019) initially pointed to developing cognitive and metacognitive, social and emotional, physical, and practical skills as part of education and professional preparation. Meanwhile, the Council of Europe (2018) recommended key competencies for lifelong learning related to technological, entrepreneurial, social, and civic skills. The 2030 Agenda of Spanish universities highlighted the need to integrate sustainability skills into undergraduate programs and support cross-cutting, linguistic, and intercultural competencies (CRUE UNIVERSIDADES ESPAÑOLAS, 2018, 2020).

In this context, and through this pilot experience, we envision adapting the university curriculum to competency-based education, where applied skills and the global linguistic environment are also crucial. Specifically, we guide our students in developing individual engineering portfolios, paying attention to completing practical tasks in English. Conducting a pilot study in this area gives us a unique opportunity to assess the feasibility of enhancing the training procedure.

The article is organized as follows. First, we motivate the need to improve the training scheme by reviewing the theoretical background of English as a Medium of Instruction (EMI), cross-cutting competencies, and competency-based portfolios. Second, we conducted an experimental task to be included in the e-portfolio, receiving feedback from students and teachers.

This article aims to address the following research questions (RQ):

RQ1. How can we enhance the applied university curriculum, considering the importance of quality competency-based education?

RQ2. What is the role of global English in preparing engineering students?

RQ3. Can active learning tasks be part of a professional portfolio?

English as a Medium of Instruction

The importance of the English language as a means of communication has become crucial in the current educational era. Many higher education institutions worldwide, especially in countries where English is not the native language, are increasingly incorporating the language into their curricula. The opportunities provided by learning the English language are limitless, especially for students seeking to move to other countries where English is widely used for communication.

Most students in technical and scientific disciplines are encouraged to embrace opportunities to learn English for their benefit. In the European Union, the Bologna Process and the Erasmus Mobility Program are developing plans and policies to ensure that students learn English, which will be a significant boost, especially when accessing the job market in other countries (PAREY; WALDINGER, 2011).

As universities attract students from around the world, the level and maturity of interaction can be diverse, as students from different linguistic and social backgrounds learn and interact with each other, irrespective of linguistic variation (HERNÁNDEZ-CAMPOY; ESPINOSA; BRITAIN, 2020). o promote interaction and learning through a globally spoken universal language, universities in areas where English is not the native language have begun implementing the methodology known as English as a Medium of Instruction (EMI) as a strategy to enable students to learn academic content through another language. EMI has been extensively studied and experimented with to help international students develop professionally, socially, and communicatively. In a world where international teams consist of individuals with varied languages, mutual understanding will likely aid in executing group projects, collaboration, and work presentations before their professors.

EMI significantly impacts the education of the younger generation and policy decisions in non-anglophone jurisdictions, as it enhances international mobility and integration into the global market. A study conducted by Agai-Lochi (2015) analyzed language policies in higher education institutions, focusing mainly on multilingual nations such as Macedonia. This study compared language objectives with learning outcomes, revealing that English enables the

combination of communicative performance and linguistic competence, promoting more effective learning for multilingual students.

The term "English as a Medium of Instruction" denotes the use of the English language for teaching purposes in jurisdictions or countries where it is not the native language of the inhabitants. Therefore, the focus is more on academic disciplines than the language (MACARO *et al.*, 2018). Questions have been raised about the effectiveness of EMI in content learning and English proficiency development. Although it is an inevitable subject, there is limited evidence to assert the advantages of EMI in both content and language. However, a study conducted by Baker and Hüttner (2019) indicates an increase in the adoption of EMI in higher education institutions across Asia and Europe.

It is observed that more countries and educational institutions are adopting English at different levels of management and developing a positive attitude towards multilingual ideologies. The study by Baker and Hüttner (2019) highlights the importance of English-medium instruction in content learning and language proficiency. The effectiveness of EMI is supported by the definition of Dafouz and Smit (2016), who emphasize using a multilingual approach as an academic language and a channel to drive international communication in higher education institutions. These researchers also highlight the dynamic nature of EMEMUS (English-medium instruction in Multilingual University Settings) in the internationalization of higher education.

Transversal competences

The current dynamics of the job market demand enhanced preparation in terms of cross-cutting competencies, as asserted by the rectors of Spanish universities. Although conceptually straightforward, "cross-cutting competency" is considered the cornerstone of the Bologna Process (BOLOGNA PROCESS COMMITTEE, 1999). In terms of general empowerment and critical thinking, as well as practical skills, cross-cutting competencies are also known as generic competencies and administrative skills, including behavioral or interpersonal skills necessary to accomplish a task (POLYAKOVA; GALSTYAN-SARGSYAN, 2021). However, in its broader sense, cross-cutting competencies refer to experiences or manifestations of professional and emotional intelligence in environments where people interact, such as businesses or universities. Most often, these experiences are encountered through cooperation. Cross-cutting competencies are widely recognized for their significant contributions to communication effectiveness.

In the current landscape of Spanish higher education, strategies to establish the framework and assessment system for competency-based student preparation are being prioritized. The present research operates based on the Cross-Cutting Competencies (CT or "*Competencias Transversales*" in Spanish) provided by the Polytechnic University of Valencia. Figure 1 illustrates these competencies:

Figure 1 – Cross-Cutting Competencies at the Polytechnic University of Valencia

CT-01: Comprehension and Integration		**CT-09**: Critical thinking
CT-02: Application and practical thinking	**CT-06**: Teamwork and leadership	**CT-10**: Knowledge of contemporary problems
CT-03: Analysis and problem-solving	**CT-07**: Ethical, environmental and professional responsibility	**CT-11**: Lifelong learning
CT-04: Innovation, creativity and entrepreneurship	**CT-08**: Effective communication	**CT-12**: Planning and time management
CT-05: Design and project		**CT-13**: Specific instrumental

Source: adapted from: http://www.upv.es/contenidos/COMPTRAN/indexc.html

Thirteen competencies regarding the benefits of sustainable education are being assessed in the university study programs. These competencies include critical thinking, understanding and integration, application and practical thinking, teamwork and leadership, analysis and problem-solving, and effective communication. In engineering training, proficiency in cross-cutting skills is directly related to the preparation of high-quality specialists ready to enter the workforce and is therefore subject to assessment (JULIÁ SANCHIS *et al.*, 2017; SANCHEZ; GONZALEZ; ALAYON, 2011).

The scope of these competencies plays a crucial role in enhancing learning outcomes while increasing student engagement during the teaching process. Teachers are responsible for developing strategies for assessing EMI competencies (JULIÁ SANCHIS *et al.*, 2019). The English language training approach also significantly addresses communicative competencies at the B2 level in non-linguistic university students (POLYAKOVA; GALSTYAN-SARGSYAN, 2019).

In a specific case related to the Industrial Design and Product Development Engineering Course, EMI competencies are included in the program to enable their harmonization across content offered by different courses at various higher education institutions worldwide.

Engineering Competency-Based Portfolio in English

Another significant aspect of this research is its applied focus. Our educational initiative addresses a valuable didactic tool called a portfolio. The essence of the portfolio, also defined as "a collection of drawings, documents representing a person's work, especially an artist" (Cambridge Online Dictionary) in education, has brought forth the need for student-centered higher education. Additionally, the portfolio helps present samples of the student's "best work" (BRYANT; CHITTUM, 2013, p. 189) advancements, performance for external (peers, teachers) and internal (self) assessment, and reflection.

For this project, we focus on the definition of an electronic portfolio, stating that it is "a web-based information management system that uses electronic media and services" used by a learner to demonstrate competence and reflect on the learning process (SUBRAHMANYAM *et al.*, 2012, p. 1). According to Slepcevic-Zach and Stock (2018), electronic portfolios have become an integral part of higher education, supporting the development of competence in critical thinking, not being a specific measure of the most recent. Simultaneously, this tool aims to plan future job or internship opportunities, advocating for professional development and lifelong learning.

While the original subdivision was conceived for teacher training, in the current research, we pursue four main objectives of portfolios and electronic portfolios: display, reflection, social, and assessment functions (KARSENTI; DUMOUCHEL; COLLIN, 2014). The role of portfolios in the development of university students' competencies has been intricately captured in the preparation of creative industries (MIETZNER; KAMPRATH, 2013), in in-service teacher training (DERVIN; HAHL, 2015) or the future training of managerial teams (LAASCH; MOOSMAYER, 2016), among others.

Content learning and language proficiency have become vital objectives that promote multilingual and plurilingual competencies. Electronic portfolios are a competency-based way of learning content and language simultaneously. EMI encourages the achievement of these competencies, although engineering students are considered technically oriented. There is a general perception that those studying technical disciplines do not master languages as well as those in other disciplines, such as social sciences.

Students who navigate their academic journey through electronic portfolios learn quickly, store information, access it, and present it effectively, regardless of their areas of specialization. Specifically, the pedagogical needs of electronic portfolio users have been assessed by three scales: planning, reflection, and information selection, proving their utility (GALVÁN-FERNÁNDEZ *et al.*, 2017).

Advanced educational technologies have enabled institutions to develop competency-based electronic portfolios for engineering students. Some of these include Peeblepad and ATLAS, all with various similar and distinct features and tools. As a web-based electronic portfolio platform, Peeblepad software allows engineering students to manage learning by storing, packaging, and presenting learning goals and achievements (ALAM *et al.*, 2015). Proficiency levels achieved through electronic portfolios promote academic independence, personalized learning, and independent and critical thinking. While different institutions use distinct portfolios, the primary goal of these educational technologies is to make learning effective and broaden students' knowledge to help them succeed and thrive in employment areas.

