



LIBRO DE ACTAS

CINIE 2018

7th, 8th and 9th of March 2018 - Madrid (Spain)

II Congreso Internacional de Innovación Educativa en Edificación
II International Conference of Innovation and Education in Building



DEPARTAMENTO DE TECNOLOGÍA DE LA EDIFICACIÓN
Escuela Técnica Superior de Edificación
Universidad Politécnica de Madrid
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Patrocinador: Cátedra Empresa PROIESCON



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PRESENTACIÓN

CONGRESO INTERNACIONAL DE INNOVACIÓN EDUCATIVA

(CINIE 2018)

7, 8 y 9 de marzo de 2018

CINIE 2018 vuelve con la intención de la apertura de nuevas propuestas de innovación educativa, favorecer el intercambio de conocimiento, experiencias y nuevas actuaciones en el ámbito. A través de la actuación de sus participantes, el desarrollo conjunto de proyectos educativos orientados a la mejora continua de la Metodología de la Enseñanza Superior, incluyendo los últimos avances e investigaciones del campo de la enseñanza-aprendizaje, con el fin de contribuir a la producción de resultados científicos de alta calidad de manera internacional.

La organización del programa CINIE 2018 se basa en diferentes actividades dentro de la innovación en los métodos educativos, comunicaciones orales, posters y exposiciones virtuales de diferentes áreas temáticas tales como los avances en investigación educativa, nuevas tendencias en educación o actuaciones en el campo BIM.

En este segundo Congreso es de destacar y agradecer el interés e implicación de los participantes, que ha supuesto la presentación de más de 50 ponencias que agrupan a más de 150 ponentes de diferentes lugares a través de sus diferentes tipologías de presentaciones.

También reconocer la valiosa colaboración de la Cátedra-Empresa Proiescón y el Consejo General de la Arquitectura Técnica de España.

El Comité organizador

PROGRAMA DEFINITIVO

Wednesday, 7th March 2018/ Morning conferences

Entrance Hall

9:30-14:30	Registration / Documentation reception
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Conference Hall

10:00 - 11:30	Opening session: D. Alfonso Cobo Escamilla. Dean of ETSEM- UPM
	Inaugural Conference: D. Jaime C. Gálvez Ruiz. Full Professor - UPM

11:30-12:30

Poster session 1 + coffee break

Room B

SESSION 1: Research in Education: Educational Innovation Chair: Álvaro Picazo Iranzo

Conferences	
12:30-12:50	THE EDUCATION IN THE UNIVERSITY WITH THE NEW TECHNOLOGIES Mercedes Valiente López; M ^a Carmen Sanz Contreras
12:50-13:10	STUDENTS EVALUATION OF TEACHING AND GENDER BIAS IN THE DEGREES OF ARCHITECTURE AND BUILDING ENGINEERING Josefina García-León; Julián Conesa Pastor; M ^a Socorro García Cascales; Antonio García Martín; Juan Pedro Solano Fernández; Gemma Vázquez Arenas
13:10-13:30	DOES SIZE MATTER IN DOING INNOVATIONS IN EDUCATION? Antonia Pacios Álvarez, Joaquín Ordieres Meré, Silvia Serrano Calle
13:30-13:50	APPLICATION OF KOLB'S EXPERIENTIAL LEARNING THEORY IN THE OPTIMAL USE OF DAYLIGHT IN BUILDING Mercedes González Redondo; Alfonso García García
13:50-14:10	MATERIALS SELECTION: A PROJECT-BASED LEARNING NEW METHODOLOG José Ygnacio Pastor; Elena Tejado; Teresa Palacios
14:10-14:30	LA FORMACIÓN EN COMPETENCIAS EN MATERIA DE ACCESIBILIDAD Y DISCAPACIDAD, COMO ÍNDICE DE CALIDAD DE LA DOCENCIA Y LA INVESTIGACIÓN EN LA UNIVERSIDAD. Nieves Navarro Cano; Pablo Muñoz Navarro; Consuelo del Moral Ávila; Luis Delgado Méndez

Wednesday, 7th March 2018/ Afternoon conferences

Room B

SESSION 2: Research in Education: Educational Innovation Chairs: Patricia Aguilera Benito y Alejandra Vidales Barriguete

Conferences	
16:00-16:20	IMPLEMENTATION IN MOODLE OF STRUCTURAL ANALYSIS EXERCISES WITH PERSONALIZED STATEMENT FOR EACH STUDENT (virtual presentation) Gracia Rodríguez Jerónimo; F. Javier Suárez Medina; Juan José Granados Romera; Angel Vallecillo Capilla
16:20-16:40	REQUIREMENTS FOR THE PROPER TRAINING IN MATTERS OF PREVENTION OF THE WORKER WITH EXPOSURE TO ASBESTOS A. Romero Barriuso; B.M. Villena Escribano; M.N. González García; M. Segarra Cañamares; A. Rodríguez Sáiz
16:40-17:00	ANÁLISIS DE LA INTERACCIÓN DE LOS ALUMNOS DE INTERCAMBIO ERASMUS EN LOS RESULTADOS DE GRUPO. CASO DE LA ASIGNATURA DE CONSTRUCCIÓN POPULAR Gregorio García López de la Osa; Sonsoles González Rodrigo; Pilar Cristina Izquierdo Gracia; Inmaculada Martínez Pérez; Ricardo Tintero Caballero; Mercedes Valiente López
17:00-17:20	VIRTUAL AND REMOTE LABORATORY FOR THE INTEGRATED ANALYSIS OF ENERGY EFFICIENCY AND COMFORT IN BUILDING Inmaculada Martínez; Rossana Laera; Luis de Pereda; Ricardo Tintero
17:20-17:40	LA TRANSDISCIPLINARIDAD EN EL CONTEXTO DE LA APLICACIÓN A LA EDIFICACIÓN DE MODELOS DE DESARROLLO SOSTENIBLE Ricardo Tintero Caballero; Inmaculada Martínez Pérez; Bárbara Serrano Pérez
17:40-18:00	LA ENSEÑANZA DE CONSTRUCCION MEDIANTE VIDEOS DE OBRA Javier Pinilla Melo; Sergio Vega Sánchez; Soledad García Morales

PROGRAMA DEFINITIVO

Thursday, 8th March 2018/ Morning conferences

Room B

Conferences	SESSION 3: New Trends in Education Chair: M ^a Paz Saez Pérez
9:40-10:00	PROJECT OF TEACHING INNOVATION: THE WORK IN THE CLASSROOM (virtual presentation) David Hidalgo García; Julián Arco Díaz; Juan Manuel Santiago Zaragoza
10:00-10:20	BASICS OF STRUCTURAL ENGINEERING FOR THE DEVELOPMENT OF COOPERATION PROJECTS FOR DEVELOPMENT AID Juan Manuel Orquín Casas; José Antonio Mancebo Piqueras; Roque Calvo Iranzo
10:20-10:40	LEARNING BASED ON PROJECTS: CONSTRUCTION OF A PHOTOVOLTAIC DRONE IN TRAINING CYCLES Jorge Pablo Díaz; David Rioja; Daniel Vígara; Daniel Ferrández; Carlos Morón
10:40-11:00	FLIP TEACHING DEVELOPMENT AND APPLICATION IN HEAT AND MASS TRANSFER Ricardo Castedo; Lina M ^a López; María Chiquito; José D. Cabrera; Juan Navarro; Marcelo F. Ortega
11:00-11:30 Poster session 2 + coffee break	
Conferences	SESSION 4: New Trends in Education Chair: Oriol Borrás Gené
11:30-11:50	THE IMPLEMENTATION OF INSTAGRAM AS A SOCIAL NETWORK IN THE HIGHER TECHNICAL SCHOOL OF BUILDING ENGINEERING OF THE UNIVERSITY OF GRANADA (virtual presentation) David Hidalgo García; Juan Manuel Santiago Zaragoza; Julián Arco Díaz.
11:50-12:10	A ROMANCE OF A MOOC ON ANALYSIS OF EXPERIMENTAL DATA COURSE José Ygnacio Pastor; Elena Tejado; Teresa Palacios
12:10-12:30	IMPROVING THE PERFORMANCE OF MATH STUDENTS IN SECONDARY THROUGH THE GAME David Perezagua; Daniel Ferrández; Carlos Morón; Gabriela Vega
12:30-12:50	LA FERIA DE MATERIALES COMO EXPERIENCIA DE GAMIFICACIÓN EN LA ENSEÑANZA DE LA CONSTRUCCIÓN David Sanz; Javier Pinilla; Eduardo Lahoz; Esther Moreno
12:50-13:20	BEYOND THE CLASSROOM: USE OF MINI NON-FORMAL VIDEOS AS A REINFORCEMENT TO UNIVERSITY TEACHING IN COMPUTER SCIENCES Oriol Borrás Gené

Thursday, 8th March 2018/ Afternoon conferences

Room B

Conferences	SESSION 5: New Trends in Education Chair: Daniel García de Frutos
16:00-16:20	ALTERNATIVE PROFESSIONAL OUTINGS FOR BUILDING ENGINEERING: TEACHING IN THE VOCATIONAL EDUCATION AND TRAINING CYCLES (virtual presentation) Ana M ^a Cruz Valdivieso, Alba Fernández Sánchez, Francisco Javier Lafuente Bolívar; Juan Manuel Santiago Zaragoza
16:20-16:40	INTEGRATION OF 3D PRINTING TECHNOLOGY IN ENGINEERING DEGREE TEACHING METHODS Antonio J. Carpio de los Pinos; Fernando J. Castillo García; David Rodríguez Rosa; Carmen Carpio de los Pinos
16:40-17:00	THE ROUTE OF THE INGENIOUS. FROM EXPERIENCE TO THEORY. A MULTIDISCIPLINARY EXPERIENCE IN THE BUILDING ENGINEERING SCHOOL. José Antonio Méndez Serrano; Lucía Comino Mateos; Francisca García Rodríguez; Emilio Gómez Cobos
17:00-17:20	FREE SOFTWARE AS A RESEARCH TOOL: EMPLOYMENT OF THERM AND GEOGEBRA FOR A PHD THESIS Paula Villanueva Llauradó; Alfonso Barba Pérez; Jaime Fernández Gómez
17:20-17:40	A TOOL FOR FLIPPED CLASSROOM LEARNING AND SELF ASSESSMENT IN CONTINUUM MECHANICS Juan Carlos Mosquera; Luis Cueto-Felgueroso; David Santillán Sánchez; Beatriz González Rodrigo; Iván Muñoz Díaz
17:40-18:00	ESCAPE ROOMS FOR TEACHING ENGLISH IN SCIENCE AREAS Guadalupe Dorado Escribano

PROGRAMA DEFINITIVO

Friday, 9th March 2018/ Morning conferences

Room B	
Conferences	SESSION 6: Building Information Modeling (BIM)/Others Chair: Oscar López Zaldívar
9:40-10:00	REFLECTIONS ABOUT INCORPORATION OF BIM METHODOLOGY ON CIVIL ENGINEERING STUDIES Ángela Moreno Bazán; Marcos García Alberti; Alejandro Enfedaque Díaz; Antonio Arcos Álvarez; Alvaro Picazo Iranzo; Jaime.C Gálvez Ruíz
10:00-10:20	STUDY AND RECOVERY OF PUNO ANCESTRAL ETHNIC ENGINEERING Yasmani T. Vitulas; Andrea Gamio; M ^a de las Nieves González; Amparo Verdú
10:20-10:40	UNDERSTANDING HISTORICAL CONSTRUCTION USING DYNAMIC CAD GEOMETRY TOOLS David Mencías-Carrizosa
10:40-11:00	ESTABLISHMENT OF PARAMETRIC OBJECTS TO SUPPORT MULTI BIM TASKS A. Zita Sampaio; Eduardo Coelho; Luis Araújo; Augusto Gomes
11:00-11:30 Poster session 3 + coffee break	
Conferences	SESSION 7: Building Information Modeling (BIM)/Others Chair: Rafael V. Lozano Díez
11:30-11:50	A COLLABORATIVE METHODOLOGY BETWEEN TEACHERS APPLIED TO THE IMPLEMENTATION OF BIM IN DEGREE OF INDUSTRIAL ENGINEERING Moisés Blanco Caballero; Patricia Zulueta Pérez; Alberto Sánchez Lite; Ignacio Alonso Fernández-Coppel
11:50-12:10	BIM MULTIDISCIPLINARY IMPLANTATION IN GIE THROUGH PARTICIPATION IN INTERNATIONAL COMPETITIONS-BIM VALLADOLID 2017- David Valverde Cantero; Jesús Alfaro González; José Manuel Cañizares Montón; Jesús González Arteaga; Jesús Ángel Martínez Carpintero; Pedro Enrique Pérez González
12:10-12:30	VR+BIM IMPROVING DESIGN COMMUNICATION A. Zita Sampaio
12:30-12:50	HYBRID ACTIONS IN THE LANDSCAPE Concha Lapayese Luque
Meeting room	
13:00 – 14:00	Closing Ceremony: D. Carlos Morón Fernández <i>Dean of Department "Tecnología de la Edificación" ETSEM- UPM</i>

PROGRAMA DEFINITIVO

Wednesday, 7th March. 11:00 – 11:30		POSTER SESSION 1 Entrance Hall
PL-C1	COMPUTATIONAL TOOLS FOR PROBLEMS RESOLUTION IN HYDRAULIC ENGINEERING SUBJECTS Leonor Rodríguez-Sinobas; Sergio Zubelzu; Daniel Alberto Segovia	
PL-C2	ASSESSING THE IMPACTS OF EXPERIENTIAL LEARNING ON PLANT PROTECTION SUBJECT Laura Gálvez; Daniel Palmero; Concepción Iglesias; Juan Manuel Arroyo; José Soler	
PL-C3	DESIGNING MASTER COURSES FOR STUDENTS WITH DIFFERENT BACKGROUNDS R. San-Segundo, A.G. Fernández, F. Fernández, P. Ituero, M.L. López, J.M. Pardo	
PL-C4	PROGRAMME FOR TRAINING UNIVERSITY TEACHERS IN UNIVERSITY OF GRANADA Raquel Fuentes García	
PL-C5	FLIPPED CLASSROOM OF SUSTAINABILITY SUBJECT IN THE UNIVERSITY José Soler; Laura Gálvez; Daniel Palmero; Concepción Iglesias; Juan Manuel Arroyo	

Thursday, 8th March. 11:00 – 11:30		POSTER SESSION 2 Entrance Hall
PL-C6	SIMILITUDES Y DIFERENCIAS EN LA ENSEÑANZA DE LA GEOMETRÍA DESCRIPTIVA. SISTEMAS DE REPRESENTACIÓN TRADICIONALES FRENTE A HERRAMIENTAS INFORMÁTICAS EN 3D Javier Pita Andreu, Óscar López Zaldívar, Agustín Balcázar Fernández	
PL-C7	TRAINING AND INNOVATION SKILLS. A WINDOW FOR THE PROFESSION M ^a Paz Saez Pérez	
PL-C8	NEW WEBPAGE FOR TEACHING BUILDING MATERIALS BASED ON TECHNICAL ASSESSMENTS OF INNOVATIVE CONSTRUCTION PRODUCTS DIT, ETE AND DIT PLUS Eduardo Lahoz Ruiz; Marina Ruiz González	
PL-C9	INTERACTIVE DIGITAL SYSTEMS IN THE TEACHING OF PHYSICS Mercedes González Redondo; Alfonso García García	
PL-C10	DEVELOPING THE FLIPPED CLASSROOM LEARNING STRATEGY: TOOLS AND RESOURCES Carolina Piña Ramírez; Marina García Andrés	
PL-C11	GEOMETRY LANDSCAPES Alberto García Olea; Oscar López Zaldívar; Rafael V. Lozano Díez	
PL-C12	THE IMPLICATIONS OF ACADEMIC GUIDANCE IN PRE-UNIVERSITY COURSES Jorge Pablo Díaz; Daniel Ferrández; Carlos Morón; Rodrigo Sanjuán	

Friday, 9th March. 11:00 – 11:30		POSTER SESSION 3 Entrance Hall
PL-C13	COMPUTER TOOLS APPLIED TO THE STUDY OF STRUCTURAL CONCRETE Kenzo Jorge Hosokawa; María Isabel Prieto; Alfonso Cobo	
PL-C14	PROJECT-BASED LEARNING APPLIED TO SUSTAINABLE CONSTRUCTION Silvia Cenzano; Marta Revuelta; Amparo Verdú; Fidel Carrasco	
PL-C15	FIRST FORMAL TRAINING EXPERIENCES IN THE BIM ENVIRONMENT. THE CASE OF THE DEGREE IN BUILDING OF THE UPM Rafael V. Lozano Díez; Oscar López Zaldívar; Sofía Herrero del Cura; Pablo Luis Mayor Lobo	
PL-C16	THE LANDSCAPE AS A TOOL FOR EDUCATIONAL INNOVATION IN THE TRANSFORMATION OF SCHOOLYARDS IN GREEN INFRASTRUCTURE Eva Fernández Pablos; Amparo Verdú Vázquez; Oscar López Zaldívar; Sara Aláez Bejarano; Rafael V. Lozano Díez	
PL-C17	USE OF KAHOOT ON MOBILE DEVICES INTO THE UNIVERSITY COURSE OF THE BUILDING DEGREE OF THE SUPERIOR TECHNICAL BUILDING SCHOOL: A PRACTICAL ANALYSIS. Carolina Piña Ramírez; César Porras Amores; Alejandra Vidales Barriguete; Patricia Aguilera Benito; Mónica Morales Segura	
PL-C18	LEARNING MATHEMATICS THROUGH MAGIC Pablo Saiz Martínez; Antonio Jesús Guerrero Lobato; Ana Isabel Cid Cid; Daniel Ferrández Vega	

ÍNDICE RESÚMENES – ABSTRACTS

<i>Does size matter in doing innovations in education?</i>	1
Pacios Álvarez, Antonia; Serrano, Silvia; Ordieres-Meré, Joaquín	
<i>Free software as a research tool: employment of therm and geogebra for a PhD thesis.</i>	3
Villanueva Llauradó, Paula; Barba Pérez, Alfonso; Fernández Gómez, Jaime	
<i>Computational tools for problems resolution in hydraulic engineering subjects.</i>	5
Rodríguez-Sinobas, Leonor; Zubelzu, Sergio; Segovia, Daniel Alberto	
<i>Assessing the impacts of experiential learning on plant protection subject.</i>	7
Gálvez, Laura; Palmero, Daniel; Iglesias, Concepción; Arroyo, Juan Manuel; Soler, José	
<i>Alternative professional outings for Building Engineering: teaching in the vocational education and training cycles.</i>	9
Cruz-Valdivieso, Ana María; Fernández-Sánchez, Alba; Lafuente-Bolívar, Fco. Javier; Juan Manuel Santiago Zaragoza	
<i>Hybrid actions in the landscape.</i>	11
Lapayese Luque, Concha	
<i>Designing master courses for students with different backgrounds.</i>	13
San Segundo Hernández, Rubén; Fernández, F.; Ituero, P.; López, M. L.; Pardo, J. M.	
<i>Basics of structural engineering for the development of cooperation projects for development aid.</i>	15
Orquín Casas, Juan Manuel; Mancebo Piqueras, José Antonio; Calvo Iranzo, Roque	
<i>Establishment of parametric objects to support multi BIM tasks.</i>	17
Zita Sampaio, A.; Coelho, Eduardo; Araújo, Luis; Gomes, Augusto	
<i>VR+BIM improving design communication.</i>	19
Zita Sampaio, A	
<i>Programme for training university teachers in University of Granada.</i>	21
Fuentes García, Raquel	
<i>Flipped classroom of sustainability subject in the university.</i>	23
Soler, José; Gálvez, Laura; Arroyo, Juan Manuel; Palmero, Daniel; Iglesias, Concepción	
<i>Reflections about incorporation of BIM methodology on Civil Engineering studies.</i>	25
Moreno Bazán, Ángela; García Alberti, Marcos; Enfedaque Díaz, Alejandro; Arcos Álvarez, Antonio; Picazo Iranzo, Álvaro; Gálvez Ruíz, Jaime C.	
<i>Project of teaching innovation: the work in the classroom.</i>	27
Hidalgo García, David; Arco Díaz, Julián; Santiago Zaragoza, Juan Manuel	
<i>The implementation of Instagram as a social network in the Higher Technical School of Building Engineering of the University of Granada.</i>	29
Hidalgo García, David; Santiago Zaragoza, Juan Manuel; Arco Díaz, Julián	

<i>A tool for flipped classroom learning and self assessment in Continuum Mechanics</i>	31
Mosquera Feijoo, Juan Carlos; Cueto-Felgueroso Landeira, Luís; Santillán Sánchez, David; González Rodrigo, Beatriz; Muñoz Díaz, Iván.	
<i>A collaborative methodology between teachers applied to the implementation of BIM in degree of Industrial Engineering</i>	33
Blanco Caballero, Moisés ; Zulueta Pérez, Patricia; Sánchez Lite, Alberto; Alonso Fernández-Coppel, Ignacio	
<i>Students evaluation of teaching and gender bias in the degrees of architecture and building engineering.</i>	35
Vázquez Arenas, Gemma; Conesa Pastor, Julián; García Cascales, M ^a Socorro; García-León, Josefina; García Martín, Antonio; Solano Fernández, Juan Pedro.	
<i>Similarities and differences in the teaching of descriptive geometry. Traditional representation systems versus 3D computer tools.</i>	37
Pita Andreu, Javier; López Zaldívar, Óscar; Balcázar Fernández, Agustín	
<i>Flip teaching development and application in heat and mass transfer.</i>	39
Castedo, Ricardo; López, Lina M ^a ; Chiquito, María; Cabrera, José D.; Navarro, Juan; Ortega, Marcelo F.	
<i>La formación en competencias en materia de accesibilidad y discapacidad, como índice de calidad de la docencia y la investigación en la universidad.</i>	41
Navarro Cano, Nieves; Muñoz Navarro, Pablo; del Moral Ávila, Consuelo; Delgado Méndez, Luis	
<i>Training and innovation skills. A window for the profession.</i>	43
Sáez Pérez, M ^a Paz	
<i>Learning mathematics through magic.</i>	45
Saiz Martínez, Pablo; Guerrero Lobato; Antonio Jesús; Cid Cid, