CINIE 2022

DEPARTAMENTO DE TECNOLOGÍA DE LA EDIFICACIÓN

23TH, 24TH and 25TH March 2022

ESCUELA TÉCNICA SUPERIOR DE EDIFICACIÓN
UNIVERSIDAD POLITÉCNICA DE MADRID
Avda. Juan de Herrera, 6-28040-MADRID

LIBRO DE ACTAS

ABSTRACTS BOOK

International Conference of Educational Innovation in Building

Congreso Internacional de Innovación Educativa en Edificación

VI INTERNATIONAL CONFERENCE OF EDUCATIONAL INNOVATION IN BUILDING

CINIE 2022

ESCUELA TÉCNICA SUPERIOR DE EDIFICACIÓN
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Organizador: Departamento de Tecnología de la Edificación de la ETSEM.
Universidad Politécnica de Madrid
Patrocinadores:
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TOPIC	
Building Information Modeling (BIM)	Herrero del Cura, Sofía Lozano Díez, Rafael Vicente
Educational Innovation in Technical Education	López Zaldívar, Óscar Gil López, Tomás
Equal Opportunities for Women in Research and Teaching	Valiente López, Mercedes Vidales Barriguete, Alejandra
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Research in Education: Educational Innovation	Borrás Gené, Oriol Ferrández Vega, Daniel Ríos Aguilar, Sergio José

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MAQUETACIÓN Y DISEÑO / DESIGN AND DEVELOPMENT

Herrero del Cura, Sofía

Lozano Díez, Rafael Vicente

Martínez Rodríguez, Mar (Diseño Web)

GREETINGS

VI INTERNATIONAL CONFERENCE OF EDUCATIONAL INNOVATION IN BUILDING (CINIE 2022)

23, 24 y 25 de marzo de 2022

This new edition of the CINIE, the sixth one, aims to lay the foundations for the development of joint projects and produce relevant results in the field of educational innovations in higher education. With the primary objective of continuous improvement in the teaching methodology within the building field, it is intended to include the latest advances and research in the field of teaching-learning, which contributes to the production of scientific results of quality of international interest.

The organization of CINIE 2022 programme contains different activities in innovation in educational methods, oral communications, posters and virtual exhibitions of different thematic areas such as advances in educational research, New tendencies in university education and other different fields, as well as differentiated actions in the BIM environment

In this sixth edition, it is important to note the quality and involvement of all participants, which has led to the presentation of a large number of papers that group more than 175 speakers from different places through their different typologies of Presentations.

The Organizing Committee

CINIE 2022 PROGRAM

ORAL COMMUNICATIONS

Wednesday, 23th March 2022/ Morning conferences	
Entrance Hall	
9:30 – 14:30	Registration / Documentation reception

Meeting Room	
10:30 - 11:00	**Opening session:** **Dean of Universidad Politécnica de Madrid (U.P.M.),** **D. Guillermo Cisneros Pérez**

11:00-12:00	**Poster session 1 + coffee break**

Meeting Room	
12:00 - 12:30	**Inaugural Conference:** **Full Professor at the Civil Engineering Department of the Faculty of Engineering of the University of Porto, Portugal** **D. Humberto Salazar Amorin Barum**

Hall of Degrees	
Conferences	**SESSION 1 (PRESENTIAL SESSION)** **Chair: Amparo Verdú Vázquez**
12:30-12:50	***(028) REVISITING THE IMPLICATIONS OF HIGHER EDUCATION FOR SUSTAINABLE DEVELOPMENT*** Marcos García Alberti; Juan Carlos Mosquera Feijoo; Isabel Chiyón Carrasco; Fernando Suárez Guerra
12:50-13:10	***(030) CDIO APPROACH TO EXPERIMENTAL LABORATORY WORK*** Antonia Pacios Álvarez; Manuel Tarifa Crespo; Angel Paris Loreiro; Elisa Poveda Bautista
13:10-13:20	***(009) LEARNING TECHNIQUES BASED ON PROJECTS, PROBLEMS RESOLUTION AND COEVALUATION IMPLEMENTATION ON TRADITIONAL LEARNING TECHNIQUE SUBJECT. PRACTICAL CASE ON UNIVERSIDAD POLITÉCNICA DE MADRID*** Rubén Muñoz Pavón; Lucía López-de Abajo; Marcos Garcia Alberti
13:20-13:50	***(026) DIGITALLY-BASED TEACHING, STUDENT READINESS AND ENGAGEMENT TOWARD ACTIVE LEARNING IN STEM COURSES*** Sandro Andrés Martínez; Juan Carlos Mosquera Feijoo; David Santillán Sánchez; Luis Cueto-Felgueroso Landeira
13:50-14:10	***(065) THE USE OF ICT FOR THE SUPPORT OF STUDENTS WITH SPECIFIC EDUCATIONAL SUPPORT NEEDS*** Lubna Morales de Paz; Manuel Álvarez Dorado

Thursday, 24th March 2022/ Morning conferences	
	Hall of Degrees
Conferences	**SESSION 2 (PRESENTIAL SESSION)** **Chair: Daniel Ferrández Vega**
10:00 – 10:20	***(023) VENEZUELA. CONSTRUCTION PROBLEMS AND SUSTAINABLE CONSTRUCTION. COLLECTING DATA TO PUT THE PUZZLE TOGETHER. Part 1.*** Licia Pietrosemoli de Dikdan;Carlos Rodríguez-Monroy;Yilsy Nuñez Guerrero
10:20 – 10:40	***(029) AUTOMATING THE CREATION OF VR EXPERIENCES AS LEARNING PILLS FOR THE CONSTRUCTION SECTOR*** María Jesús Bopp; Felipe Muñoz La Rivera; Cayetano Sierra Martí; Javier Mora Serrano
10:40 – 11:00	***(064) SMATH STUDIO: WRITING, MATHEMATICAL CALCULATION, PLOTTING AND PROGRAMMING FREE TOOL*** Jorge Pablo Díaz Velilla; Guadalupe Dorado Escribano; Alberto Morón; Alicia Zaragoza
11:00 – 11:20	***(024) A SERVICE-LEARNING EXPERIENCE OF COLLABORATION BETWEEN THE UNIVERSITY AND SECONDARY EDUCATION TO PROMOTE VOCATIONS IN STEM STUDIES*** Sergio Blanco; Belén Muñoz-Medina; Marcos G. Alberti; Alejandro Enfedaque; María Teijeiro

11:30-12:30	**Poster session 2 + coffee break**

Hall of Degrees	
Conferences	**SESSION 3 (PRESENTIAL SESSION)** **Chair: Mª Paz Sáez Pérez**
12:30-12:50	***(016) HYBRID DIGITAL IDENTITY WORKSHOP USING INTERACTIVE TOOLS*** Oriol Borrás-Gené
12:50-13:10	***(039) LEARNING ACTIVITIES FOR SUSTAINABLE HUMAN DEVELOPMENT COORDINATED FOR THE PROJECT MODULE: COMPOSITION, PROJECTS AND URBANISM*** Iballa Naranjo Henríquez; Pablo Miguel De Souza Sánchez
13:10-13:30	***(019) TEACHING LAB EQUIPMENT COMMISSIONING FOR HIGH PERFORMANCE MECHANICAL VENTILATION CLASSES BASED ON LEARNING BY DOING METHODOLOGY AND OPEN SOURCE TRENDS*** Alexander Martín-Garín; José Antonio Millán-García;Cristina Marieta-Gorriti;Iñigo Rodríguez-Vidal; Nacim Alilat; Abderrahmane Baïri
13:30-13:50	***(020) TFM OR PFC. TIME CONSTRICTION, COLLECTIVE WORK AND PROGRAMMATIC FREEDOM AT THE ETSAM*** José Francisco García-Sánchez; Sergio Martin Blas

GLOCAL II, 24th March 2022

12:30 p.m. to 13:30 p.m., ETSEM – UPM

GLOCAL

https://glocal.pb.edu.pl/en/

. Pilar Izquierdo Gracia: ": "GLOCAL: Summer Schools". **10 min.**

. Mª Aurora Flórez de la Colina: "GLOCAL: Some preliminary results of an Erasmus + Project, developed under an international pandemic". **10 min.**

. Dorota Gawryluk: "GLOCAL. Future of the city". **10 min.**

. Jurga Kučinskienė: "GLOCAL Glossary: an innovative learning tool to train future engineers in Europe". **10 min.**

. Alejandra Vidales: "GLOCAL – Sustainable cities", at ETSEM-UPM". **10 min.**

Questions and Discussion - Preguntas /Debate. **10 min.**

Innovative training of future engineers responding to problems of contemporary cities, Erasmus+ 2019-1-PL01-KA203-065654
Formación innovadora de los futuros ingenieros, que responda a los problemas de las ciudades contemporáneas
Escuela Técnica Superior de Edificación de Madrid, Universidad Politécnica de Madrid,
Sala de Juntas (ETSEM - UPM), Avda. Juan de Herrera, 6 – 28040 Madrid, Spain

Friday, 25th March 2021/ Morning conferences	
Hall of Degrees	
Conferences	**SESSION 4 (PRESENTIAL SESSION)** **Chair: Manuel Álvarez Dorado**
10:00 – 10:20	***(054) ANALYSIS OF THE INTERACTION OF ERASMUS EXCHANGE STUDENTS IN THE GROUP RESULTS. CASE OF THE SUBJECT OF SPANISH POPULAR CONSTRUCTION (III)*** Gregorio García López de la Osa; Sonsoles González Rodrigo; Pilar Izquierdo Gracia; Fernando Magdalena Layos; Beatriz González Rodrigo
10:20 – 10:40	***(022) THE USE OF VIDEO AS A TOOL TO TEACH TO USE A SOFTWARE IN CIVIL ENGINEERING*** Lucía López-de Abajo; Rubén Muñoz Pavón; Marcos Garcia Alberti
10:40 – 11:00	***(027) LEARNING THROUGH SUBJECTS INTERCONNECTION: COORDINATION AND TRANSVERSALITY OF DISCIPLINES IN THE DEGREE IN TECHNICAL ARCHITECTURE OF THE EPS OF ZAMORA (UNIVERSITY OF SALAMANCA)*** María Ascensión Rodríguez-Esteban; María Almudena Frechilla-Alonso; Ana Belén González Rogado; Susana Nieto Isidro; Ana Belén Ramos-Gavilán
11:00– 11:20	***(031) CONSTRUCTION COMPREHENSION BY MODELING. THE CASE OF THE STARICASE OF LINA BO BARDI*** Fernando Altozano García

11:30-12:30	**Coffee break**

Meeting room	
12:30-13:00	**Closing plenary conference:** **Consejo General de la Arquitectura Técnica de España**
13:00-13:15	**Closing session:** **Dean of Department " Tecnología de la Edificación" ETSEM- UPM** **D. Carlos Morón Fernández**

VIRTUAL SESSION

(001) IMMERSION IN THE PROFESSIONAL WORLD OF BUILDING: EDUCATIONAL INNOVATION THROUGH TECHNICAL VISITS TO WORKING ENVIRONMENTS
David Villanueva Valentín-Gamazo; Gustavo Arcones Pascual; Santiago Bellido Blanco

(002) ACCESSIBILITY TEACHING: ARCHITECTURE, URBANISM AND FACILITIES
Gonzalo Lillo Menchero; Antonio José Carpio de los Pinos

(007) INNOVATIVE PROCESS OF CREATING SMALL ELEMENTS FOR BUILDING
Jose Antonio Hernadez Torres; Ángel Mariano Rodríguez Pérez; Julio Jose Caparros Mancera

(010) METHODOLOGY FOR ONLINE METAL CASTING
Ángel Mariano Rodriguez Perez; Julio Jose Caparros Mancera; Jose Antonio Hernadez Torres

(011) PROVIDING CHARACTERIZATION AND NEW CONSTRUCTION MATERIALS TO HIGH SCHOOL STUDENTS.
Álvaro Alonso Díez; Raquel Arroyo Sanz; Lourdes Alameda Cuenca-Romero; Sara Gutiérrez-González; Verónica Calderón Carpintero; Ángel Rodríguez Sáiz; Alba Rodrigo

(012) REELS IN FOREIGN LANGUAGE TEACHING IN SCIENCE AREAS
Guadalupe Dorado Escribano; Jorge Pablo Díaz Velilla

(013) SERIOUS GAMES APPLIED TO UNIVERSITY PROJECT MANAGEMENT STUDIES
Manuel Botejara-Antúnez; Pablo Garrido-Píriz; Jaime González-Domínguez; Gonzalo Sánchez-Barroso; Justo García-Sanz-Calcedo

(015) SYNERGISTIC APPLICATION OF CHALLENGE-BASED LEARNING AND AGILE METHODOLOGY TO PROJECT MANAGEMENT EDUCATION
Manuel Botejara-Antúnez; Jaime González-Domínguez; Pablo Garrido-Píriz; Gonzalo Sánchez-Barroso; Justo Gª-Sanz-Calcedo

(051) MODELING TOOLS FOR UPDATING THE ARCHITECTURAL GRAPHIC EXPRESSION LEARNING PROCESS
Rafael Vicente Lozano-Diez; Oscar López-Zaldívar; Sofía Herrero-del Cura; Pablo Luis Mayor-Lobo

(032) DESIGN OF MECHANICAL ELEMENTS IN 3D MODELING PROGRAMS
Mercedes Perdigones Gómez; Ángel Mariano Rodríguez Pérez; Julio José Caparrós Mancera; José Antonio Hernández Torres

(034) PGFPLOTS: PLOTS FOR SCIENTIFIC PAPERS
Alberto Pedro Manzano Herrero; María Fuente Ruiz

(035) OPEN LEARNING ON THE NETWORK: MOOCS AS INNOVATION IN EDUCATION
Hernández Garrido Rocío; David Perea; Perez Calañas Cinta; Rodriguez Perez Angel Mariano

(036) THE USE OF GAMIFICATION IN EDUCATION: AN EXPLORATORY STUDY
Perez-Calañas Cinta; Hernández-Garrido Rocío; Perea David; Rodriguez-Perez Angel Mariano

(038) VIRTUALIZATION OF MANAGEMENT AND PROJECT MANAGEMENT SUBJECTS
Juan Pablo Carrasco Amador; José Luis Canito Lobo; Manuel Matamoros Pacheco

(040) INCORPORATING COLLABORATIVE ONLINE INTERNATIONAL LEARNING (COIL) INTO ARCHITECTS AND BUILDING ENGINEERS. A STUDY CASE IN PERÚ AND SPAIN
Sara Gutiérrez González; Claudia Elena Coello Torres; Mario Abramonte; Verónica Calderón Carpintero; Ángel Rodríguez Sáiz; Alba Rodrigo Bravo

(042) THE URBAN PROJECT AS A LEARNING MECHANISM FOR THE PROJECTUAL PRACTICE OF THE THESIS
Bruno Bellota Noguera

(043) PLAYFUL STRATEGY MEDIATED BY ICT AS SUPPORT FOR TEXT COMPREHENSION IN PRIMARY SCHOOL CHILDREN
Rubén Jerónimo Yedra; Laura López Díaz; Doris Laury B. Dzib; José Trinidad Acosta de la Cruz

(045) PROYECTOS BIM MÁS ALLÁ DE LOS MODELOS CONSTRUCTIVOS
Ángela Moreno Bazán; Marcos García Alberti; Antonio A. Arcos Álvarez

(048) PLOGGING: ECO SPORTS IN PHYSICAL EDUCATION CLASSES. PRACTICAL PROPOSAL OF ACTIVITIES IN LINE WITH THE SUSTAINABLE DEVELOPMENT GOALS (SDG).
Patricia Val Fernández

(056) ANALYSIS, MODEL AND SIMULATION OF MANUFACTURING AND PRODUCTION SYSTEMS IN ENGINEERING
Julio José Caparrós Mancera; Ángel Mariano Rodríguez Pérez; José Antonio Hernández Torres

(057) DIDACTIC METHODOLOGIES IN TECHNICAL EDUCATION
Cesar Antonio Rodríguez González, José Antonio Hernández Torres, Ángel Mariano Rodríguez Pérez, Julio J. Caparrós Mancera

(062) THE COMPANY, A NECESSARY AND INVALUABLE AGENT IN THE PROFESSIONAL LEARNING PROCESS THROUGHOUT ONE´S LIFE
Bonifacio Pedraza López

(006) IMPLEMENTATION OF THE ASSOCIATION BETWEEN ORTHOGRAPHIC VIEWS AND RELATED 3D OBJECTS IN CeDG: A PROOF OF CONCEPT
Manuel Prado Velasco; Laura García-Ruesgas

CINIE 2022 PROGRAM
PÓSTERS

Wednesday, 223th March 2022. 11:30-12:30	**POSTER SESSION 1** **Entrance Hall**
PL-C1	***(059) DEVELOPMENT OF A GAMIFICATION APP TO ENCOURAGE WORKERS TO IMPROVE THEIR PHYSICAL HEALTH*** David Manuel Sánchez Martín; Catalina Mondragon Enguidanos; Amparo Verdú Vázquez; Tomas Gil Lopez
PL-C2	***(063) RESEARCH AS A LEARNING TOOL IN CHEMICAL PROCESS CONTROL FOR CHEMICAL ENGINEERING STUDENTS*** Evangelina Atanes-Sánchez; José Antonio Díaz López; María José Martín de Vidales Calvo; Antonio Nieto-Márquez Ballesteros; David García Casillas; Verónica Blanco Gutiérrez; Antonio Juan Dos Santos García; Lucía Isidoro García; Francisco Fernández Martínez
PL-C3	***(003) ANALYSIS OF EXPERIENCES OF LEADERSHIP AND COLLABORATIVE WORK IN THE TEACHING OF SURVEYING*** Cristina Torrecillas Lozano; Eduardo Vázquez-Lóquez; Laura García-Ruesgas
PL-C4	***(004) COGNITIVE AND AFFECTIVE EMPATHY IN FUTURE SECONDARY EDUCATION TEACHERS*** Irantzu Recalde Esnoz; Rafael Marcos Sánchez; Daniel Ferrández Vega; Héctor del Castillo
PL-C5	***(008) INTRODUCTION TO TECHNICAL ASSESSMENT OF INNOVATIVE BUILDING PRODUCTS. JAE-INTRO GRANTS EXPERIENCES AT IETCC-CSIC (2019-2021)*** Eduardo Lahoz Ruiz; Angel Armando Arquero; Rafael Hdez. Rosales; Mónica Sanz Roldán
PL-C6	***(014) SUSTAINABLE EVALUATIVE METHODOLOGY FOR LEARNING IN ENGINEERING DEGREE COURSES*** María Paz Sáez Pérez; Susana Robles Sánchez
PL-C7	***(018) TEACHING CONCEPTS OF ACOUSTIC CONDITIONING OF BUILDINGS THROUGH 3D ACOUSTIC MODELING IN TECHNICAL EDUCATION*** Francisco Javier Rodríguez Rodríguez; Arturo González Gil; Antón Cacabelos Reyes; Javier Pérez Vallejo
PL-C8	***(021) THE ABANDONMENT OF END-OF-LIFE TIRES (ELTS) ON THE SPANISH COAST: A SERVICE LEARNING PROPOSAL IN HIGHER EDUCATION*** Héctor del Castillo; Irantzu Recalde Esnoz; Daniel Ferrández Vega; José Vicente de Lucio Fernández
PL-C9	***(025) CHALLENGE-BASED LEARNING ORIENTED TO PROFESSIONAL REALITY: A MULTIDISCIPLINARY APPROACH THROUGH APPLIED PHYSICS*** Daniel Ferrández; Manuel Álvarez Dorado; Alicia Zaragoza; Carlos Morón
PL-C10	***(033) PREVENTION AND RESOLUTION OF CONFLICTS IN THE CLASSROOM THROUGH SOCIAL SKILLS*** Laura Martínez Badillo; Alejandra Vidales Barriguete; Mario González Barriguete; Noelia Sánchez Moreno
PL-C11	***(037) TWITTER AS A METHODOLOGICAL RESOURCE IN HIGHER EDUCATION: AN EDUCATIONAL EXPERIENCE*** Patricia Aguilera-Benito; Juan López-Asiain-Martínez; Isabel Bach-Buendía; Mercedes Valiente López
PL-C12	***(066) DIDACTIC PROPOSAL THROUGH THE USE OF PROJECT-BASED LEARNING IN THE DOUBLE DEGREE OF BUSSINES ADMINISTRATION AND BUILDING ENGINEERING*** Pablo Saiz Martínez; Herman Martin; Alicia Zaragoza-Benzal; Alberto Morón

Thursday, 24th March 2022. 11:30-12:30	**POSTER SESSION 2** **Entrance Hall**
PL-C13	***(041) ACQUISITION OF TRANSVERSAL COMPETENCES LINKED TO PROGRAMMING IN HYDRAULIC ENGINEERING SUBJECTS*** Sergio Zubelzu; Sara E. Matendo
PL-C14	***(044) CHALLENGE-BASED LEARNING PROJECT. MONITORING AND TESTING PHYSICAL PROPERTIES IN BUILDING*** Manuel Álvarez Dorado; Engerst Yedra Álvarez; Daniel Ferrández Vega; Alicia Zaragoza
PL-C15	***(046) INTERNATIONAL GROUP COOPERATION MEETINGS FOR THE DEVELOPMENT OF SUSTAINABLE DEVELOPMENT PROPOSALS IN UNIVERSITIES*** Patricia Aguilera Benito; José Ángel Capitán Gómez; Miguel Fernández Álvarez; Daniel Ferrández Vega; Carolina Piña Ramírez; Alejandra Vidales Barriguete
PL-C16	***(047) RAISING AWARENESS: Friendly Cities*** Patricia Aguilera Benito; Patricia Benítez Hernández; David Caballol Bartolomé; Julián García; Francisco Gil Carrillo; Fernando Magdalena Layos; Ana Marín Palma; David Mencías Carrizosa; Mónica Morales Segura; Paz Núñez Martí; Carolina Piña Ramírez; César Porras Amores; Antonio Vela Cossío; Alejandra Vidales Barriguete; Paola Villoria Sáez
PL-C17	***(061) INCLUSION OF THE SUBJECT: RESEARCH METHODOLOGY, IN THE CURRICULA OF ENGINEERING IN LATIN AMERICA*** Aura F. González; Samuel E. Fernández; Engerst Yedra; Daniel Ferrández
PL-C18	***(050) SKILLS FOR THE FUTURE BUILDING PROFESSIONAL. THE CASE OF THE AMBASSADOR'S PROGRAM AT THE UPM*** Paola Villoria Sáez; Mercedes del Río Merino; Celia Esteban; Laura Martín
PL-C19	***(052) PROJECT-BASED LEARNING: POSSIBILITIES OF APPLICATION WITH BUILDING STUDENTS*** Alicia Zaragoza; Daniel Ferrández; Alejandra Vidales Barriguete; Alberto Morón
PL-C20	***(053) REUSE OF CONSTRUCTION AND DEMOLITION WASTE: EXPERIENCE THROUGH DESIGN THINKING*** Daniel Ferrández; Alejandra Vidales Barriguete; Evangelina Atanes-Sánchez; Alicia Zaragoza
PL-C21	***(055) FLIPPED CLASSROOM AND PROBLEM BASED LEARNING AS ACTIVE LEARNING TECHNIQUES FOR THE STUDY OF INTERVENTION METHODOLOGIES IN STONE FAÇADES*** Mª Jesús Morales-Conde; Mª Isabel Romero-Gómez; Manuel Alejandro Pedreño-Rojas
PL-C22	***(005) FINAL DEGREE COOPERATION PROJECTS WITHIN THE FRAMEWORK OF RESEARCH*** Cristina Marieta Gorriti; Alexander Martín-Garín; José Antonio Millán-García; Iñigo Leon; Ana Guerrero
PL-C23	***(060) USING ARTIFICIAL INTELLIGENCE TO ASSESS ACADEMIC PERFORMANCE*** Samuel E. Fernández; Aura F. González; Engerst Yedra; Daniel Ferrández
PL-C24	***(049) TEACHING WITH DIFFERENT ALTERNATIVES WITHIN THE FLIPPED CLASSROOM. CASE STUDY IN HIGHER EDUCATION SUBJECTS*** Patricia Aguilera Benito; Cesar Porras Amores; Carolina Piña Ramirez; Fernando Magdalena Layos; David Caballol Bartolomé; Alejandra Vidales Barriguete; Monica Morales Segura; Francisco Gil Carrillo; Julian García Muñoz; Ana María Marín Palma

CINIE 2022

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SUMMARY INDEX

CINIE 2022
ABSTRACTS

IMMERSION IN THE PROFESSIONAL WORLD OF BUILDING: EDUCATIONAL INNOVATION THROUGH TECHNICAL VISITS TO WORKING ENVIRONMENTS

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Keywords: *Immersion, technical visit, professional activity, employability, cooperative learning*

Abstract

The university education that students receive should be as closely related as possible to the professional profiles and outlets and the labor market. Today's changing world of work and the constant technological evolution and sustainable development are leading to the appearance of new opportunities associated with specialized technical profiles. For this reason, the trinomial formed by the curricula, the dynamic actions that complement the generalist education and the university-enterprise-public administration connection are key.

The present educational innovation project aims to contribute to this need and provide a previous experience to the so-called External Practices or Internships. It incorporates a system of teaching and learning between subjects focused on the accomplishment of academic technical visits to work environments, companies and public and private sector entities. These visits are oriented at providing students with direct contact with professional outlets linked to their university studies. The aim is to help them to recognize the intellectual and interpersonal skills and abilities required in a wide range of jobs positions. It also aims to inspire and guide them in the best way in the choice of the training itinerary leading to the performance of a job, contributing in parallel to awaken in young people values appreciated by employers.

The complete methodology developed, being applicable to any degree, was implemented in the 2018-19 academic year in the Degree in Technical Architecture at the European University Miguel de Cervantes (UEMC) in Valladolid. Just before the strong impact caused by the Covid-19 pandemic in the educational system and the restrictions that have occurred in the normal conditions of mobility and access to workplaces. The visits were carried out during each semester as vertical academic activities connecting students from different courses and subjects and involving several teachers. In a sort of joint and coordinated approach with some individual and team tasks, subject to evaluation. Among the students, some were chosen to play the role of delegates-coordinators, in charge of informing the group of each course and organizing the distribution of tasks. Always under the supervision and guarantee of the teachers, basing the dynamics on cooperative work and the application of observation techniques.

In addition to gaining first-hand knowledge of the situation of the real estate and the construction sectors and of the building work activity from the employers' point of view, they exercised skills directly linked to the subjects and to their future professional practice. Among other advantages, the experience in turn promoted employability and enabling them to draw conclusions about the profession. In this pilot phase of the project, the results were compiled in the form of notes and photographic material, and through more than 60 questionnaires on the visits. All this integrating a valid academic documentary background in the application of the system in more aligned educational strategies.

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ACCESSIBILITY TEACHING: ARCHITECTURE, URBANISM AND FACILITIES

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Keywords: *Accessibility, Building, Urbanism, Facilities, Teaching.*

Abstract

Research that analyzes different scenarios of demographic growth indicate that the evolution of the population tends to be that the majority age will be between 70 and 80 years old by 2050. Currently, in view of this scenario, it is necessary to analyze and work on the future vision, so that the profound transformations that the different sectors will undergo in socioeconomic aspects can be put before them [1]. In view of this situation, the question arises as to how it will affect the current buildings and urban areas as a whole. It is essential to propose policies and laws that adjust to the majority population growth according to age, considering aging and population decline [2].

The implementation of universal accessibility is still a pending issue [3]. Currently, about 4% of people with reduced mobility cannot leave their homes and, within this percentage, 42% do so occasionally [4]. All this is due to the lack of systems adapted to the building and the urban layout to enable the use and mobility of all people. At present, there are still situations of lack of accessibility in urban areas, with inadequate coexistence of routes and areas for vehicles, bicycles and pedestrians. Being incompatible, in most of the occasions, the implementation of these joint layouts due to economic interests. Although, at present, specific implementations of universal accessibility are being carried out: sidewalks, pedestrian crossings, elevators, etc [5].

From the academic-teaching point of view, it is essential to make it known that, by the mere fact of adapting an area of the building, it is possible that this affects not only the building itself, but also the entire urban environment in which it is located. Thus, what may seem a priori a simple or punctual accessibility action in the building, causes the modification of many other aspects, such as existing facilities (electrical, lighting, plumbing, sanitation, gas, telecommunications, etc.), or the necessary modification of the urban layout if it is affected by the implementation of universal accessibility and the adaptation of urban planning regulations. Therefore, this research analyzes the implication and the profound changes, which have involved in buildings and in the urban layout, of a project of adaptation to universal accessibility in a neighborhood of Toledo: Palomarejos and, in particular, in an area commonly known as "Corea" [6] (Figure 1).

The installation of elevators to facilitate accessibility is essential. Most of the buildings constructed between the 1950s and 1980s lack these systems. Due to the year of construction of the neighborhood and the constructive characteristics of the buildings, elevators and stairs had to be placed outside the building, occupying part of the public

road. For a better management of the public space, a "superblock" [7] configuration was chosen, thus improving pedestrian mobility, air quality and road traffic. In addition, a new electrical and lighting network was designed, both in buildings and in the urban area. In short, universal accessibility will involve the adaptation and transformation of existing cities, making them more empathetic.

Figure 1: *Aerial view of the Korean Quarter. (Source: Google Maps).*

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ANALYSIS OF EXPERIENCES OF LEADERSHIP AND COLLABORATIVE WORK IN THE TEACHING OF SURVEYING

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Keywords: *field practices, teamwork, skills, evaluation, cloud*

Abstract

Among the transversal competencies of degrees, employers have detected some training deficiencies in teamwork and leadership in fresh graduates [1, 2]. For a long time, various teaching methodologies have been progressively implemented to promote these aspects in "Surveying", a second-year course subject, corresponding to Civil Engineering studies at the University of Seville [3]. This subject requires two hour-weekly practices, mainly in the field, and after some office work there is a weekly collection. The practices are distributed in fourteen sessions, totally compulsory, whose completion and overcoming are an essential requirement. Between them, ten are carried out in teamwork, being an appropriate environment to promote these competencies. Activities are supported by a practice book containing the objective and purpose, its description, field work and office work, and the correct structure of the document index.

In this article, we show the different techniques currently used in this subject for the promotion and control of leadership and teamwork, as well as the problems derived from their implementation. Among these techniques are: the existence of a practice leader with double punctuation; a meeting leaders; role rotation; the signing of a group ethical commitment; the use of personal protective equipment (a reflective vest); and, as a recent novelty, the use of shared folders with teachers in the cloud. As main conclusions, in the teamwork, we can indicate that the greater control of the teaching staff over the student's work, the better the resolution of the practices, although some students feel pressure to feel watched (7%). The tutorial activity has been enhanced using online feedback on student's files. Individual student work is identified more easily by cloud track changes made by members of the group. Regarding leadership and the change of roles, some students try to avoid acting as a practice leader or prefer not to manipulate the surveying instruments for fear of doing it wrong. The cloud working with collaborative applications has perhaps been one of the great steps in promoting and controlling teamwork. It is worth mention that the level of students' ignorance of office skills, in terms of text editors and spreadsheets, is surprising (35%); although knowledge of the cloud is widely known (75%), its use for teamwork is widely unknown (72%). 85% of the students rate the inclusion of the teacher in their work environment as positive and in that percent, they will continue to use it for future practices. In addition to this,

64% found this tool useful to organize the practice data. Finally, it is necessary to indicate, as a negative teaching aspect, the additional work supported by the teachers and the essential control and continually remind of the role of each student in each practice.

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COGNITIVE AND AFFECTIVE EMPATHY IN FUTURE SECONDARY EDUCATION TEACHERS

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Keywords: *teachers, empathy, Secondary Education, Cognitive and Affective Empathy Test*

Abstract

In social psychology, empathy is considered one of the key factors for the development of prosocial behaviours, i.e. for the development of helping behaviours [1,2]. Empathy is divided into two types: cognitive and emotional (or affective) empathy. The former refers to the ability to put oneself in the other person's shoes, to deduce their thoughts and emotions; the latter refers to the ability to experience the same emotions as the other person, to react in a similar way as the person who is feeling them [2-4].

It is undoubtedly important for secondary school teachers to adequately develop their cognitive and affective empathy towards the students they will be assisting in their classes. The ability to actively listen [5], the understanding of student behaviour derived from certain situations, the sharing of experiences, among others, will improve the learning process of the student, and to a large extent depend on the empathic capacity of the teacher [6].

Given the relevance of empathy in the world of teaching, the Cognitive and Affective Empathy Test [7] was applied to a non-probabilistic sample of future secondary education teachers. This test, designed for Spanish-speaking respondents and lasting approximately 7 minutes, aims to assess the participants' cognitive and affective empathic capacity. It is for this reason that it has been considered ideal for the objective pursued in this research.

The results of this work are intended to serve as a reference for future studies that aim to determine the level of empathy shown by secondary school teachers. The work highlights the importance of carrying out this type of activity among the future secondary education teachers, with the aim of raising awareness of the importance of showing empathetic behaviour in the classroom among future teachers. Only by putting ourselves in the students' shoes and getting to know their concerns, fears and motivations will we be able to generate significant learning among students. For this reason, this type of experience can also be carried out in educational centres and serve as a starting point for reflection in order to improve the performance of the profession.

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FINAL DEGREE COOPERATION PROJECTS WITHIN THE FRAMEWORK OF RESEARCH

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Keywords: *Final Degree Cooperation Projects, Education for Sustainable Development (ESD); Research, Cement/Concrete*

Abstract

Education for sustainable development (ESD) is one of the great challenges that university faculties have to face. Therefore, a multidisciplinary team from the faculty of Engineering of Gipuzkoa (EIG) at the University of the Basque Country (UPV/EHU) carries out several activities to apply in construction degrees, namely Civil Engineering and Technical Architecture, such as problem-based learning (PBL), research-based learning (RBL) [1,2], and the use of environmental tools for developing Final Degree Projects (FDP/TFG), for example, the life cycle assessment (LCA) [3,4]. All of them are characterized by the fact that, in one way or another, they work on competencies in relation to the Sustainable Development Goals, SDGs, which were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and promote peace and prosperity for the whole planet. On the other hand, the team members research in collaboration with the Higher Council for Scientific Research (CSIC) on ecological binders for construction based on the use of wastes from different sources, in line with the new economic paradigm of Circular Economy [5]. In the last few years within the framework of this research FDP/TFGs have been developed which are related to the circular economy, through the revaluation and reuse of concrete waste generated in construction and fly ash from municipal solid waste incineration. Furthermore, the new approaches would also make it possible to modernize the production infrastructure of the industrial sector through developing new innovative manufacturing processes based on environmentally sound models by means of using resources more efficiently. In the present work, the results derived from the development of the FDP/TFGs will be presented. On the one side, the repercussions for the university will be discussed:

1. Revalorization of waste generated in laboratory practices of engineering and construction degrees. Figure 1 shows an example of aggregate for mortars obtained from the cementitious residues of the laboratory practices, which are mixed with

commercial sand in the appropriate proportion according to the results obtained experimentally.

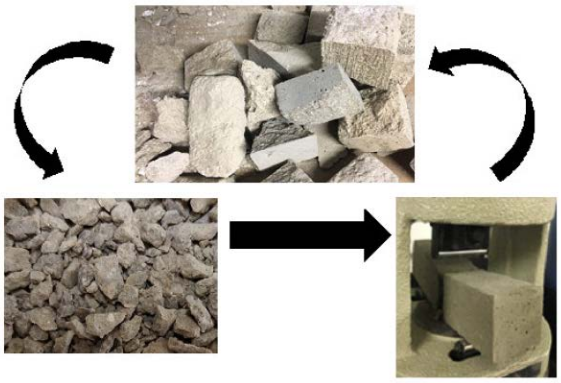

Figure 1: *Circular economy in construction laboratories*

2. Incorporation of ESD laboratory practices as a part of the curriculum.

On the other side, results of scientific interest in the investigation of binders for construction with a low carbon footprint will be presented.

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IMPLEMENTATION OF THE ASSOCIATION BETWEEN ORTHOGRAPHIC VIEWS AND RELATED 3D OBJECTS IN CeDG: A PROOF OF CONCEPT

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Keywords: *Descriptive Geometry, Computer Graphic Modelling, Dynamic Geometry Software, CAD, Educational Innovation.*

Abstract

Graphical representation of three-dimensional elements requires the use of a technical language that provides precision and facilitates their analysis and communication with procedures applied to plane shapes. Descriptive geometry allows the representation and analysis of a 3D system from its projections on the plane [1]. This discipline, supported by projective and metric geometry [2], defined the foundations of the graphic language of modern technical drawing.

The procedures for the graphical representation of three-dimensional systems had an important body of standards in the 1970s, which have been evolving, confirming the paradigm shift in the graphical representation techniques in engineering, due to the emergence of computer-aided design (CAD) systems [3].

Nowadays, CAD technology enables the representation of three-dimensional systems, allowing the construction of computational parametric models [4], facilitating the modification of their geometric properties and the automatic propagation to the rest of the model, the control of the design and manufacturing process [5], [6] and the study of the system behaviour through the connection with its dynamic model [7]. However, there are limitations of CAD in relation to descriptive geometry [8], [9].

The university teaching of graphical expression in engineering has undergone a gradual change to include CAD, displacing descriptive geometry as the foundation of the graphic language in many Anglo-Saxon universities [10], although it continues to be an important core in the rest of universities due to its importance in the development of visual analysis skills [11].

The proposal made in this work is a computational modelling technique based on descriptive geometry or Computer extended Descriptive Geometry (CeDG) devised as a complement to the CAD methodology to incorporate into computational 3D geometry models the ability to solve spatial analysis problems which is inherent to Descriptive Geometry [12]. The CeDG technique combines the solving capacity offered by descriptive geometry procedures with the ability of dynamic geometry tools to implement graphical-mathematical models with dynamic parameterization.

Geogebra has been chosen as the dynamic geometry software to implement CeDG because it presents a set of features that facilitate its conceptual design. This paper

presents a proof of concept that evaluates the possibility of incorporating into Geogebra the relationship between orthographic views and associated 3D objects by means of Javascript.

This proof seeks to complete the presentation of user code examples that extend the functions available to the CeDG technique. In previous tests, tools were generated, in addition to GGBScript code, to simplify the creation of composite graphic-algebraic entities and to automatically position the 3D geometric system. Any function implementable from GGBScript can also be taken to Javascript, although the code is more complex, adding possibilities not available in GGBScript. In addition, by demonstrating the possibility of incorporating in a CeDG model the relationship between orthographic views and their associated objects using Javascript (figure 1), a simpler route for the evolution of CeDG is provided than acting on Geogebra's Java sources.

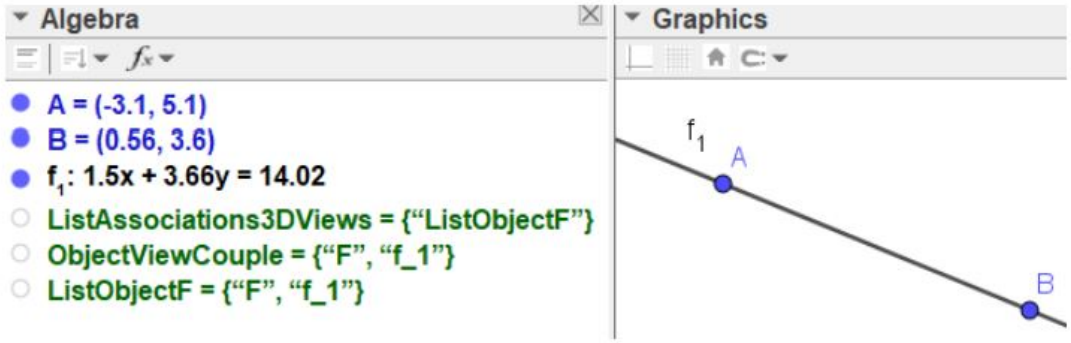

Figure 1: *Initial state of a CeDG model defined by f1 view associated with F spatial object.*

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INNOVATIVE PROCESS OF CREATING SMALL ELEMENTS FOR BUILDING

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Keywords: *Molding, aluminum, recycling.*

Abstract

Technological and technical advances require engineers to keep up to date with the new tools that are being developed to optimize the different processes. With regard to engineering students, it is necessary to update the study plans so that they are competitive and have developed a series of requirements and knowledge that will be demanded of them at the beginning of their professional careers [1]–[3].

With the aim of adapting the study plans and implementing new tools, a didactic proposal is developed that is proposed to be implemented in the different Degrees of Industrial Engineering, as well as in Building. The proposal consists of a laboratory practice that can be implemented in subjects whose content is about casting or manufacturing processes, from a more generic point of view. With this practice it is intended that students design, through a 3D modeling program, beams (Figure 1) to subsequently manufacture them through a sand casting process.

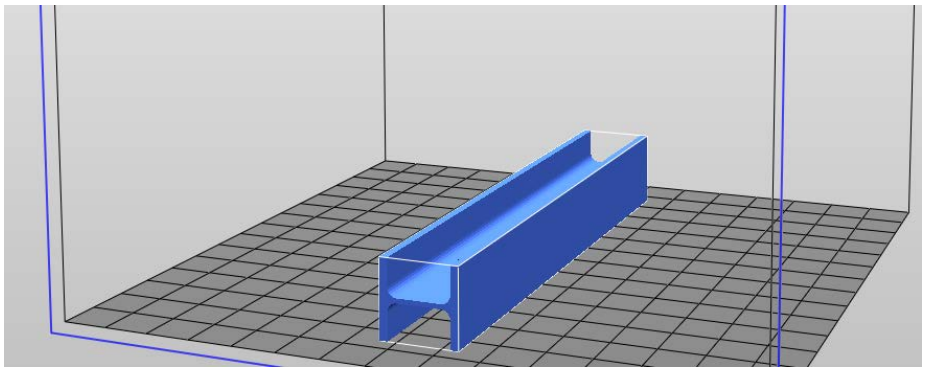

Figure 1: *3D modeled building element*

To make the piece, previously, a 3D printer is used to make the model that is inserted into the sand and in this way, obtain the monde in which the metal to be melted will be poured. This is showed in Figure 2.

Figure 2: *Aluminum pouring into sand mold*

The material to be used is aluminum, as it is a material whose melting point is relatively low (660 °C) compared to materials normally used in construction, such as carbon steel, which has a melting point higher than twice as hot as aluminum.

Once the aluminum beam has been manufactured, different tests are carried out, mainly traction and compression, to check the quality of the manufactured beam.

The objective of this practice is that students can develop their skills in the use of different ICT tools, as well as in traditional processes such as sand casting for the manufacture of parts using new technologies such as 3D modeling programs or 3D printers. This brings students closer to more real work environments and closer to the real world.

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INTRODUCTION TO TECHNICAL ASSESSMENT OF INNOVATIVE BUILDING PRODUCTS. JAE-INTRO GRANTS EXPERIENCES AT IETCC-CSIC (2019-2021)

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Keywords: *JAE-INTRO, research, scholarship, innovation, technical assessment DIT*

Abstract

The JAE Intro programme offers grants at CSIC centres like Instituto de Ciencias de la Construcción Eduardo Torroja (IETcc) aimed at university students interested in starting a research career. Since 2019 and up till now, at the Innovative products´ assessment Unit. National Technical Approval (DIT) it has been carried out a training program on the research of technical assessment of innovative building products, mainly for 4th to 5th course students from ETSAM-UPM, who want to take their first steps in research. JAE Intro grants, supported by CSIC, or JAE-INTRO ICUS grants supported by IETcc, have lead the opportunity of an introduction to cutting-edge knowledge of scientific topics and scientific praxis.

In particular, the Innovative Products´ Assessment Unit. National Technical Approval (DIT) develops scientific-technical cooperation activities with the construction industry related to the assessment of fitness for use (DIT, DITplus and DITEX) and the assessment of performance (ETA) of construction products, as well as their certification processes. The main objective of the Unit is to facilitate innovation in the sector and to guarantee the quality and safety of products through actions aimed, among others, to:

- Remove the restraints of architects, engineers and technicians in general, to the use of non-traditional or innovative products for construction sites.
- Avoid technical barriers to the use of non-standardized construction products, and facilitate their incorporation into the national and international markets.
- Disseminate and develop the use of the National Technical Approval (DIT,) National Application Document (DITplus), Experimental National Technical Approval (DITEX), as well as the European Technical Assessment (ETA)

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Figure 1: *Initial image from website: https://ietcc.csic.es*

The Quality and Formation department of DIT-Unit, detected a real gap between the technical skills required for being the scientific responsible research of such technical assessment activities and the level of knowledge of graduated students. Then it was clear that the sooner those skills were gained, the better they could get a recommendable background for future hiring process. The Table 1 summarizes JAE-INTRO grants of UPM students at the Innovative Products´ Assessment Unit. National Technical Approval (DIT):

Table 1: JAE-Intro grants at Ud. DIT

JAE Grant	Period	Duration	UPM School	Student
JAE Intro	**2019-2020**	10 months	ETSAM	Angel Armando Arquero
JAE Intro-ICUS	**2020**	6 months	ETSAM	Sonia García Iglesias
JAE Intro-ICUS	**2020**	6 months	ETSAM	Laura Molero Ballesteros
JAE Intro-ICUS	**2020**	6 months	ETSIC	Darlin Danilo Ruiz Mendez
JAE Intro-ICUS	**2021**	6 months	ETSAM	Rafael Hernández Rosales
JAE Intro-ICUS	**2021-2022**	10 months	ETSAM	Mónica Sanz Roldán

It is important to remark that all granted students mentioned at Table 1 have been selected out of an open competition. In the particular case of JAE Intro calls, both student and tutor are selected by CSIC, among very different research areas.

The formation procedure has consisted in general terms in the following stages:

- Review of main properties of building materials via short power-point presentations and lecture of DIT webpage
- Assignation of a tutor per student, in charge of its formation along the grant duration
- Involvement in the technical activities leading to the issuing of technical reports manufacture inspections, works inspections, test reports, draft of DIT, DITplus, DITEX (valid for national market), but also at international level (European Assessment Document) in the area of innovative building products
- Involvement in the development of webpage as well as ISO-9001 and ENAC accreditation activities

The conclusion is that all of these experiences have been very fruitful for IETcc and also for the students, which have acquired specific formation on the area of technical assessment, but also on a real functioning of construction industry, and also have achieved skills that have allowed them to improve substantially their access to a first employment in the sector.

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LEARNING TECHNIQUES BASED ON PROJECTS, PROBLEMS RESOLUTION AND COEVALUATION IMPLEMENTATION ON TRADITIONAL LEARNING TECHNIQUE SUBJECT. PRACTICAL CASE ON UNIVERSIDAD POLITÉCNICA DE MADRID

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Keywords: *video, Robot Structural Analysis, digital tools, civil engineering.*

Abstract

Theorical classes implementation are quite common along the European Universities [1]. A high number of subjects based on traditional evaluation schemes are detected, stuck in a simple single or couple final exams qualifications. The complexity of knowledge to be taught, lack of student predisposition or a lower time consumption to prepare expositive classes are some of the reasons why this kind of teaching has such a high percentage usage.

Integrated Project Management subject of the Civil Engineering School in the Universidad Politécnica de Madrid is an example of it. Taught in the Third Semester of the official Civil Engineering Master's, this subject is based mainly on the expository class as magistral lesson, with only one evaluable exam, losing the possibility of taking advantage of the units' suitability to implement new learning techniques.

The present project hosts the whole updating of the subject. Not only new lessons and knowledge techniques are designed, but also evaluation criteria are completely new developed. Regarding to teaching classes, the subject was completely based on expository class. This technique has some advantages such as the knowledge equity taught or the total control of information provided to the students [2]. Nevertheless, important drawbacks such as the lack of follow-up learning or the promotion of student passivity are detailed too [2]. Multiple researches detail an increase in the quality of teaching if expository techniques are used with others like learning based on projects, learning based on problems resolution or learning based on challenges [3], [4]. In addition, new TIC's usage within collective groups dynamization techniques is implemented in this subject updating.

On the other hand, traditional evaluation criteria are substituted by new ones based on multiple components. The new evaluation structure proposed is the following: PE1 20%,

PE2 20%, PE3 40% and PE4 20%, being First partial Exam, Second partial Exam, class and project respectively. PE4 mark covers the evaluation of the student through the learning techniques based on problems resolution or challenge facing. Apart from that, PE3 mark host the student evaluation applying learning techniques based on projects. Pupils must develop by themselves a complete management project, using techniques and knowledge provided along the classes. Moreover, a critical vision of the subject and students' projects is promoted though all the class due to the co evaluation implementation. Students must evaluate mate project following the same rubric points as the professor.