Competency-based electronic portfolios include spaces for feedback that engineering students can use to enhance performance and future reference. Students can self-direct and track their development through personalized learning and assessment. They also contribute to the development of digital literacy skills. This educational technology can boost international students' communication skills as they learn from others with different linguistic backgrounds. Enhancing employability skills is a significant step towards professional development and employment for all engineering students.

The use of EMI and the acquisition of cross-cutting competencies add benefits to the use of these educational tools or technologies. At the end of each learning activity, students must track their development and reflective goals to verify if they have been achieved. The methodology applied for using the electronic portfolio will dictate the outcomes obtained.

To address the structure of a learning portfolio from a scientifically grounded perspective, we reviewed suggestions from various practitioners (FUKUNAGA, 2018; HALL; REGNITZ, 2020; SLEPCEVIC-ZACH; STOCK, 2018), examples from the MIT Communication Lab (https://mitcommlab.mit.edu/) and arrived at the following design:

Figure 2 – Structure of a Competency-Based Electronic Engineering Portfolio
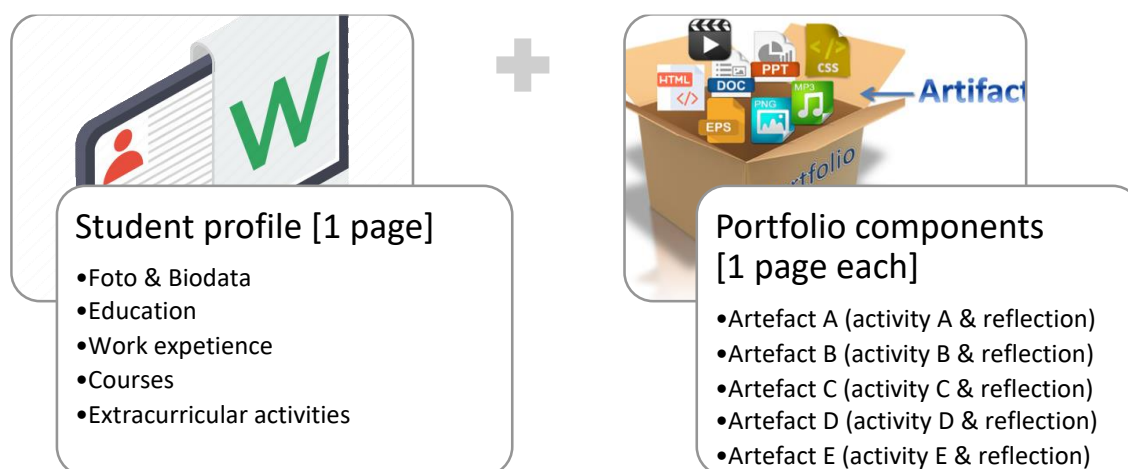
Source: Own elaboration

To construct the electronic portfolio, we chose to integrate two significant sections: student profile information and the content section, in which each activity performed by a graduate in L2/L3 is aligned with specific competencies. Below, we detail the procedure and report the implementation of a specific activity based on the integration of disciplines, guidance, and student participation.

Methods and procedures

The development of harmonized content in the educational curriculum plays a significant role in ensuring learners can share ideas and experiences, regardless of their native language. Furthermore, implementing EMI promotes the internationalization of education, enabling individuals to attend schools in any country without the fear of language barriers (RAHMAN; SINGH, 2020). In the long term, students can work towards accessing the global job market due to a mutual communication language that eliminates cultural barriers (KIRKPATRICK, 2014). People and educational institutions worldwide must embrace English as a common language and develop a positive attitude towards multilingual ideologies. These are distinct elements influencing the scope of our research, aimed at achieving the applied main goal of developing a competency-oriented electronic engineering portfolio and designing specific activities.

A group of 20 undergraduate students from the Industrial Design and Product Development Engineering course (*Universitat Politècnica de València* - Alcoy Campus, the academic year 2018/2019) anticipated in the experiment. Assuming a student-centered approach

and an evidence-based electronic portfolio, we generated a set of activities to integrate competencies, L2, and active learning approaches. For this purpose, precise notions of "Mechanics of Materials" and "Foreign Language II," along with cross-cutting competencies of application and practical thinking (CT-02), innovation, creativity, and entrepreneurship (CT-04), design and project (CT-05), effective communication (CT-08), and specific instrumental (CT-13) are presented.

To ensure dynamic capacity-building progress, the institution prepares graduates for the triple experience of achieving substantial competency development, assembling a multimedia learning asset, and reflecting on the curricular and professional context. Therefore, course teachers and researchers keep in mind structural support, tutorials, interdisciplinary integration, and student engagement (HALL; REGNITZ, 2020) to create an inspiring training experience, following these steps:

STEP 1. Pilot Study: Design and define pilot study objectives, structure, methods, and action plan, as well as share these guidelines with students.

STEP 2. Preparation of the work plan: Establishment of the study project framework (timeline, considerations of activities through the electronic portfolio, and competencies).

STEP 3. Activity: Design, implementation, and evaluation of a specific activity.

STEP 4. E-portfolio Artifact: Analysis of cross-cutting competencies achieved with the conducted training project.

The following sections describe the steps, reflecting primarily theoretical and applied characteristics.

Pilot study

This experimental approach explores higher education, engineering studies, second language acquisition, and capacity-oriented implementation. A general goal of developing a professional electronic engineering portfolio from undergraduate studies emerged at the faculty level. Various educators pioneered collaborative initiatives through combined disciplines that promote active learning and the development of practical electronic portfolio artifacts.

(1)   Presentation of the Electronic Portfolio and English Competencies: The current endeavor included an initial presentation of the engineering electronic portfolio within the organizational framework, focusing on its educational potential and professional value. Additionally, students received a review of the development of cross-cutting competencies linked to this as a valuable part of quality undergraduate programs. The explanation of the pilot

project also clarified a specific way to approach some learning activities (or future electronic portfolio artifacts) in terms of purpose, timeline, and evaluation.

(2) Learning Approach from a New Perspective: Aligned with the comprehensive development of assignments, the methodology used to implement the mentioned characteristics related to three main points: content, activity, and evaluation (Figure 3), all incorporated into a competency-based engineering electronic portfolio framework. This means that, before producing a portfolio artifact, students are guided through the training process to acquire curricular preparation and achieve specific learning outcomes.

Figure 3 – Active Learning Approach for Electronic Portfolio Tasks
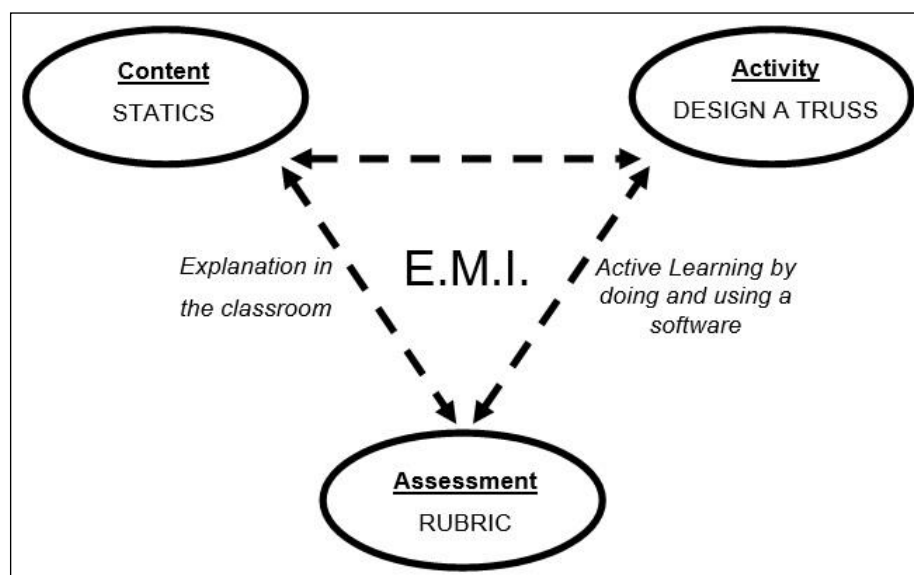
Source: Own elaboration

(3) Analyzing Results: At this stage, we assessed students' tasks (formative and summative evaluation) and conducted a survey on their opinions regarding this training experience.

Work Plan

Further progress in the study involved using the Work Plan, specifying the tasks to be developed during the academic year. Below, we detail its four main tasks:

TASK 1: Initial meeting.

TASK 2: Activity Design.

TASK 3: Activity Implementation.

TASK 4: Evaluation and Conclusions.

The planned schedule for the academic year is shown in Table 1:

Table 1 – Schedule

	Week 1	Week 2	Week 3	Week 4
September				
October	TASK 1	TASK 1		
November				
December				
January		TASK 2	TASK 2	
February		TASK 2	TASK 2	
March			TASK 3	TASK 3
April	TASK 4	TASK 4		
May				

Source: Own elaboration

The two courses in the proposed activity are taught in the third year (spring semester) of the Industrial Design and Product Development Engineering course. Table 2 presents the distribution of teaching units per week.

