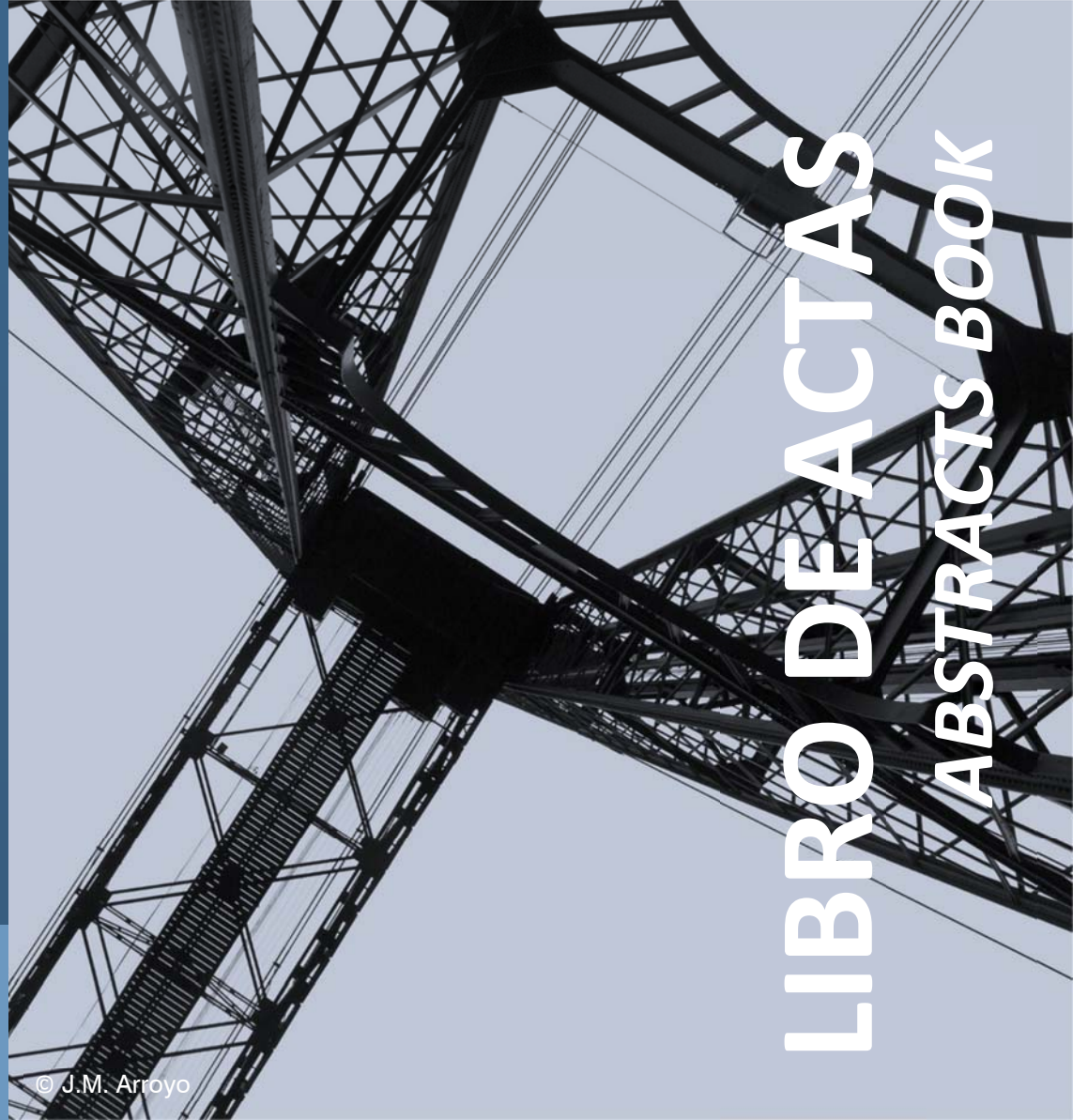


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Este año 2020 estrenamos la modalidad de congreso virtual en la cuarta edición del CINIE. Como todos sabéis estamos seriamente condicionados por la situación actual mundial y nacional derivada del Covid-19. Por ello el Comité organizador del congreso, valorando el importante trabajo de todos los ponentes, ha decidido seguir adelante con el mismo.

Queremos también que sirva este esfuerzo de todos, como sincero homenaje a todos aquellos que sufren y luchan contra este problema actual.

El congreso queda organizado a través de una plataforma virtual para la exposición y búsqueda del intercambio de conocimiento, experiencias y nuevas propuestas en el ámbito de la innovación educativa y dentro del ámbito edificatorio. Lo anterior se ha organizado a través de diferentes áreas temáticas principales, con la finalidad de contribuir a la producción de resultados científicos de alta calidad en el campo internacional.

En esta cuarta edición queremos hacer constar la evolución tanto de la calidad como de la cantidad de los trabajos presentados, a través del importante número de ponencias aportadas y a través de más de 160 participantes en las diferentes áreas.

Nuestro agradecimiento a la inestimable cooperación de las compañías Placo SAINT-GOBAIN, URSA Ibérica Aislantes, a la Cátedra Empresa PROIESCON y por supuesto a todos los participantes e implicados en estos momentos tan especiales.

The Organizing Committee

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ORGANIZATIONAL LEARNING EXPERIENCE USING LEGO™ FOR LEAN CONSTRUCTION LESSONS

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Keywords: *Lean Construction, Last Planner System, Lego™, Management*

ABSTRACT

Classroom games are effective hands-on learning tools for construction management students and practitioners [1]. This study analyses a simulation management game with Lego™, which simulates aspects of the Last Planner System (LPS) and Lean Production principles.

Lean Thinking philosophy is based on the strict fulfillment of customer needs, avoiding anything not valuable from the client viewpoint [2]. In the last few years, Lean Thinking philosophy has been applied to construction projects, to become a differentiated management system, called "Lean Construction". Lean Construction provides a more stable and reliable production environment in projects, decreasing workflow variability and creating reliable work plans to derive maximum project benefits [3].

The purpose is for students to learn that LPS requires continuous and collaborative effort from all stakeholders for the planning and control of a construction project by simulation with Lego™ game [4]. The sample groups for this analysis were chosen from the master's degree in Execution of Rehabilitation and Restoration Works (MEJORR), which is run in the Superior Technical School of Building of the Polytechnic University of Madrid. The simulation was run in one session scheduled for 2 hours.

Participants build the Lego™ houses first using a traditional management approach and then using Lean-based approach in two rounds (Figure 1). These two techniques are compared to demonstrate the benefits and differences of the Lean-based approach while consecutively teaching them.

The results of the average durations of the work teams showed as faster construction time and fewer errors in the Lean-based.



Fig. 2: Lego game in a class.

Evaluation results demonstrated its capability to transfer Lean-based knowledge into construction, also more enthusiasm and attention dedicated by students when new contents are taught is typically observed in this type of simulation game [5].

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BIM SHORT COURSES ORIENTED TO CONSTRUCTION PROFESSIONALS

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Keywords: *BIM, training, professional course, construction industry*

ABSTRACT

The demonstration of the benefits inherent in the use of the Building Information Modelling (BIM) methodology in the construction industry, registered in the development of various activities based on the project, motivates the great interest, which has recently verified by designers and managers, to know its concept and the scope of its applicability. The methodology is based on the technological advances achieved and the level of interoperability established between BIM-based tools, supporting the development of collaborative and centralized projects [1]. The school has been following this interest, introducing curricular changes at the last degree of studies and also in the organization of short courses, offered to industry professionals. Thus, the continuing training offered by the school has recently included courses on the theme BIM covering several aspects, from the concept of parametric modelling to the analysis of the interoperability capacity. The text presents the organization of professional courses in the BIM framework. The degree of satisfaction manifested by the participants is analyzed and confronted with their expectations and interest in attending the courses.

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HBIM IN AN EDUCATION CONTEXT

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Keywords: BIM, HBIM, objectos paramétricos, arquivo documental, reabilitação

ABSTRACT

The *Building Information Modelling* (BIM) concept is based on the generation of a centralized digital model of all building-related information, supporting its construction and management, being strongly based on parametric modeling and on the ability to data storage. Although the BIM base tools, of current use, are more dedicated to the new construction, adapted to the geometry of the current architecture, the growing interest in the rehabilitation sector, has led to the incursion of the application of BIM in the support of the conservation of historic buildings. In this context, a research perspective arises, applied in real cases [1], called the *Historic Building Information Modelling* (HBIM). Old constructive solutions require adequacy libraries of parametric object, to enable the implementation of BIM, also in the recovery of heritage-value buildings. Parametric modeling admits the archive of all information regarding its constitution and form, as the basis of the creation of the BIM model of the building, as a support for decision-making related to the conservation, reconversion or repair of the old property. The ongoing work in the field of academic research, addresses the generation of specific parametric objects, representative of relevant architectural geometry, and the archive of the documentation collected in public institutions, in the context of the study of the rehabilitation of a building of patrimonial value.

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SUPPORT FOR SECONDARY EDUCATION AND PROMOTION OF THE ENGINEERING CURRICULUM THROUGH A SERVICE LEARNING METHODOLOGY

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Keywords: *Active Learning, Project Oriented Learning, Service Learning, Teaching Quality, Transversal Competencies*

ABSTRACT

This work presents the development and results of an Educational Innovation Project (EIP) carried out at the School of Civil Engineering (Escuela de Ingenieros de Caminos, Canales y Puertos) of the Technical University of Madrid, in collaboration with secondary education centers of the Region of Madrid within the framework of Service-Learning pedagogy. Service-Learning (S-L) is defined as learning by doing a service to society, or what is the same, the learning process takes place by making a community service to society. This learning methodology allows students to develop social skills and attitudes such as greater critical capacity, creativity to find alternative solutions, curiosity and motivation and strengthen their social and civic response ethics [1].

Under the EIP, students of the Final Degree Project (FDP) of different degrees have presented their FDP through an oral and written presentation, which consists of a real construction project, to several groups of students from the last courses of secondary education. In this way, these students strengthen their transversal skills of communication and creativity. At the same time, motivation is increased in high school students, and by knowing what a civil engineering project consists of, they can consider Civil Engineering as a possibility of training and professional future.

Service learning is an effective technique to improve the motivation of university students and thus favor their learning process. Students acquire a sense of achievement and pride that is a reinforcement of their learning activities. On the

other hand, high school students make a first contact with their future university education and thus reinforcing their self-perception and their commitment to their own training.

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INTERDISCIPLINARY COLLABORATIVE CHALLENGE

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Keywords: Educational challenge; Inter-schools; 3D Models; Interdisciplinary

ABSTRACT

From the educational innovation group "Actitud Constructiva" of the Universidad Politécnica de Madrid [1], during the past academic year 2019-2020 we presented and developed a proposal that was articulated as a collaborative challenge [2,3,4]. In this challenge, a specific construction problem (the complete construction of a roof) was approached from a multidisciplinary approach. The intention of the project was that the students participated in the challenge through inter-school and/or interdisciplinary groups [5] so that they would be aware that in the world of construction the problems are complex, it is necessary to approach them from different perspectives and that different perspectives can give originally different and enriching visions.

The challenge they were presented with was presented as a competition between multi-dimensional teams in which the complete construction of a roof had to be solved by means of a three-dimensional (3D) model. To solve it, they were provided with technical assistance and access to the laser cutting machine of the Escuela Técnica Superior de Edificación (ETSEM). The rules of the competition required the participants to prepare audio-visuals documentations in which the concepts considered, the relationship with the different subjects and their points of view were suitably explained.

We presented in this communication the results we obtained with the project and also explained the difficulties we had to face and the small disappointments and adaptations that were necessary to achieve the implementation in ETSEM of such an ambitious project.

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DEVELOPMENT OF A PYTHON ALGORITHM TO SIMULATE AND ANALYZE THE RELIABILITY OF MULTIPLE CHOICE TESTS TO EVALUATE THE STUDENT KNOWLEDGE

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Keywords: *multiple-choice test, Python, evaluation, algorithm*

ABSTRACT

There are many literature related with the reliability of true/false and multiple-choice tests and their application in higher education [1]. Choices per question, positive or negative marking [2], rewards of partial knowledge [3] or how long they should be [4]... The combination of all these parameters shows the wide set of test setup that each examiner could design. Are there any optimized configuration? An extended educational research has tried to answer these questions using probability calculations and empirical evaluations.

In this investigation, a novel algorithm was designed with Python code to generate hypothetical examinees with specific features (real knowledge, degree of over-cautiousness, fatigue limit...). High knowledge level implies high probability to know whether an answer choice was true or false in a multiple-choice question. Over-cautiousness was related with the probability to answer an unknown question or the risk capacity of the examinee. Finally, fatigue is directly related with the number of questions in the test. Going beyond its upper limit the knowledge level is reduced and the over-cautiousness is increased. The algorithm launched tests to the hypothetical examinees analysing the deviation between the real knowledge (a feature of the examinee), and the estimated knowledge.

This algorithm was used to optimize the different parameters of a test (length of test, choices per question, scoring system...) in order to reduce the influence of fatigue and over-cautiousness on the final score. An empirical evaluation was performed comparing different test setups in order to verify and validate the algorithm.

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USE OF CES EDUPACK TEACHING SOFTWARE FOR MATERIALS SELECTION IN A PROJECT BASED LEARNING

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Keywords: *Project Based Learning, ICT, CES Edupack, Material Science*

ABSTRACT

The educational methodologies used in higher education has shown an important evolution: from the “Theory-Based Learning” (TBL), that was only focused on the theoretical aspects [1], and the “Problem-Based Learning” (PbBL), that was centered on the resolution of problems as a learning methodology [2], to the “Project-Based Learning” (PjBL) where the way of learning is focused on a complex question which needs the application of multidisciplinary knowledge in a longer collaborative project [3]. Although these three educational methodologies were developed in the 20th century, their implementation in higher education is nowadays limited to isolated cases.

Information and Communication Technology (ICT) has been implemented widely in higher education: virtual learning, educational software, guided self-learning with Internet resources, etc. All of them are examples of the positive benefits of the use of ICT. The combination of ICT and PjBL could provide an interesting tool to generate a relevant learning environment.

This investigation was centered in the subjects of Materials Science of different university grades, where a PjBL was implemented using the CES Edupack software of ANSYS Granta. Students, distributed in groups, had to develop a product design where the material selection was a relevant topic. Depending on the product requirements (density, composition, tensile strength, toughness, weldability, raw material cost, etc), students used the CES Edupack software to search and limit the material database. Searching on standard databases (AENOR, ISO, ASTM and ASME), students found the limitations and design guidelines for their products. The implementation of this PjBL learning methodology in the Materials Science subjects was widely welcomed by the students. The development of a product design, guided by the professor, was a case study that motivated the learning process in a practical way. The knowledge was better retained and the freedom feeling perceived by the students during the project development motivated them.