Through this new structuration, the subject passes from a traditional evaluation and expository class teaching based to a total new concept. Teamwork, Leadership, Collaboration, Co evaluation and Cooperation are new competencies promoted in this subject updating.

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METHODOLOGY FOR ONLINE METAL CASTING

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Keywords: *Thermal camera, casting, Covid-19.*

Abstract

Technological and technical advances require engineers to keep up to date with the tools which are continuously developed in order to optimize the different processes. With regard to engineering students, it is necessary to update the study plans so that they are competitive and have developed a series of requirements and knowledge that will be demanded of them at the beginning of their professional careers [1, 2].

Likewise, situations such as the one experienced recently, due to the Covid-19 pandemic, have shown that it is also necessary to adapt to situations in which teaching can be carried out remotely. Traditionally, carrying out laboratory practices has been one of the most difficult activities to adapt to variable situations. This project proposes a proposal to improve the quality of teaching by implementing new tools and making the possibility of moving to online or hybrid modalities more flexible [3].

The proposal is based on the implementation of the use of thermographic cameras with remote access to carry out practices based on foundry processes. With this camera, students can see the temperatures that are reached at all times, as shown in Figure 1. Without this camera it would be impossible to appreciate what a real foundry is, as this factor is the most significant.

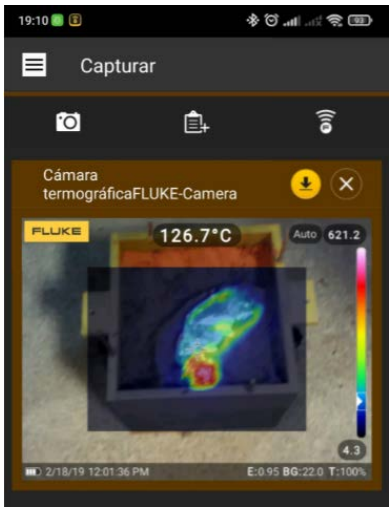

Figure 1: Temperature display.

Current thermographic cameras can be viewed from remote devices as shown in Figure 2, allowing visualization of the activity to be carried out from an augmented reality system. Carrying out the practice in person implements the use of different tools, but the main difference lies in the use of thermographic cameras to complement the casting processes, being able to control the casting and cooling temperatures. It is in the case of online activities that this tool comes into play, since it allows monitoring using an augmented reality model.

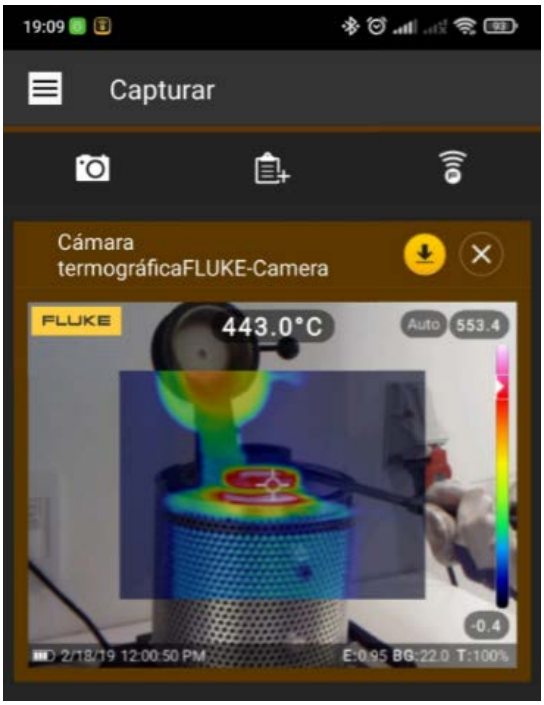

Figure 2: Remote access thermal camera vision

The activity takes place with only two people in the laboratory. The students make the different models through the use of CAD tools, they send the files and it is in the laboratory where the staff there is in charge of printing them using a 3D printer, once done, it is the laboratory staff who carry out the compaction of the sand and the extraction of the model, while the students follow the practice through the augmented reality system.

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PROVIDING CHARACTERIZATION AND NEW CONSTRUCTION MATERIALS TO HIGH SCHOOL STUDENTS

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Keywords: *Materials, Construction, Eco-materials, Education, Teaching.*

Abstract

In the following analysis we want to show the work carried out at the University of Burgos, in which high school students are given their first notions about construction materials, both in their characterization and in the knowledge of new eco-materials. In this way, teenagers can have their first contact with the scientific world from a theoretical and practical point of view.

In order for the students to have a knowledge base prior to practice, they receive a few theoretical classes about the materials to be used [1], their life cycle and a series of instructions for them to carry out bibliographic searches. Subsequently, they proceed to practical learning in the laboratory, where students come in contact with the materials studied, in this case focusing on plasters, to learn about their properties and start with the respective basic characterization tests.

Taking into account that nowadays it is essential to introduce circular economy and sustainable development politics in all areas of society, these are added in the learning process through the production of new eco-sustainable materials on based gypsum with recycled polyurethane and ladle furnace slag [2], analyzing the different properties that these presents in comparison with traditional products.

This process provides teenagers with a closer knowledge of construction materials and the research processes carried out at the university, as well as the introduction of environmental aspects and life cycles that encourage sustainable development.

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REELS IN FOREIGN LANGUAGE TEACHING IN SCIENCE AREAS

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Keywords: *Reels, Higher Education, Science areas, collaborate-cooperative learning, peer-assisted learning*

Abstract

Education implies knowing the characteristics of students as they are the center of the teaching-learning process. Students are digital natives who spend a significant amount of time with technology [1,2]. Therefore, outdated teaching methods that are far away from the students' interests should be forgotten and new trends in education must be adapted.

Paradis [3] declared that a positive emotional attitude will enable a better acquisition of the second language. Following authors such as Gardner and Lambert [4]), Pavlenko [5,6] or Gardner [7], we consider that attitude, motivation and other emotive factors are present somehow in language learning.

This is why, nowadays, incorporating the use of technology is a necessity since students were born into technology, and will be more interested in what they have to learn. Moreover, this methodology will be a learner-centered paradigm and not a teaching-centered paradigm.

The project presented here consists of an educational experience in higher education that aims at continuous improvement in teaching English by using a really recent, innovative and creative trend, that is, reels in science areas. First of all, students were invited to look for some reels related to English on Instagram. We must acknowledge that students do not learn only from formal education but also from informal education such as social media.

Social media is believed to be a captivating teaching resource as it could get students' attention [8]. Consequently, students were asked to create reels with two kinds of concepts. On the one hand, students had to choose concepts they were comfortable with. On the other, they must dig into areas that they did not understand properly. Collaboration and creativity are some aspects to be worked in groups.

Students' feedback showed the effectiveness of this new approach as it was innovative and engaging. Cooperative learning, peer-assisted learning or the use of digital tools also determined the relevance of this research.

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SERIOUS GAMES APPLIED TO UNIVERSITY PROJECT MANAGEMENT STUDIES

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Keywords: *Serious Games, Gamification, Teaching Innovation, Project Management, Educational Innovation.*

Abstract

The main challenge in Project Management (PM) education is to prepare potential project managers and other members of the project team to deal with the diverse and spontaneous problems associated with the life cycle of a building project [1]. To do this, it is not enough to have knowledge of project management, but a series of skills, abilities and/or competencies must be available to enable the specialist to apply them in different situations. Moreover, in a university educational environment, it is difficult to achieve a correct and realistic transfer due to the scarcity of resources and the limitation of the academic environment [2].

n this context, the application of serious games in university classrooms is conceived as a potential solution to face the different challenges posed. The concept of "gamification" projects the use of this type of game in non-playful and educational contexts [3,4] with the aim of increasing participation, involvement and the acquisition of skills through the formulation of different cases, challenges or projects based on reality [5,6]. n contrast to traditional education, Serious Games applied to PM training offer students the opportunity to experience the consequences of realising or neglecting the principles of project management, to face complex problems and to try different approaches to solving them [7,8].

Considering this, the Engineering Projects Area of the School of Industrial Engineering of the University of Extremadura implemented different games in subjects. These were used to promote the development of student competences in eight of the ten areas of PM (scope management, procurement management, time management, resource management, cost management, communications management and risk management) through the resolution, by multidisciplinary teams, of different case studies, challenges and projects.

It was concluded that gamification applied to Project Management education offers innovative teaching methods through active, realistic and experiential learning for students, allowing them to be more competitive in their professional future.

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SUSTAINABLE EVALUATIVE METHODOLOGY FOR LEARNING IN ENGINEERING DEGREE COURSES

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Keywords: *professional skills, engineering degree, sustainable methodology, Problem-based learning (PBL)*

Abstract

The teaching system promoted by the European Higher Education Area (EHEA) highlighted the need to establish models that make up the teaching, learning and evaluation processes to facilitate the acquisition of general and specific skills of the different specialties in the context academic.

In the field of technical degrees, professional demand requires having the ability to solve problems and develop activities in which it is necessary to make specific proposals, carrying out different actions. The implementation of new methodologies helps the development of skills and confirms that learning in this training context is not very different from learning for life and specifically for professional life.

In the degrees which involve recognized professional skills, it is more interesting to place the student as the focus of learning, being a part of the activities that are developed during it, having to be part of the applied methodology and its evaluation.

In this form, the student purchases the tools that will have to use to face up to the professional demand in which they will manage. This paper proposes a sustainable methodology [1], [2] understood as an option that allows the construction of possible responses and solutions aimed at improving the actions of its participants [3].

The challenge proposed was the application of a methodology that allowed to develop the competitions that finally were evaluated through a system that will cater a positive influence and an improvement of the process, developing of this practical form valuable that fulfill the purpose of the EHEA [4].

The teaching innovation experience was set up over 4 academic courses in which approximately 500 students participated who were taking different subjects that recognized direct professional skills.

Specifically, the methodology applied through practices related to the activities that a graduate in engineering will set up in his work coinciding with the professional attributions recognized by law. Concerning the results, according to previous experiences and research [5], [6], it is confirmed that the application of teaching

methodologies increases student motivation, and in this case has contributed to improving the teaching-learning process, without assuming an increase in time commitment. In addition, it has ACHIEVED the increase in students presented (≈75%) and the increase in success rates (≈80%) and performance (≈70%).

Based on the results of this study, the acceptance of this type of methodology HAS BEEN verified WITH a very positive response. In addition, it can be concluded that the system facilitates not only the time dedicated but also the fulfillment of the teaching objectives focused on the process teaching-learning of the student. The development of skills and learning strategies is a viable option, and in this case applicable to professional fields, with direct involvement of the professional powers themselves, recognized by the law.

Acknowledgments

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SYNERGISTIC APPLICATION OF CHALLENGE-BASED LEARNING AND AGILE METHODOLOGY TO PROJECT MANAGEMENT EDUCATION

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Keywords: *Challenge-Based Learning, AGILE methodology, Scrum, Project Management, Educational Innovation.*

Abstract

Current education is a critical issue in society and learning processes must be adapted to the needs and realities of the context in which they take place. Almost the entire world population is immersed in a chaotic and changing society, and it is necessary to have professionals prepared to deal with the problems that arise in it. This requires specialists with a deep degree of knowledge and skills in different methodologies, tools and competences that allow them to know how to act correctly in each situation.

With this in mind, a pilot experience was designed to synergistically apply Challenge-Based Learning (CBL) and the Scrum methodology in the subjects "Project Planning and Control Management" and "Formulation, Management and Evaluation of R+D+i Projects" of the Engineering Projects Area in the School of Industrial Engineering of the University of Extremadura. CBL is constituted as a didactic strategy, so that students, with the help of the teaching staff, become actively involved with a real, significant problem situation related to their environment, which leads them to define a challenge and implement a solution for it [1]. This didactic methodology offers an approach in a student-centred learning framework that emulates the experiences of a modern workplace. In this way, CBL taps into students' interest in giving practical meaning to education [2], while developing key competencies such as collaborative and multidisciplinary work [3,4]. In addition, this didactic resource was complemented with the agile teamwork methodology "Scrum" [5] to carry out a previously defined challenge. For this purpose, the students were divided into teams of four people and each team was assigned a challenge.

An important step in the combination of both methodologies was the establishment of a timeline with due dates for the CBL stages: the Great Idea, the Essential Question, the Challenge, the Guiding Questions, the Resources and Activities, the Resolution and the Evaluation [6]. The integration between methodologies started at the solution gate and ended at the evaluation gate, as shown in Figure 1.

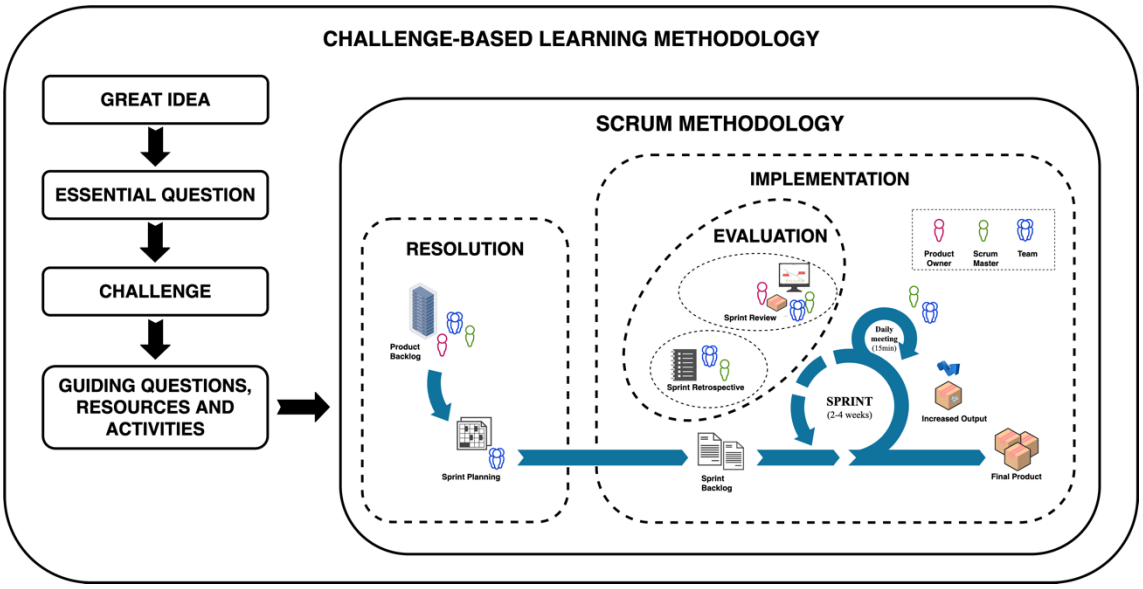

Figure 1. *Synergistic Challenge-Based Learning and Scrum Methodology.*

The conclusion was that the CBL methodology in synergic combination with Scrum promoted project management skills, teamwork, and resilience in situations of uncertainty in which the limits of the project are imposed by external agents and/or factors. In addition, the implementation of a collaborative project under these teaching methodologies enriched both teachers and students, contributing to their training and in turn to the reinforcement and development of competences.

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HYBRID DIGITAL IDENTITY WORKSHOP USING INTERACTIVE TOOLS

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Keywords: *Digital Identity, COVID-19, Interactive tools, Hybrid Education and Higher Education.*

Abstract

As a result of the COVID-19 health crisis and the associated home lockdown, there has been a considerable increase in the use of the Internet as a medium for communication and interaction in society. This fact has affected people's digital identity, defined as a set of assertions that an individual makes about himself or herself or another digital individual (1).

Education has been one of the sectors most affected by the pandemic, forcing all its players to adapt and reinvent themselves in an extraordinary amount of time. After the end of a totally online course, universities have returned with different face-to-face proposals, choosing on many occasions hybrid options, where half of the students are in the classroom and the other half at home. This solution, far from being the most appropriate, has made it necessary to look for ways of management that are as egalitarian as possible for students and affordable for a professor who has become a multitasker.

This research describes a workshop on Professional Digital Identity for students and, as main objective, offers a solution to overcome the limitations of interaction and participation, typical of a face-to-face workshop, in an unfriendly modality such as the hybrid one, making use of interactive online tools.

In the 2020-21 course, a workshop on Professional Digital Identity was offered, in hybrid mode, to students of the School of Computer Engineering, with a total of 25 participants, of which 23 attended (8 in person and 15 online).

The interaction was performed using the online tool Mentimeter1, which allows the creation of interactive questions to encourage participation. Throughout the workshop, different questions were asked by using codes that students had to enter through a specific web address from any electronic device connected to the Internet. In this way the teacher can generate an activity in which knowledge is built together with the students, adapting the workshop in real time and overcoming physical barriers.

To measure the results, a validated questionnaire [2] and all questions extracted from the Mentimeter tool were used, focused on the students' perception of the Professional Digital Identity, which they had to fill in at the end of the workshop, with open questions

[1] https://www.mentimeter.com/es-ES

and a 5-level Likert scale. Of the 23 students who attended, 17 completed the two activities and obtained the final certificate.

The main conclusion is that, with conditions that are not very propitious for a workshop of these nature, it was possible to achieve an authentic atmosphere of union between the students who were at home and those who were in class, overcoming the disadvantages of the hybrid modality and achieving a participative workshop. This experience is totally extrapolable to any teaching format and area of knowledge.

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TEACHING AS A BASIS FOR INCORPORATING INDUSTRIAL ARCHITECTURE IN THE BUILDING SECTOR

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Keywords: *BIM, Industrial sector, Construction sector, Facilities, Teaching.*

Abstract

In a changing world, where the time of everyone is increasingly limited [1], adding the obstacles that nature imposes on us [2], we have to prepare for a more complex future and be more efficient, fast and precise [3]. When translating ideas into architectural projects, self-critical thinking about the tools used and the level of detail must be mandatory for professionals who will subsequently interpret the work [4]. In addition, an important concern that should not be postponed and is a sign of progress, should be to ask ourselves if the current generation in the university training phase is qualified to implement the software technologies that the present offers us [5].

Currently, with the rise of the digital world, the implementation of BIM technology can be benefited and accelerated with greater penetration in all sectors (building, industry, electronics, construction, etc.) and take advantage of its resources [6]. Since 2015, little progress can be seen in the use of this design model, only being mandatory, in public works of the Ministry of Development and, with exceptions, in certain autonomous communities such as Catalonia and the Basque Country [7]. Beyond these entities, we find interested obligations of the promoters in large projects with a substantial economic base [5]. On a day-to-day basis, few professionals dare to use this type of technology, following the CAD standard as the basis for their work, where solutions to possible conflicts on site are scarce and decisions remain in the hands of the professionals in charge of executing the project.

The academic/teaching universe diminished and lacking in coherence, due to the needs of the market, or else, due to the insurmountable slowness of adaptability to technology, should lose the fear of experimentation by attracting ideas from other sectors for certain installations within the building. The installations form a concise and scarce compendium of information, giving rise to interpretations and, above all, erroneous implementations, causing the balance of the fragile execution time to be broken. In recent years, the industrial sector has created custom-made, complex, and versatile tools that are perfectly integrated into building development (figure 1).

It is an extraordinary approach to learn to incorporate new tools that facilitate physical and digital documentation. This involves changes to current registration and visa standards. The changes in the foundations of all technology belong to the academic guides, called teachers, being the link to the fastest way to implement, in real life, the

habits that are needed to improve the current model. Changes and experimentation, in the building sector, are... or should be, the immaterial wall that every professional crosses in every project without fear of innovating, mixing, and attracting ideas from other sectors, with an eye on the simplicity of understanding of the work performed.

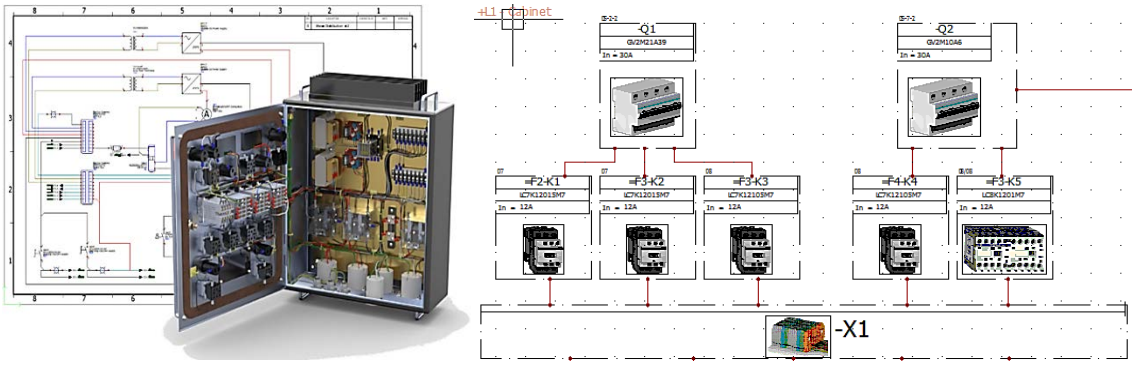

Figure 1: *Synoptic diagram and 3D detail made with SolidWorks-Electrical. (Source: SolidWorks).*

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TEACHING CONCEPTS OF ACOUSTIC CONDITIONING OF BUILDINGS THROUGH 3D ACOUSTIC MODELING IN TECHNICAL EDUCATION

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Keywords: *Acoustic Sustainability, Standard 12354, 3D modeling, optimized architecture*

Abstract

The regulatory framework for acoustic conditions in buildings, "DB-HR Protection against noise" of the Spanish Technical Building Code, establishes the minimum acoustic conditions so that buildings within its scope of application (residential, administrative, health and teaching use) are legal with respect to their habitability. The teaching approach described in this article aims at familiarizing students with the requirements of the DB-HR document in a visual and didactic manner. It basically consists of analyzing and discussing with students the acoustic conditioning evaluation performed on the construction project of a given building obtained through three-dimensional acoustic modeling. This methodology has proven to be useful to better understand concepts such airborne noise insulation, impact noise or reverberation time and to visually determine possible conflict points and then gain capacity to suggest improvement actions to the construction project. Therefore, 3D acoustic modeling can be considered an effective teaching tool to transmit knowledge about insulation and acoustic conditioning in building in technical education.

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TEACHING LAB EQUIPMENT COMMISSIONING FOR HIGH PERFORMANCE MECHANICAL VENTILATION CLASSES BASED ON LEARNING BY DOING METHODOLOGY AND OPEN SOURCE TRENDS

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Keywords: *Active Learning, Education for Sustainable Development (ESD); Internet of Things (IoT); Open Science; Teaching Lab Equipment*

Abstract

New pedagogical approaches based on active methodologies have acquired great relevance since the students have become the protagonist of their learning process [1]. On the other hand, additional educational methodologies coexist that seek to transmit sustainability skills to students during their training period, given the current commitments that society has with the environment [2]. Finally, other relevant aspects in the teaching field in technical faculties is the training of students through laboratory practices that allow them to acquire the necessary knowledge from the experimental perspective of *learning by doing* [3].

This communication presents the work carried out for the implementation of a teaching lab equipment focused on the practices of Building Facilities II subject of the Technical Architecture Degree of the University of the Basque Country (UPV/EHU). It should be noted that the work performed is part of the ERASMUS+ collaboration program between the Université Paris Nanterre (UPN) and the UPV/EHU through the international stays carried out by students from both universities.

For this, the pedagogical framework was based on an active learning approach through the direction of two tutored projects, Figure 01. First, the main objectives that they should achieve through the projects developed during their stay were identified. In this sense, the goal to achieve was the complete installation of a Mechanical Ventilation with Heat Recovery (MVHR) system together with a monitoring infrastructure for its use in the practices of the Technical Architecture Degree.

Figure 1: *Methodology of the proposed educational approach. (Source: Own Authorship)*

The second part consisted in the learning phase of the students about the specific contents and tools necessary during the assignments. To do this, they were offered the bibliography related to subjects of sustainability and energy efficiency in buildings and digital technologies focused on monitoring based on open-source technology [4,5].

Once the necessary knowledge on the subject had been acquired, the third phase related to the implementation of the teaching laboratory equipment began. For this, the MVHR equipment was installed, specifically the DF EXCELLENT 3 4 / 0L model from the manufacturer Siber in adittion to the monitoring infrastructure for monitoring the energy behavior of the equipment. For this, the students made use of the existing server in the laboratories based on Raspberry Pi and the IoT infrastructure based on LoRaWAN implemented in previous research [6]. Subsequently, they developed a graphical dashboard interface based on Grafana. This interface offers the ability to display the data monitored by the wireless sensors implemented for temperature, relative humidity and CO_2 concentration.

Once the complete laboratory equipment had been put into operation, the students reflected the activities carried out during their stay by writing the work and defending it. The results of this project have shown a pedagogical approach that allows the student to be actively involved in the development of activities at the universities themselves. Thanks to this, it has been possible to set up the laboratory teaching equipment for use in subject practices.

The authors would like to acknowledge and thank the work carried out by the students Gary Popp and Antoine Paris during their stay, as well as the Université Paris Nanterre for their collaboration in the teaching and research fields. Thanks in turn to the company Siber Zone, S.L.U. for the supply of the equipment used and the interest shown in the project.

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TFM OR PFC. TIME CONSTRICTION, COLLECTIVE WORK AND PROGRAMMATIC FREEDOM AT THE ETSAM

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Keywords: *architectural projects, active methodologies, critical discipline, degree project, constriction*

Abstract

The Master in Architecture at the Universidad Politécnica de Madrid (UPM), known as Máster Habilitante (March) has been implemented at Escuela Técnica Superior de Arquitectura de Madrid (ETSAM) since the 2015-2016 academic year. As part of its content, the Qualifying Master's Degree contemplates the preparation and presentation of a *Trabajo Fin de Máster* (TFM), which includes the declared continuity "of reason" of the old *Trabajo Fin de Carrera* (PFC) in the new teaching organization, according to expresses the current Curriculum (Plan 2010). The recent implementation of this new mode of access to the professional qualification of architects graduated from the UPM, as a consequence of the international homologation processes framed in the process initiated by the Bologna Declaration (1999), has produced an immediate but not always thoughtful comparative analysis with the previous system, that of the PFC.

The objective of this paper is to provide an adequate conceptual framework for the comparison between *Trabajo Fin de Máster* (TFM) and *Proyecto Fin de Carrera* (PFC) at ETSAM, through the formulation of some of its pedagogical bases [1]. Among these, the role of the temporary constraint [2] assumed by the new system will be highlighted, in which the preparation of the TFM is associated with a period of a single year, as well as the group work dynamics associated with the idea of "classroom" , "laboratory" or *Design Studio*, which connect the new teaching methodology with well-known international experiences, from the Italian *Laboratori di Laurea* to the Dutch *MSc Design Studios*. The validity of the figures of the "teacher" and the "disciple", inspired by the mythical stories about the Renaissance workshop, and more generally the student-teacher relationship, must be critically reconsidered in the new situation, in which times and processes are subject to pre-established guidelines and controls [3]. On the other hand, and beyond the contrast with the PFC, the role that the definition of an architectural program or content plays in the development of the new TFM, as well as the possibility that its development is assimilated to a research process with original contributions that go beyond the concept of "demonstration" of professional skills.

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THE ABANDONMENT OF END-OF-LIFE TIRES (ELTS) ON THE SPANISH COAST: A SERVICE LEARNING PROPOSAL IN HIGHER EDUCATION

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Keywords: *End of Life Tires (ELTs), Environmental Science, Service Learning, Higher Education*

Abstract

According to the National Environment Congress [1], marine debris is an international challenge, affecting all countries, regardless of where the waste originates. The United Nations Environment Programme (UNEP) defines marine debris as all solid waste of non-natural origin, which has been discarded, deposited or abandoned in marine and/or coastal environments [2], and can be classified by size as macro-debris when it exceed the 5 mm or micro-debris when it is smaller [1]. Among the macro-debris, the case of End-of-Life Tires (ELTs) stands out. Tires are one of the most common plastic pollutants on the planet, which also leads to the generation of micro-debris, as small plastic polymers are released as they wear out. They are highly polluting wastes, because, although most of these are made up of caoutchouc, they also contain textile fibers of nylon or steel, indissolubly mixed with caoutchouc, toxic additives such as sulfur or zinc oxide [3]. Faced with this problem, there are different initiatives in Spain to alleviate the accumulation of ELTs on the coast. Different cleaning actions have been carried out, for example, in 2019 a large seabed cleaning campaign was carried out in more than 30 points of the Spanish coast, from which 11 tons of marine debris were removed, with the ELTs [4]. Knowing and contributing to eradicate this environmental problem becomes a fundamental issue, in addition to being aligned with several of the Sustainable Development Goals (SDGs), such as No. 6 "Clean Water and Sanitation", No. 11 "Sustainable Cities and Communities" or No. 14 "Life Bellow Water" [5].

From this perspective, the use of a Service Learning (SL) methodology in Environmental Sciences Degree at the University of Alcalá is proposed to link students to learning from an ethical and social commitment to our environment. The SL is a student-centered learning methodology, which aims to develop competencies linked to social commitment and which, as a result, leads to both academic and personal growth. Its application related to the phenomenon of the abandonment of ELTs on the coast opens a framework of action in which students can learn and return that knowledge to the community through a service, both concepts (learning and service) being integrated in a well line of work articulated [6-8]. In this case, the service offered to these students is participation in training sessions and collection actions for ELTs at various points along the coast within the Network of Marine Protected Areas of Spain within the framework

of the project 'Abandonment of End-of-Life Tires in Natura 2000 Network areas: Analysis of the phenomenon, reduction and valorization of waste' (NeumaticOUT), carried out with the collaboration of the Biodiversity Foundation (Ministry for the Ecological Transition and the Demographic Challenge) through the Pleamar Program, co-financed by the European Maritime, Fisheries and Aquaculture Fund (EMFAF).

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THE USE OF VIDEO AS A TOOL TO TEACH TO USE A SOFTWARE IN CIVIL ENGINEERING

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Keywords: *video, Robot Structural Analysis, digital tools, civil engineering.*

Abstract

The actual digital technologies implemented in universities are changing the traditional approaches into more innovative ones, such as flipped classrooms, which allow the students to develop relevant competencies such as comprehension reading or critical thinking [1]. Also, during the last years, the online teaching derived from the worldwide COVID-19 emergency has forced to promptly develop some measures, practices and methodologies using digital resources that might have come to stay [2]. Among these new methodologies, the use of instructional videos is proved to offer a wide variety of possibilities for effective teaching [3, 4].

This work presents the methodology followed in one of the subject matters of the module of BIM: Smart Construction, from the Master of Engineering in Civil Engineering at Universidad Politécnica de Madrid. One of its topics is an introduction to the Robot Structural Analysis software (structural calculation tool from the group Autodesk), which allows them to perform the calculation and dimensioning of a structure, previously implemented in a BIM software such as REVIT and export it back, once calculated, with the new sections [5]. Although it is a very useful and powerful software, this subject may have some initial topics that may not result very attractive for the students, so the aim of this work was to focus its teaching in a way that could promote the motivation of the students, as Robot Structural Analysis is a software that they can use for their Master's Thesis or their future working life.

Following this rationale, a methodology based on presential teaching and video learning has been implemented. Videos containing practical cases have been recorded in order to reach a better understanding of the theorical part of the lessons performed in the classroom. These videos have been included as video tutorials for practical lessons, and they develop, step by step, different examples of the dimensioning and calculation of simple structures. These examples are relevant for the right use of the software, and they also revise important structural concepts such as beam calculations, lattice structures or influence lines. They also approach the examples from different perspectives, drawing the structures directly in the Robot software or importing the structures from other ones such as REVIT or AutoCAD. These examples are also replicated by the students in their computers.

Also, this lesson starts with a piece of video from the film Sully (2016), stating that this film is about a real case in which a pilot is taken to court for taking a decision which, although it saved the passengers lives, it seemed that it was an unnecessary risk. This video allows to open a debate about the responsibility of the calculations made by an engineer over the final results obtained with the software.

By means of this methodology, the use of the video in class is used to increase the motivation of the students to learn how to use the software, also promoting the autonomous learning.

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VENEZUELA. CONSTRUCTION PROBLEMS AND SUSTAINABLE CONSTRUCTION. COLLECTING DATA TO PUT THE PUZZLE TOGETHER. Part 1

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Abstract

The Venezuelan construction sector faces complex problems from multidisciplinary causes. The severe consequences keep the country far from the sustainable development goals established by UN to 2030. The extreme consequences that the country faces in terms of loss of production, poverty, energy shortages and the progressive deterioration of the quality of life, have led the authors to perform various researches in related matters. In consequence, in the last years, the authors have been working with the identification of the world benchmarks of competitive countries, knowledge management, renewable energy, the UN Sustainable goals, the sustainability efforts, the value of ancient knowledge and lessons learned and the efforts in the recovery of normality in the COVID 19 Pandemic era, as the framework needed to compare what happens with the Venezuelan case [1] [2]. In previous researches the Venezuelan case has been approached from perspectives that include competitiveness, public policies, energy, construction problems, infrastructure deficit, poverty, sustainability, public services, education, knowledge management and Covid 19 impact among other [3] [4] [5]. With the certainty that the education is fundamental to find global long lasting solutions and the aim to try to progressively address Venezuela into the sustainable path, in the current article the authors add new data about the fundaments of the sustainable construction education that is performed in Venezuela and the main problems that confront the construction sector. With the participation of some construction stakeholders of the western Zulia Region and public records, the authors collected and made available some data regarding the basic characteristic of the participating companies, their quality control processes, and the sustainability background received during their educational development. Additionally, the data include the incidence of problems confronted in terms of 3 different aspects that comprise: 1. General aspects as public policies, inflation or insecurity, 2. Project management, including decision making, planning and design or coordination and communication and 3. The availability of resources as skilled workforce, including artisans, administrative and management, financial resources or lack of information, fuel or public services. Additionally, the survey included the evaluation of the main consequences generated by such problems in terms of projects quality deviations among planned and executed, delays with project advances, over costs and financial loses as well as environmental damages, among other. The data collected shows a widespread variety of cases and perspectives about the complex cases that Venezuela confront. The information tries to progressively add new pieces to assemble the puzzle

of the Venezuelan case in an attempt to help to develop a consciousness about the importance to improve education from a holistic perspective. The emphasis is put in the construction sector, as the authors propose to incorporate sustainability concepts since the basic steps of education to make all individuals - in particular the Venezuelan construction stakeholders - to be able to identify opportunities, risks and to be resilient, evolve and succeed in the current changing and unpredictable world. This approach may conduce Venezuela to take the best and sustainable profit of the vast country resources.

Keyword: *Sustainability, construction, problems, education, Venezuela*

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A SERVICE-LEARNING EXPERIENCE OF COLLABORATION BETWEEN THE UNIVERSITY AND SECONDARY EDUCATION TO PROMOTE VOCATIONS IN STEM STUDIES.

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Keywords: *learning-service, stem vocations, peer review*

Abstract

This work presents a collaboration, within the framework of the Service-learning methodology, between the E.T.S.I. de Caminos, Canales y Puertos (UPM) and the secondary school Gerardo Diedo (Pozuelo). The aim of the collaboration has been the promotion of vocations in STEM studies, and in particular in Civil Engineering studies. To this end, it was proposed that university students present their final degree projects to secondary school students.

This activity has been framed within the context of the Service-Learning pedagogical technique. According to this methodology, students seek to help in a societal problem while gaining a deeper understanding of the content of the course in which it takes place [1]. This implies that service-learning activities are associated with an academic course and should be designed to achieve specific learning objectives [2].

The university students presented six final degree projects to a total of seventy-eight high school students. Due to COVID-19 restrictions, these presentations were carried out online in a synchronous way. After the activity, the high school students answered a Likert-type questionnaire on what they thought of the activity and their degree of understanding of the content presented. Finally, the university students answered their own questionnaire on those aspects that had been most enriching for them.

The results obtained indicate that the activity has had a very high degree of acceptance among secondary school students. These students have found the activity very interesting and have shown their interest in attending a similar presentation in the future. A significant percentage of them have stated that they are considering studying an engineering degree, and in particular the Civil Engineering degree. Regarding the contents of the presentations, the Likert-type questionnaires answered had highly positive evaluations (both with respect to the contents of the presentation and the technique of the exposition). Finally, the university students also showed a very high

degree of satisfaction with the activity. For them, presenting their final project has reinforced their self-perception as engineers and improved their self-esteem.

The service-learning methodology used is a very effective technique that has improved the motivation and self-esteem of university students on the one hand, and on the other, has strengthened the personal project of secondary school students.

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CHALLENGE-BASED LEARNING ORIENTED TO PROFESSIONAL REALITY: A MULTIDISCIPLINARY APPROACH THROUGH APPLIED PHYSICS

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Keywords: *Challenge-Based Learning; Applied Physics; Educational Innovation.*

Abstract

For years, the Innovation Group in Physics Applied to Building has been committed to the implementation of new teaching methodologies that bring the teaching of physical phenomena closer to the diversity of students that make up the classrooms of the E.T.S. de Edificación. Being aware of the challenge that facing new concepts that are difficult to understand represents for students recently enrolled in Bachelor's and Master's degree courses, we have opted for the application of methodologies that make the classroom more dynamic, exploit and make the most of the laboratories and link research projects with the teaching objectives of the teaching staff.

Challenge-Based Learning (CBL) is a teaching methodology that allows students to become actively involved in the resolution of a real problem, linked to their professional activity and which favours the acquisition of the competences included in the curriculum of the subjects [1]. To this end, the teacher must pose challenges that provide concrete solutions that are useful for society, that allow the subject contents to be explained and to dwell on the more complex concepts in order to address them in greater depth, as well as to acquire knowledge that would otherwise be taught in the form of a master class [2]. In order to achieve this, students have the technological and bibliographic resources (internal and external to the university), their previous training and mutual support among students, as well as the help of the teaching staff who act as a guide in the teaching-learning process.

This paper presents an example of how to implement the ABR methodology in higher education. To this end, the guidelines followed when planning a semester course of the Physics subject of the E.T.S. in Building in which ABR has been used as an active methodology when developing classroom practices. The use of this type of teaching initiatives not only favours the development of the competences and objectives included in the learning guide by the students, but also improves their understanding of complex calculations that they will later have to apply in their professional careers. This generates a symbiosis between the teacher's interests in teaching the contents of the subject, and the students' interests in developing skills and abilities that will allow them to integrate into the labour market in a differentiated way [3]. In such a way that this research shows the possibilities offered by ABR in university environments, summarising the steps followed, the planning carried out and the evaluation methods used, so that this experience can serve as a starting point for other teachers who may be interested in getting involved in educational innovation projects.

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DIGITALLY-BASED TEACHING, STUDENT READINESS AND ENGAGEMENT TOWARD ACTIVE LEARNING IN STEM COURSES

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Keywords: *student engagement, learning outcomes, tablet, active learning, digital technology*

Abstract

Many studies broadly agree that education should be engaging for learners as it is associated with academic success [1, 2]; also, using digital technology in the classroom may influence student engagement [3, 4]. The widespread in-class use of digital devices has impacted student experience [5] and soared since the COVID-19 pandemic outbreak. However, their effectiveness in higher education settings needs further research. The ways students use digital devices to learn and communicate among themselves or with instructors are still under study [6, 7, 8, 9]. Likewise, instructors must achieve digital competencies to address the current transformative processes as teaching practices can no longer rely on passive blackboard-based lectures, which hinder skill development and competence achievements [10, 11, 12]. Hence, both instructors and course designs must adapt to the new scenario [13, 14]. Digital technology can become a powerful tool to boost evidence-based teaching and experiential learning in Science, Technology, Engineering, and Mathematics (STEM) disciplines [15, 16, 17]. For instance, tablets are suitable tools for creative teaching in STEM modules [18]. In addition, learners can replicate digitally the phenomena they have observed once earlier in the lab practices.

Engagement positively influences factors such as school attendance rates, confidence, achievement [19], a sense of belongingness [20], and learning outcomes [21]. Also, increasing attention is devoted to the pillars that lie behind behavioral engagement [22].

Active learning has increasingly gained instructional, research, and political interest toward a more student-centered action. This concept refers to instruction, i.e., activating instructional methods and instructor-led activities rather than learning [23]. It has been generally measured through variables concerning learning outcomes [24] (for instance, based on students' self-reports, course grades, exam grades, and work assessment) when applied to subject-related knowledge, professional, social, and communication skills, and transversal competencies.

This study gives an insight into the effectiveness of the use of digital devices in student both readiness and outcomes from diverse experiences carried out in Hydraulics and Structural Engineering courses. It collects feedback from student perceptions on satisfaction and expectancy accomplishments. The modules involved in this study used blended learning and digital resources (mobile devices, tablets for teaching, simulation

software, classroom response systems, and learning management systems) most often, with undergraduate students and master's students as target groups. The behavioral engagement was the most frequent response from students, followed by affective and cognitive one, attributable to using educational technology.

The findings suggest that digital technology, particularly the tablet and simulation software, has potential as a tool in the classroom setting. They also highlight the need to shift to evidence-based and learner-centered teaching practices, focused on both active learning and formative assessment, emerging as a core issue to adapt instruction amidst the competing pressures.

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LEARNING THROUGH SUBJECTS INTERCONNECTION: COORDINATION AND TRANSVERSALITY OF DISCIPLINES IN THE DEGREE IN TECHNICAL ARCHITECTURE OF THE EPS OF ZAMORA (UNIVERSITY OF SALAMANCA)

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Keywords: *Degree Technical Architecture, interconnected subjects, coordination*

Abstract

In university studies and, especially, in Degrees that qualify for technical professions, among which is the Degree in Technical Architecture, the competency model demands assuming a teaching-learning method that provides to the students an approach to reality professional. To get it, it is necessary to acquire knowledge gradually but also in parallel, hence the subjects included in the training program are grouped into blocks that allow establishing an order of knowledge that ensures educational coherence and disciplinary relationship [1]. However, organizing the subjects in semesters and courses is not enough for the student to perceive a fluid, coherent and really coordinated learning that interrelates the contents and their use in the profession.

We have noticed that there are two handicaps that prevent this objective from being achieved, on the one hand, the flexibility that exists for students to enroll in the subjects they want, skipping the established order, which we understand is very necessary to facilitate the understanding and learning of certain subjects; and on the other, the lack of a clear coordination that interrelates the subjects, beyond a general coordination that monitors the overlap of subjects, tests or works. Regarding the first difficulty, we cannot interfere beyond the recommendations that we include in the subject programs, so that students do not enroll in one if they have not previously passed certain other ones. However, regarding the interconnected learning of subjects, teachers have all the responsibility to propose and develop strategies, avoiding individuality and generating a transversality of disciplines, assumed as a natural principle [2].

In this feeling, which depends personally on each teacher, we have to get involved so that students find the real correspondence between the contents of different subjects as an integrated whole and do not perceive them as a sum of knowledge.

Taking into account these backgrounds, this communication describes the coordination work that several professors of the Technical Architecture Degree of the EPS of Zamora of the University of Salamanca are studying in order to put it into practice, so that the

students of their subjects work together unison in certain aspects, linking two or more subjects. To do this, we are going to analyze which subjects are susceptible to disciplinary transversality, and from there, we will propose the work methodology and the possible difficulties that may be encountered, focusing on global and interconnected teaching-learning.

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REVISITING THE IMPLICATIONS OF HIGHER EDUCATION FOR SUSTAINABLE DEVELOPMENT

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Keywords: *sustainable digitalization, circular economy, sustainability in higher education, university rankings, education for sustainable development.*

Abstract

Academia has been witnessing the spread of a gamut of terms, ideas, practices, processes, and policies related to higher education (HE) for the last decades: active learning, student engagement, problem-based learning, service-learning, instruction quality, university rankings, critical or design thinking, collaborative or cooperative learning, digital transformation, sustainability, etc. somehow becoming a conundrum. Indeed, HE is undergoing challenges and rapid changes, especially after the COVID-19 pandemic outbreak. This in-progress digital transformation of universities has arrived to stay and poses challenges to instructors and academic authorities. Teaching the HE students of the 21st century should no longer use the methods of the 20th. Instruction modes and strategies focus on online teaching, competency-based education, active learning, and student engagement. Besides, the traditional university missions are under review and debate. The two dominant business models of HE, the classic non-profit and the for-profit online one, are somewhat undergoing an upheaval implied by the pending changes regarding societal demands and requirements, which impact their instruction quality, reputation, degree offerings, job market compliance, and human progress in the long term.

The World Commission on Environment and Development (WCED) coined the Sustainable Development (SD) concept in 1987, which implies the progress of all humankind and the whole person. HE institutions must be committed to promoting a mind shift, built on the common good and the person-centered basis, toward a peaceful, inclusive, and well-being future [1]. These involve rethinking policies, strategies, and outcomes to ensure training in democratic values, equal-opportunity and human-right principles, transversal competencies, and to emphasize the ethical dimension of HE [2].

HE can address socio-civic competence gaps in future professionals from a holistic approach towards the circular economy as a pathway to the Sustainable Development Goals (SDG) [3, 4]. Sustainable entrepreneurs may contribute to this transformation process by creating innovative market solutions with ecological, social, and economic value [5]. However, the necessary competencies to solve sustainability challenges as

sustainable entrepreneurs are not clear yet, particularly in architecture, engineering, and construction (AEC) courses. The challenge is on the table [6, 7].

This work reviews sustainable development aspects related to HE actions built on outcomes and competencies (Figure 1), focused on AEC modules. We mention some strategic areas to address from the HE balcony to pursue a better sustainable society: 1) Action plans to enhance knowledge and awareness on the circular economy. 2) Inclusion of the circular economy features -reduce, reuse, recycle- from the early modules in HE. 3) Learning from experiences of implementation of circular economy issues in AEC curricula. 4) Alliances of universities toward SD. 5) Collaboration among academic institutions, civil society organizations, private sector entities, or local and national governments [8]. 6) Transversal competencies in HE toward sustainable technology in construction, industry, production, and consumption. 7) The rationale behind the university rankings concerning SD [9]. 8) Responding to global challenges and seeking the common good through entrepreneurial, sustainable, and pro-environmental education in AEC curricula [10, 11].

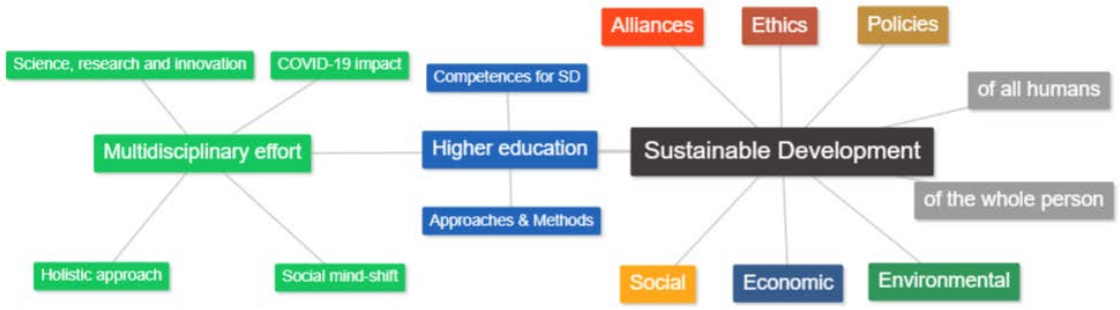

Figure 1: *Workflow of the main features involved by the implications of AEC education for sustainable development.*

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AUTOMATING THE CREATION OF VR EXPERIENCES AS LEARNING PILLS FOR THE CONSTRUCTION SECTOR

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Keywords: *educational innovation in construction; virtual reality; gamification; construction safety.*

Abstract

Currently, the architecture, engineering, construction, and operation industry (AECO industry) is migrating towards digitization due to the momentum of Construction 4.0 [1]. Thus, the day-to-day use of Building Information Modeling (BIM), digital twins, computer vision and many other key emerging technologies, demands a reflection on the topics taught in university and the ways and methods of teaching [2]. The digital skills of the new students and the recent virtuality imposed by the COVID-19 pandemic have led to the use of technologies with a didactic approach [3].

Among these new tools, those associated with virtual reality are being used for training in different sector topics [4]. Thanks to these tools, students and workers can interact with construction environments in the first person, without the risks and difficulties associated with an on-site visit, for example [5]. Thus, it is possible to train in safety and risk prevention, knowledge of construction processes, work environment including unforeseen weather, use of machinery and equipment, among other possibilities [6], [7]. A simple recreation of the work environment can be useful for the student to recognize the building site elements, but to achieve significant learning, other kind of components are required [8], [9]. Of particular interest are gamification and storytelling to capture students' attention, keep them motivated, and ease deeper comprehension. However, shortcomings have been identified in incorporating gamification elements and the absence of storytelling [10]. Together with the difficulties of access to technology and the development of experiences, these elements mean that their implementation is not massive [11].

Responding to these needs, this research analyzes virtual reality for construction training. It proposes and develops a framework for implementing virtual training experiences for non-expert users with a low level of programming. The aspects of gamification and storytelling are prioritized. One approach is to clearly distinguish between training objectives, not necessarily known and visible to the user, and experience objectives. As a reference and use case to explore the possibilities of this approach, a set of tools to automate the creation of an VR version of "Escape room" is developed. The focus is to keep the attention and involvement of the student by using some common resources of the entertainment industry. For example, training objectives associated with knowledge of the workplace or training in occupational risk prevention are hidden behind the experience's objectives, where fulfilling missions, maintaining living standards, and responding to different incentives become relevant from the player's perspective. Different algorithms are developed to create an escape room demonstrator, which is adaptable for developing other training experiences.

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CDIO APPROACH TO EXPERIMENTAL LABORATORY WORK

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Keywords: *project based learning, CDIO, collaborative learning, construction, laboratory practices*

Abstract

In the design of engineering curricula, laboratory practices for undergraduate students, during the first years of education, have played an important role. Curricula have changed over the years, seeking to better adapt to new markets, stakeholders' needs and new technologies [1], [2]. New educational methodologies for the teaching have been studied and implemented [3]. However, the same effort has not been put into adapting laboratory practices. Few publications have been found [4], [5], and fewer related to educational practices in construction subjects.

Open-ended experiments, or project-based experiments increase the independent learning and also promotes the creative thinking, by giving them the tools to design and develop the experiment. Implementation of open ended experiment in the construction engineering area [6]. According to survey reported by Haron et al., students believe that open-ended experiment helps to understand experimental concepts better than with traditional experimental instruction. They are forced into a situation close to professional work so the students' perception is to be better prepare for the real work. This approach will improve the innovation and creativity student curricula competences that need to be strengthened [2].

The CDIO is an initiative to educate the students. As established by CDIO network the main goals are: *a) To master a deeper working knowledge of the technical fundamentals; b) To lead in the creation and operation of new products and systems; c) To understand the importance and strategic value of their work in order to meet these goals.* CDIO promotes reforms in teaching and learning, and focuses on hands-on learning where students are asked to solve the open-ended problems that don't have a single correct answer. It has been implemented with success by many universities, in different subjects, from bioengineering to mechanical design, for example. It provides a universal structure for a strong engineering education integrating an entire set of graduate attributes [7], [8], [9].

American Concrete Institute has been pioneer launching students' competitions for promoting concrete mixture design as an important aspect to understand performance of the material, as sustainability, lightness, toughness, for example. American Ceramic Society also sponsors various contest for undergraduate and graduate students. In Spain, model competitions for large-span structures are becoming more popular. The

aim is to achieve the most economical structure with the highest load capacity, while meeting the requirements demanded. To this end, the structures could be monitored with displacement sensors to compare strength, stiffness and stability results. These competitions allow students to integrate knowledge from different disciplines; however, the results of a survey conducted at ETSIAE show that students perceive this laboratory practices approach as an additional overload.

The aim of this paper is to make a review and evaluate the project-based practices or competitions approaches in education focused on the "Laboratory Practices" in the construction field, that have been adopted in some universities, in order to propose a more adequate framework for learning and evaluation practical classes. It also seeks to identify the barriers that cause students to reject this approach.

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CONSTRUCTION COMPREHENSION BY MODELING. THE CASE OF THE STARICASE OF LINA BO BARDI

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Keywords: *model, drafting, construction, stairs, design.*

Abstract

The fact that first-year students do not have an in-depth knowledge of construction systems often means that first-year architectural drawing focuses more on the representation of shape and space than on construction detail. However, this position can be misinterpreted by some students who have some difficulty with technical drawing, but who could understand the relationship between representation and construction through modeling.

This paper attempts to explain a case study that has been carried out for this purpose with two groups of first-year Interior Design students at the ESNE School of Design, Innovation and Technology.

The case study for this experience was the helicoidal wooden staircase that Lina Bo Bardi designed for the Museum of Popular Art installed in an old 15th century building in the Unhão complex in Salvador de Bahía. It is a staircase of some complexity, since its helicoidal directrix is superimposed on a rectangular outer boundary formed by a series of inclined stringers between pillars with which the helicoid must construct a detail in accordance.

The practice consists of making the exploded drawings of all the elements involved and composing, from the analysis of the original staircase, the plans for making the scale model, translating each detail into the material of the model and its scale.

Once the model has been built, it is analysed and corrected together with the correction of the exploded drawings. Finally, the drawings of the complete staircase in plan, elevation and axonometry are carried out. The models were made in groups.

Despite the initial difficulty in understanding the construction detail, the group work in the production of the model facilitated the direct understanding of the constructed form. In the individual results, there is an evident evolution in the maturity with which the final plans are approached, in which the students understand drawing as a form of technical communication and the models as an instrument of constructive analysis.

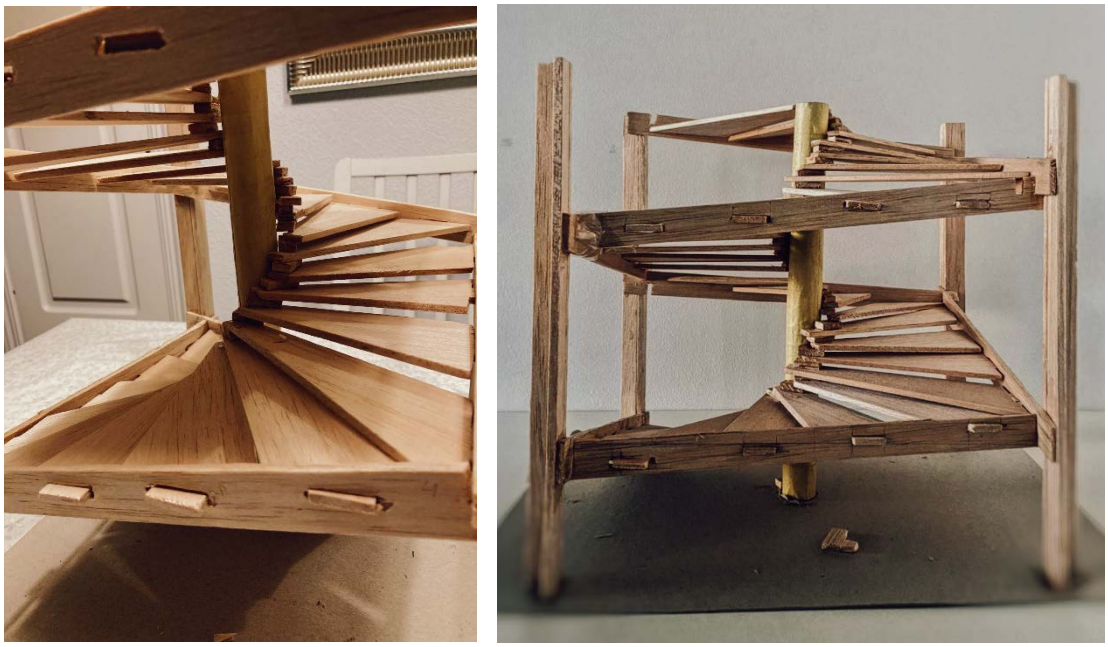

Figure 1: *Model of the stair (Source: Student's work)*

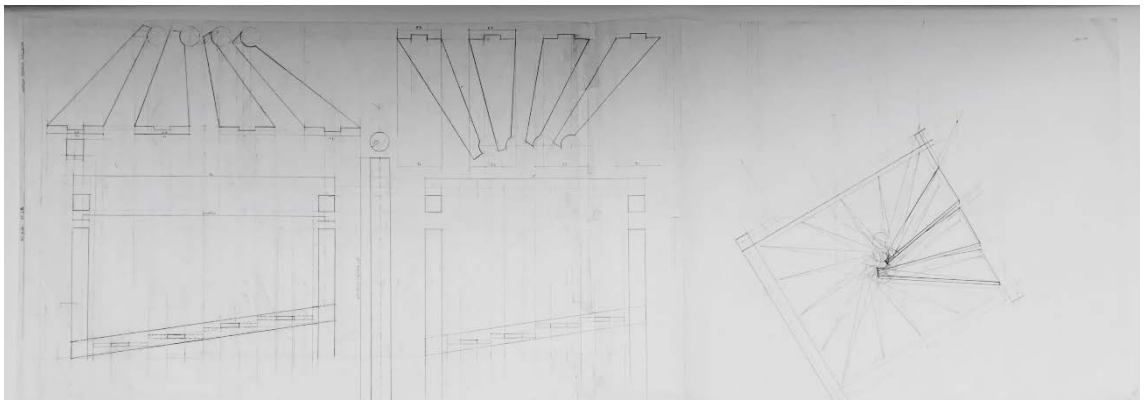

Figure 2: *Model template development and axonometric view (Source: Student's work)*

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DESIGN OF MECHANICAL ELEMENTS IN 3D MODELING PROGRAMS

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Keywords: *Mechanisms, cross learning, future skills.*

Abstract

This work approaches a Cross Learning methodology focused on developing the interrelationship between different areas, linking theoretical and practical knowledge [1]–[3]. This experience is applied to Mechanical Engineering students with regard to the subject “Calculation, Construction and Testing of Machines”. Current labor market requires engineers to stay up-to-date steadily. Thus it is a duty of faculties to provide students with the necessary tools to successfully develop their future tasks [4]–[6].

First, the methodology in this work approaches the selection of a mechanical element. Designing mechanical elements implies to execute a variety of different techniques like fastening elements calculations, which is widely applied in structural calculations, 3D design, and the use of advance CAD programs as SolidWorks, CATIA or Autodesk Inventor, as shown in Figure 1.

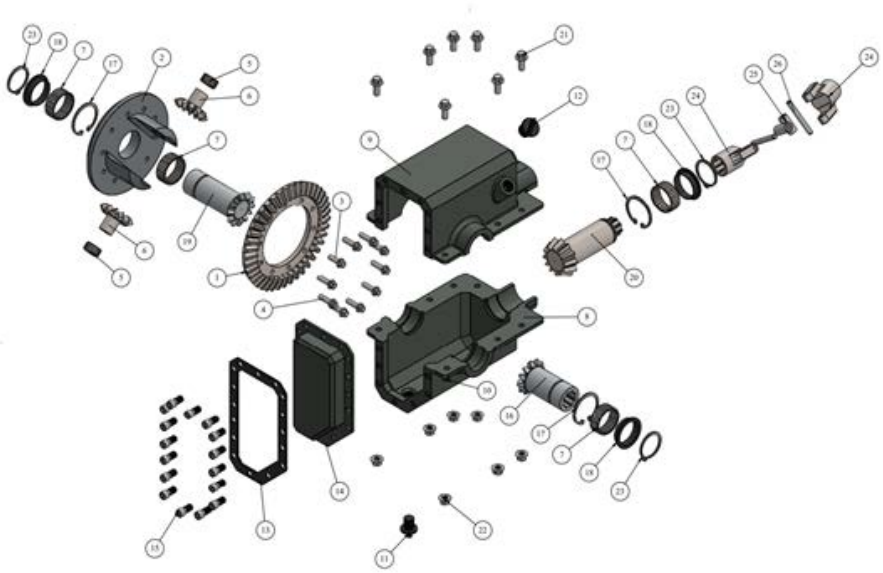

Figure 1: *Differential Mechanism*

This project implies the complete design of relevant mechanisms, with application in building engineering, such a gear boxes, differential mechanisms or crankshaft, among others. Thus, the methodology in this work is based on Project Based Learning by implementing Cross learning techniques in order to improve the quality of the learning process [7].

The presented methodology can be extrapolated to subjects related to building such as resistance of materials, calculation of structures or industrial architecture. In which, the realization of a real project, in which typical techniques of other disciplines are applied, in parallel with the development of the theory is very profitable.

Through the development of the experience, it is verified how these types of activities allow students to develop knowledge and understanding, while reinforcing interdisciplinary skills. Therefore, this work implies being a more realistic and practical approach to working life for the engineers.

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PREVENTION AND RESOLUTION OF CONFLICTS IN THE CLASSROOM THROUGH SOCIAL SKILLS

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Keywords: *Conflicts in classroom, Social skills, Resolution of conflicts, Prevention of conflicts*

Abstract

The concern about the lack of communication in the different educational communities, as well as peaceful coexistence in schools in the educational establishments and the resolution of conflicts between the students and between the students and the teaching staff [1] is increasingly present. This project of educational innovation offers the possibility of providing students with skills and strategies through a program in a way that allows them to face the conflict in a peaceful way, facilitating, in turn, a safe environment in their school and social life with which to develop fully. To do this, the game "Among Us" is used as a tool which intends to approach students in a playful and attractive way for them and in a positive environment [2].

Talking about conflict does not always have to denote a negative contribution. When students find themselves in conflictive situations, they expand their global perspective of the society in which they live, get maturity and seek the right solutions and the relationships between those involved are strengthened. It is at this point that the conflict becomes talent and an opportunity to foster the skills of students. Therefore, it is not necessary to avoid the conflict, but to face it [3].

On the other hand, socialization and sharing experiences with the rest of the people begin in the first moment of life, last forever and provide foundation in social relationships. In order for these interactions between several people to be constructive, respectful and meaningful, social skills must be put into practice, since these enable the strengthening of self-esteem, the generation of beneficial interrelationships, the management of prosocial behaviors and contribute to inclusion in the immediate context. For example, social skills in adolescence play a crucial role in the personal development of individuals because they provide them with the fundamental means to feel and appear calm, confident, secure and empowered to others; and in turn, to get on confidently and without difficulties in the social world around them.

It is essential that the teachers involved in the project have specific knowledge of the individual characteristics of the students who the program is aimed at and, in the same way, of the different forms of conflict resolution that exist; In this way, they will be able to achieve the objective of preventing and solving conflicts that arise both in the educational context and outside of it, as well as giving a favorable response in the family, school and social contexts.

In short, as long as teachers perform their role and their functions, they will promote the creation of positive affective relationships, which will lead to the establishment of significant bonds. In other words, to the extent that teachers manage to establish close and beneficial ties with their students, they will ensure that their classrooms become a comfortable and calm place.

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PGFPLOTS: PLOTS FOR SCIENTIFIC PAPERS

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Keywords: *Text editor; Latex; Pgfplots; Mathematics; Graphics;*

Abstract

LaTeX is the most extended text editor for scientific papers. Two of the reasons for this are the polished system for rendering mathematical formulas and the fact that the software is free and open source. Nevertheless, Microsoft Word has a wider adoption outside the academic realm. One of the reasons for this is that Microsoft Word is part of a whole ecosystem including applications such as Excel or PowerPoint which integrate seamlessly with it. LaTeX can also be used in combination with another powerful set of tools to exploit all its potential. In this paper we want to briefly discuss one of them: the *Pgfplots* package.

Pgfplots is a LaTeX package designed for creating technical graphics inside LaTeX documents. The syntax is very intuitive and it is very well integrated with the rest of LaTeX. It has many interesting features, here we cite some of them.
First, let us highlight that it can produce figures from formulas or raw data. On the one hand, the ability to make plots directly from formulas is very convenient. Also, the syntax for plotting the formulas is the same as the formulas itself, what makes the learning process easier for the users. On the other hand, the possibility of making plots from raw data avoids the problem of dealing with multiple files, one for the data, another for the document and another for the image to insert on it.
Second, the style of the figures can be changed directly in the document, which makes the edition extremely fast and flexible. Third, the pictures produced by the library are directly embedded in the document as vector graphics. This way, we avoid losing quality when rescaling the picture. Last, the fonts used in the embedded picture are the same as in the rest of the document giving a more professional look.

To conclude, in Figure 1 we give a simple example of the capabilities of the package. To fully realize its potential, the reader should consider that this picture was produced in LaTeX and exported to Microsoft Word, so it has lost some of the cited features. However, it still produces neat results. For all the previous reasons, we consider *pgfplots* the ideal complement for those researchers and students who want to produce professional looking plots inside scientific documents.

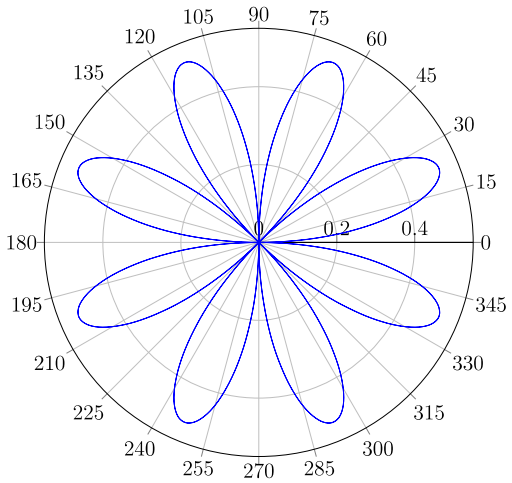

Figure 1: *Taken from the pgfplots manual.*

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OPEN LEARNING ON THE NETWORK: MOOCS AS INNOVATION IN EDUCATION

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Keywords: Innovation, E-Learning, Docencia, Apps, Reviews, Courses

Abstract

Massive open online courses (MOOCs) have been the object of analysis by researchers, thanks to the increase in different educational offers and the ever-increasing demands for learning by society (Palacios-Hidalgo et al., 2020). The use that is being made of this new modality of e-learning within the university world as opposed to traditional methods is noteworthy, with a wide innovative range in topics of a very diverse nature in terms of content and quality, and with great potential to be able to expand knowledge in different branches of science and education (Mackness et al., 2010).

MOOCs contribute to learning through different virtual platforms. MOOCs courses today are presented as a new and innovative way for distance learning as well as a new way of acquiring knowledge online.

Therefore, the objective of this study is to analyze how MOOCs contribute to online learning.

To achieve the objective, the reviews of the main MOOCs apps are analyzed. Within the MOOC sector, four platforms stand out: Udemy, edX, Coursera and LinkedIn Learning. These platforms are used through two means; web pages and mobile applications. They will be the last ones where the reviews of the users who use these platforms will be extracted. Reviews are obtained using web scraping tools. This technique allows the total number of reviews for each app to be extracted massively and automatically. Thus, 23,189 reviews in Spanish have been obtained, ranging from the launch of each app to January 2022.

In addition, the content of the reviews has also been extracted using the Web Scraping technique and bigrams have been applied to measure the frequency of each word. The words obtained will be analyzed according to the three categories of feelings (positive, neutral and negative).

The results obtained show the good functioning of these platforms and especially of their courses. The variety of courses, the usefulness and ease of these apps and the possibility of being able to use them on demand when desired are factors that highlight their users, as well as the free nature of this service.

However, there are also negative aspects related to technical problems when logging in, watching videos or buying courses. Also, it is interesting to note that the latest updates bring with them variations that users dislike. A common factor that users tend to highlight in numerous of different kinds.

In conclusion, this new way of learning makes it accessible to anyone who wants to learn new knowledge, since, as indicated in the positive aspects, the variety of courses is one of its most relevant factors. Therefore, MOOCs are useful for any educational field, engineering or other more technical fields related to programming, finance and business etc.

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THE USE OF GAMIFICATION IN EDUCATION: AN EXPLORATORY STUDY

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Keywords: *Education, Innovation, Apps, Gamification, Reviews, Web Scraping*

Abstract

The information and Communication Technologies (ICTs) have become a means of learning (Pérez-Escoda et al, 2016). These new technologies have meant that students can learn in a more creative and at the same time more fun way, having to "learn to learn" (Bonilla & Aguaded, 2018).

One of the most popular uses of ICTs in the classroom is gamification. Gamification refers to game-based mechanics, aesthetics, and game thinking to engage individuals, motivate them, enhance their learning and problem solving (Deterding, 2011). Besides, different authors as Grávalos-Gastaminza et al. (2022) have shown that the use of gamification in the classroom has positive effects on education.

Therefore, the aim of this study is to analyze the use of gamification in teaching through the main existing gamification apps.

We focus on the reviews of the most used apps. These apps are kahoot, classcraft, plickers, quizizz, quizlet, socrative student, and socrative teacher. The collection of your reviews will be obtained from web scraping techniques using open source software, R, applied to the official Android app store, Google Play.

In this way, 27,162 reviews of these apps have been automatically obtained. The collection was carried out during the month of January 2022.

Once the reviews were obtained, a qualitative analysis was carried out in which we analyzed the content of each of the reviews obtained with the aim of identifying the frequency of each word and thus being able to know what the perception of users about this type of apps through the use of text mining.

In this way, the most frequent words for the three categories of feelings (positive, neutral and negative) were obtained.

From this analysis, the positive tone of the reviews is obtained insofar as they refer to the usefulness of the apps, however, there are technical aspects that cause problems and generate criticism in the reviews. It is also noteworthy to point out the versatility of these tools, since they are applicable to any subject such as finance and business, engineering, architecture, health, etc.

In conclusion, despite the fact that there are certain technical errors, this type of app is highly valued, which is why its use is widespread when it comes to entertaining classes without stopping learning. Its versatility, usefulness and accessibility are factors for which its use is so widespread in the teaching community.

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TWITTER AS A METHODOLOGICAL RESOURCE IN HIGHER EDUCATION: AN EDUCATIONAL EXPERIENCE

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Keywords: *Twitter, digital platforms, innovative methodologies, collaborative learning, participatory methodology.*

Abstract

Today, society could not be understood without its link with the latest technological developments technological developments and their applications, and is characterised citizens interconnected on a continuous basis, thanks, among other things, to the easy access to the internet and telephone access to the internet and mobile phone communication. This new way of communicating and understanding of relationships has considerably the way we conceive what surrounds us and how we adapt and adapting to new realities [1]. According to Martínez and Acosta [2] and López-Noguero and Cobos [3] information and Communication Technologies (ICT) make it possible to and Communication Technologies (ICT) make it possible to have instant access to a large instant access to a large amount of information, which information, which must be managed bearing in mind that the exponential that the exponential growth of these new technologies is reconfiguring these new technologies is reconfiguring communicative situations and teaching and learning teaching and learning processes.

We live in an eminently digitalised society and, therefore, we must be aware of the fact that aspects related to coexistence in the community, values, emotions, the relationships we establish, but also the way we the way we communicate and the way we treat the information the information we create and share, are totally influenced by the way we communicate and the treatment we give to the information we create and share, are totally influenced by the way we use the way we use the technological tools that allow us to technological tools that give us access to these digital contexts. Whether we like it or not, new technologies are media that educate and socialise, which is why it is essential to work on the to work on competences related to these issues in Higher Education.

Nowadays, social networks are used on a regular basis for social interaction in socio-educational in socio-educational spaces, with the social network Twitter standing out among the university population the social network Twitter. The incorporation of this social network in Higher Education Higher Education has been the subject of many studies in in the specialised literature, among which the following stand out those by Grosseck and Holotescu [4], who point out the educational potential that this social

network provides by favouring the development of information synthesis skills in a context of immediate interaction.

For this reason, the Installations Workshop Classroom of the Madrid School of Building Technology is trying to support the subject with the social network Twitter. In this way, we analyse how students perceive the usefulness of this technology inserted in a participatory methodology in the classroom.

In this way, through the social network, students are shown parts of different facilities, so that they can try to recognise, analyse and comment on them. It is also a means of communication between students to make their opinion known and at the same time to warn of any course, seminar, or matter of interest, always related to the facilities.

The inclusion of innovative methodologies based on new technologies in Higher Education contexts is an increasingly tangible reality. Higher Education contexts is an increasingly tangible reality. This type of pedagogical experience is a step towards the towards adapting university teaching to the new contexts and social realities of the to the new contexts and social realities of this era of this era of vertiginous change.

The profile of the university student has changed, behavioural patterns towards learning are different learning compared to past times, and the university has the responsibility to adapt to these changes in order to offer a meaningful and quality education, in line with the new demands of today's society.

The results obtained in the research, show the positive impact that the inclusion of Twitter the positive impact generated by the inclusion of Twitter as a teaching tool in the subject.

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VIRTUALIZATION OF MANAGEMENT AND PROJECT MANAGEMENT SUBJECTS

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Keywords: *Virtualization, Moodle, On-line questionnaires, Interactive video tutorials*

Abstract

The pandemic that we have been experiencing since 2020 has accelerated a change that was already taking place and that is related to the inclusion of Information and Communication Technologies in the academic and teaching field. This educational revolution, to which we teachers cannot remain oblivious [1-3], demands the promotion and development of innovative teachings that allow rapid and effective adaptation to social, labor and economic situations, in such a way that they eliminate the various existing barriers [4].

The main objective of this work has been the virtualization of different subjects in the area of Engineering Projects and the area of Graphic Expression in Engineering of the Higher Technical School of Industrial Engineering, among which are: Project Planning, Project Execution and Project Control. All of them taught in the new Master's Degree in Project Management and Management at the University of Extremadura, taught entirely online.

For the virtualization of all the didactic material, the following have been used [5-7]:

- Interactive video tutorials. Includes problem solving and case studies.

- Presentations with video included to be able to follow asynchronously.

- Online questionnaires. That allow the teacher to know the degree of student learning.

- Satisfaction questionnaires, to observe and analyze the impact that this methodology generates in student learning.

- Video tutorials. Both individual and group.

- Forums, used as a teaching tool and also for evaluation.

- Evaluation tests. Design of the deliverables of the tasks throughout the course and the exam at the end.

The tools used to support the designed material have been: video-power point, "OBS Studio", for making video tutorials and video sessions; "Zoom", to carry out online tutorials; "Moodle", for uploading all resources, preparing questionnaires and evaluation processes, both for individual and group tasks. All this elaborated material has been housed in the Virtual Campus UEx [7]

The application of the teaching methodologies described, as well as the virtualization of 100% of the contents, have been highly valued by the students. In addition, they have enabled active, dynamic learning, adjusted to the availability of students, many of them professionals, which has received a very good evaluation and acceptance by students.

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LEARNING ACTIVITIES FOR SUSTAINABLE HUMAN DEVELOPMENT COORDINATED FOR THE PROJECT MODULE: COMPOSITION, PROJECTS AND URBANISM

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Keywords: *Educational innovation, Human development, Urban planning, Territory, Landscape*

Abstract

This article exposes the application of an innovative coordination methodology, through different activities, in matters of urban planning in the search to improve human development in the particular context of learning sustainable project dynamics at various scales.

The selected activities exposed are part of the subjects: Urban Areas and Sustainable Design, from the 2nd year, City Planning, from the 3rd year, City Workshop, taught in the 4th year, and Territory and Landscape Planning, from the 5th year of the degree. These four subjects are part of the urban planning sub-module (Table 1) included in the Design Module: Composition, Projects and Urban Planning [1], and are compulsory as subject matter of the specialty, within the degree in Fundamentals of Architecture.

These subjects have common general learning objectives, emphasizing obtaining knowledge of the planning mechanisms of the territory and the city, as well as the understanding and analysis of the relationships of territorial and urban planning with the geographical, socioeconomic, ecological and of environmental sustainability. From the transversality, it is sought that human development be integrated into the understanding of the concept of urban fact. In this way, the complexities of these notions are transcended to the actions of the various urban fabrics, functional models, economic realities and environmental challenges [2].

For this, coordination meetings were established prior to the beginning of the course between the teachers of the subjects, which served to deploy a series of learning activities agreed upon among them. Activities that have been developed through different experiential learning methodologies [3] such as Project-Based Learning -PBL- and Challenge-Based Learning -CBL-, as well as other methodologies such as cooperative learning, practice-based learning, in workshop teachings and in field experiences.

Are presented here the specific activities that have helped the development of transversal and general competences that allow linking the contents of the subjects with

human development at a local level, with specific territorial problems, and the Sustainable Development Goals -SDGs- [4] initiative promoted by the United Nations Organization worldwide.

Among the different training objectives of the module's subjects, is that students gradually delve into the complex challenges that the new millennium holds for humanity and acquire the largest number of response tools. This coordination has allowed and will allow students to acquire the necessary resources to prospect the complexity of the territory, taking into account sustainable development from the large scale to the local scale with appropriate interventions that guarantee human development.

Table 1: *Submodule or urbanism of the Degree in Fundamentals of Architecture.*

Curso	ECTS	Subject
1º	6	Urban Development Basics
2º	6	Urban Areas and Sustainable Design
3º	6	Urban Planning
4º	6	Project Workshop of the City
5º	6	Territory and Landscape Planning

Relation between the courses, the ECTS credits and the subjects of the submodule of urbanism.

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INCORPORATING COLLABORATIVE ONLINE INTERNATIONAL LEARNING (COIL) INTO ARCHITECTS AND BUILDING ENGINEERS. A STUDY CASE IN PERÚ AND SPAIN

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Keywords: *Collaborative Online International Learning (COIL), Architecture, Energetic Efficiency, cultural backgrounds, inclusive education*

Abstract

The Covid-19 pandemic has caused changes at the teaching and academic level. These changes have meant a radical change in our way of doing and thinking, and in a certain way, have opened up new opportunities for virtual teaching, favouring new cultural experiences [1,2]. At an educational level, high education are on a global horizon, in which the different agents involved must work collaboratively to achieve comprehensive academic enrichment [3]. Collaborative Online International Learning (COIL) activity is an innovative online pedagogical methodology, which provides students the opportunity to interact with international peers. COIL projects usually involve the co-development of an activity by two or more instructors from different countries and students from different lingua-cultural backgrounds to communicate and collaborate online [4].

This research will analyse students' experiences and engagement when being involved in a Collaborative Online International Learning activity as part of the assessments for 1st year undergraduate students in Architectural Degree in Piura, Perú, and pos graduate students of the Master in Inspection, Rehabilitation and Energy Efficiency, in Burgos, Spain.

43 students of undergraduate and pos graduate studies from two different universities, in Perú and Spain, were enrolled in a six-week virtual collaborative project (Table 1). The selected topic for the activity was a "Energy Efficiency Architecture" assignment, where students had to analyse and discuss four different aspects of this topic in buildings placed in the two different countries; i.e. i) climatology, ii) architectural design, iii) materials and iv)energetic thermal performance.

Table 1: *Number of undergraduate and pos graduate students involved in the study*

Module	Piura, Perú	Burgos, Spain
Introduction to Architecture (Degree)	40	
Energy Efficiency (Master Degree)		3

The students from the University of Burgos, within the Energy Efficiency Module, will focus specifically on the analysis of the energy performance between two buildings in both locations, while the students of the University of Piura, recognized in these two buildings, the concepts learned in the Introduction to Architecture Module, finding similarities and convergences.

The challenge arose in the implementation of the COIL Course in both courses, due to the fact that high difference between age students and level of knowledge.

For them, it was a framework for international learning and cultural exchange, which facilitated collaborative work between different groups, from different disciplines, of different ages, with different interests and responsibilities. In order to minimize the risk, the COIL Course project was designed jointly by both partners, taking into account all those aspects that could barriers in the implementation.

The learning experience has provided students with the possibility of enhancing their confidence and communication skills, as well as the taking part of a new learning environment, exchanging knowledge with international peers, preparing them to be part of a global environment.

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ACQUISITION OF TRANSVERSAL COMPETENCES LINKED TO PROGRAMMING IN HYDRAULIC ENGINEERING SUBJECTS

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***Keyword**: programming languages, spreadsheet, hydraulics, transversal skills, hydrology*

Abstract

Subjects within the framework of the current syllabus cannot ignore the need to implement activities that guarantee the explicit consideration of transversal competences. The current needs imposed by the labor market make transversal skills linked to programming an essential aspect in the education of students. Curricula increasingly incorporate content linked to said area of knowledge. However, the true acquisition of such skills requires not only specific subjects but the use of programming tools in a generalized way with the rest of subjects in the syllabus. The solution to this requirement is perfectly viable for technical degrees where programming tools can help reach an added dimension of understanding relating to many problems that are addressed. This paper presents the experience of using Python as a tool through which to teach event hydrology which forms part of the Hydraulics and Environmental Hydrology subject offered in the Agro-environmental Engineering degree.

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THE URBAN PROJECT AS A LEARNING MECHANISM FOR THE PROJECTUAL PRACTICE OF THE THESIS

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Keywords: *Thesis Seminar, Design Practice, Discursive Logic, Urban Project, Idea of the City*

Abstract

The teaching of the urban project within the Graduation Seminar is important to be implemented, since it gives the possibility that the students develop a critical posture of making a city, with a comprehensive vision of the problems that this entails. This teaching is driven by urban research to generate a discursive logic, of how to approach projects of an ecological-territorial order, this as the basis of project practice, understanding architecture from an urban, social and multidimensional spectrum, with character methodological, theoretical and technical. The urban project is born from understanding architecture and urban planning as an agent of change and a social activator, which can influence the urban processes of urban practices that are being developed in our cities day by day and which it assumes as an object of study, the social and ecological responsibility that the projects have.

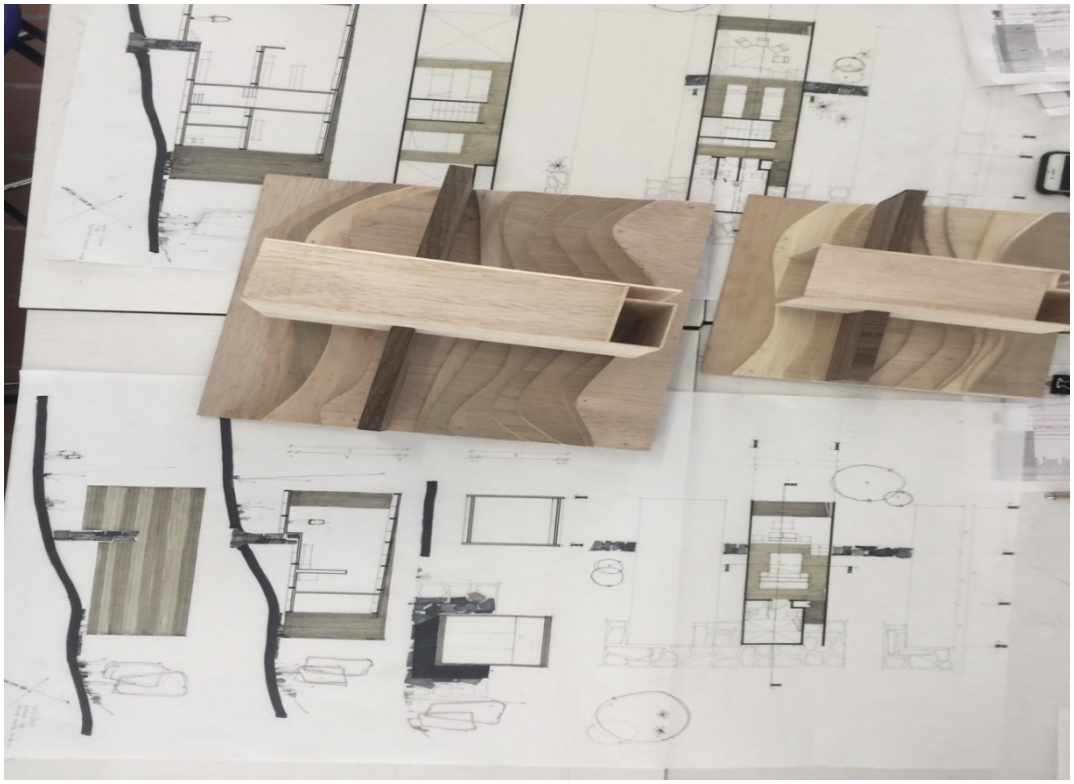

Figure 1: *Fotografía del Trabajo del Alumno Erick Sebastian Negrete. (Fuente: Elaboración Propia)*

PROFESOR 3						
CONOCIMIENTO CIENTÍFICO			CONOCIMIENTO EMPÍRICO			TOTAL
FUNCION (HAB–INCL)	FORMA–CONCEPTUAL (HAB–INCL)	TECNOLOGICA–SUSTENTABILIDAD (SOST–FACT)	PRESENTACION	EXPRESION GRAFICA	PROY DE CONJUNTO	TOTAL
7.0	7.0	7.0	8.0	9.0	10.0	8
6.0	7.0	5.0	6.0	6.0	10.0	6.66666667
5.0	5.0	6.0	6.0	9.0	7.0	6.33333333
7.0	6.0	6.0	8.0	9.0	10.0	7.66666667
6.0	5.0	5.0	6.0	7.0	8.0	6.16666667
7.0	8.0	9.0	9.0	10.0	7.0	8.33333333
5.0	5.0	5.0	5.0	6.0	6.0	5.33333333
8.0	8.0	7.0	9.0	10.0	10.0	8.66666667
8.0	7.0	7.0	6.0	6.0	7.0	6.83333333
6.0	9.0	6.0	7.0	8.0	7.0	7.16666667
7.0	7.0	8.0	9.0	9.0	8.0	8
5.0	5.0	5.0	5.0	6.0	7.0	5.5
5.0	5.0	5.0	5.0	5.0	5.0	5
8.0	7.0	7.0	6.0	5.0	7.0	6.66666667

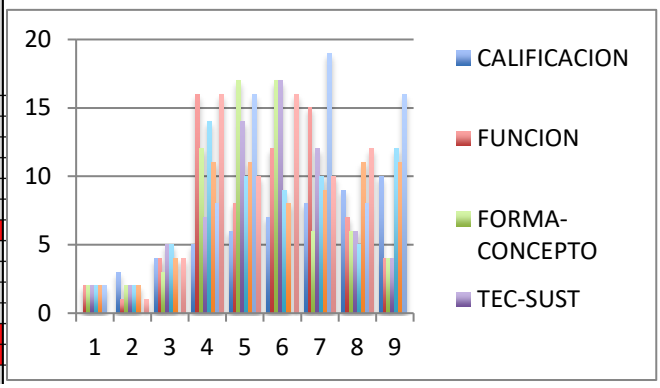

Figure 2: *Muestra y valoracioes del Instrumento de Evaluación. (Fuente: Elaboración Propia)*

Figure 3: *Fotografía del Mapeo de las alumnas Lucero Barcenas y Aurora Rojas. (Fuente: Elaboración Propia)*

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PLAYFUL STRATEGY MEDIATED BY ICT AS SUPPORT FOR TEXT COMPREHENSION IN PRIMARY SCHOOL CHILDREN

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Keywords: *Didactic strategy, ICT, Texts*

Abstract

In recent years, the quality of Mexican education has been called into question by many factors, including the poor reading comprehension skills of children and young people, especially because in the latest international evaluations, the country has stood out for leaving failed in this activity.

Text comprehension is a problem that many people present today, since it refers to the process of interpreting and extracting the main ideas of a document, in order to understand the main objective of the topic, so that in this way the individual can value it, criticize it or relate it to the ideas they already have.

This situation occurs in many children who attend the first level of their basic training, for which it is necessary to take certain measures to solve this problem, otherwise it will become more and more complicated, which will not allow them to advance at the same rate as the other groupmates. Commonly, the ages at which these cases occur are in children from 5 to 6 years old, since at this stage they must be induced and motivated to acquire the habit of understanding.

With the intention of supporting the problem raised, a playful strategy mediated by Information and Communication Technologies (ICT) was developed, which aims to support children in the first grade of primary school, who present problems of slow learning, to help them develop text comprehension.

In this didactic strategy, multimedia technology was used, obtaining a product with an attractive and fun interface, with images, sounds, games and exercises based on the textbook, which is used in the primary level of the Mexican Republic.

For the present investigation, the qualitative approach was used, using observation and interview as a data collection tool. Under the premise of optimizing the teaching process and therefore the achievement of quality learning, this proposal was made to develop a playful strategy mediated by ICT, with the fundamental intention of achieving that the understanding of the texts, be from of games where they elaborate and solve exercises.

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CHALLENGE-BASED LEARNING PROJECT. MONITORING AND TESTING PHYSICAL PROPERTIES IN BUILDING

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Keywords: *challenge-based learning; engineering; architecture; monitoring.*

Abstract

Today's students come from a generation that is increasingly self-taught; the boom in social networks and the creation of content encourages them to learn and show interest in certain subjects [1]. This means that students need to put themselves at the centre of learning, namely through their own experimentation with what they learn. In this context, challenge-based learning, which is the methodology in which students improve this level of competences through the direct application of the scientific method, is the most appropriate methodology to achieve results adapted to the current reality of the professional world. Regarding this project, the building sector in Spain, thanks to its regulations and laws, has managed to regulate conditions such as energy saving with the implementation of the mandatory use of solar contribution or the correct insulation of walls in contact with the exterior, as well as hygiene and health with the requirements of sanitation and water drainage [2]. The project presented consists of the development, by undergraduate students, of a modular model, with the help of the 3D printing laboratory of the Madrid Higher Technical School of Building, consisting of a series of dwellings that can be configured in different ways, and then used to study the physical properties applicable to the building [3]. At the same time, the master's students will be able to carry out monitoring studies of the thermal comfort variables, so that they can work in parallel with the undergraduate students, forming a symbiosis and an enriching exchange of knowledge for both. The class will be divided into working groups, which will be made up of no more than 5 students, who will choose the variable to be studied. During the course, and during class hours, they will have to elaborate and place the measurement sensors and the corresponding circuits for monitoring the home at the points they consider appropriate. And, as they obtain results, they should discuss them in class to suggest changes in the composition of the house to optimise its functioning. With this project, students are expected to develop and achieve skills and competences that are not only academic, but also transversal, such as teamwork, work autonomy, meaningful learning, and communication skills [4]. At the end of the course, the groups will have to present the results obtained to their peers, proposing improvements, either by changing the walls or restructuring the spaces. These improvement options must be quantified economically to make the project credible. A general "budget" is established for all the groups, which they will have to share to obtain the best possible result. In this

way, not only do we introduce students to monitoring, but we also put into context the real economic cost of carrying out these projects.

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BIM PROJECTS BEYOND CONSTRUCTION MODELS

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Keywords: *Building Information Modelling (BIM), Civil Engineering, Port, 5D, management.*

Abstract

There has been a tendency in the construction sector to think that BIM methodology is only focused on the creation of new constructions. However, BIM methodology incorporates four stages of a project (design, construction, use and maintenance) and multiple benefits are obtained at each stage. Although, management systems (use and maintenance) applied to the construction and architecture sector have made considerable progress in recent years. In Civil Engineering, its presence is incipient. Examples are probably very few and relate to particularly projects with high level of budget, such as TfL (Transport for London), but there is a general widespread resistance to change.

BIM methodology education in Civil Engineering has been carried out only for a relatively short period of time. Some European universities already promote postgraduate programs that include BIM methodology in their plans, such as the Polytechnic University of Madrid. However, these master's programs dedicate an important part of the course to learning the tools themselves and the parameterization of the constructive elements in the field of Civil Engineering. All this covered a large part of the teaching, so the students focused on the design and construction part.

Given this situation, and within the current demands of the sector. This academic year has required, as a new objective, going one step further and trying to provide a complete training that covers the four stages of the project. For this, groups of four students have been formed for each project. That will speed up the process of generating the model to focus on the management part. It is also worth mentioning that until today constructive models have been formed mainly of infrastructures such as bridges or roads, and this year we also wanted to introduce other more complex infrastructures such as ports to generate knowledge and put into practice the BIM manual of state ports that was published in 2019.

In the case of a port, the BIM methodology has focused on coordinating the location of elements, taking into account their functional, spatial, regulatory and accessibility requirements. To do this, it is first necessary to parameterize the port elements (Figure 1) using software such as Autodesk Revit. Once the elements have been parameterized and the terminal modeled, everything is integrated into the model and a control panel for the management and maintenance of the installation using the BIM model was generated (Figure 2). Obtaining even by means of software such as Bentley's MicroStation, the simulation of the movement of the port terminal was achieved in terms of the loading and unloading of the containers from the ships, as well as the operation of the cranes inside the terminal.

Figure 1. *Parameterization of port elements in Autodesk Revit.*

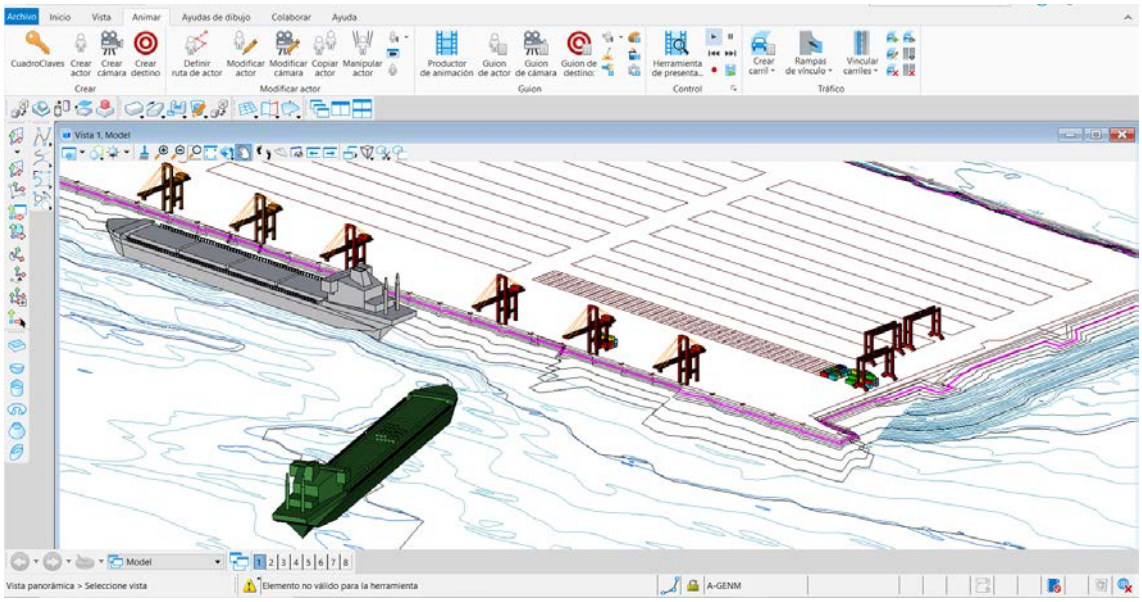

Figure 2. *Simulation of activity movement in the terminal with MicroStation.*

The work presented here is only a small part of all the benefits that BIM can bring to the Civil Engineering industry. As we can see, the advantages of BIM are innumerable compared to the classic work methodology. However, it requires an effort to adapt the BIM guides to the rest of the infrastructure.

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INTERNATIONAL GROUP COOPERATION MEETINGS FOR THE DEVELOPMENT OF SUSTAINABLE DEVELOPMENT PROPOSALS IN UNIVERSITIES

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Keywords: *Cooperative learning, Virtual collaboration, Transversal skills, EELISA communities, Enterpreneurship*

Abstract

In this contribution we present a teaching innovation project that will be carried out in the degrees of Degree in Building Engineering and Double Degree in Building and in Business Administration, both of them held at Technical School of Building Engineering (Technical University of Madrid). On the one hand, our work aims at the integration of students from different European universities, being an excellent opportunity to promote their prospective professional career, achieve a global vision, and establish links and relations that transcend the university. On the other hand, our project is about carrying out a group actions that promote the use of the most sustainable, healthiest and safest means possible in the university, contributing to achieve specific Sustainable Development Goals (SDG) [1,2] and the climatic and energetic commitments targeted at the European level.

The collaboration between students from different universities will be fundamental to this project, which is also intended to promote the acquisition of the so-called soft skills, which will help students in their future working duties [3]. Although these skills are part of different curricula, in many cases these skills are regarded as less relevant or even secondary, due to the usually heavy workload of the subjects taught. They will be promoted in the activities planned in our project.

To this end, professors and researchers belonging to different EELISA communities have put their efforts together. Among other objectives, the following are promoted in EELISA communities: contribution to the internationalization of students, the use of active learning methodologies, the creation of a space to address social challenges from the curricular perspective of the students, training in transversal skills and effective involvement in a variety of activities with broad social impacts.

To achieve all these goals, meetings between students of different nationalities and universities will be held. In these encounters the proposals and actions that are being carried out in different universities will be shared among students, aimed at addressing the SDGs within each university. The main outcome of this project will be a common document (a good practice guide) that will include different actions aimed at achieving more sustainable campuses.

To quantify the results of the project and the achievement of objectives, we will discuss some surveys that will be carried out before and at the end of the activity. Another indicator of the success of our proposal will be the assessment of the interest shown by the participants and by the continuity that this experience may have in the future. The development of our teaching innovation project will help know the strengths and weaknesses of the students and teachers involved in the development of the SDGs and the 2030 Agenda, in such a way that a series of conclusions will be drawn leading to potential improvement actions that could be implemented in the upcoming academic courses.

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RAISING AWARENESS: FRIENDLY CITIES

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Keywords: *awareness, service-learning, friendly, regard, city*

Abstract

Society tends to think that problems in cities are solved by prohibiting and isolating people in their home or in closed private areas. In this way, our neighborhoods begin to be filled with placards saying: do not playing, do not passing, do not stepping on, etc. In the streets there are only fences and closed doors, there are no children playing in the playgrounds because they bother and, in parks you can only walk on the paths. This does not motivate you to use public spots then, neighbors stay in their homes and, cars turn into main actors. All of this generates an aggressive city model. [1]

To solve this situation in which technicians and society must connect, we have proposed a project based on the service-learning methodology [2]. A neighborhood in the north of the city of Madrid known as SACONIA is the real environment where students go to learn the different constructive aspects that exist in the buildings and in the common areas. At the same time, they are going to provide a service to the neighborhood, since they will carry out technical and usage information that will be delivered to the neighbors who can use it in order to improve coexistence.

The aim is that students make users aware that the problems of coexistence can be resolved responsibly and respectfully once the functioning of the buildings and common spaces is known. To run this, students will study the buildings *in situ*: they will analyze construction systems, materials, and thermal and acoustic insulation systems. It will be necessary to collect data, to fill methodological sheets, to take photographs and

measurements. Once the situation is known, solutions will be proposed to improve coexistence, then good practice guides will be made with recommendations for the neighborhood in such a way that it helps to have a better coexistence.

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PLOGGING: ECO SPORTS IN PHYSICAL EDUCATION CLASSES. PRACTICAL PROPOSAL OF ACTIVITIES IN LINE WITH THE SUSTAINABLE DEVELOPMENT GOALS (SDG)

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Keywords: *physical education, eco-sport, sustainable development goals, primary school, healthy habits*

Abstract

It is about the elaboration of a didactic unit for the students of 6th of Primary Education. The teaching unit is made up of four sessions focused on promoting and encouraging physical activity from an ecological approach, hence the name eco-sport. It is intended to give a transversal approach to the subject of Physical Education together with subjects such as Natural Sciences and Plastic and Visual Education, so that learning is more significant for students, leading them to empathize with the importance of caring for and preserving the environment. environment. In this didactic unit, the race is worked from different methodologies and games, launches, receptions, jumps, among other skills and motor skills, in line with the Sustainable Development Goals, seeking that students commit to the development society and in defense of the care of the environment.

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TEACHING WITH DIFFERENT ALTERNATIVES WITHIN THE FLIPPED CLASSROOM. CASE STUDY IN HIGHER EDUCATION SUBJECTS

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Keywords: *Active Learning, Flipped Classroom, Self-Learning, Autonomous Learning, Multimedia Material, Moodle, Open Educational Resources (OER), Educational Video*

Abstract

A team of lectures from the Escuela Técnica de Edificación has put into practice a Flipped Classroom model based on training itineraries adaptable to the situation and the student's background training [1,2,3].

This model has been prepared and taught in several subjects through flipped classroom pedagogy, with a micro-learning approach [4,5] aimed at creating personalized training itineraries, and more adapted to the different learning styles of each student. The main purpose of this phase of the project is to ensure that as many students as possible understand the fundamental concepts of the subjects and are able to put them into practice when they come. For this, microvideos, short videos, texts, and infographics have been used, tracing different nonlinear itineraries, and always relying on the "Book" and "Lesson" modules offered by Moodle [6].

The developed itineraries have been designed to offer students different options to learn about a given concept but from different perspectives, paths, or methods. In this sense, by using a basic trial-error system, students can choose the path that best suits their learning style.

The procedure followed to design the possible itineraries to be covered by the student has been adapted to the content to be taught. However, some invariants have been developed that can be applied together. The general criterion adopted is to allow advancement vertically after passing a phase and horizontally if it is not exceeded.

This phase is intended to enable students can extrapolate the knowledge and skills obtained in one subject to another related subject. Also, it allows lectures not to "start from scratch", as if the skills and knowledge acquired no longer exist and had no

relationship whatsoever. Thus, when the student expects to see, in a short explanatory video, his usual teacher, he will also meet the teacher of another related subject, who explains the concept and shows him the close relationship between both subjects.

At the end of the 2020-21 academic year, different data has been collected in the different subjects, in order to better understand the benefits obtained with the proposal, the results obtained being those indicated below.

- The methodology of 'training itineraries' is interesting to students.
- The high acceptance of the non-evaluable test format is due precisely to the fact that they are not evaluated. This takes pressure off the student and allows him to advance through the subject knowing what his level is always.
- The point that generates the most acceptance, and the main virtue of this methodology, is the possibility of approving the subject through different paths. The student is aware that teaching is adapting to her abilities and values this effort by trying themselves.
- The students are concerned that all subjects in the career adopt flipped classroom strategies, which would mean being systematic, working daily at home, and taking responsibility for their own learning.

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SKILLS FOR THE FUTURE BUILDING PROFESSIONAL. THE CASE OF THE AMBASSADOR'S PROGRAM AT THE UPM

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Keywords: *Skills, Building Engineer, XXI Century, Mentoring, Motivation*

Abstract

Theoretical and practical lectures are important components of university education. However, currently, companies and society require Engineers with a wide range of knowledge and soft skills that would allow them to meet labor market expectations [2]. Therefore, during the last years specific knowledge and training on skills and competences to prepare students for the professional market have been implemented at the University, but not all students are as motivated to study and actively engage in such activities.

In order to enhance students' motivation and gain competences for future building professionals, an Ambassadors' Program (AP) was implemented, within the context of the Cátedra Universidad-Empresa ARPADA, at the Escuela Técnica Superior de Edificación (ETSEM) from the Technical University of Madrid (UPM). This paper presents the experience developed during the academic year 2021-2022 and highlights the advantages and barriers found during its implementation, giving insights and actions to successfully involve students' in achieving skills for the future building professional.

Initially, a total of 10 students participated as ambassadors in this experience. The AP consisted of several two-hour brainstorming sessions were professionals from the Cátedra and the ambassadors worked on identifying the needed skills for the future Building Professional of XXI Century and which actions were needed to implement them in the School. The sessions took place once a month, from November 2021 to March 2022 and will continue until July.

The analysis carried out was mainly performed using the information brought up by the participants during the brainstorming sessions. Results show that "respect towards people" (teamwork, active listening, collaboration, humility,…), "communication" and "adaptation to change" (stress tolerance, resilience, proactivity and flexibility) were the key skills that the future builders will need to address in their professional life.

Finally, planning visits to several construction sites, developing short videos of the construction process or organizing workshops and seminars --avoiding the exams period—, are some of the remedial actions brought up by the ambassadors in order to keep up students' participation and decrease their demotivation.

MODELING TOOLS FOR UPDATING THE ARCHITECTURAL GRAPHIC EXPRESSION LEARNING PROCESS

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Keywords: *BIM-EDU, BIM Educational, Educational Innovation* in *Architectural Graphic Expression, BIM Learning.*

Abstract

The objective is to improve the spatial and graphic skills of students of architectural graphic expression. The improvement of their learning within the subjects of architectural drawing within the studies leading to the degree of graduate in building, ETSEM-UPM.

First of all, it is necessary to consider the previous aspects to be considered in the development of the teaching of Architectural Drawing subjects. These aspects are based on the diversity of backgrounds and previous knowledge of the students before starting the course. The students coming from the EVAU, who have studied their corresponding courses of Bachillerato, present a disparate formation. There are those who have never studied technical drawing, who come from social studies or baccalaureate courses. The experience with them is of a slower (logical) adaptation. There are also those who have studied technical drawing subjects, who have knowledge of representation systems and adapt quickly to teaching in the field of architectural representation.

But although we can consider that new students are supposed to be digital natives, and are regular users of Information and Communication Technologies (ICT) [1], the reality evidences an absolute lack of training in Artistic Drawing [2] or freehand drawing, something vital to face their university teaching period within the field of architectural graphic expression.

For this reason, we intend to take advantage of part of their technological training in order to improve their learning process. For this purpose, we intend to use BIM (Building Information Modeling) modeling tools, as an aid or support to the teaching of architectural drawing. This concept has been introduced rather slowly in the university and in the teaching of graphic expression [3], but it turns out that the teaching of building information modeling (BIM) in relation to building science provides students with a remarkable understanding of the nature of building science [4].

During the last few years there have been different pilot programs derived from the teachers' own desire for educational innovation within the teaching-learning process of architectural drawing [5], [6] and related areas [7], [8].

For this purpose, a specific use of modeling tools is proposed (in our case through Revit@Autodesk), for the improvement of different aspects and specific sections, in the learning of key elements related to architectural drawing.

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PROJECT-BASED LEARNING: POSSIBILITIES OF APPLICATION WITH BUILDING STUDENTS

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Keywords: *Project Based Learning; Educational Innovation; Building; University Education.*

Abstract

Project Based Learning (PBL) is an active teaching methodology that places the student at the centre of the teaching-learning process. Thanks to this teaching tool, the student acquires the necessary competences described in learning guides as a result of the development of a project that connects the contents of one or more subjects [1]. This results in a meaningful learning, contextualised in problems that are close to reality and which prepare students for a subsequent performance of their future professional activity [2]. Furthermore, the application of this methodology, which culminates in the completion of the project, allows students to visualise the result and obtain a tangible product as a result of the effort applied to achieve it.

This methodology is of special interest to building students who must prepare themselves to work on construction projects in the future, where several agents intervene with the final objective of successfully completing the works initiated. PBL methodology allows the development of transversal competences such as communication skills, peer learning, selective information search, conflict resolution and teamwork, etc [3]. Ultimately, there is a change in the teaching philosophy, focusing on the just-in-time model to display the information, i.e., when the student really needs the teacher's assistance, and not providing all the contents at the beginning, as has been done in traditional master classes.

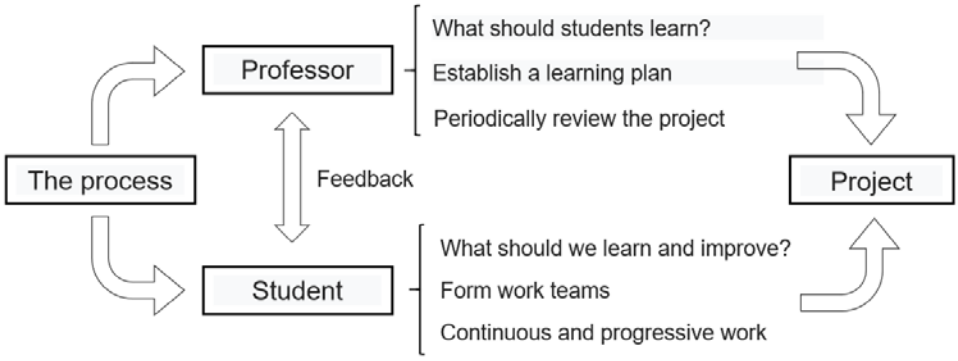

Figure 1: *Process to develop PBL methodolgy [4].*

This paper proposes how to apply this teaching methodology in the university classroom. To this end, it shows how the ideal classroom distribution should be in groups

of three to four people and in classes of no more than 50 students. It is especially important to carry out a continuous evaluation process, where emphasis is placed on the achievement of the project's objectives, leading to a final product that is the result of teamwork and the acquisition of the competences involved in the subjects in which the project is developed. In this way, the aim is to provide university teachers with the necessary guidelines to implement this methodology, taking into consideration the advantages and difficulties that may arise from its application in university classrooms.

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REUSE OF CONSTRUCTION AND DEMOLITION WASTE: EXPERIENCE THROUGH DESIGN THINKING

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Keywords: *Design Thinking; Construction and Demolition Waste; Construction; University Teaching*

Abstract

The growing depletion of natural resources and the increase in industrial activity is leading the construction sector to search for new, more environmentally friendly materials [1]. In this sense, engineering schools must emphasise the importance of reintroducing raw materials from the recycling of end-of-life products into production processes. Thus, an increasing number of subjects are incorporating thematic blocks on sustainability and waste management into their contents.

In the specific case of the construction industry, according to EUROSTAT sources [2], it is the sector that generates the most waste in the European Union's industrial conglomerate as a whole. For this reason, it is essential to train students of the Bachelor's Degree in Building by highlighting the importance of reusing Construction and Demolition Waste (CDW) for the development of new, more sustainable and environmentally friendly construction materials.

The Design Thinking methodology is a creative and analytical process that favours the generation of innovative ideas and positions the student as the central agent of the learning process, allowing them to experiment, model prototypes, gather information and redesign existing processes [3, 4]. In this work, taking innovation in Construction and Demolition Waste management processes as a starting point, we present how this type of activity can be developed in the subject of Quality Management and Control. To this end, an activity has been designed in relation to the subject of environmental quality management, which involves students in the process of generating ideas that allow them to control or correct the negative impacts that construction products and processes have on the environment. Therefore, the aim is to provide teachers interested in the Design Thinking methodology with a series of tools to develop this type of activities in the classroom. For this purpose, a schematic outline is given of how to organise a two-hour session to address the problem of CDW management in construction companies, as well as a possible standard evaluation rubric that can be used for the activity proposed.

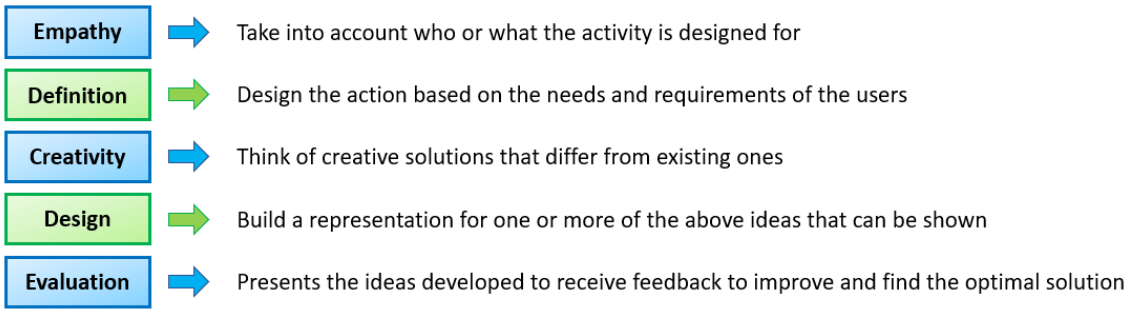

Figure 1. *Phases to develop the Design Thinking. (Source: own elaboration base on Arias-Flores et al., 2019 [5])*

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ANALYSIS OF THE INTERACTION OF ERASMUS EXCHANGE STUDENTS IN THE GROUP RESULTS. CASE OF THE SUBJECT OF SPANISH POPULAR CONSTRUCTION (III)

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Keywords: *student, exchange, group, erasmus, magallanes.*

Abstract

This paper presents the results of the analysis about the data obtained from the performance of the students in the optional subject of Spanish Popular Construction. Specifically, the aspects related to the presence of exchange students.

The subject was taught in the 2013-2014 [1][2] academic year for the first time. Regarding the presence of exchange students, they have been incorporated in the last six years, representing a substantial percentage of the total students.

For these exchange students the attractiveness of the subject lies in the fact that it is optional. This allows to them more curricular plastic possibilities. In the other hand the subject is properly dedicated to the Spanish field. This is especially indicated to satisfy the curiosity for a different culture for them. And finally, nevertheless refers to a universal technology such as construction, therefore, easily integrated into their own knowledge.

In this work have been essential the factors related to the interaction between students who are exchange and those who are not. Looking for conclusions that allow to guide the exchange student. Not only in the development of the subject, but in the way of face it and for work with the rest of the students [3].

To pass the subject of Spanish Popular Construction it is necessary to carry out an individual work and another in a group (team) [4] [5]. The first will deal with a building of its own kind of heritage. Carrying out a detailed analysis of the physical characteristics

and the constructive strategies chosen to face or respond to the conditioning factors of the environment in which it is located. In the second, the group one (teamwork), they are asked to elaborate an analysis of the environmental, geographical, geological, climatic, historical, and economic factors of one of the historical regions of Spain and a catalogue of the constructive solutions that respond to these characteristics.

Then, to success in this subject group work (teamwork) is therefore substantial [6]. Its demand from the students a close relationship of work, exchange, discussion, and collaboration. Initially, it is not required that the working groups be mixed in gender and nationality. Therefore, teams are formed in which the components are all exchange, teams with both types and teams without exchange students. Although the recommendation is made that the groups be mixed, asymmetrical and culturally and linguistically varied.

This freedom allows us to analyse results from teams with different compositions. For the overall analysis, factors such as the proportion of total exchange students, individual qualification, average group grade, discriminated average grade, average grade of the teams in relation to their composition, etc.

It has been observed that group work generally improves qualifications compared to individual work [1][2].

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FLIPPED CLASSROOM AND PROBLEM BASED LEARNING AS ACTIVE LEARNING TECHNIQUES FOR THE STUDY OF INTERVENTION METHODOLOGIES IN STONE FAÇADES

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Keywords: *Problem based learning, Construction Technologies, Stone Facades*

Abstract

The present paper shows the objectives, the procedure and the results obtained when active learning techniques are applied. Flipped classroom and problem based learning (PBL) are used as strategies for the learning of intervention methodologies in Stone façades. Both these techniques were put into practice in the subject of Construction 5 (Building refurbishment). This subject is taught in the fourth course of the degree in Architecture, in the School of Architecture in University of Seville.

A Real Case Study is proposed for with the aim that students analyze and learn about existing intervention techniques for the development of a refurbishment project in a building with a stone façade. This case study must be faced by students in groups. In this way, it is intended to promote active student participation through their own research, creativity, cooperation, and socialization among students. At the same time, it breaks with the fragmentation of theoretical and practical sessions in the classrooms.

The Case Study takes place in a temporary space of two four-hour sessions. It is organized by the teacher through a series of questions that must be answered in sequence in different stages. The questions are raised from a logical process of construction of knowledge following a content map developed previously by the teacher. The research developed by each group and the conclusions obtained are shared and debated in the classroom at different times.

The students learning is evaluated through the results obtained from two questionnaires (Initial test and Final test) carried out in different stages of the process, before starting the resolution of the proposed Case Study and at the end, once it has been resolved. The questions that arise in both tests are analogous with the aim that the students can compare their initial response and their one after completing the exercise, once they have acquired the conceptual, procedural and attitudinal contents.

As a conclusion, this methodological model aims to achieve student involvement by acquiring dynamic and participatory sessions, which requires the commitment and responsibility of all the agents involved in the learning process.

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ANALYSIS, MODEL AND SIMULATION OF MANUFACTURING AND PRODUCTION SYSTEMS IN ENGINEERING

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Keywords: Mechanical Engineering; ARENA; Transformation processes.

Abstract

Production and manufacturing systems require constant review to be more competitive and effectively adapt to the changes that surround them. Currently, the European Green Deal proposes a strategy towards which to guide the new competitiveness of companies in the production and manufacturing sector [1], [2]. With this, the factor of sustainability comes into great consideration and how this affects all productive agents. With the guidelines of sustainability, a production system must first adapt the suppliers of its raw material to be transformed. Thus, you will have to look for competitive prices, but also analyze how they are obtained and how they fall within the sustainability guidelines. Next, the transformation process itself must be analyzed, the machinery it uses, the specific tasks carried out by its workers, as well as the operation and preventive maintenance of the installation. Finally, the characteristics of the final produced object, as well as storage, are taken into account. Other feedback agents (analysis and improvement of the process) as well as external agents (the Green Deal itself, regulations, competences, the context and the situation, etc.) additionally affect [3]–[5].

In this work, the analysis of a production and manufacturing process is applied, with different techniques of mechanical engineering, applied within the training of engineering students. During the process, they not only carry out the different transformation processes, limiting it to handling the machine, but also analyze all the external and internal variables, taking into account factors of efficiency and competitiveness.

In a second phase of the training, and with the previous data obtained from the applied experience, the complete system is modeled in a discrete event simulation software for the optimization of complex processes [6], [7]. With this, they obtain statistics of their process, compare them with the results obtained from experience and propose a series of specific improvements to the production and manufacturing process.

This proposal constitutes a real application of the industry to engineering studies, as well as an improvement in digital skills with the use of system modeling. The conclusions obtained are applicable to many transformation processes, since they are specific processes present in building and industry.

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DIDACTIC METHODOLOGIES IN TECHNICAL EDUCATION

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Keywords: *Project Based Learning, Didactics, Active Teaching, Construction, Mechanics.*

Abstract

This work develops a review based in the usual didactic methods in technical teachings and the obtaining some clarifications on their application. The teaching of engineering and architecture, with its own characteristics, uses didactics with the proper orientations that its practical nature prints [1]. What unites one didactic with another, before any subsidiary objective, is the need for a teaching-learning process [2, 3]. Without knowledge to transmit, and some agents to participate, we cannot speak of didactics. Within these didactics, active didactics such as Problem-Based Learning (hereinafter ABP) and Project-Based Learning (hereinafter ABPr) stand out. Both active didactics are very similar, but they also have some distinctive elements that we will try to elucidate. The object is none other than to avoid confusion between didactics that, due to the name or other aspect, are often confused with what a PBL or PBL is, implies and needs [4]. A diagram with the commented didactics in Figure 1.

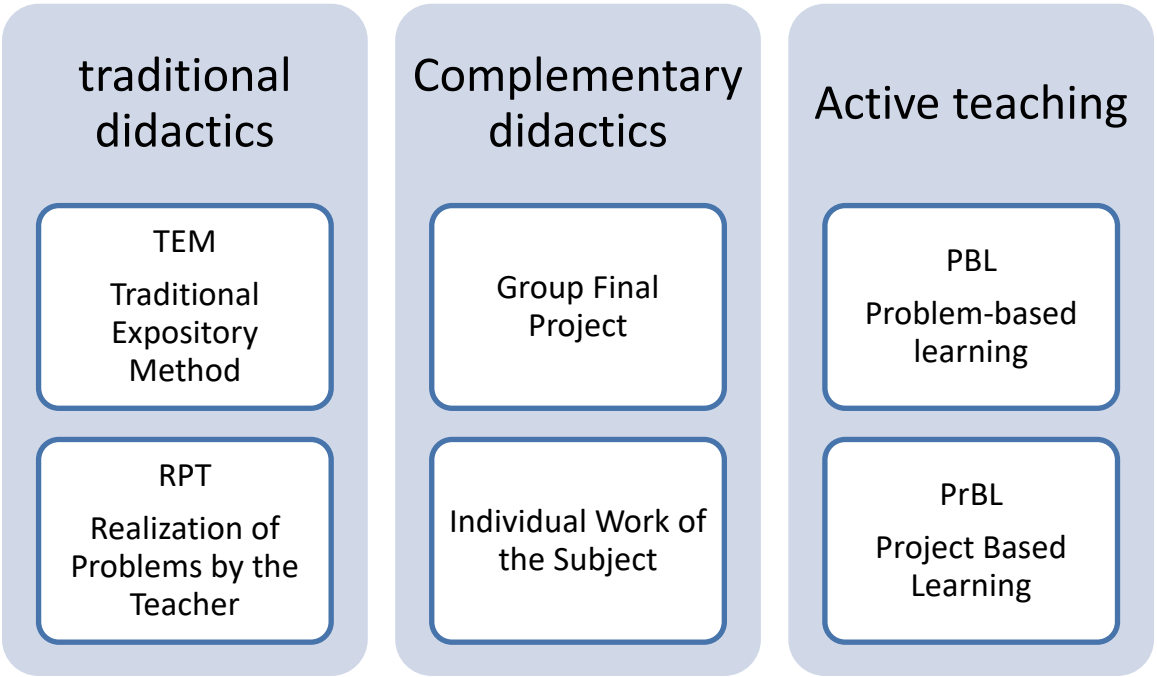

Figure 1: Usual didactics in technical teachings.

After analyzing the previous methodologies, applied to technical teachings it is possible to state some conclusions: The adequacy of one didactic or another to the teaching of a certain subject will depend on the contents to be taught. Not all subjects in engineering or architecture are refractory to the TEM due to their content. Some subjects have adapted reasonably well to this didactic method, for example, the subjects on legislation. Even so, TEM, as the only and exclusive didactic method, is not advisable in all types of subjects typical of technical education.

Regarding RPT, a very common didactic in technical teaching, with respect to PBL and PBL, the teacher still plays an active role in didactics, so we cannot consider this teaching methodology as an active didactic or a variant of PBL. However, it is preferable to the MET exclusively in technical teachings.

For certain subjects, PBL and PrBL methodologies are configured as an effective teaching method, and in turn, more efficient than the method that combines TEM and RPT.

TEM and RPT continue to be essential to lay the foundations for the subjects taught, regardless of whether it is combined with other active teaching methods. Performing a PBL or a PrBL methodology without any training given in the didactic form of the TEM and/or RPT is not recommended. However, the reduction to an essential minimum can be achieved with the appropriate teaching material and the help of the virtual platform.

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IMPACT OF INNOVATION: BIBLIOGRAPHY STUDY, DIAGNOSTIC TOOLS, CONSIDERATIONS OF PARTICIPANTS INVOLVED

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Keywords: *Contemporary administration, Transformational leadership, Ubiquitous leadership.*

Abstract

All innovation must start from the knowledge and the needs of the workers of the center under study (workers, technicians, professionals and executives) so that the changes generate true transformations; that is to say, not to innovate in what is unnecessary, but in what has repercussions.

Bibliographic citations from “The End of Management and the Emergence of Organizational Democracy”, by the authors Joan Goldsmith and Kenneth Cloke; references to “In Search of Excellence” by Tom Peters and Robert Waterman; as well as selected instruments of organizational diagnosis, obtained from the work "Social Psychology" by Dr. Julio César Casales, constitutes an important contribution.

It includes receiving criteria from a representative sample from the organizations involved.

This integration constitutes the modest experience proposed.

Finally, progressively achieve effective leadership, which represents its very essence. Practical, with itinerant management and carrying out three activities at the same time: listening, teaching and facilitating things.

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DEVELOPMENT OF A GAMIFICATION APP TO ENCOURAGE WORKERS TO IMPROVE THEIR PHYSICAL HEALTH

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Keywords: *Gamification - Ergonomics assessment - App - Workplace adaptation - Work ability*

Abstract

The BIONIC Gamification App is one of the components of the BIONIC system. Overall, the goal of the BIONIC Gamification App is to provide users with the physical activity that reflects their needs and to motivate them to follow this regimen towards an improvement of their physical health.

This app encourages workers to keep track of their physical and ergonomic health in a visual, simple and fun way. It is able to show the worker's records during their working day and proposes a series of improvements and exercises to implement in their daily life, in the form of games or challenges, and in this way involves the person in improving their health. It is even able to create a "competition through challenges" between several workers so that each one wants to get involved in improving their ergonomic health, often forgotten in the construction field. The app also has a virtual coach who acts as a guide and tutor within the app, making it more attractive to the worker. [1]

By linking the app to the smartwatch (device included in the full system), users can get insights on their daily activities (step counts). Another function of the Gamification App is to propose physiotherapy exercises according to the feedback received from the BIONIC system and the needs of the users. These exercises are given by a virtual coach, Bill, who is meant to guide, motivate, and support users. Finally, the Gamification App has a gamification feature to prompt users to do the exercises proposed, to change their physical activity (when needed), and to, consequently, prevent injuries. [2]

Data retrieved from the App: All data retrieved will be anonymous.

The data which will be retrieved from the BIONIC Gamification App are:

- The step counts tracked by the smartwatch, thus the users' physical activity. This data is collected to give insights to users and to create personalized messages. For example, if the user is sitting for a long period, the app may send notification to motivate the user to do some activity.

Usage in case of pain: In the Gamification App you can choose which exercises to do according to where you feel some pain (for example on the back). It is up to you to decide the kind of exercise and the difficulty. [3]

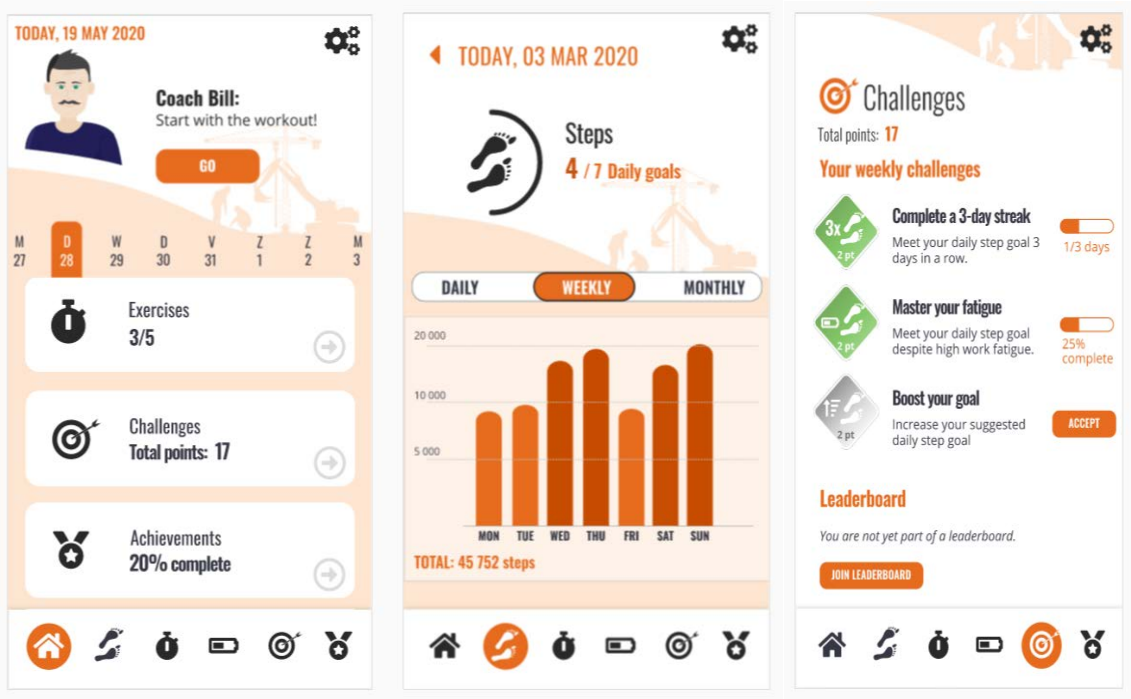

Figure 1: *Images of the app showing the virtual trainer, the daily and weekly records and the weekly challenge screen proposed to the worker.*

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USING ARTIFICIAL INTELLIGENCE TO ASSESS ACADEMIC PERFORMANCE

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Keywords: *Machine Learning, Higher Education Curricula, Artificial Intelligence, Latin America Education Systems*

Abstract

Nowadays, the academic performance of students has decreased dramatically, so it is vitally important to evaluate their performance to know the level of knowledge acquired during their time at the academic institution they have chosen to carry out their studies. In conceptual terms, academic performance is understood as a measure of the capacities that a student presents regarding what they have learned, due to a training process and participation in an established program. That is an indicator of the level of learning achieved and some pre-established objectives by the Institution of Higher Education [1].

In the educational system, in some Latin American countries, the use of technologies has increased to teach the subjects, so automating the analysis of student performance will facilitate the evaluation of teaching methods. This will allow the system to provide suggestions, alternatives, and methods to improve student performance, which depends on multiple aspects such as the objectives of the teacher, the institution, as well as the student. In this way, it is required to perform an integration of the different techniques and methodologies to predict it [2].

Automatic Learning or Machine Learning (ML) applied to education can be defined as the collection, analysis, and dissemination of data on educational actors, with the purpose of understanding and optimizing related aspects of the teaching-learning process [3]. It is a set of tools and methods for the analysis of data from educational processes, which makes it one of the techniques that will help shape the future of higher education.

The main idea is that each subject, by section, generates a database, which will be managed by the teacher in charge of the subject, so that the management of this database is simple and organized for each grade through a template, in which it can be edited. The competencies to be followed in each subject are described by periods, which are defined by each institution in its educational programs. The system will be in charge of analyzing the data as many times as requested, to optimize the registration tasks in the same way. With artificial intelligence, it will be possible to analyze student

performance results. The task of Artificial Intelligence will be to launch results of previously established indicators, as well as statistics by a period that identify weaknesses and provide suggestions on what to improve, following the agenda and curriculum of each Higher Education Institution.

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INCLUSION OF THE SUBJECT: RESEARCH METHODOLOGY, IN THE CURRICULA OF ENGINEERING IN LATIN AMERICA

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Keywords: *Research Methodology, Higher Education Curricula, Engineering*

Abstract

The teaching of research methods has now become a subject of great importance in higher education curricula, mainly in the area of engineering. The learning of the scientific methodology provides the techniques and methods for engineering students to develop a higher level of critical-reflexive analysis, interpretation skills, and, in turn, the stimulation and enhancement of the capacity for inquiry and interest in research from a logical, creative and systematic reasoning to argue ideas from a logical perspective. In this way, generate questions and inquiries, which through their analysis will lead to the construction of new knowledge.

Research in higher education should motivate students to investigate topics of interest, innovate, discover, and respond to problems with creative solutions. In addition to proposing research, to generate original scientific knowledge, it can also serve to transform reality based on the results obtained, generating new bases for the design of strategies that help improve some sectors of society [1].

Besides logic and techniques, the research methodology requires a lot of creativity, all of these characteristics being transferable; but it can only be shown with practice [2], in the day to day where the teacher as a tutor encourages the student to focus on any subject in their point of view, looking for a way to realize themselves new questions and thus assume an investigative attitude that allows them to question everything that surrounds them from an objective and argumentative perspective.

Nowadays, it is emphasized that there is no true higher education without explicit and implicit research activity, this is a fundamental part of the teaching-learning process, research being a contextualized process which we must conceive in a direct relationship with the problems that arise. They show around since it is investigated to transform reality and thereby contribute to the development of any aspect of society [3].

The student must have the opportunity to learn the necessary techniques to link the knowledge acquired in each subject they study in the curricula corresponding to the research methodology since it will serve as a support to produce new ideas in the

preparation of academic texts, effective solutions to the problems raised and propose innovative proposals.

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THE COMPANY, A NECESSARY AND INVALUABLE AGENT IN THE PROFESSIONAL LEARNING PROCESS THROUGHOUT ONE´S LIFE

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Keywords: *Learning throughout one´s life, Professional skills, Business centres, Dual training*

Abstract

The present economic and social context is presently immersed in a process of ecological and digital transformation which inevitably is generating considerable changes which require innovative actions for a highly technological environment with a high commitment to sustainability and skills in the technical professional and social context of a distinctly digital nature. A new profile of skills which need to be acquired and updated preferably by way of educational methods and training within the framework of learning throughout one´s life.

Companies in a productive and working environment will have to count on professionals who have acquired these new skills participating in the model learning throughout one's life in which companies will have to assume a role of joint responsibility and implication in the process of acquirement and updating of skills.

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RESEARCH AS A LEARNING TOOL IN CHEMICAL PROCESS CONTROL FOR CHEMICAL ENGINEERING STUDENTS

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Keywords: *chemical process control, research-based learning, chemical engineering*

Abstract

One of the functions of University is to provide the student with "the ability to produce knowledge, apply skills and continue learning throughout their professional life" [1]. For this, it is of great importance to encourage students to know and apply research methods.

Research-Based Learning (RBL), as its name suggests, has as its fundamental objective to bring research closer to the teaching-learning process. The RBL implies learning from practice, and in the educational framework of the University, the teacher, who continuously participates in research processes, can guide the student in this practical learning, advising and tutoring him. Therefore, Research-Based Learning encourages students to improve their level of skills through the application of the scientific method. Depending on the purpose of the research, Research-Based Learning is developed through different strategies, and in this work Teaching Based on Guided Research [2] is proposed as an active methodology centered in the student.

The objective is to involve the students of the Degree in Chemical Engineering taught at the Escuela Técnica Superior de Ingeniería y Diseño Industrial (ETSIDI) in problems related to this area of knowledge, and especially those focused with the Regulation and Control of Chemical Processes (core subject of the 4th course of the Degree in Chemical Engineering), promoting the processes of reflection, inquiry, data analysis, capacity for self-criticism and knowledge generation. This work is part of an Educational Innovation Project funded in the 2021-2022 call for Educational Innovation and Improvement of the Quality of Teaching of the Universidad Politécnica de Madrid.

In this line of promoting the motivation and involvement of students in the field of Process Regulation, in the 2017-2018 academic course the Student Section of the *International Society of Automation*-ISA began its journey at the ETSIDI [3]. The Advisor provides help and guidance to a Student Committee made up of a group of students. The ISA-ETSIDI-UPM Student Section is therefore an important asset that will help in the planning of the proposed evaluation activities, by allowing the approach to research problems close to the industrial reality, and will be used as a vehicle for the dissemination of the project and its results.

The main objective of this work is to involve the students of the Degree in Chemical Engineering in a real research process, autonomously and based on the scientific method, in order to acquire the skills and knowledge required in the subject of Regulation of Chemical Processes. At the same time, the necessary structure is created to interrelate with other subjects of the Degree, that will promote a multidisciplinary didactic approach.

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SMATH STUDIO: WRITING, MATHEMATICAL CALCULATION, PLOTTING AND PROGRAMMING FREE TOOL

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Keywords: *Smath Studio; Text editor; Mathematics; Graphics; Finances*

Abstract

Spreadsheets are undoubtedly formidable tools for automating repetitive tasks, but they suffer from the undeniable disadvantage of having to construct mathematical expressions with great difficulty. Not to mention the effort required to unravel the existing calculation engine in a spreadsheet built by someone else: it is not for nothing that there is a saying that spreadsheets are understood only by those who write them. We believe that the main reason for this is that the usual representation of formulas in spreadsheets is totally linear, far from the formats that mathematics has inherited for us. As a result, we can ask ourselves if there is any software that is legal and free, that allows us to write conventional text, operative mathematical expressions but with their original format, perform graphical plotting of functions in 2D/3D and even integrate simple programming code... The answer is yes: Smath Studio, both in its desktop version and in its cloud version. Indeed, on the one hand, this impressive application has a friendly WYSIWYG (What You See Is What You Get) text editor with the basic functionalities of this type of application, which also allows you to insert photos and create simple images ("Word" style).

On the other hand, it implements an editor of equations that are not mere mathematical expressions easily readable with their native expression (which is also the case), but are "alive": you can operate with them numerically and symbolically. It has full support for a multitude of units of measurement, and the users can also define their own. What's more, Smath Studio can be used to plot 2D and/or 3D functions in a simple and agile way. It offers numerous functions of its own that allow the generation of simple programming code, which in turn can be integrated with the aforementioned mathematical expressions and function plotting. In addition, its power and versatility can be easily extended by adding add-on extensions (small downloadable programs) or by integrating with other similar mathematical applications with which it is compatible, thus enriching the application with hundreds of both official and third-party resources.

In short, we can safely say that once its use has been learnt, it can become an ideal tool for teaching or writing research articles that require a visual and attractive appearance, facilitating the dissemination of knowledge. And to try to support the previous assertion,

we will show a simple example linked to the world of finance: specifically, the prices of buying and selling of financial assets. We hope that this document will be useful in order to make this wonderful computer tool known, which we are sure will be a good travelling companion for our work in the future.

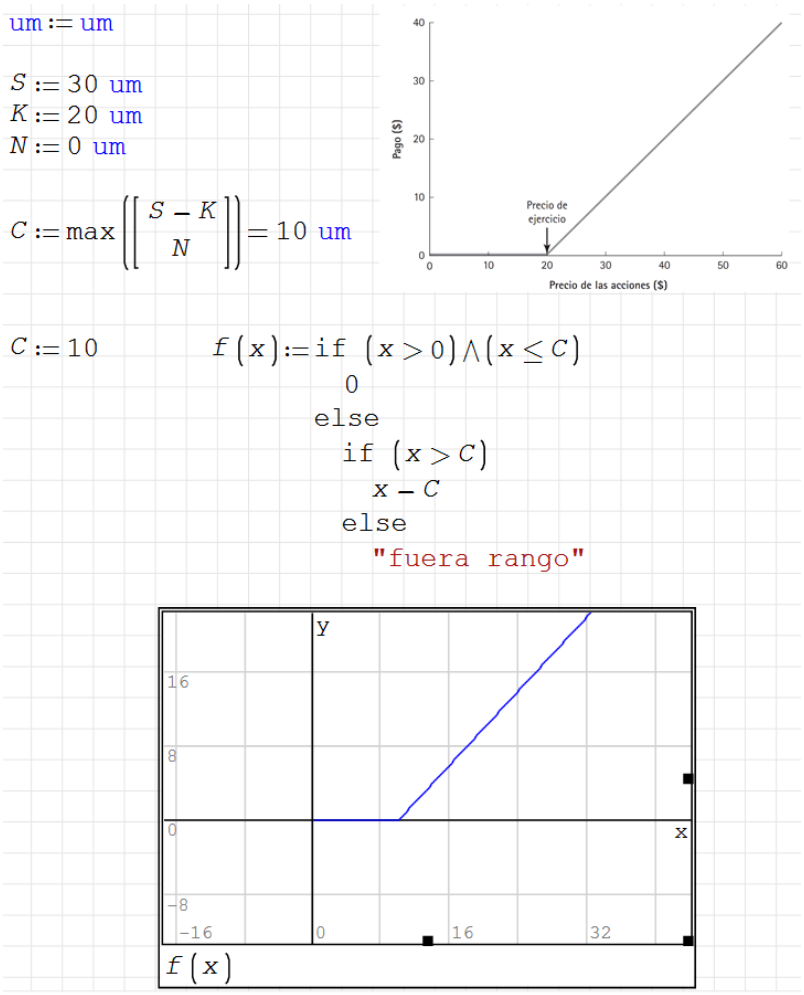

Figure 1: *Opción de compra de activo financiero (elaboración propia)*

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THE USE OF ICT FOR THE SUPPORT OF STUDENTS WITH SPECIFIC EDUCATIONAL SUPPORT NEEDS

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Keywords: *NEAE, TIC, Education support, methodologies, software*

Abstract

Attention to diversity in the classroom is one of the main pillars of our education system and, at the same time, one of the greatest challenges. They are aimed at responding to the specific needs of each student, in order to make it possible to achieve the objectives set for each educational stage. They seek to promote policies and practices that allow all students to have access to a common education, with methods that take into account the different paces and types of learning. As Barrio (2009) says, diversity in human beings is complex and multiple, and this reality finds a privileged space of relationship in the different educational microcosms, such as our classrooms.

Committing to inclusive education implies a philosophy of action that goes beyond the educational framework and promotes the construction of a society that rejects exclusion and is committed to the real integration of all the people who make up this society. Knowing the needs that students with Attention Deficit Disorder or ADHD may have, and how it affects the teaching-learning process, can help to provide answers that allow these students to be truly integrated. Achieving an inclusion that guarantees their permanence, participation and achievement in the education system (Molina Carbajal, 2018).

In this sense, most of the support offered to SEN students is based on non-significant curricular adaptations, such as the extension of test-taking times, the resolution of doubts in personalised tutorials and longer deadlines for submitting work and problem solving. However, all these actions are for the most part solutions provided by the teaching staff, with all the other actions necessary for their correct development remaining fairly isolated. The emergence of ICT has enabled the development of tools that allow SEN students to keep pace with their peers in the daily flow of classes. In this study, a review is made of the different existing, free and available tools for the correct inclusion and simultaneous progress of these students.

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DIDACTIC PROPOSAL THROUGH THE USE OF PROJECT-BASED LEARNING IN THE DOUBLE DEGREE OF BUSSINES ADMINISTRATION AND BUILDING ENGINEERING

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Keywords: educational innovation, active methodology, project-based learning (PBL), university education.

Abstract

The technological innovation of the last decades within the field of employment brings, in turn, an innovation progress in the teaching-learning processes in the universities; a progress based on the use of new information technologies, on the creation and development of work groups and on the individual construction of knowledge based on research and search for solutions to real problems.

Within these new teaching-learning strategies demanded by society, Project-Based Learning (PBL) is one of the active methodologies that are being currently highly developed and more adapted to university education [1]. A first approach to this method is given by the concept that the student can acquire the required knowledge developing a project that provides a solution to a problem given by the teacher. This practical approach is not only more motivating for the student, since it brings theoretical concepts closer to their application to real problems, but it also allows them to develop critical and reflective thinking and encourages interest in research [2, 3].

A pedagogical element adjacent to PBL is the possibility to work on a project that encompasses several disciplines, creating comprehensive learning by the student, who is thus able to connect concepts and contents from various subjects in the same project and with the same objective. That is why the appearance of dual degrees in Spanish universities creates an ideal setting for the application of this methodology. Thus, in this paper an educational proposal has been developed based on PBL applied in the university environment, specifically in the dual degree of Business Administration and Management and Building Engineering, in the subjects of “Métodos Cuantitativos”, “Estadística” y “Materiales de construcción”. The main objective, therefore, is to provide the teaching staff of this educational stage with a useful and innovative tool, an alternative to the master class and with all the aforementioned advantages.

In this chapter special emphasis has been placed on the planning and development of the different stages of the methodology. In addition, a series of projects are described that, carried out in the classroom, would allow students to acquire the contents and skills in these subjects in a transversal, active, practical and cooperative way.

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ECO-DESIGN IN PIG WASTE MANAGEMENT

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Keywords: *Biogas, Biomethane, Biofertilizer, Eco-design of waste, CO_2 mitigation.*

Abstract

The aim is to show the process of generating biomethane and biofertilizers with high added value from the treatment of pig slurry. Intensive livestock farming is an important source of greenhouse gas (GHG) emissions: mainly methane (CH_4) and nitrous oxide (N_2O), derived from a multitude of microbial reactions.

For this reason, in order to mitigate it, the eco-design of a plant in Soria, Spain of the LIFE SMART AgroMobility project is analysed [1]. This process is based on anaerobic digestion with a low-cost digester, where biogas and a co-product called digestate are obtained [2]. In order to meet the requirements of biomethane for vehicle use (UNE-EN 16723-2:2017 Automotive fuels specification), biological upgrading is carried out using microalgae to reach 97% CH_4 [3,4].

A practical case of pig slurry management with a low-cost geotextile biodigester with a total capacity of 150 m^3 is presented, where 4.7 tonnes of slurry are managed, generating 7 tCH_4/year and avoiding 730 tCO_2/year. The process allows a saving of 2.57 kg CO_2e for each kg of meat produced, or in other words a 42% reduction in emissions.

With regard to the production of biofertilizers, it constitutes a biofertilizer of interest from microalgae due to its N, P, phytohormones and natural fungicides. The use of this biofertilizer leads to a minimization of the carbon footprint of the agricultural sector. Generating an amount of 2100 tonnes of biofertilizer per year.

Based on the IPCC and REDII guidelines, a detailed flow chart of the material and energy balance has been established to provide the basis for the environmental impact assessment, following the model shown in Figure 1. In addition, the economic analysis of the products avoided if this model were to be replicated in the different intensified areas is also considered.

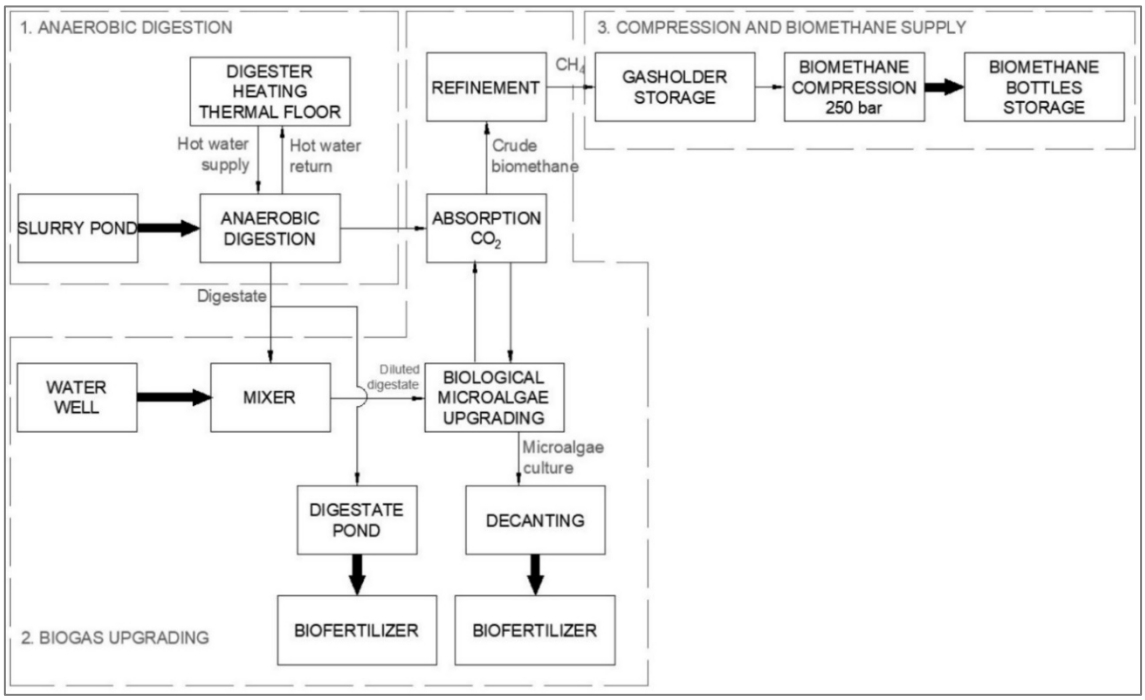

Figure 1: *Calibri 10, lower-case, italics. (Source: LIFE SMART AgroMobility project)*

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