Table 2 – Distribution of teaching units per week (spring semester)

Week	Foreign Language II	Mechanics of Materials	Week
1	Unit 1. Communication	Unit 1. Statics	1
2	Unit 2. Environment		2
3	Unit 3. Design	Unit 2. Section Properties	3
4	Unit 4. Material Types	Unit 3. Tension, Compression and Shear	4
5	Unit 5. Transport		5
6	Unit 6. Statics and Dynamics	Unit 4. Elements axially loaded	6
7	Unit 7. Architecture		7
8	Unit 8. Globalisation	Unit 5. Torsion	8
9	Unit 9. Measurement		9
10	Unit 10. Assembly		10
11	Unit 11. Mechanisms	Unit 6. Bending	11
12	Unit 12. Technology		12
13	CONTENT REVISION		13
14	ORAL PRESENTATIONS	Unit 7. Columns	14
15	ORAL PRESENTATIONS	Unit 8. Stress and Deformations. Combined Loading	15

Source: Own elaboration

As noted, when students begin Unit 6 in the "Foreign Language II" course, they have already acquired the necessary knowledge from Unit 1 in the "Mechanics of Materials" course.

Activity "Truss for a Bridge"

Below is a more detailed explanation of the selected activity for the experiment, which consists of:

- Designing a truss for a specific application.

- Determining the external forces acting on the structure.

- Determining the internal forces transmitted in the bars of the structure.

- Presenting the activity to the class as an e-portfolio artifact (in-class presentation or video).

Through a topic previously familiar to students, the activity is proposed to apply the English language and skills to a technical task. This assignment is related to trusses, a set of members under two-force loading behaving as a single object and designed to support external loads (BEER *et al*., 2012).

Figure 4 – Truss for a Bridge
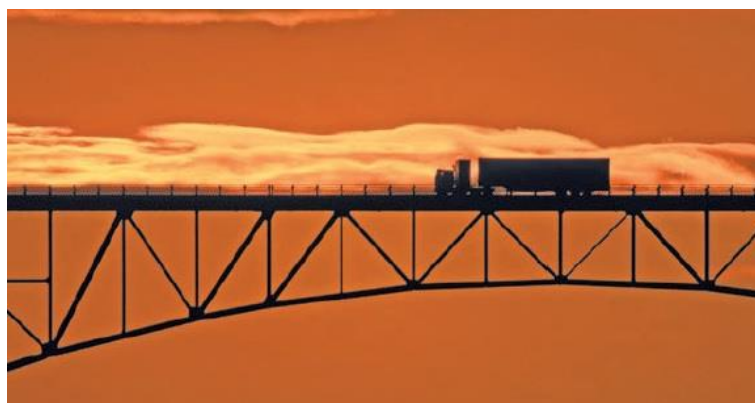
Source: Beer *et al.* (2012)

The task is structured as follows:

1) Introduction.

2) Objective of the structure.

3) Structure design (dimensions and loading condition).

4) Calculations (external reactions and at least two joints).

5) Problem solution using MDSolids software (results).

6) Conclusions.

At the end of the activity, students will be able to: Apply vocabulary related to the content in the context of Statics; Design a truss for a specific purpose, Use educational software, and Develop cross-functional skills.

Assessment

This experiment's planned three-level evaluation system represents a unique feedback configuration to achieve project objectives. The details of each aspect of measurement are described below:

a) Measuring learning outcomes

Effective communication competence (oral and written) will be assessed considering two essential items: the correct use of technical terminology and the order and clarity in the presentation.

Regarding the specific scientific-technical aspect, the activity aims to achieve the following objectives:

- Objective 1: Expand technical vocabulary in English.

- Objective 2: Promote active learning through teamwork activity.

- Objective 3: Develop a rubric for its application in the assessment phase.

To assess specific objectives, the indicators presented in Table 3 will be considered:

Table 3 – Indicators to evaluate specific objectives

Indicator	Evidence	Objective
Use appropriate language.	The student uses magnitudes, units, numbers, etc. correctly.	Objective 1
The presentation transmits relevant information.	The student exposes all the main ideas, also referring to other more secondary aspects.	Objective 1
The presentation is adequately prepared and adjusts to the established time.	The student shows hierarchy, synthesis of ideas and examples of quality in the presentation.	Objectives 1 and 2
Use means of support in a relevant way.	The student chooses the appropriate support resource and makes good use of it: austere, coherent presentations, considering the transition of ideas, respecting a homogeneous, readable and clear format.	Objectives 1 and 2
Accept and meet the team's objectives.	The student does the assigned tasks.	Objective 2
Design of a rubric.	The rubric is adequately designed.	Objective 3

Source: Own elaboration

We have also developed an assessment matrix to analyze students' tasks. Various studies highlight the effectiveness of assessment matrices in higher education. Reddy and Andrade (2010) review and investigate the use of assessment matrices in higher education, focusing on student performance, teaching enhancement, and program evaluation. The use of assessment matrices has been shown to correlate with improved academic performance.

According to Dawson (2017), assessment matrices, both in practice and research, have represented diverse meanings. Therefore, the term "assessment matrix" sometimes provides inconsistent understandings. This author synthesized various matrices, identifying the elements that differentiate them from one another.

b) Progress in competencies. Based on our experience, the developed assessment matrix is represented in Table 4.

Table 4 – Matrix for Student Work Assessment

Indicator	(D) Not Reached	(C) In Development	(B) Good	(A) Excellent	Transversal Competence
Makes a justified statement	Explains the need for the project but gives no reasoning.	Justifies the needs of the project based on contrasted and reasoned opinions and judgments.	Justify the context and needs of the project correctly but not wholly.	Justify the context and needs of the project correctly and completely.	CT-05
Gets the necessary information from different and contrasted sources	Does not identify the information or the consulted bibliography.	Gets some necessary information from a simple search, naming it rarely.	Gets all the necessary information from a simple search.	Gets all the necessary information from an advanced search.	CT-02
Software management	The student is not able to manage this tool.	Manages the tool at a basic level.	Manages the tool at an advanced level.	Manages the tool at an advanced level, taking advantage of all its functionalities.	CT-13
Elaborates conclusions using suitable vocabulary	There are no conclusions.	There are conclusions but no analysis of the results.	Makes a detailed analysis of the results.	Analysis in depth of the results with appropriate conclusions.	CT-04
Uses clear and appropriate terminology	Does not make good use of language or terminology.	The presentation is not fluid and uses scarce specific terminology.	Expresses correctly, respecting the linguistic rules and using the specific terminology of the topic.	The presentation adapts to the audience, making use of the specific terminology appropriately and precisely.	CT-08

Source: Own elaboration

This rubric allowed the involved teachers to assess the activity, correlating each indicator with the corresponding transversal competence.

c) Presentation of the e-portfolio artifact.

The critical element of this experiment lies in implementing the training activity in the engineering e-portfolio setting. By emphasizing learners' critical thinking ability and reflection on the educational process, we recommend the previous section (see Table 4) as a guide for self-assessment and peer evaluation of the final e-portfolio product. On the one hand, this evaluation will assist students in drafting an individual justification of the activity's relevance to the e-portfolio (200 words).

On the other hand, once a short video presentation (1-2 minutes) of the portfolio is edited, it is assigned to two peers for evaluation according to the same section. Their brief feedback and suggestions will inspire the development and presentation of future items. Special attention will be given to effective L2 communication skills: the written aspect corresponding to the justification and the oral aspects linked to the video presentation.

Results

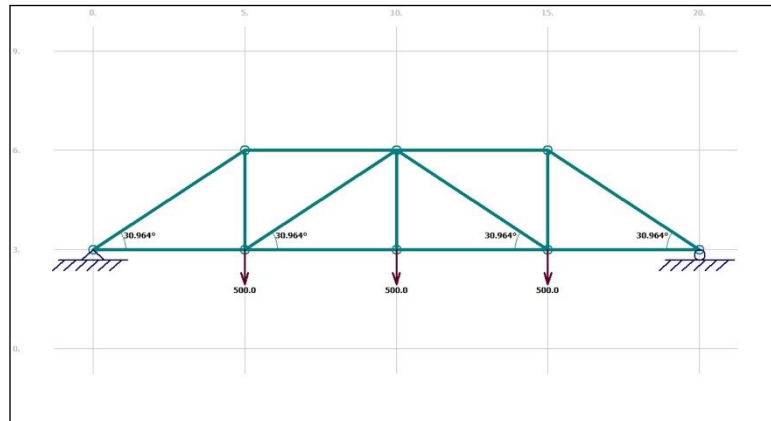### Evaluation of the "Truss for a Bridge" Activity

Students must complete and submit the task to the online platform by the deadline. They must present the activity in class; as an optional item, they can record a video presentation. Figures 5, 6, and 7 show the example presented to students by the teachers, while Figure 8 includes a series of screenshots of the teamwork/pair work of students and the learning outcomes.

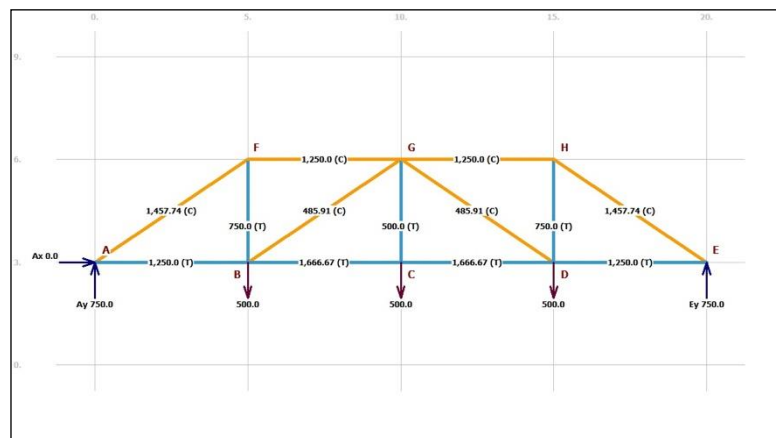**Figure 5** – Truss Application Sketch for a Bridge
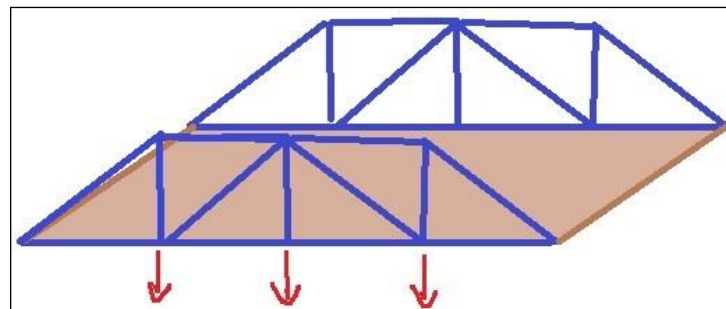
Source: Own elaboration

Figure 6 – Truss Application for a Bridge (Software Model)

Source: Own elaboration

Figure 7 – Truss Application for a Bridge (Solved Model)

Source: Own elaboration

Figure 8 – Video presentation of the activity performed by students (screenshots)
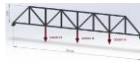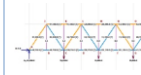

Source: Own elaboration

Due to confidentiality reasons, assessment results cannot be published, but the group achieved an average with grades ranging from 6.00 to 9.2. On the positive side, there was increased awareness, recognition, and understanding of specific aspects of statistics and Dynamics. Additionally, students' creativity and specialized preparation were enhanced. Both teachers recommended improving L2 communication skills, which directly impact the production of technical and academic language.

E-portfolio artefact

The applied engineering e-portfolio system described in this study consistently addressed the practical side of engineering education. In this way, we present an anonymous example of a proposal from one of our students to illustrate how the first item of the e-portfolio looked (see Figure 9 below):

Figure 9 – Example of Individual E-portfolio Project A

	Name: Student3 Surname: Student3 About me: I am currently an undergraduate student in the Technical University of Valencia (Spain); my major is Industrial Design and Product Development. I am working on Mechanics of Materials and willing to apply my knowledge to my final degree project as well as possible internship programmes.
Artefact A: A truss for a bridge	Courses: "Mechanics of Materials" and "Foreign Language II" General description A truss is a structure made from connecting long narrow bars at their ends with a particular purpose.
	Real application / 2D simplified model / MDSolids Model / MDSolids solution
Reflection Transversal competences of application and practical thinking (CT-02), innovation, creativity and entrepreneurship (CT-04), design and project (CT-05), effective communication	*The process of truss design involved different initial tasks such as learning technical vocabulary and key concepts in Spanish and English. It was also necessary to study how to use a bridge design software, Bridge Designer. However, it was not the hardest part because I have already saw the tutorial. Probably the most challenging task was to speak in English. Normally I write a report but in this case I had the design and defend in English by orally presenting it and then recording a video of my artefact.* *Before the project, I was not able to observe competences applied to a specific item, they were too general for me. Now I know what each one means and where I use in this activity. The most important result is that my learning has become more open, imaginative and*

Source: Own elaboration

Survey

After completing the activity and project presentations, a survey is conducted among participating students to gather their opinions, enabling teachers to receive corresponding feedback to enhance the training process in future courses. Table 5 presents the questionnaire results, with 16 respondents:

Table 5 – Opinion Survey and Results

Question	Students' opinion
Question 1: Has this activity contributed to your content and language acquisition process?	Yes: 100% No: 0%
Question 2: Was the topic appropriate?	Yes: 100% No: 0%
Question 3: What are the main benefits of this activity for your learning process?	Some of the answers: To use technical vocabulary. To apply the English language to a technical topic. To learn useful vocabulary for engineers. To apply portfolio system and competencies.
Question 4: What are the drawbacks of this activity?	Some of the answers: The complexity. The time required for the activity. The presentations of the activity and artefact.
Question 5: Would you like to carry out similar activities with other technical topics in the future? If yes, indicate which.	Some of the answers: Yes, renewable materials. Yes, packaging. Yes, technology.
Question 6: Generally speaking, how satisfied are you with this activity?	Very satisfied: 56,3% Rather satisfied: 43,7% Unsatisfied: 0%

Source: Own elaboration.

The responses indicate that virtually all students consider learning through English relevant to their future professional careers. The results support the implementation of the Content and Language Integrated Learning (CLIL) methodology, e-portfolios, and competency-oriented training in technical higher education institutions.

Discussion

At the beginning of the study, three fundamental research questions served as the starting point for this investigation. Therefore, we will address the following research questions and discuss the findings related to each question independently to ensure clarity and precision:

RQ1. Given the importance of competency-based quality education, how can we enhance the applied university curriculum?

Referring to the primary characteristics of the Bologna system, one of the most relevant facets of the Sorbonne Joint Declaration (1998) is the competitiveness of the European Higher Education Area. The essential tool to achieve this goal is directly linked to the choice of transversal competencies, the promotion of the global language, and the e-portfolio as a clear support for engineering education and readiness for the future job market.

The research responses to question 6 illustrate mostly benefits for learners (56% very satisfied and 44% satisfied). Despite the overall approval of participants regarding the chosen theme (question 2, 100% suitability), educators can make a difference by expanding the scope of the e-portfolio theme, as recommended by the feedback from question 5. Teachers agree with the project evaluation given by the responses to question 4 (complexity of the training process, timing, or difficulties with presentations) and understand that the pilot process was complex, with room for improvement in guidance, monitoring, or other methodological and scheduling adjustments.

RQ2. What is the role of the English language in preparing engineering students?

English-mediated education is a valuable asset in this experimental study. However, we agree with Arnbjörnsdóttir (2017, p. 77), who, referring to students at the University of Iceland (2017, p. 77), states that the "hidden challenge" of EMI initiatives consists of the lack of academic English skills. In the Spanish context, we additionally observe the potential lack of confidence in L2 as the core issue.

Nevertheless, the implementation of English as a vital part of content and language acquisition was well-received by students, as shown in the responses to question 1 (100% yes). Graduates felt that participating and engaging in the course with English as the Medium of Instruction made them more convinced of their ability to apply English to engineering tasks. Linguistic benefits become evident through openness to the global language, emphasizing content education for a sustained period.

RQ3. Can active learning tasks be part of a professional e-portfolio?

To address the design of the e-portfolio combined with engineering education, we proved that other teachers and researchers who successfully tested some of the e-portfolio learning benefits (BHATTACHARYA; HARTNETT, 2007; MACÍAS, 2012) had reasons to praise its applicability.

In responding to question 3 about the contributions of the activity to the training process, our students highlighted primarily specific English vocabulary. Moreover, they recognized the importance of the e-portfolio and the competency framework. The most stimulating part of this

study was meaningfully intertwining various projections (course curriculum, competencies, EMI, active learning, and e-portfolio artifact). Overall, students revealed a more responsible attitude and demonstrated greater readiness for their future professional careers.

Final considerations

Implementing competency-oriented technical training, the English-medium instruction (EMI) methodology, and the e-portfolio in this experience broadened future engineers' cognitive and applied networks. The conclusions helped solidify significant aspects of the conducted training plan:

1) Pedagogical Initiative: New and challenging educational scenarios induce a reassessment of training methods in higher education. In this case, due to the joint efforts of institutional authorities promoting competency development, teachers and students materialized this practical experience.

2) Student-Centered Training: Though traditionally considered mere knowledge receivers, active learner participation in the training process has become a crucial driving force within the Bologna system.

3) Professional Preparation: While maintaining university standards, we aimed to provide authentic scenarios to showcase our students' specialized skills, practice L2, and encourage versatile development in the younger generation of specialists.

Despite some study limitations (a small group of students, limited artifact production, early e-portfolio implementation stage), we strongly advocate for the educational use of competency-based e-portfolios. From a long-term research project perspective and addressing the concerns expressed by Hall and Regnitz (2020), we recommend some considerations:

- For a profound and reflective use of the e-portfolio, plan a meaningful career-focused activity with a practical learning, design, or project setting.

- Explain the purpose of designing a professional item in the portfolio as part of the lifelong learning process, competency development, and reflective practice.

- Structure the training process, monitor, and guide students rather than correcting them directly.

- When measuring outcomes, deepen the scope, including self-assessment, peer assessment, and performance.

Contrary to satisfaction, researchers are eager to apply the pilot study to the new higher education landscape. More than ever, universities struggle to provide quality and sustainable education based on online platforms and hybrid learning systems. Therefore, teachers need to be creative, resourceful, and innovative coaches, guiding the younger generations through uncertainties.

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