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OBJECTIVE DATA AND IMPRESSIONS AFTER SIX EDITIONS OF MOOC: A BITTERSWEET EXPERIENCE

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Keywords: MOOC; Educational experience; Long live learning.

ABSTRACT

Under the auspices of the 2016 call for proposals for educational innovation for the development of MOOC's of the Universidad Politécnica de Madrid (UPM) , three professors from the Escuela Técnica Superior de Edificación, belonging to the Educational Innovation Group, "Actitud Constructiva" of the UPM [1], created and published a MOOC entitled " Construcción de Estructuras de Madera de Modo Tradicional ". [2]

Six editions were carried out with evident success as the number of students was high. However, the experience of the six editions was not without surprises, errors and difficulties that we explain in this communication.

At present, several platforms that offer these courses, (including the platform chosen by the Universidad Politécnica de Madrid) offer "premium" courses [3] with biometrics systems in a first attempt to incorporate the MOOC as a new option for formal education.

Taking into account the problems encountered, the widespread trapping of students and the methodological contradictions in evaluation, the authors of this communication do not consider that biometric control is sufficient and makes it possible to use MOOCs [4] as a method of formal education.

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GAMIFICATION IN HIGHER EDUCATION: A CASE STUDY - KAHOOT AS A TOOL TO TEACH CEMENT STANDARDIZATION

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Keywords: *Gammification, Kahoot!, game-based learning, classroom technology, student engagement, eLearning.*

ABSTRACT

Gamification means utilising the techniques normally used in common games, including computer games as Kahoot, in a learning context to increase user's engagement in performing several kinds of learning activities, especially if such activities are considered boring or routine. Then, gamification learning activities may motivate student learning. Therefore, this technique will be used for improving both the users' engagement and their knowledge.

On the other hand, smartphone functions allow their use in learning activities. For instance, Kahoot is a program which can be utilised as a gamification learning tool in class. The only requirement is to have a smartphone plus internet connexion.

In order to improve the learning of the boring topic of the "cement standardization", some quizzes were designer by the lecturers. In class, they were solved by using the student's mobile phones (Master Course in "Cement Chemistry"). The issue of engaging students in a didactic process of learning adequately the topic of the "cement standardization" is an old problem. Therefore, gamification could be a solution for a low students' engagement problem with regard to this topic. In addition, Kahoot quiz has to be carefully designed before being implemented into this didactic process.

The results showed a significant improvement in the learning process of good students. "Cement standardization" subject is adequate to be taught by using Kahoot. It can be highlighted that the main factor for the success of the gamification on learning "standardization" is the student engagement in the game. Consequently, this driver may be one of the most important implications for education.

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A MODEL TO ESTIMATE THE DISTRIBUTION OF THE STUDENT'S WORK LOAD FROM THE JOINT SCHEDULE

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Keywords: *Workload, horizontal coordination, mathematical models, schedule, academic management.*

Abstract

An unevenly distributed workload along a semester is one of the crucial factors that affect the academic performance of university students [1]. Excess or unevenly distributed workloads may significantly harm the academic results and, importantly, determine the learning approach adopted by the students [2] [3] [4]. The horizontal coordination aims at ensuring a rational workload distribution along an academic semester. To achieve this, Universidad Politécnica de Cartagena (UPCT) uses 'Joint Chronogram', where the activities planned by the faculty for the different courses in a given group and semester are put together.

Although this type of chronogram allows for detecting workload peaks, which occur when several singular activities are scheduled in the same period, it does not retrieve information on the way that the student's workload is distributed, which depends on the period of time when the tasks are accomplished.

The main objective of this work is the development of a model that allows for evaluating the student's workload distribution along a semester, using the initial planning of activities retrieved by the faculty.

Several approaches have been employed for estimating the student's workload [6] [7]. This work is based on the weekly workload survey conducted for several courses in a number of undergraduate degrees at UPCT, which has allowed the authors for quantifying the average student's workload for different types of activities, for measuring the planned activities and for simulating the workload time distribution of a given activity as a function of the available time for accomplishment.

Once the planned activities are introduced into the chronogram for each course, the model computes and represents graphically an average-student's workload distribution, which depends on the type of activities and their distribution along the semester. This simulation allows for modifying the time-

planning of the most critical activities, in agreement with the faculty, in order to ensure a more even workload distribution.

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NEW APPROACH FOR A FLIPPED CLASSROOM: STUDENTS AS CREATORS

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Keywords: *Flipped classroom, collaborate learning, cooperative learning, peer-assisted learning, digital tools.*

ABSTRACT

Flipped classrooms have been a new strategy in education since the start of the century. This new trend has gained popularity all over the world as it enhances learners' engagement and active learning. Many are the advantages of using this methodology in a daily basis. However, for students, this continues to be a teaching-centered paradigm and not a learner-centered paradigm.

Therefore, new insights should be incorporated to make students even more actively engaged in their learning. In order to achieve this and following Bonwell & Eison (1991:5), students should be provided with "instructional activities involving students in doing things and thinking about what they are doing".

For this reason, high school students were asked to be the "creators" of a flipped classroom. They were given a specific topic and they had to create the video for the rest of students. Once the video was created, they needed to upload it in a blog. The time in class was devoted to collaborate learning in which students were the ones that answered the questions that their peers had (peer-assisted learning).

Students' feedback showed the effectiveness of this new approach as they felt empowered as being in charge of a specific topic. Cooperative learning, peer-assisted learning or the use of digital tools determined the relevance of this research.

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PROPOSAL FOR EDUCATIONAL TRANSVERSALITY IN THE DOUBLE DEGREE OF BUILDING AND ADMINISTRATION AND MANAGEMENT

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Keywords: transversality, innovation, interdisciplinary, university education system

ABSTRACT

The current university education system, developed over 120 years ago, has barely undergone changes. It is generally based on independent, closed subjects, which are taught individually. This is something that does not correspond to the real educational needs demanded by the students of the present, but rather represents an obsolete tool [1]. The future passes, as experts say, by interconnecting content so that the student learns through the concepts and previous knowledge acquired [2], [3].

There is no doubt that "educational mainstreaming enriches the formative work in such a way that it connects and articulates the knowledge of the different learning sectors and gives meaning to disciplinary learning" [4]. This is what is intended from the subjects of Quality in Building (fifth year) and Statistics (second year) of the Double Degree in Building and Business Administration and Management (ADE), taught at the Higher Technical School of Building belonging to the Polytechnic University of Madrid.

The educational innovation proposal is based on the analysis of the subjects taught in the subjects involved, Building Quality and Statistics. In the first one, the topic "Basic statistical tools of quality management" is discussed, this is histograms, Pareto diagrams, correlation diagrams, control charts... In the second and through software, everything is dedicated one semester to descriptive statistics, probability distribution models, statistical inference, analysis of variance and regression.

Taking these premises into account, it is considered interesting that, students who study Quality in Building, and who have already studied Statistics, will only review the basic statistical tools with the teaching staff of said subject. Next, a

quality management practice would be proposed to be solved by means of the program used in the subject of Statistics and supported by its teaching staff. In this way the students could check the usefulness of a subject studied in previous courses (statistics subject) and the application for their working life (quality course in the building).

In short, for the university education the application of transversality constitutes a combination of understanding, meaning and knowledge in the group of students [5] that we should not miss out on by the mere fact that, as teachers, we do not want to leave our comfort space. This task is the exclusive responsibility of the teaching staff and does not require “extra” training. Integrating different subjects into the same activity can be a motivating and attractive strategy for the student who, in turn, achieves an attitude that is more receptive to learning.

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VIRTUAL REALITY APPLIED TO THE PRACTICAL TEACHING OF SOLAR ENERGY

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Keywords: *Virtual reality, Solar energy, 3D learning environments, Technical training*

ABSTRACT

The experts say that the future of classroom training lies in building methodologies that allow students to acquire skills autonomously (as if they were studying a distance course) but with the accompaniment of the teacher in situ. Having said that, the master class is beginning to give up its leading role to the detriment of serving as a guide for the student. In this situation, the rise of telecommunications and information technology has played a crucial role in offering new alternatives that allow for a change in the way technical knowledge is transmitted: virtual reality is emerging as one of them without a shadow of a doubt. In this work, we approach the way in which the current students of training cycles, future people responsible for maintenance tasks and failure diagnosis in solar energy installations, can acquire useful skills to develop their work. Thanks to the effort of our students Andrea Subirana and Ismael Perez, students of the superior grade formative cycle of energy efficiency and solar thermal energy of Salesianos Carabanchel, we can see how to model in 3D CAD a real room (the classrooms and workshops of our cycle) to later migrate this design towards an application that virtualizes it until being able to visualize it with specific glasses for that purpose. What is achieved in the end is a total immersion in three-dimensional design to the point of making our senses believe that we are literally inside the solar installation. In addition, and with the aim of promoting free and legal software, our students do all this interesting work with freely distributed computer tools. This fact democratizes its diffusion without needing big investments in original licenses (economic resources that can be dedicated to buy other devices) and that allows the student to study freely and in his own house with total freedom and legal guarantees. In short, virtual reality technology, alone or in combination with augmented reality, has come to stay in both education and industry: the flexibility, simplicity, power and creativity it offers to simulate environments and behaviour in real working environments, accelerates the acquisition of knowledge very significantly.

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DESIGNING SEISMIC ISOLATORS FOR BUILDINGS: A TEAMWORK PROBLEM-BASED LEARNING CASE IN STRUCTURAL DYNAMICS

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Keywords: *Seismic engineering, Vibration control, Base-isolation, competency-based learning, STEM disciplines*

ABSTRACT

The European Higher Education Area (EHEA) envisages an education framework that focusses on both competencies and goal achievement, rather than on concepts and knowledge. Some authors define the goal orientation as the purpose for engaging in competence-relevant behaviour so that it leads the student attitude and strategy. Current learning pathways have been tailored by strong competition from institutions whose main purpose is to deliver learning, anytime and anywhere, and by quick advances in information transmission. In this regard, the competency-based learning (CBL) is a suitable strategy, which builds on a stage-based learning progress so that learners must demonstrate their acquisition of competencies after each stage.

In this work, we report some issues and reflections from an implementation of a learning approach in an engineering master's degree. The module under consideration is Dynamic and Structural Analysis, taught during the spring semester. About half of the students are simultaneously working as engineers, so they are eager to achieve practical competencies as well as prone to teamworking. Students form groups of four to five. Each team must perform a set of tasks in order to design a base isolation system for a building. The applied model consists of a teamwork problem-based technique and comprises five one-week stages. Students are supposed to demonstrate mastery of all required competencies after each step. To master the learning competencies, students are given support, electronic resources and additional time as needed. The key aspect to assess their level of goal achievement is their ability to perform demonstrations. Thus, the way they show their mastery is by applying their knowledge and building some MatLab apps, not just by repeating facts. They must make a public presentation in the classroom as a concluding task for

each stage. The first stage tackles the seismic response spectrum and its related calculations and implications. Then they learn about the various isolation systems during the second stage. The third one deals with modelling the seismic response of a two-degree-of-freedom system to a given excitation. During the fourth week, they extend the scope to the multi-degree-of-freedom system. In the last stage, they are prompted to select a case study and address the design of an isolating system for a given building with the tools that the teams have built previously. In addition, we use some tools to measure their individual progress, mastery and degrees of participation within the team, such as the competency matrices and analytics. Furthermore, we conduct some surveys to obtain their perceptions about both the learning process and their levels of goal achievements.

Lastly, we include some reflections on the usefulness as well as validity of the applied method. We conclude that the CBL strategy is appropriate for this type of technological subjects for graduate engineering students, subject to certain conditions.

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MONITORING OF THE HARDENING IN CONGLOMERATE MATERIALS: PRACTICAL PROPOSAL FOR GRADUATE STUDENTS IN BUILDING

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Keywords: *academic practices, building, monitoring, Arduino, building materials.*

ABSTRACT

Mixing water has a dual function in the elaboration of construction conglomerate materials, since, it is responsible for hydrating the material so the final mass reaches the desired resistance, and on the other hand, allowing the workability of the material for subsequent handling [1]. The water/cement ratio thus becomes a determining factor when determining the applications of this type of material, even more so if it is mortar or concrete made from recycled aggregate whose absorption coefficient is higher than in the natural aggregate [2].

The understanding of this concept and its importance by the students of the Degree in Building is of vital importance for the subsequent exercise of their profession [3]. For this reason, this paper presents a proposal for teaching practice that involves students in the task of research and management of new technologies [4]. For this purpose, it is intended to carry out a curricular practice applying monitoring techniques with Arduino, to track in real-time the evolution of the setting in conglomerate materials, thus being able to corroborate in a practical way the theoretical concepts taught in the degree subjects.

This work presents a low-cost system based on Arduino resistive sensors, capable of reliably quantifying and in real-time, the loss in mixing water in masonry mortars through the hydration of the cement and the evaporation of water itself from its preparation. The research developed in this work shows how through a very simple introduction to programming, undergraduate or master students can acquire new knowledge very related to their professional activity.

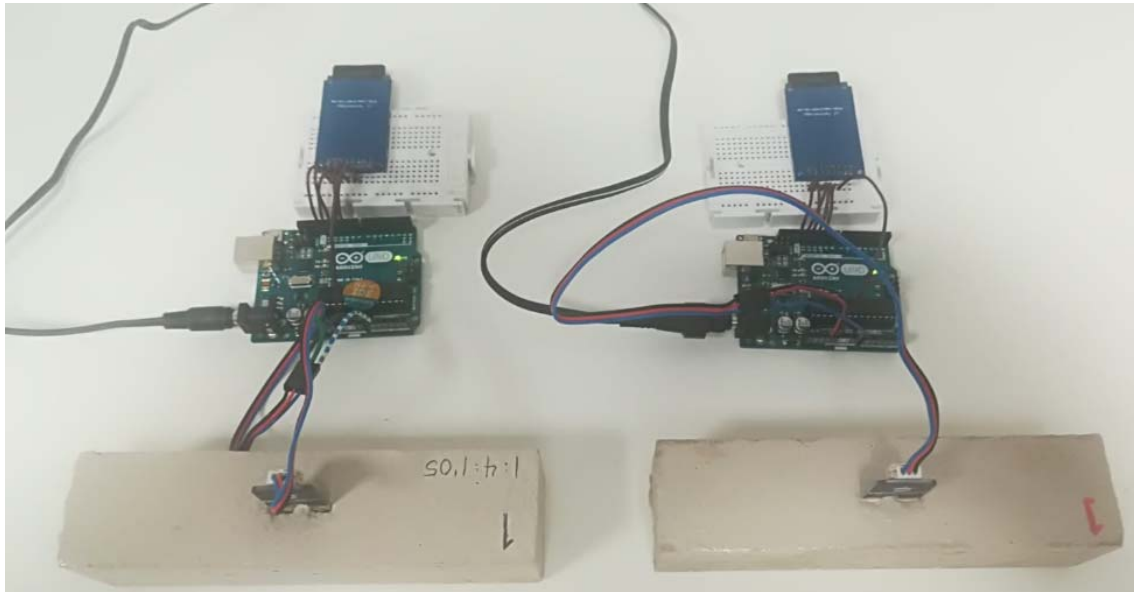


Figure 1. Arduino measurement system developed and electronics components.

Thus, the teaching practice would consist of the design, programming, and assembly of the Arduino platform, for the subsequent collection and interpretation of data by students. It is thus a multidisciplinary project that combines the areas of telecommunications and building, enriching the syllabus of Degree in Building with new leading laboratory practices in the engineering sector.

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BIC / BLOC TEACHING METHODOLOGY: PRACTICAL APPLICATION TO THE SUBJECT ECONOMY APPLIED TO ARCHITECTURE AND BUILDING ENGINEERING

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Keywords: *Building engineering, Teaching methodology, Applied economics, Architecture, Urban planning.*

ABSTRACT

Since October 1999 and for eighteen consecutive academic courses, the BIC / BLOC methodology has been applied with “success and advantage” in the subject Economics applied to Architecture and Building Engineering at the University of San Antonio de Murcia (Spain) [1].

The BIC / BLOC methodology is based on the technique of learning by doing, which basically consists of students learning the theoretical and practical contents of the subject, summarizing in their handwriting all the didactic developments of each epigraph, using for the aforementioned synthesis Handwritten, two simple work tools:

- A pen (as a perceptual and sensory transmitter of information from the hand to the brain).
- An exclusive A4 format notebook for the subject.

The procedure of perception of the information, processing and assimilation of the educational contents, follows the following roadmap:

BIC: through the pen (b), and the fist and letter of the student, the information (i) is transported to the brain (c). Through the senses of touch and sight, students write all the epigraphs of the subject, synthesizing each epigraph on a sheet in A4 format of the BLOC, and this, based on the 73 educational developments contained in the two volumes of the book of the subject edited in paper format.

BLOC: lodged knowledge in a latent state in the brain of the student, which acts as a compass (b), through which it is located (l) and searches for the origin (o) of knowledge (c), which has been transmitted to through the upper extremity of the student, to his brain.

The BIC / BLOC methodology is an innovation with respect to the traditional model in which the teacher explains and the student limits himself to taking notes and / or visualizing the images of a presentation, where the student does not use all his senses, and the empirical experience we dictates that after 15 or 20 minutes of projections, your brain is no longer focused exclusively on the explanations of the teacher and the images on the screen, a question that does not happen when you are analyzing conceptually and digitally with your "handwriting" A specific epigraph of the syllabus of the subject.

With this very simple methodology, students also develop their analytical vision, their ability to synthesize, and as it is empirically demonstrated, the discovery of their own ideas is facilitated, which in latent state are internalized in their brain, and that when they need them in the future, they will be externalized through the reverse path traveled through the BIC / BLOC learning and teaching methodology.

The results of the application of the BIC / BLOC Methodology in the subject of "Applied Economics" show that of 70/75% of students who regularly attend the face-to-face classes and develop all the work, practically 100% approve the subject. These data have been evaluated during eighteen consecutive academic courses, from the 1999/2000 academic year to the 2017/2018 academic year.

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STATISTICAL STUDY OF QUALITY INDICATORS IN BUILDING DEGREES OF THE UPCT

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Keywords: *quality indicators, student evaluation of teaching, perceived workload, evaluation of university degrees.*

ABSTRACT

Management of college degrees requires that data from several academic variables be collected, sorted and analysed, those variables are quality indicators. The information obtained, is part of the quality assurance systems, the internal and external monitoring evaluation processes of university degrees and the teaching evaluation models, among others [1]. Academic leaders use the analysis of the values obtained and their evolution, for the realization of improvement actions and allowing them to study the adequacy of these actions and their results.

Among data collected at the Polytechnic University of Cartagena (UPCT), which is managed by the Office of Data Prospecting and Analysis (OPADA), are satisfaction surveys of student evaluation of teaching, which value different aspects with 11 items. The UPCT also quantifies the perceived workload of students, through an *ad hoc* survey with the aim of improving horizontal coordination [2]. The OPADA database also includes the academic results of all subjects (filing rates, success and performance, medium rating, etc.), information about subjects (matriculated students, typology, etc.), and the characteristics of the teaching staff.

The work presented consists of an analysis of the UPCT quality indicators data using simple statistical tools, with a bibliographic review of publications on satisfaction surveys and the perceived workload of students [3-4]. The data of the Architecture degree and Building Engineering degree of the UPCT have been used, in addition to comparing them with all the University data.

The objective of this work has been to know the relationship between the variables to improve the information management processes of the UPCT, studying their temporal evolution and the possible differences by courses, types of subject, levels, etc. The results obtained are discussed including the study of

biases in student satisfaction surveys and the influence of high workloads in subjects.

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THE USE OF STUDENT RESPONSE SYSTEMS FOR TEACHING CONSTRUCTION MATERIALS

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Keywords: *construction materials, formative evaluation, information and communication technologies (ICT), student response systems (SRS), gamification.*

ABSTRACT

University architecture studies are organized in different areas of knowledge: urban planning and land planning, architectural projects, architectural composition, architectural graphic expression and architectural constructions. Within the latter are the subjects of construction materials, which are aimed at providing the student with the competence for the selection of construction materials and products in the stages of drafting the architectural project and construction management.

To achieve these objectives, in the Degree in Fundamentals of Architecture taught at the Universidad Politécnica de Cartagena (Spain), a teaching methodology has been chosen consisting of guiding the student along a cognitive path towards the knowledge of construction materials through the use of three teacher strategies. Thus, on the one hand, aspects such as historical background, characteristics, manufacturing process, commercial types, applications, regulations and environmental impact are addressed through exhibition classes. On the other hand, through laboratory tests various materials are analyzed following the corresponding technical specifications. The third approach corresponds to direct contact with the materials by visiting the materials library so that the student can interact with the construction materials and products, identifying their shapes, dimensions, etc. and perceiving their color, brightness, roughness, etc.

As for the evaluation system used, the university educational context promoted by the European Convergence process has led to a change in the evaluation practices used. Thus, in the face of the traditional final evaluation based on the verification of the knowledge acquired by the student through an exam that determined their definitive qualification, it has been opted for the use of an evaluation system of type: formative, carried out during the teaching-learning process with the purpose of adapting the didactic process to the progress and learning needs observed in the students; and summative, carried out at the end of the teaching-learning process to establish a balance of the acquisition of knowledge and capacity development by the student.

The formative evaluation supposes the great educational challenge of finding new ways of work and intervention in the classroom adequate to develop this type of teaching-learning system [1]. In this sense, information and communication technologies are especially useful for the implementation of formative evaluation processes [2]. In addition, some digital applications such as Socrative, Kahoot or Mentimeter allow gamification of learning through the organization of surveys and contests in which the student responds from his mobile device [3 and 4].

Their use has shown that they are useful tools to facilitate and increase the involvement of students in the dynamics of continuous work and in the processes of acquisition of skills, generating experiential learning through the use of alternative assessment instruments [5]. In addition, this type of practice greatly facilitates the analysis and improvement of teaching constantly.

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EXPERIENCES TEACHING BIM IN CIVIL ENGINEERING AFTER TWO ACADEMIC YEARS

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Keywords: BIM, Methodology, Mandatory, Civil Engineering, Infrastructure

ABSTRACT

This work presents results after the second academic year of teaching a pilot module of BIM methodology as part of the Master of Engineering (MEng) in Civil Engineering. The target was to improve the programming for the following years and set a precedent for the implementation in the rest of the syllabus of the Civil Engineering School at Universidad Politécnica de Madrid [1, 2]. The second session of the module was designed with several changes compared with the previous academic year [3] in line with students' demands.

The previous year they asked for an increase in the time spent on BIM management applications and not so much in the modelling software. And also, the prioritization of certain software. In accordance with it, several changes were made in the content of the module. As can be seen in Figure 1, the results of the students' satisfaction survey at the end of the first and second edition, 2018/2019 and 2019/2010 respectively, were very positive.

The results revealed that the students were in favour of these changes in the distribution of the module, from 59% to 71% this year. Even so, some of them indicated their preference to increase even more the time on management software due to high demand from the companies in this sense. The results also showed that the dedication of the students was significant in both courses. Finally, the use of project-based evaluation system was remarkably accepted by more than 90% of the students, as can be seen in Q4 shown in Figure 1.

Therefore, this module is an effective way to introduce students to the use of BIM methodology and thus enhances their future labour insertion.

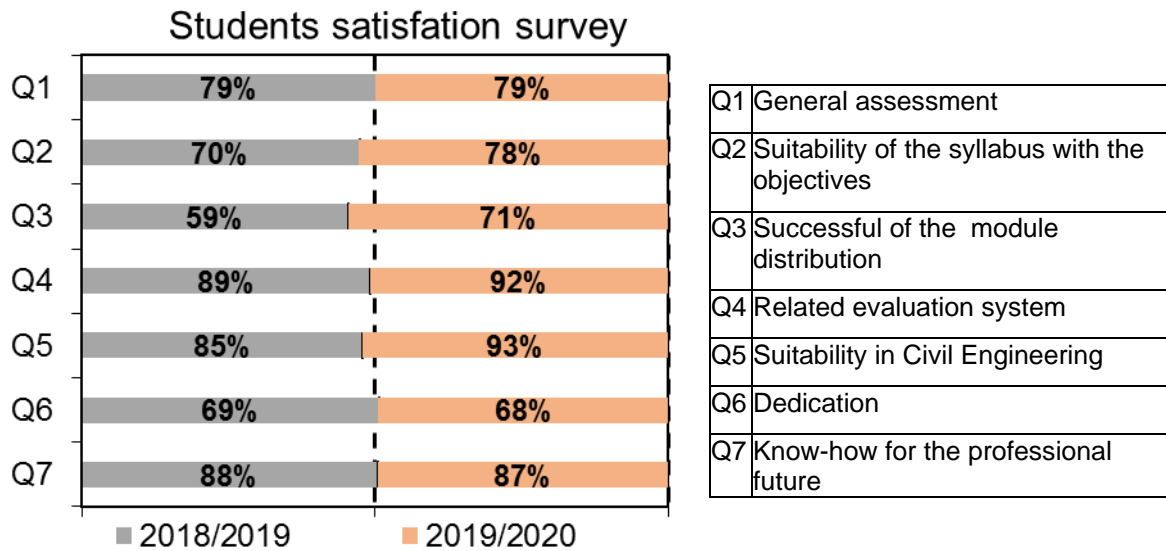


Figure 1. Results of students' percentage satisfaction in 2018/2019 and 2019/2020 surveys. [Q=Question]

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THE IMPORTANCE IN THE CHOICE OF METHODOLOGY IN THE EDUCATION OF URBANISM.

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Keywords: *University teaching, Innovation, Methodology, Projects and Urbanism.*

ABSTRACT

In recent years, in technical degrees, there have been multiple advances in relation to the implementation of new teaching methodologies for the teaching of subjects related to the field of urban planning and the shape of the city. These methodologies are endorsed by specialists in the field of pedagogy and psychology, and their number of adepts has been increasing considerably over time [1], [2], [3], [4]. However, within these fields it is difficult to find studies that consider in depth the opinion of the agents involved in these methodologies, that is: students and teachers. For a teacher of these subjects it is essential to choose an appropriate methodology in order to achieve the objectives of facilitating the acquisition of knowledge to students and overcoming the contents [5].

During the academic year 17-18, in the subject of Urban Development Project, included in the curriculum of the Degree in Building of the Higher Technical School of Building Engineering of the University of Granada, a pilot program of use of the three most used methodologies in technical education: Traditional (60%), Flipped Classroom (15%), also known as Inverted Classroom and Project Based Learning (ABP) (25%) [6].

In general, the results obtained through the implementation of the three methodologies have been positive, both for teachers and students. It is interesting how the students of the subject urban development project do not opt for one of them, but prefer the alternation of the three as a motivating and innovative element of the training process. Circumstance that is reflected not only in the number of students who pass the subject, but also in the increase in the average grade of the approved students.

The objective of this paper is to know the opinion of the agents involved in the subject indicated after the use of the three most used methodologies in university teaching, and subsequently, relate these data to the improvement of their competencies through the results obtained in its evaluation [7], [8].

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BIM-EDU A METHODOLOGY FOR EDUCATION INFRASTRUCTURES MANAGEMENT. CASE STUDY OF ETSI CAMINOS, CANALES Y PUERTOS DE MADRID

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Keywords: *Design-Thinking, BIM-EDU, BIM Educational, ETSICCP, Aprendizaje-Servicio (ApS).*

ABSTRACT

This paper summarize the development related to the BIM-EDU project elaborated by the School of Civil Engineering (Escuela de Ingenieros de Caminos, Canales y Puertos). BIM-EDU implement the BIM methodology into the final master's academic year in Civil engineering as well as bring the possibility for students to carry out a Final Master Thesis based on BIM. The implement of this methodology during the student phase improves the qualifications of students and make them realize about the possibilities of BIM methodology in either all new project phases [1,2] or existing infrastructures [3]. Thoughts and opinions about benefits or BIM are collected in many surveys results [4] outstanding Facility Management profits [5].

As a result of BIM-EDU application, a BIM tridimensional model of the Civil Engineering School was obtained. Such infrastructure houses two degrees: Civil and Territorial Engineering and Material engineering. Additionally, in the building various Masters Degrees are taught such as the Master degree in Civil Engineering, Master Degree in Materials Engineer, Master Degree in Structures, Foundations and Materials or the Master Degree in Civil Engineering Systems. Such amount of studies involve a detailed management according to the properties of the infrastructure, which has already now 51 years.

The developed tridimensional BIM model enables to store data according to several aspects such as pure educational terms (classrooms schedule or occupation), mechanical equipment maintenance or even testing safety protocols [2]. Moreover, the BIM model supply the chance of quantifying any kind of refurbishment of the building or previsualize how any modification affects the geometry or occupation tendency. This three-dimensional model is already able to manage a schedule Data Base. However, new interesting developments based on IoT (Internet of things) or Big Data plus BIM make possible to integrate environmental data [6] or energy simulations of the existing building [7]. Two Final Master projects permitted obtaining the tridimensional BIM model of the Building and the main targets of the model are shown in Figure 1.

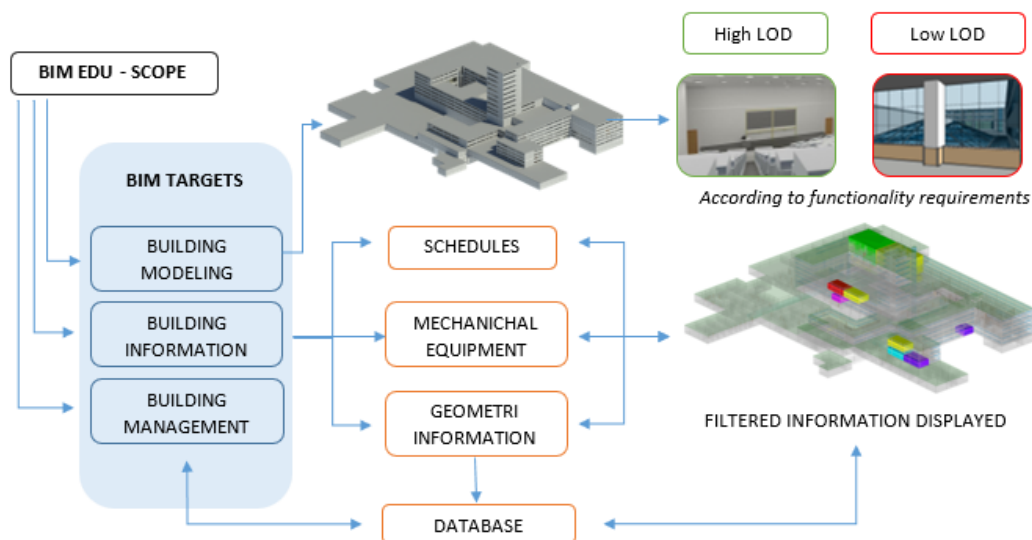


Figure 1. Main targets of the BIM model of the Escuela de Caminos, Canales y Puertos de la Universidad Politécnica de Madrid.

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PEER ASSESSMENT BETWEEN STUDENTS OF “ENERGY IN BUILDINGS” TO ENHANCE LEARNING AND COLLABORATION

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Keywords: Peer-review, Project-based assessment, Workshop, Moodle platform, Rubric.

ABSTRACT

In educational settings, peer assessment is defined as the process of considering the level, value, worth, quality or success of the outcomes of learning by classmates with the same status (peers) [1]. Peer assessment as a teaching system has been recently implemented in courses of buildings [2] and engineering [3].

In the framework of an educational innovation project at Universidad Carlos III de Madrid (UC3M), peer assessment has been implemented during two years in the course of “Energy in Buildings” [4]. In this subject, elective of 4rd year in the Bachelor of Energy Engineering, students individually develop their own project, mainly based on software tools. Throughout the development of the project, the students apply the knowledge and skills learned within the course. The individual project accounts for the whole mark in this subject, as long as full continuous assessment is enforced.

The peer-review applied in “Energy in Buildings” follows the sequential process shown in Fig. 1. The preliminary hand-in by the students (1st step) is reviewed by their classmates (2nd step), so that a revised and improved final version of the hand-in is finally delivered to the professor (3rd step). Peer assessment does not replace the teacher grading which is performed in the 4rd, and last, step.

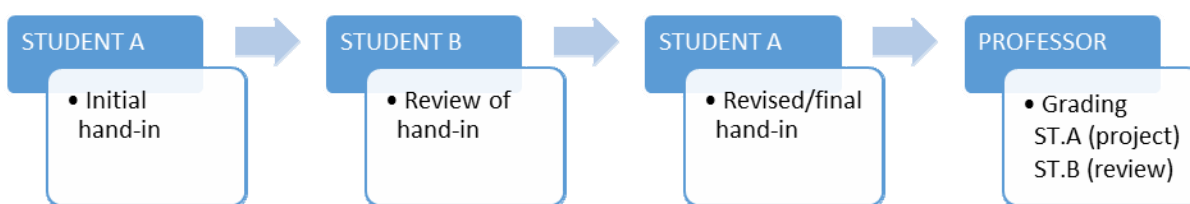


Figure 1: Peer-review process between students

The goal of peer assessment in this course is, not so much to increase student’s marks, but to increase their learning outcomes. This way, collaboration and critical thinking skills are enhanced. The resulting classroom setting also allows a smoother transition to real-life professional settings and the development of interpersonal skills with future co-workers.

This paper presents the lessons learned during the two years of application of peer assessment in “Energy in Buildings” course. For peer-review

implementation in the class, a learning management system was utilized: Aula Global, virtual platform for students at UC3M, that is based on Moodle. For this purpose, workshop activities in Moodle [5] were set. To guide the assessment by the students, rubric templates were generated in the same virtual platform.

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CREATING A FRAMEWORK TO DEVELOP MULTIDISCIPLINARY LEARNING ACTIVITIES IN THE CONTEXT OF SDGs: COLLABORATION BETWEEN ARCHITECTURE AND COMPUTER SCIENCE

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ABSTRACT

Currently, universities see the need to carry out learning activities aligned with the SDGs [1], as an important part in the training of students. In order to develop ambitious and motivating projects in the context of the Sustainable Development Goals (SDGs), collaboration between experts from different areas of knowledge is necessary. Integrating these two issues into the teaching activities of the degrees involves complex and difficult work.

This work is aimed at creating an infrastructure to carry out teaching activities in which the contribution to the SDGs is put into practice through the development of multidisciplinary projects, that is, through the collaboration of students from different specialties.

In our specific case, undergraduate students of Architecture Foundations collaborate with undergraduate students of Software Engineering and Computer Engineering to develop a project on energy efficiency and comfort in public buildings. The system consists of the deployment of a sensor network to measure parameters of environmental temperature, humidity, surface temperature of the walls, luminosity, noise, CO2 level and presence of people in a classroom. The system monitors these parameters, the data can be consulted online in real time and they are stored in a database. Therefore, a study of the energy efficiency [2] and comfort of the classroom is carried out.

The method followed consists of two phases. During the years 2018 and 2019, five students of the aforementioned grades have developed their Final Project [3][4] to perform a first implementation of the system. Two case studies have been developed. The first one was carried out in the Atlantic Copper classroom of the E.T.S.I. de Minas, where measurements were obtained for a total of 4 months, distributed over two periods (winter and summer). The second case is the Laboratory 1301 of the E.T.S.I. de Sistemas Informáticos, which has very different architectural characteristics to the Atlantic Copper classroom.

The second phase consists of preparing the infrastructure for the degree subjects, based on the system developed. The infrastructure consists of

selecting a case study, defining the objectives of the project, preparing the appropriate laboratories, choosing the necessary tools such as [5][6], developing a web site and defining the data that will be shared. This phase is currently in progress. It is planned to participate 2 subjects of the degree of Software Engineering, 1 subject of Computer Engineering and 1 subject of Architecture Foundations.

In this work we will describe both, the system that is currently running as well as the infrastructure for the degree subjects.

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PROFESSIONALIZATION OF THE CONSTRUCTION SECTOR

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ABSTRACT

The project “Aportando Profesionalidad” [1] has a sectoral scope, since it transfers the influence of its actions to the entire group of plasterboard system installers, a main job in the construction sector, based on current trends in the use of the Construction Systems.

This business sector located in an upward economic activity faces two many difficulties:

- The majority of current workers don't have a qualification that accredits them as professionals, which limits their differentiation in the face of professional interference, generating a tendency to banal products.
- It is not possible to find qualified workers for insertion, which is limiting their capacity for business growth.

Therefore, the Project is formulated based on two main objectives and seeking to generate a series of internal and external impacts. Its main objectives are as follows:

- Professionalization of the sector. Understanding this as a professional is “a person who exercises an activity and has a degree or diploma, which guarantees the knowledge acquired and the suitability for the exercise of his trade”.
- Insertion of new professionals through regulated trainings and employment trainings.

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Reference: <https://www.placo.es/profesionalizacion-del-sector-0>

METHODOLOGY OF DETAILING DESIGN OF STRUCTURAL PARAMETRIC CONNECTIONS

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Keywords: *structural connection, parametric design, materiality, construction detail, adaptive detail.*

ABSTRACT

The PONTIFICIA UNIVERSIDAD CATOLICA DEL ECUADOR, through its architecture school, maintains innovation in design and the use of last generation technology in its teaching emphasis. One of them focuses on the use of BIM tools in their different guidelines. The present research is addressed to the digital development of parametric modeling (PM), used with an architectural BIM software through the development of structural connections, which allows tie diverse technical-constructive-elements, function and materiality. [1]

Ecuador is located directly above the Pacific Ring of Fire and the Andes range cross it entirely, representing an elevated seismic risk. This situation knows that structural systems in edifications should be basic premises considering within an architectural design, whose purpose is to decrease construction vulnerability and increase security for the habitants. Due to the cultural, natural, altimetric and climatological diversity of Ecuador, the country has developed and combined diverse materiality, technologies and architectural typologies to the generation of living spaces. For those reasons, the research proposes a parametric design methodology of structural connections between constructive components, where the union not only meets its structural function, but also includes an architectural-compositive element that emphasizes functional and formal aspects of the design project. [2]

The applied methodology implies a researching work where the student understand the five basic concepts of forces that affect to structures: tension, compression, shear, torsion and traction. [3] The second phase involves the exploration of general function of structural connections, focused on the development of constructive details where are considered technical and formal aspects of the architectural project. The knowledge related to materiality is part of the process: characteristics, properties, benefits and limitations of steel,

wood and concrete, used in an independent or combined way. The objective is to link the concepts reviewed previously and apply them in a structural connection in order to build it and as the same time, develop a formal and functional input of the architectural project. Therefore, the practice of parametrization with a last generation BIM software allows using and visualizing different projection planes in two and three dimensions to understand the structural connections and possible interferences of the constructive components in the space. [4]

The result of this methodology is the generation of a constructive detail about a structural connection with diverse materials, making it functional, buildable and replicable. Those conditions will allow multiple dimensional adjustments, adaptability to the project requirements and the correct use of local construction materials. The constructive detail will be developed and studied in an architectural BIM software, in order to be properly included in the student's design project. The accurate methodology to be developed in the current research implies that each student has to model all of the constructive components of the structural connection detail in AUTODESK REVIT 2020, with the intention of ensure a correct work, adaptability and placement of all of its diverse constructive elements in the project. [5][6]

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IMMERSIVE LEARNING IN 3D VIRTUAL ENVIRONMENTS

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Keywords: *Immersive learning, Virtual reality, Building Information Modelling (BIM)*

ABSTRACT

Beyond of BIM technology consolidation, the incorporation of virtual reality in the field of architecture and construction, implies a new breakthrough which, among other advantages, will lead to a better interpretation of the data 3D with the consequent increase in quality and productivity, the design virtual pre-visualization at any time, the early detection of errors in the designs, the incorporation of other technicians and customers to the design process, etc. [1].

From the point of view of the learning process and methodologies, it is said that virtual environments can contribute to learning from multiple perspectives, such as improving comprehension, reducing learning time, and generating more lasting knowledge, among other [2].

The main objective of this research project is to study the incorporation of virtual reality in the teaching of Technical Architecture and Industrial Engineering, on one hand, as "teaching tool" for "immersive" learning, and on the other hand, as "design tool" in the fields of architecture and industrial engineering.

For the development of the field activities, the virtual reality models were generated, using Showbuilding tool by the company *INVELON Technologies* [4], from the BIM models created by 15 students of the subject "Graphic Expression 3" of the degree in "Technical Architecture and Buildings" of the "Polytechnic School" of the "University of Lleida" [3].

This "*Showbuilding*" tool allows the user interacting with the virtual architectural environment through a set of tools, such as measurements, changes of materials, addition and subtraction of furniture, advanced movements inside the model, changes of lighting, among others.

To evaluate students' behaviour, a series of activities, to be performed during immersive experiences, were designed. The ability and the time used by each

student to perform and accomplish the assigned tasks was assessed and measured. In addition, a series of on-line surveys were carried out during the execution of the activities in order to evaluate the learning process and the student's perception. The activities were repeated twice, with a week of separation between the first and second session, with a third training session between the two main sessions.

From the results it can be concluded, on the one hand, the great potential of these technologies for learning purposes in the field of Architecture and Engineering, and on the other hand, the great ability of students to learn and operate in this new context. This ability implies that they can optimize not only the learning process, when virtual reality is added, but also they realize about the potential as design and management tool in the professional world.

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STYLES OF EMOTIONAL INTELLIGENCE AND ACADEMIC PERFORMANCE IN AGRICULTURAL ENGINEERING STUDENTS

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Keywords: *emotional intelligence, flipped classroom, learning styles.*

ABSTRACT

A flipped classroom experience was carried out in the course of 2018/19 in two subjects (Agronomy and Plant Protection) of agricultural engineering bachelor's degree at the Technical University of Madrid. In this experience the emotional intelligence styles of the students were evaluated (with the Warner questionnaire of 40 items [1]). This Profile of the emotional intelligence [1] describes four styles: Conceptual, Empathetic, Organized and Reflector. The Conceptual style is defined by strategic thinking and focused on global overview. The Empathetic one is interested in the others and focused on help them and spiritual harmony. Organized style is reliable and like planning. Reflector one has a logic and analyzing mind centered on problem solving. The aim of this work was to analyze the relationship of those emotional styles and academic performance of the students. Thus, the numerical scores in the emotional questionnaire of 29 students that took the two subjects of Agronomy and Plant Protection were evaluated in relation with their final grades in that subjects. The relationships of the four emotional styles were studied by correlation analysis. Thus, Reflector style was positively correlated with the Empathetic and Organized ones. However, Conceptual style was weakly and even negatively correlated with the other three styles. In Agronomy subject all styles of emotional intelligence presented negative correlations with the final grade of the subject, specially the Organized style, so there are no clear conclusions about the relation of those styles and the academic performance in this subject. However, in Plant Protection subject the Organized and Reflector styles (focused more on theoretical aspects than in practical ones) showed positive correlation with the grades, while the Conceptual and Empathetic styles (focused more on experimentation than to the world of ideas) showed a negative correlation with the grades of the students in that subject. These results can help to design the teaching-learning activities in the flipped classroom methodology, in order to take into account the main emotional styles of the students and their main interests and style of learning, trying to include and promote more experimental and practical activities that are more preferred by some emotional styles of the students.

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TAKING THE LECTURER'S ROLE IN UNDERGRADUATE ENGINEERING MODULES: SOME EXPERIENCES FROM FORMATIVE ASSESSMENT IN THE CLASSROOM

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Keywords: *formative assessment; classroom response systems; educational technology; question-driven instruction; STEM disciplines*

ABSTRACT

It has been proven that improving formative assessment can help students to raise their achievement and instructors to change their teaching practice. Although the European Higher Education Area (EHEA) focusses on competencies, designing and applying formative assessment aim to serve the purpose of promoting students' learning. It differs from the assessment mainly conceived with the aims of scores, ranking, or certifying competence. A well-designed assessment activity provides feedback that both instructors and learners can use in assessing themselves as well as one another. The "formative" quality implies changes, i.e., teachers can adapt their strategies to meet learners' needs whereas the latter can redesign their learning activities.

Self-assessment is a key tool for goal achievement if students realize such goal and can assess what they must do to reach it. Peer assessment is a suitable complement to the former.

In this work, we describe some experiences on the use of classroom response systems (CRS) in combination with guided classroom study, self-assessment and peer assessment in two modules for undergraduate Civil Engineering students.

In the first approach, students are prompted to use CRS to either respond to a quiz or solve a problem. Later on, the teacher addresses the answer to the posed issue in the classroom, so students can measure their performance and have the opportunity to learn about their mistakes and lacks. Learning from failure can help them to redesign their learning technique to achieve their goals.

Another action builds on the flipped classroom model. The teacher gives the students some support material (e-textbooks, printed material and multimedia resources) and some problems statements. They study at home and try to address these problems. The next class day, the teacher delivers one problem

to be solved in the classroom. There are no two data sets alike, although they can address the problem in groups or pairs. After a given time, the exercises are collected and delivered back randomly. Then the teacher solves the problem, so each one has the chance to review another classmate's exercise. Anonymity is ensured, so they feel more confident. Digital resources are helpful in this stage of the class session in order to improve the leverage of the subject.

We conducted questionnaires to obtain students' perceptions on the effectiveness of the implemented model. They agreed that their attendance level increased due to the bigger interest of impartations. Besides, the rapid feedback from the quizzes helped them to identify their knowledge lacks. Results show that both formative assessment and CRS can be helpful to increase student engagement in learning activities, either in large groups or in a medium lecture-class size. We received students' positive feedback, although we could not find significant learning improvement. Surprisingly, around 10% of participating students are not comfortable with taking the lecturer's role or do not rely on peer review.

We draw some conclusions and reflections on effective questioning and the use of these tools to boost their engagement and achievement.

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COOPERATIVE DESIGN WITH THE FLIPPED CLASSROOM METHOD BETWEEN SEVERAL SUBJECTS

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Keywords: Absenteeism, Innovation, Flipped classroom, Teaching quality, Educational video

ABSTRACT

Several lectures from different disciplines of the Building Engineering School have prepared an Educational Innovation project (project reference: IE1819.5403) in order to improve the teaching quality in their subjects. The lectures have identified several problems that are related to student learning. Among others we can highlight the abandonment of studies, the high absenteeism and the high compartmentalization of knowledge. In this sense, there are previous studies showing that in university education there is an excess of compartmentalization [1]. In many cases the knowledge acquired by students in a specific subject does not apply beyond said subject or semester. Therefore, it is important to remember that learning is a continuous process that should not end once a certain subject has been passed [2].

In order to try to solve the problems mentioned above, the lectures have cooperatively designed and prepared several subjects through the Flipped Classroom method. The work developed have been focus on the interrelation of knowledge among subjects. The Flipped classroom is a teaching method whose main objective is that the student assumes a much more active role in his learning process than the one he had traditionally occupied. Broadly speaking, it consists in the student studying the theoretical concepts for himself through various tools that the lecture puts at his disposal [3]. The proposal of the study aims to improve the quality of teaching in various subjects of Degree and show students that the reality of the concepts studied is closely interrelated. The teaching material is done by different professors whereas they explain their own topic so that students realize the connection between topics. The teaching material is developed by different lectures, where each of them explains their own topic so that the students realize the connection between the topics. It is expected that the teaching material developed in this study will be useful in other subjects of the School of Building Engineering as well as with other subjects of the Universidad Politécnica de Madrid.

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IMPLEMENTING PROJECT-BASED LEARNING THROUGH BIM TECHNOLOGY

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Keywords: *Project-based learning, BIM, engineering projects, educational innovation.*

ABSTRACT

The engagement of engineers from various specialties is demanded by construction projects to ensure their success. Its main consequence is the need to create collaborative working environment. Consequently, one of the most demanded competence in professional activity nowadays is the ability to carry out projects in multidisciplinary teams [1]. Project-based learning is a suitable tool for improving this skill in construction projects engineering students [2].

This paper focuses on showing the framework developed for implementing project-based learning through Building Information Modelling (BIM) technology in engineering construction education environments. A collaborative framework managed by BIM execution plan was established. This document assigns roles and tasks for each member of the team, who work on the same digital file hosted in a cloud. Furthermore, it establishes the characteristics and timing of project's deliverables.

The results show a qualitative enhancement in the quality of the work developed by the students with respect to 2D technology previously implemented. Keeping track of their partner's work improves coordination to design compatible solutions. So, a better coordination among engineers is the reason of this improvement. This methodology aids to develop transversal competences of engineering students by favouring their performance in multidisciplinary teams.

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THREE DIMENSIONAL BUILDING MODELS FOR CONSTRUCTION TEACHING IN HIGHER EDUCATION

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Keywords: *3D models, building projects, construction, teaching, SketchUp*

ABSTRACT

In general, students who start learning subjects related to construction, usually find difficulties in understanding and visualizing the different components of a building. In addition, the use of information and communication technologies has become a common resource to improve teaching skills and students' motivation. For this reason, the use of three-dimensional visualization of the different elements comprising a building is essential in construction subjects, especially in the first subjects of the Degree. These 3D visualization models will allow the visualization of a complex element, such as a building, whose representation and understanding through a 2D conventional graphic material is complicated. These 3D models not only allow visualizing the different components of a building, but also understanding their execution.

For this reason, this work aims to implement 3D building models in the teaching of two subjects: "Introduction to Construction" and "Construction of masonry walls and renders" at the Escuela Técnica Superior de Edificación of the Universidad Politécnica de Madrid. For this, several building models, covering foundations, structures, interior partitions, finishes and roofs, were prepared using SketchUp. Finally, a survey was conducted to the students in order to collect their opinion and experience of the methodology and the models developed.

The results obtained are very positive, since 100% of the respondents fully agreed that 3D visualization models help them to better understand the topic

and the elements of a building. In addition, 83.3% of respondents totally agreed that the experience of using 3D models in the subjects has been very positive for their learning.

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TREND SCENARIOS AS EDUCATIONAL INSTRUMENT FOR MICROCLIMATIC DESIGN IN CARE HOMES FOR MITIGATION OF CLIMATE CHANGE EFFECTS. STUDY CASE IN USERA DISTRICT, MADRID

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Keywords: thermal comfort, microclimate, older people, health, climate change

ABSTRACT

Determining the influential parameters in thermal comfort is necessary to design comfortable spaces that can support good health and wellbeing. It also allows adopting new strategies for efficiency and energy saving in buildings, relevant factors addressing sustainable development goals (SDG 3, SDG 11 and SDG 13) considering buildings account for 40% of the global energy consumption and contribute over 30% of the CO₂ emissions. According to statistics in Spain, the population over 65 has increased a 19% from 2007 to 2017. This means a total number of 8.8 million persons in 2017 which is expected to turn into 11.5 million in 2030. In this context, it is estimated that there about 359.035 beds in approximately 5.378 health care centers for older people in Spain [1]. These buildings are generally built before 2000 and they present low-energy efficiency design and no consideration about its environmental microclimate conditions. In addition, current thermal comfort standards are not adapted for older people necessities. On the other hand, outdoor spaces play a key role in healthy ageing and strengthening social interaction, as they represent the place for physical activity, socialization, relaxation and for being in contact with nature. Improving the experiences people have in outdoor spaces [2]. Thus, there is a need to create pleasant environments with adequate thermal comfort, both outdoor and indoor spaces, considering the specific thresholds for older people. Otherwise, uncomfortable thermal conditions may ruin the user experience on outdoor spaces, compromising the use of them [3, 4].

Passive conditioning measures for outdoor spaces surrounding constructions are control of solar radiation (sun-shade), control of winds and environmental humidity. These factors can have a major impact in environments where older people reside and attend daily. It is estimated that variable environmental conditions (not static) hinder the study of outdoor thermal comfort, as they are difficult to control, unlike those studies in indoor spaces and the subjective perception of older people. Thermal comfort also depends on health and sex.

Older people have reduced muscular strength, low capacity to transport heat from the skin and sweating, reduced cardiovascular capacity and reactivity. This physiological factors increase the risk for them to have pneumonia, cardiac arrest, dehydration, hypothermia and hyperthermia [5].

Postgraduate education should comprise attractive and updated contents so students can learn from challenges that society demands. In this sense, the proposed methodology consists on the evaluation of trend scenarios. This evaluation is conceived as design criteria for a dynamic discussion about the different solutions developed for improving environments through refurbishment and urban design of surroundings of health care centers. A health care center was selected in Zofío, a neighborhood of the district of Usera in Madrid. This area is affected by urban heat island effect and high levels of air pollution, which will both increase in the following years according to climate change forecast. Outdoor design conditions have not been considered in the design of this center. In addition, interviews to users, considering genre, revealed major problems such as the slope that they have to face from public transport stops, lack of benches to rest in the way and shadows to protect from excessive radiation in summer. Also, noise around this area makes it difficult to meet and talk in streets. Thus, this real case was a great opportunity for introducing challenge-based-learning methodology addressing society necessities in higher education.

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GAMIFICATION THROUGH ICT QUESTIONNAIRES AS A LEARNING METHODOLOGY IN GRAPHIC EXPRESSION SUBJECTS

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Keywords: *Questionnaires, gamification, learning improvement, Socratic, Graphic Expression.*

ABSTRACT

The application of game mechanisms in the classroom, gamification, greatly favors learning [1]. Representing an application learning strategy at all educational levels [2]. This work has focused on the application of gamification with the objective of evoking previous knowledge, through ICT questionnaires [3].

For the development of this teaching innovation work, different applications have been studied, being the one finally used, thanks to its versatility and design specially adjusted to the needs demanded, the Socratic application.

The main objective of this work has been the improvement of learning through questionnaires, which has allowed us to know the level of prior knowledge of the students and the evolution of the learning process of the new, that is, the systematic evolution of knowledge Learned by students [4] [5]. In addition, it has become a valuable training complement, observing a high interest on the part of the students to improve their results. For this, it has been necessary a thorough work of design of questionnaires adapted to the characteristics of the different subjects of the Department of Graphical Expression of the University of Extremadura in which it has been applied.

With very satisfactory results, as reflected in the improvement of grades, thus favoring the learning process.

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FLIPPED LEARNING METHODOLOGY ADAPTED FOR APPLICATION IN GRAPHICAL ENGINEERING

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Keywords: *Flipped learning, Graphic Engineering, flipped classroom*

ABSTRACT

Teaching at university level today, requires adapted methodologies capable of placing the student as the main protagonist. Something that teaching based exclusively on master lessons prevents [1] [2].

The application of the flipped learning model and the flipped classroom, based on the promotion of pre-class study [3], together with the application of other innovative teaching methodologies, such as self-assessment and co-evaluation, favor learning and encourage the student learning role, allowing other complementary activities to be carried out in the classroom [4], which contribute to exercising those competences to be developed [5].

Aware of this need, from the Department of Graphical Expression of the University of Extremadura we have developed this work in the framework of the subjects of Graphic Engineering, subject of the second year of the degrees in engineering of the industrial branch.

The adapted application of reverse learning presented in this work, combined with the inclusion in the classroom of ICT tools (Socrative and Moodle), that have acted as facilitators and at the same time, as motivating agents, are generating very positive results, with evident improvements in the ratings. But even more important, contributing significantly to student learning.

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ARCHITECTURAL DESIGN OF A NATURE-CONNECTED BUILDING: AN INNOVATIVE TEACHING AND LEARNING PROJECT

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Keywords: *Architectural Design, Innovative Teaching, Gamification, Flipped Classroom, Design Thinking.*

ABSTRACT

Innovative teaching and learning methodologies challenge conventional architectural design education for improved students' creativity, knowledge, skills and competences. These new strategies can improve students' engagement, motivation and attainment, but they also demand a great effort of the teaching team and are linked to a set of difficulties. This article analyses and unfolds the keys of an innovative teaching project proposal, devised and planned by me to be developed, as a lecturer and postdoctoral researcher, at the Royal Danish Academy of Fine Arts in Copenhagen (KADK) School of Architecture (the top university in the field of architectural design in Denmark), the Institute of Architecture and Design (IAD).

The proposal emerged from my visit to IAD's facilities and building materials workshops, invited and accompanied by Professor of History of Architecture and Interior Design and Head of the MA program Spatial Design within IAD at KADK PhD Peter Thule Kristensen. The project design blends diverse teaching and learning experiences: 1. My extensive collaboration with the teaching and research team Grupo 4!, Bachelor architecture studies, Architectural Design Department (DPA), School of Architecture (ETSAM), Universidad Politécnica de Madrid (UPM), which has an outstanding track developing innovative teaching projects by gamification methodology [1] [2] 2. My involvement in several teaching innovation workshops organized by the Institute of Educational Sciences (ICE), UPM; 3. My participation as guest speaker and external evaluator in the seminar "Consolidation and improvement in the independent collaborative learning of first courses architecture students: housing and dwelling" arisen from the innovative education projects developed through the academic collaboration between the History of Architecture and Architectural Design Departments, School of Architecture, Universidad de Sevilla (US).

The project, where the classroom is conceived as an architectural laboratory where the meeting between the disciplines of Architectural Design and Building Construction takes place, integrates a variety of innovative education methodologies: Gamification, Flipped Classroom, Learning Based on

Challenges, Design Thinking, Collective Intelligence, etc... Through it, architecture students are able to achieve creativity, diverse knowledge, strengths and complementary skills, among them: the creation of a private space, reflection on the idea of inhabiting a dwelling space, exploration of

Nature-connected architectural design, notions of sustainable design and recycling, their creative and critical thinking, oral and written communication skills, independent and original thinking, leadership and organisational skills, co- design, time management, problem-solving and decision making skills.

The article offers resources for innovative teaching good practice and implementation, and therefore to facilitate innovation at the classroom level. It gives tools to overcome the challenges facing innovative learning models in architecture education. Above all, it aims to foster innovation in architectural design education by empowering and inspiring teachers and other education staff to use innovative teaching methods while sharing best practices and experiences with their colleagues.

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UNDERSTANDING EARTHQUAKE EFFECTS ON CIVIL ENGINEERING STRUCTURES THROUGH SHAKING TABLE EXPERIMENTS

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Keywords: Experiment-based learning, Multidisciplinary knowledge, Active learning technologies, Dynamic analysis of structures, Project-based learning, Motivation

ABSTRACT

Understanding how earthquakes interact with civil engineering structures is a very difficult and complex question which must be addressed by the dynamic analysis of structures. This is mainly due to the confluence of multiple concepts related to math, physics, materials and construction which must be mastered by the students before they are able to assimilate the complex mechanisms which govern the earthquake-structure interaction.

The conventional way of teaching this subject is based on both, the development of tricky mathematical formulations and the implementation of numerical computational tools. However, even though this way of teaching is rigorous and accurate, it is not always properly understood by students.

In order to overcome this limitation, this conventional teaching method can be reinforced with additional activities which facilitate the understanding of these difficult engineering concepts and motivate students to study this subject.

According to this new trend (the inclusion of additional activities), shaking tables are usually employed as an educational tool to better explain the effect of earthquakes on civil engineering structures. The educational innovation activity described in this study is in line with this new trend, and it has involved the design, manufacturing and implementation of a new shaking table in the "Laboratory of Structures" of the ETSI Caminos, Canales y Puertos of Universidad Politécnica de Madrid (UPM). The shaking table has been built reusing different equipment available in the laboratory. Additionally, several reduced-scale models of civil engineering structures have been built and tested

using this educational tool to show, in a practical way, the effect of earthquakes on structures. Thus, key concepts in the field of seismic engineering as resonance, damping and ductility become easily understood by the students.

The current context of civil engineering, in which engineering practitioners must be prepared to work anywhere in the world (including high seismicity areas), is changing the way of teaching. Hence, nowadays, new teaching methodologies must be focused on training qualified engineers with an advanced knowledge in specific disciplines, as the dynamic of structures. In this sense, it is essential that the future engineers must be able to transform easily all this theoretical knowledge into practical know-how. Accordingly, this work presents the effort made by the “Structural Engineering Group” to meet this goal. The shaking table experiments has been implemented within one master course imparted at ETSI Caminos, Canales y Puertos of UPM, “Dynamic and Seismic Analysis of Structures”.

Finally, it is important to highlight the student satisfaction with this new educational tool as well as with the experimental tests performed, that allow them to engage these difficult engineering concepts with ease.

KNOWLEDGE AND AFFECTS IN THE CARING CLASSROOM: KEYS FOR AN ARCHITECTURE EMOTIONAL LEARNING

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Keywords: *Un-learning, Pedagogies, Emotion, Creativity, Freedom*

ABSTRACT

When playing Twister, you must decide in which colour you put your foot, your hand on, but no time to decide or you fall. Tension and balance make you take a choice. You are free to decide. Nowadays, most of undergraduate students seem to be afraid of making decisions, of being free to decide. The difficulty focuses not generally on the academic teaching methodology, but on kindergarten and the school, society and education trends. Not training emotional abilities means we, professors of architecture, receive soldiers instead students which follow rules, but not to decide. As they suffer creating and designing, we try to motivate, turning everything upside down, making circus strategies and contortionist movements to make them committed and involved within the architectural design project.

Our proposal has the goal to open a dialogue among professors through a teaching catalogue. The hypothesis is to implement a methodology of learning in a way that we un-learn, change emotional responses, focused on having fun. The overview is to implement freedom into pedagogical methodologies. We try to make blended pedagogies, distorting and improving old ways to learn, to make room for new critical practices handled in a freedom context.

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SEMANTIC FISSION AND POSTPRODUCTION. CONNECTIONS (AND DIFFERENCES) BETWEEN TWO IMAGINARY-OPERATIVE PROJECT TECHNIQUES AT ETSAM

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Keywords: *imaginary-operative techniques, semantic fission, copy-paste, cut-paste, postproduction*

ABSTRACT

The paper intends to establish a connection between the teaching work carried out by Juan Daniel Fullaondo (between 1986 and 1994) and by Federico Soriano (throughout the courses 2008/2009, 2009/2010 and 2010 / 2011) at the ETSAM. Semantic fission and postproductive techniques are, respectively, for Fullaondo and Soriano, two specific ways of approaching the architecture project from an educational point of view, and of understanding the link with the vanguards (in the case of Fullaondo) and with the new computer and digital graphic tools that are used in architectural production (in the case of Soriano). Both pretend to face, at the level of their teaching work, the plurality of situations generated by the crisis (respectively, for Fullaondo, that of the sixties and, for Soriano, the current one) by raising questions, outlining paths that the coming generations of architects are called to explore.

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MULTISENSORY TEACHING. ORIGAMI APPLIED TO THE STRUCTURAL CALCULATION LEARNING PROCESS

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Keywords: multisensory learning, structural calculation, papiroflexia

ABSTRACT

The human being mostly uses sight and hearing to relate to his surroundings. But these are only 2 of the 5 senses. Smell, taste and touch also serve to relate, and therefore, to learn [1].

Traditionally, regulated theoretical learning processes are based on two basic senses. hearing with which the teacher's explanations are heard, and sight with which books or notes on the board are read. Instead, throughout life, the rest of the senses do intervene in the different learning processes in which we are involved. Who has not remembered childhood when passing through the door of a bakery and smelling what comes from inside? In certain professions it is evident that they use other senses as a tool, and therefore, they have to be part of their cognitive process. A chef needs taste to practice their profession, so it has to be present in their learning. The same as for a physiotherapist the touch, or for a winemaker the smell.

The learning process in children is very different from that of adults. The neurocerebral structure evolves over the years. This difference makes learning processes at an early age much faster and more efficient than over the years. What is learned in childhood often remains in the memory even after many years of being buried. We all remember the tune of our favorite TV show when we were children. Even older people with severe neurodegenerative diseases associated with memory loss, who are unable to remember anything they did the day before, have internalized things that happened in their childhood [2-3].

Children have integrated touch in their learning process, apart from neuronal differences at different ages. In addition to seeing and hearing, they learn by touching. When children play, they receive a huge amount of information through touch, which serves them in their learning process. Not only do they learn by touching, but also the interaction of the senses serves them to fix the ideas.

On the other hand, traditional learning differentiates between theoretical learning and practical learning. The concepts are first explained in a theoretical way. Later they are reinforced in a practical way through exercises or practices with real elements.

Learning the structural calculation implies the assimilation of complex concepts. These concepts have traditionally been explained theoretically with the help of graphic elements. Subsequently, they have been reinforced with practical exercises to complete the learning. You can hardly take real structural elements to the classroom for interaction with the student.

Origami facilitates the process, providing simple elements that can be used as structural components. You can easily change the shape of a simple sheet of paper, so that the parameters involved in the concepts of structural calculation can be seen and experienced at the time.



Origami was used with very satisfactory results during a courses on building project management, with a broad-spectrum student body, in which it was necessary to introduce these concepts,

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POLYHEDRAL COMMUNICATION IN ARCHITECTURE

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ABSTRACT

There are multiple communicative strategies in architecture depending on the target audience. The mechanisms of representation may radically vary when the recipient is the client, the constructor, the curator, a colleague or even an instructor. As an example, the approach may be mainly visual when the target is the client. However, it may be strictly structural to start a conversation with a peer and mostly conceptual when pointing to the jury members in a competition. In certain cases, the adaptation of the graphic language to the different scenarios leads such a distortion on the message that the original project is hardly recognizable [1]. To illustrate this point, the article will focus on the project of the Public Seattle Library, designed by the architect Rem Koolhaas. The analysis of five different communicative strategies of the project show peculiar and unequal graphic narrations: from the concept book of the competition, the website of LMN (the American partners of Rem Koolhaas-OMA in this particular project), the web of OMA, the coverage on the Seattle press and the approach developed on the "Content" book [2]. Rem Koolhaas coined the concept of "design of information" to express the fundamental relationship between the message and media in architecture [3]. In his practice, the communicative strategy is present from the beginning of the design process. In this article, the thoughtful comparison of these examples enables to extract conclusions on the use of communication on Rem Koolhaas' projects and reflect on the iconic and communicative dimension of architecture [4].

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THE IMPORTANCE OF TRAINING IN THE REDUCTION OF OCCUPATIONAL ACCIDENTS IN THE CONSTRUCTION SECTOR

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ABSTRACT

Looking back, if we analyze the evolution of the accidents rate in the Construction Sector in Spain during the peak years of the economic crisis, a significant decrease can be seen. There has been a sustained decrease in the Total Work Accident Index with medical leave during working hours during the period from 2006 to 2012, mainly justified by a significant slowdown in activity, the disappearance of companies engaged in construction and auxiliary activities, as well as the destruction of jobs, both direct and indirect, with a considerable loss of relevance by the Sector in productive activity [1] [2].

Table 1. Analysis of mortality due to work-related accidents in Spain. Causes with more frequency in Construction. Data in percentage / position it occupies in the ranking. Source: INSHT, 2019 [5].

Most frequent cause in construction	2008-2010	2011-2013	2015
Inadequate, non-existent training / information on risks or preventive measures	3.3 (5th)	-	3.8 (4th)
Inappropriate or non-existent training / information about the task	2.4 (9th)	3.7 (4th)	3.4 (6th)

In line with the above, the direct relationship between work accidents and the risk- prevention management model in companies must be underlined, in conjunction with the level of training of those responsible and workers [3]. This circumstance is corroborated in the analysis of the results obtained in the surveys carried out for this study. As a complementary measure, aimed at the suppression of accidents, the subcontracting chains in the Construction Sector were limited by Law 32/2006 [4]. Such is the importance of the correct training and information that the worker receives in the matter of prevention for the exercise of his work in a safe way, that the lack of said training and information is among the 10 main causes of fatal accidents in the Sector of Construction in Spain, as shown in the following Table 1.

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TECHNOLOGICAL PROPOSALS FOR SELF-ASSESSMENT OF 3D MODELING EXERCISES

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Keywords: *Evaluation methodologies, correction strategies, automatic assessment, solid modelling, learning and teaching.*

ABSTRACT

Nowadays, there are several contrasted procedures and other proposals [1] for the self-assessment of exercises or exams of subjects which are evaluated using numerical exercises. Intermediate or final values are compared and an automatic qualification of self-assessment is assigned. It is possible to extend this classic correction procedure by the teacher [2]. The automatic assessment of exercises based on texts is more complicated because the appearance of certain keywords or their synonyms could offer a possible approach as a mechanical assessment of those exercises. However, the difficulty in the assessment of these exercises is the interpretation of their meaning [3].

In the case of 2D graphic exercises, which are typical of technical drawing, the problem is very different, since there are no alphanumeric chains to compare. Similarities between images and the comparison of primitive entities (vector objects) may be possible ways for evaluation [4]. The problem is more complicated when we want to evaluate 3D models mechanically.

This article presents a compilation of possible procedures to use in the generation of a self-assessment tool for industrial solid modelling exercises, that is, of mechanical parts [5]. In these cases, certain parameters such as volumes, surfaces, centres of gravity or moments of inertia can be a first approximation to their corrections [6]. These evaluations could continue with the analysis of the constructive operations that exist in the modelling of the object, such as solid parts, emptying, holes, threading, etc., all of them included in its modelling trees or lists of operations. The generation of a utility that helps in the correction of 3D modelling exercises would be of great interest, since it would bring effectiveness and agility to the evaluation process, as well as greater objectivity when using a computer system that isolates similarity factors and implements rules of measurable evaluation automatically.

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SUSTAINABILITY THROUGH DIGITAL METHODS

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Keywords: *BIM; Blockchain; Embodied Carbon; Sustainability*

ABSTRACT

3D Modelling, through Building Information Modelling (BIM) in itself, does not contribute to Life-Cycle Analysis (LCA) but it can enable such a discourse. This is especially true when mapping big data on to the mix. How this is done requires intervention from the Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning (ML), together with financial modelling and increasingly insurance pay-outs. How these elements interreact is of interest.

Interaction with a BIM database can be argued to generate new value propositions, through what can be termed intrinsic intangible value sets. Enabling such work, necessitates a ledger, which is transparent, robust and accountable. This is better known as Blockchain and bring track and trace abilities, together with collaboration and added value, in a somewhat low margin's industry. This means that most actors within the construction industry/sector operate on very small margins (up to 3%, but more often than not under 1%, meaning that having won the lowest bid at tender, they need litigation, to claw back their lost revenues), which is often expensive and annoyingly acrimonious.

Embodied carbon also is not fully understood or used to improve profit margins, and this will be outlined and demonstrated as an alternative or parallel source of income. Construction accounts for 35 – 40% of embodied carbon, as well as the energy footprint of a building throughout its life. Why these methods are not implemented is a source of disbelief. Digital methods can bring a tangible improvement to construction.

TOWARDS THE INTERNATIONALIZATION OF ENERGY THEME SUBJECTS IN THE MASTER'S DEGREE IN INTEGRATED BUILDING MANAGEMENT OF THE UNIVERSITY OF SEVILLE

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Keywords: *internationalization, ISO standards, university education, energy audit in buildings*

ABSTRACT

In recent years, the nationality of students at Spanish universities has changed [1]. The Erasmus and the Ibero-American mobility programmes are favouring that the nationality of the students enrolled is no longer only Spanish [2,3]. This new scenario has numerous advantages for university education, such as the exchange of knowledge and relationships between different regions. However, it also presents the challenge of adapting the teaching content to this new situation. For this reason, a balance must be found between the demands of national students and those of international students [4]. In this sense, the teaching of subjects related to the building sector represents the challenge of renewing the teaching content related to state technical regulations (as the Spanish Building Technical Code) so that subjects have the same competences, both nationally and internationally.

This research proposes the analysis of the internationalization of the teaching content of the subject of Audits and Energy Certification from the Master's Degree in Integrated Building Management of the University of Seville. The research consisted of an adaptation of the teaching content to an international approach by replacing the agenda related to the Building Technical Code with international testing standards. Likewise, new contents related to the characterization of elements of the thermal envelope that were not taught in the previous editions were included. By modifying the teaching content, students were provided with an international content of the subject. In addition, aspects which were not previously developed were included, thus contributing to the improvement of the quality of education in the subject of energy audit. The results of the surveys and the marks achieved were positive. Therefore, the results obtained in this research may constitute a methodology for the internationalization and improvement of the teaching content in the university teaching related to building.

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GAME-BASED LEARNING: TEACHING EXPERIENCES IN BUILDING ENERGY AUDIT SUBJECTS

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Keywords: *energy audit, game-based learning, gamification, Apps, Kahoot*

ABSTRACT

Technological evolution allows new resources in university education to be applied. In this regard, smartphone applications (as Kahoot) could be used in complex learning activities [1]. Kahoot constitutes a learning tool for gamification techniques, and students could participate by using their smartphones or laptops [2-4]. Through these techniques, teachers can promote the learning of difficult or boring, but essential knowledge to obtain a degree and even for professional practice. For this reason, a test was carried out in the subject of Energy certifications and audit in building engineering of the Master's Degree in Integrated Building Management of the University of Seville. The gamification approach consisted in answering questions related to the topics dealt with in the previous classes. The live resolution of questions was combined with small explanations of the correct answer. Likewise, the response time was evaluated with the success rate. The results were satisfactory: 100% of the students considered that they learned with the game, and 88.89% recommended this gaming approach. Thus, these results reflect the possibility of using the gamification approach as a learning tool in the Master's Degrees in Buildings and in energy efficiency subjects.

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GAMIFICATION AS A TOOL TO EASE THE STUDENT'S CONTINUOUS ASSESSMENT IN OVERCROWDED CLASSROOMS

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Keywords: Gamification; e-quiz; Continuous Assessment; Kahoot

Continuous assessment becomes harder and harder as the number of students increases in a classroom, and the availability of educational tools practically vanishes [1]. Professors have then the only chance to give up assessing continuously the student's performance and use exams to evaluate it. Therefore, the introduction of less time-consuming, manageable and truly effective continuous assessment tools, which have a significant contribution to student's learning, becomes challenging. Gamification is proved to be a practical solution, which at the same time fosters the student's motivation [2,3]. This work analyses the use of the application Kahoot to create e-quizzes that then were used in a course of 90 students of Chemical Engineering. 6 e-quizzes (from now on *kahoots*) were created and launched as soon as a topic of the course is finished. Due to the fact that this study corresponded to a pilot test, participation in *kahoots* was neither mandatory nor assessable.

The evaluation of the proposed tool was divided in three areas: first of all, a complete qualification of the student's performance by comparing the 4 possible scenarios pass/fail *kahoots*/course. It is important to note that students received their qualification of *kahoots* on the basis of the number of correct answers and *kahoots* performed. Then, student's satisfaction was evaluated through a survey of eight questions. Finally, professors' satisfaction was evaluated separately through a survey of eight questions and a free-comment box.

Evaluation results revealed some positive aspects. Firstly, student's participation was relatively high in all *kahoots*, being the percentage of participation in the range 56.7 – 68.9%. Secondly, an interesting trend was observed when the 4 scenarios above mentioned were represented in a single figure: 19.2% of the students fell in the area "pass *kahoots*/pass course", comparing to only 12.3% in "fail *kahoots*/pass course". However, 24.7% of the students fell in the area "pass *kahoots*/fail course", so that it was concluded that *kahoots* had a positive impact on the students learning process. However, passing *kahoots* was not enough, as expected, to pass the whole course.

As for student's survey, results showed that they were satisfied with the use of *kahoots* in the classroom, although the degree of satisfaction was not very high in two key questions: "*Kahoots helped me to understand better the concepts described in the classroom*" (49.02% fully/quite helpful) and "*How do you think kahoots have influenced on your learning process?*" (47.06% fully/quite positive influence).

Finally, professors underlined in their survey the positive aspects of this pilot test: e-quizzes with Kahoot were a manageable and less time-consuming tool for student's continuous assessment. However, they also stated that it did not fully contribute to the student's performance and satisfaction as this pilot test was neither mandatory nor assessable. Therefore, they proposed to include *kahoots* as an assessable activity in the following courses.

It is also important to note that both professors and students approved unanimously the use of all kind of questionnaires as educational tool for continuous assessment. Most of them preferred Kahoot, although other options such as Moodle were also proposed.

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APPLICATION OF FACEBOOK AS AN ACTIVE METHODOLOGICAL TOOL: A CASE STUDY IN BLENDED LEARNING

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Keywords: Active methodology, ICT tools, Blendend learning, Facebook

ABSTRACT

Up until today, the physical classroom remains as the main teaching space in university levels, especially in those subjects where practical contents are taught. The face-to-face teacher student contact is still considered essential in the teaching-learning process and yet, other types of teaching methods such as e-learning show certain complementary advantages which may be missing in traditional education. The methodology applied in this research, Blended learning (BL), shows how the teaching realm can be expanded by combining the physical classroom with a virtual classroom, thus adding new teaching tools.

Since the outset of BL, defined as the methodology that combines e-learning with traditional methods in the classroom [1], [2], the real challenge has been to achieve a smooth integration of its main components: face-to-face and online teaching, thereby adding up the advantages belonging to each method [2]. At the same time, due to the massive impact recent communication technologies have had on society, a whole new generation of natural e-learners show an ever increasing demand for online educational content and expect alternatives to face-to-face education, forcing universities to quickly adapt to this new scenario. The bet for a transformation in the training strategy [3], [4], requires trial implementations to find out, not only its advantages and disadvantages, but specifically the impact in time and extra effort such a methodology would represent, prior to its introduction in any official teaching programme.

Based on the above, this study's main objective is to analyse the advantages and difficulties to be found in the specific application of BL to the design-studio teaching model. In agreement with the students, Facebook (FB) was chosen as the online platform due to its immediacy and accessibility, thus forming a closed FB group to serve as a virtual classroom. At the end of the course, both teachers and students participating in the study rated their experience through a structured questionnaire.

The results indicate this system provides several advantages that significantly contribute to improve student learning, highlighting a steep decrease in absenteeism when compared to traditional teaching and a higher rate of top grades achieved by the students participating in the study.

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PROJECT-BASED LEARNING IN THE MATHEMATICS

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Keywords: *Project-based learning, mathematics, Compulsory Secondary Education, ICTs*

ABSTRACT

The aim of this work is the application of the Project-Based Learning (PBL) methodology in combination with the ICTs in the secondary education stage in the subject of the mathematics.

Numerous researches describe the problematic transition from the Primary Education (CPE) to the Compulsory Secondary Education (CSE) when one of the mayor problems for students is obtaining worse scores [1, 2].

The worse qualifications, among other variables, are connected to the methodology given at this new educational stage, where the expositions of the professor and textbooks follow-up gain highest importance. In this way, the number of masterclasses increases and becomes almost the unique methodology used in the CSE, causing for the student a situation of passivity towards the learning process.

This research carried out an educational experience through the use of the PBL in secondary education, specifically at the 3rd year of the CSE, in the educational centre Salesianos of Carabanchel. An experimental group (26 students) and a control group (31 students) were used in order to compare the results obtained in the subjects of the mathematics, geography and history.

The results do not show a significant difference in terms of the obtained scores in both groups, however the motivation of the students and the number of passes are higher in the experimental group.

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CONSTRUCTION OF STRUCTURES: SELF-LEARNING USING CAM-CAD TOOLS

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Keywords: *Design thinking, experiential learning, structural models, interschool challenge*

ABSTRACT

The difficulties existing in teaching-learning process through abstract concepts of subjects with hard physical components, considered with the emergence of new general skills (group work, leadership skills, creativity, sustainability, etc.), sometimes difficult to implement. They also need to be continually developed and tested and therefore, it makes increasingly more likely to search for new methodologies in the classroom that are committed to experiential learning and that involving the active participation of the student allows them to learn by rehearsing.

The design, calculation and construction of structures requires knowledge of many different fields: the material, its mechanical and rheological characteristics. The planning operations of the manufacture and the laying out, etc. This multiple points of view makes sometimes impossible to gather the teaching in a single subject. On the other hand, learning independently makes it difficult for the student to understand it. The possibility of bringing together this multiplicity of points of view in a single experience, however limited it may be, manages to confront the student before the complexity of the constructive fact from a holistic approach.

Previous experiences of elaboration by students of scale structural models, which have subsequently undergone stress tests in a competitive environment between different subjects and schools, have proven to be helpful in the development of various aspects of learning. Its utility is difficult to quantify given that these activities are incorporated into the curriculum on a voluntary basis, but it has been verified by both, teachers and students, that the achievement. Therefore, the average mark of the students who joint these activities have been superior to those of those who have not.

The present work tries to involve the student in a learning experience where he can apply the theoretical knowledge acquired, not only in the specific subjects of structures, in the construction of a structural prototype that adjusts to some elements or challenges that must be met. The model must be made with fixed maximum and minimum dimensions, and its parts must be obtained, by laser cutting from a previous cutting made by CAD, of a maximum number of wood

fiber boards, equal for all the equipment. Subsequently, on a fixed day and in a competition environment between teams from different subjects and schools, it is verified that the presented models meet the requested specifications and undergo a load test. For those models accepted, the parameter that determines their effectiveness is the relationship between the load supported and the model's own weight.

As can be deduced from the foregoing, not only are knowledge of the properly structural subjects involved, but others such as computer-aided design, or the concept of compliance with certain standards are necessary. Therefore, in the future it should be considered to expand participation to work teams made up of students from different subjects.

A first pilot test, with a reduced number of teams formed on a voluntary basis, has been carried out by conducting a competition in structural models between the School of Building and Civil Engineering of the Polytechnic University of Madrid, which has allowed the exchange of experiences among students of subjects related to the construction and analysis of structures. The future objective is to extend this experience to a greater number of participants and to carry out some type of quantitative verification of its usefulness.

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NEW CHALLENGES ON EDUCATIONAL KITS DEVELOPMENT: ROLLED STEEL JOINTS USING 3D PRINTING

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Keywords: *STEM experiences, experiential learning, structural models, 3D models impression.*

ABSTRACT

Traditional teaching based on master classes needs a continuous adaptation to the new methodologies that have emerged in the implementation of new requirements of the EHEA. The use of cooperative work and practical workshops are some of the tools used to complement training [1,2]. Structural model laboratories for destructive and non-destructive testing are an excellent complement to the theories taught in classrooms, allowing the student to assimilate knowledge through experimentation and transforming him into the protagonist of his learning process [3-5].

The visualization of the encounters between different pieces of rolled steel is sometimes difficult in the learning process of the building structure growing. Previous experiences in the use of structural models and kits have shown that the understanding of these subjects improves when the student is able to reproduce, in a practical way, with the help of physical models, the constructive solutions that he has learned theoretically. Even though, the limitations of this system must also be taken into consideration. Therefore, the connection of different parts needs welding to ensure the connections. This allows highlighting the priority of some elements over others. The necessity of giving a continuity of parts associated with local solicitation, the order of the welding of each of the bars and the need for cuts in the pieces for their connection. The present work tries to analyze the advantages of the use of models made by means of 3D printing in the motivation of the student in a learning experience.

The reduced scale models allow analysing and understanding how the behaviour of the structures, the geometric, dimensional, material and interlocking characteristics at the nodes influence [6]. Likewise, it is possible to verify how different constructive elements with a structural function are capable of presenting different responses when considering different load hypotheses [7]. Therefore, it is possible to achieve a significant advance in the simulation of basic behaviors of joints of the different structural elements explained in the theoretical lessons, attending to the different criteria of load, dimensioning and connection exposed, allowing to visually check concepts of load transmission, deformations, buckling instability and variables on which they depend.

Currently, tools available to our students, such as the 3D printer, allow us to create models with greater precision, which facilitates the isolation of structural behaviour, object of analysis, from other variables typical of the execution of the models. Almost any geometry can be obtained with 3D printing, however complex it may be [8]. This versatility offers a great opportunity for teaching, allowing the generation of experimental material to improve the learning process within a structural modeling workshop and keep this material for future classes.

Through the creation of models and experimentation with them, the student fixes and deepens the concepts seen in the theoretical lessons regarding efforts, structural systems, construction systems, materials, types of joints, etc. In addition, you will be able to check complex concepts such as slenderness and will delve into the importance of global and partial stability of structures and how decisions on site execution can significantly influence the final behaviour of the structure.

There are many difficulties in planning, designing and manufacturing the parts for the realization of a complete structural kit. In this research work, the difficulties encountered during the design and development of an educational kit to support the learning of rolled steel knots are highlighted.

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EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD) IN THE SEARCH FOR INTERACTION SPACES

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Keywords: *sustainable design, learning spaces, pedagogy of spaces, environmental behavior.*

ABSTRACT

New educational spaces must meet a long list of requirements to adjust to the challenges of the current society that is making a place for itself in the field of sustainability through Education for Sustainable Development (ESD), which has become the latest addition. ESD was born with the ambition of becoming more than an accessory activity to the curriculum and with the determination of becoming the cornerstone of the education system. In order to achieve this goal, ESD must define, not only the learning content, but also pedagogy and the learning environment. ESD encourages us to “conceive teaching and learning in an interactive student-centered way, that enables an exploratory, action-oriented and transformative learning”. At the same time, it advocates for rethinking learning environments to inspire learners to act for sustainability [1]. The focus is on action, and in this direction we have analyzed sustainable spaces to manage to find out how this question is being answered. Traditionally, school buildings have been considered the stage where learning-teaching activities take place. Therefore, they have been judged according to their ability to prevent, hinder, facilitate or promote their development. The key could now be in interaction, one of the essential elements in the learning processes, and in the role that these spaces play in such processes.

In Spain, the most widespread approach of the ESD in the educational field has been done, so far, from the point of view of the natural environment preservation through Environmental Education (EE) programs promoted by public or private institutions. These projects have been developed in schools, or extracurricular imparted in Environmental Education Centres (EEC) [2]. This valuable task has usually been carried out via curriculum in standard built spaces, or in natural spaces. Thus, conveying the hidden message that the

building was not part of the ecosystem and that, therefore, it was not an important factor in the preservation of the environment. It turns out that buildings and construction together account for 36% of global final energy use and 39% of energy-related carbon dioxide (CO₂) emissions [3].

That is why ESD is also very much interested in the built space, both indoor and outdoor. However, there are many other reasons beyond the positive impact that certain habits changes would have regarding energy savings or responsible resource consumption. ESD cares about the built space because of its immense potential as a teaching resource, and ultimately, because it relies on the transformative power that the spaces have themselves up to the point of wondering if the fact of inhabiting a space sustainable designed and built has the capacity of bringing us to adopt sustainable attitudes and behaviors [4]. In other words, the school building is being asked to collaborate in the task of teaching for sustainability.

This fundamental change in the role played by sustainable spaces in the learning-teaching processes, can not be performed without increasing the knowledge of students and teachers about the characteristics of the building and its facilities. Knowing how buildings work not only allows us to achieve these optimal requirements of lighting, air quality and temperature, but also to become aware of the impact that our actions have on health and the environment, which entails the starting point to the change towards sustainability [5].

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LEARNING STYLE IDENTIFICATION APPLIED TO DIDACTIC MATERIAL SELECTION IN TECHNICAL STUDIES

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Keywords: Learning style, didactic material, student engagement, mathematics

ABSTRACT

Mathematics is a subject for which technical students usually have low motivation. Many of these students are looking forward to subjects more related to the practical aspects of the degree, which demand a more active implication and are usually taught in the latter years. Mathematics is rather theoretical and reflexive and, in its purest form, has low active contents for the student engagement. This is a common scenario for students out outside of pure mathematics degrees, in particular the ones in the Technical University of Madrid up to today.

In the teaching of mathematics, the traditional master class approach has little relevance to the technical student and the academic performance is low. Thus, in order to boost motivation and engagement, many teachers have adopted a more active and pragmatic viewpoint in mathematics teaching. The theorem+demonstration paradigm has given way to the applied problem; gamification techniques and flipped classroom are also in rise.

Our objective is to investigate which other changes can be done, in terms of didactic material, that can enhance motivation and engagement from students to this theoretical subject. To this end, we have conducted a study of the learning styles of the students of several schools from the Technical University of Madrid using the Honey-Alonso questionnaire [1], which contemplates four styles: active, pragmatic, reflexive and theoretic. Parallel to this, we have conducted a survey that quantitatively scores the preference of the students for different kinds of didactic material. By correlating these two, we could adapt mathematics subject teaching to the particular students of each degree.

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TRAINING TO DISTANCE: EMAIL – CDS - MOODLE PLATFORM - VIRTUAL CLASSROOM. SEVERAL EXPERIENCE.

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Keywords: Moodle, E-learning, Cause and Effect Diagram, Visio Microsoft Office, DAFO Matrix

ABSTRACT

This paper has among its purposes to make a diagnosis from the National Headquarters of the Branched School of Agriculture, which could facilitate with efficient results the courses taught using a Moodle virtual platform held in the Minister of Agriculture's website.

In the first eight pages, the experiences associated with the e-learning, including a brief description of the actions done by the author of this paper and his direct participation in seventeen courses related with technical and professional topics within the construction sector are described. To obtain these results, the author used e-learning with a multimedia held in a CD. All the courses were finally evaluated in a face-to-face exam, including seven editions of a Diploma Paper in Management and Work Executions in Buildings with the direct participation of the Polytechnic University of Madrid, Spain, the Faculty of Architecture in the University of Technical Science in Havana and the Minister of Construction.

In the current diagnosis several methods and techniques were used such as work matrix with the content of the economic and social policy 2016-2021, brainstorming, experts' criteria agreements, cause and effect diagram (using the Visio Microsoft Office Tool) and DAFO Matrix.

To finish with, several activities and ideas are recommended to elaborate an action plan. In addition to this, a survey is proposed to help to find the qualification needs for the coming courses using the Virtual Classroom.

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CREATION OF TRAINING ITINERARIES THROUGH CLASSROOM STRATEGIES INVESTED IN THE CLASSROOM WORKSHOP FACILITIES

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Keywords: Flipped classroom, Teaching/learning strategies, Innovation learning, Improving classroom teaching.

ABSTRACT

This paper shows the creation of training itineraries of the Flipped Teaching Methodology on the workshop practice in facilities subjects, of a technical degree of building.

Many studies reflect the importance of change in teaching. Bates and Galloway [1] find that 80% of survey respondents in a first-year physics course preferred the flipped structure to a traditional approach. Strayer [2] finds that students in a flipped classroom introductory statistics class were less satisfied with classroom structure than those in a traditional class, but that they became more open to co-operation and innovation as the semester. Many other studies show satisfactory data with the implementation of this teaching methodology. [3], [4], [5].

With this project we want students to study every week, reflect on what they study and inform us about their interests, difficulties and doubts. The analysis of your answers allows us know what interests them most, their doubts urgent, what they don't understand and so we adapt the classes to your needs. We will incorporate more questioning, more active learning (mini-videos, QR codes, activities on the moodle platform, etc.) and more discussion to the classes [6].

The results that we want to obtain with this inverse model is that the majority of the students do to learn those things than in the traditional model, they only do spontaneously the best students.

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SERVICE LEARNING. PRACTICAL APPROACH FROM THE SUBJECT OF MANAGEMENT AND QUALITY CONTROL

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Keywords: *Service Learning, methodology, quality, university students, evaluation.*

ABSTRACT

The Service Learning methodology (ApS) encourages teachers and students to engage in a project or subject in greater depth, since, in addition to complying with the curricular content, this methodology encourages the strengthening of certain social values. Furthermore, the ApS seeks to ensure that these social values are in line with the attitudes of the person who acquires them. That is to say, that values and attitudes are coherent, something fundamental for the type of society, of rapid changes and high mobility in which we operate today [1]. Likewise, it aims to make the most of the student's experience of facing subjects hitherto unknown to him and use that process of acquiring knowledge to facilitate work for some sector of the population or social group by providing a service linked to learnings you are acquiring [2]. Therefore, this methodology stands out from others for its solidarity aspect, for associating pedagogical practices and community services in certain neighborhoods or groups, or as a practical way of applying the knowledge studied to real cases raised for companies or educational centers [3].

Regarding the applicability of this methodology to the building sector, it must be taken into account that the conservation of the environment is one of the main causes for which environmental management systems are put in place. The Quality Management and Control course emphasizes the importance for the building sector of developing, implementing and maintaining environmental policies aimed at minimizing the impact of buildings on the environment, complying with the required legal standards. in the built-up area [4]. For this reason, it is intended to design the participation of students in the Service Learning experience in the subject Management and Quality Control of the Degree in Computer Engineering and ADE of the Polytechnic University of Madrid, by designing an environmental quality plan for a real company in the building sector.

This methodological proposal, in the specific case that arises, pursues the objective of raising awareness and solidarity with the students about their responsibility to the environment as future construction professionals while applying what they have learned and providing a service to society. To do this, it is proposed that students work in teams of three to four people, to develop an application plan for ISO 14001: 2015 [5], in which they implement in a practical way and with a sense of social responsibility the concepts studied in the theory classes of the subject of Quality Management and Control.

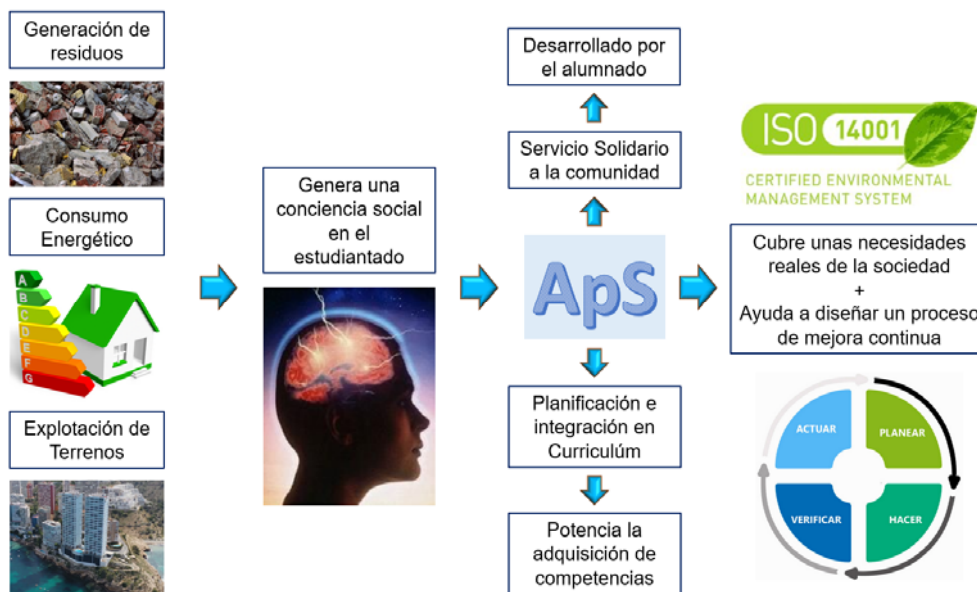


Figura 1. Service Learning applied to the building sector. Perspective from the implementation of a quality environmental management system.

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RESEARCH BASED LEARNING. AN APPROACH FOR GRADUATE AND POSTGRADUATE STUDENTS

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Keywords: *Research-Based Learning (ABI), Active Learning, Teaching Quality, Educational Research, Entrepreneurship.*

ABSTRACT

Research Based Learning is a methodology in which students have the possibility of improving their level of competences through the direct application of the scientific method, so that scientific knowledge, skills and attitudes are assimilated through their participation in a process real research [1].

It is an active methodology that has as its central axis the student, the research process, the reflection and analysis of data and the capacity for self-criticism [2]. This way of intervening in the classroom has its origin in the USA. where it was proposed to improve the training of students in universities, developing a scientific literacy in which pedagogical activities were combined with research within the classroom [3]. Thus, the need to train professionals in the scientific-technical area who are capable, not only of replicating knowledge, but also of creating technologies, forms of analysis and giving visibility to the research carried out, is increasingly evident.

On the other hand, the building sector has experienced in recent years a turn towards sustainable construction, and more and more companies are betting on the hiring of professionals with a scientific vocation for their incorporation in I+D+ i areas. In this line, the professors of the Master in Technological Innovation in Building (MITE) of the E.T.S. of Building works each year to train students capable of solving problems related to the exercise of their profession, promoting autonomous research and teamwork.

Technical training in building has traditionally been associated with professionals who are able to cope in adverse situations to achieve the best quality / price results in a limited time. It is therefore a matter of managing to achieve maximum efficiency with limited resources [4]. In this way, Research

Based Learning presents a didactic approach that allows the use of active methodologies, promoting creative research and linking doctoral programs with teaching. In addition, it allows adapting the work and teaching practices to the concerns of the students, promoting the use of ICT in the classroom and the inclusion of simulation tools and free software to obtain and interpret data.

Specifically, the subject of Monitoring buildings for its energy certification, security and rehabilitation, which is taught at MITE, has been betting on teaching innovation for several years, improving academic results year after year and trying to make the subject more attractive for postgraduate students. As a result of this effort, multiple applications of Arduino technology have emerged in university education, applications of free software in buildings, and patents derived from work on the subject.

This work presents the guidelines to implement this type of teaching methodology in university classrooms. Thus, the main objective is to provide university teachers with the necessary tools to carry out research-based academic planning, without deviating from the curricular content required for their subjects.

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EDUCATIONAL INNOVATION TO EXCELLENT PERFORMANCE OF PROFESSORSHIP OF TOP TECHNICAL SCHOOL OF ARCHITECTURE

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ABSTRACT

The 2019 course was characterized by an important advance in the training of teachers, thanks to the launch of the Educational Innovation Course for the Excellent Performance of the Teaching of the Top Technical School of Architecture as part of the Specific Courses of Teacher Training and Innovation of the Faculty inside the FIDOP Program. The success of the announcement, has been the starting point for new training requests and the possibility of be part of a recognized WORK TEAM From the Institute of Education Sciences ICE as "GRUPO FIDOP ARQUITECTURA" for the academic year 2020. This pathIt begins by betting on training among the teachers of the same Center. Currently, groups belonging to Medicine, Nursing and Physiotherapy and Education already exist at the University of Seville.

The course objectives begin with sharing teaching and innovation experiences for improve teaching training and improve the way of teaching. As course methodology, Progress is made around discussion seminars and activities focused on improving classroom practice with the exchange of own innovative experiences. With this opportunity, the dissemination of experiences and the possibility of sharing the design of improvements, innovation and methodologies applied in the classroom, has generated an interesting work dynamic that, in a relaxed way, is fed by encouraging its participants to share their progress in each one of the sessions carried out as in the annual conferences organized for this purpose has been verified. Likewise, this work network is allowing the review of each of the subjects that make up the Degree in Fundamentals of Architecture from three aspects: the content of the teaching, the applied teaching methodology and the evaluation system of the knowledge that the student should acquire. The content of the sessions is organized into 5 topics: Participants experiences; Detected lacks and irregularities in classroom, ¿Which type of students we get?, ¿How do they look us?,¿Which instruments do we have to awake their interest?; Experiences in first designs of improvement and educational innovation projects in process;

Factors that present more difficulty in the design of teaching: the selection and formulation of teaching content, applied innovative methodologies, the promotion of student participation and involvement or the formulation and design of coherent activities and resources, formative assessment and monitoring of the evolution of student learning; Continuous evaluation system and new possibilities in the development of teaching and monitoring in the classroom.

As a result, the team has consolidated and has improve in this direction with new suggestions of IMPROVEMENT IN CLASSROOM to new course 2020.

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FLIPPED CLASSROOM: ACTIVE METHODOLOGY USED IN INTEGRAL CALCULUS

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ABSTRACT

The aim of this work is to review the state of play about the Flipped Classroom methodology and develop a proposal for its use as a didactic recourse in the mathematics. The proposal is developed to work on the integral calculus at the university educational stage, mainly oriented to the grades of social sciences such as Business Administration and Management and Economics.

Due to the teaching experience and corroborated by the consulted literature [1,2], it was observed that the students present significant difficulties for the correct learning of the concept of the integral as well as the calculus itself, what is directly related to the poor performance of the students in the exams.

This paper embraces the origin and basis of the Flipped Classroom and analyses the advantages and disadvantages of its use in the teaching-learning process. Flipped Classroom or inverted classroom is a pedagogical model framed into the hybrid learning where the material is provided out of the class in order to transport the elaboration of the contents traditionally considered as tasks to be performed inside the classroom [2].

One of the first investigations was the research of Walvoord and Johnson Anderson [3]. The authors offered the model in which the students have the first contact with the material before the class. After that, in the classroom, understanding of the content (synthesize, analyze, solve problems) is promoted using the active learning. In order to be sure that the students do the necessary preparation before the classroom work, the students had to perform some activities (tests, questionnaires, etc.) before the class.

Other authors [4] suggest the work scheme called "peer instruction". By this model, the students work with the material before the class and answer several

questionnaires. The time in the class is structured on the mini-lessons and responding conceptual questions.

Based on the good results demonstrated by the consulted literature, a didactic proposal has been designed with the aim of improving the learning process of Integral Calculus using the methodology of the Flipped classroom in combination with cooperative learning.

Obtained results show improved motivation of the students and better understanding of integral calculus. The percentage of passes compared to the previous year was of 8%.

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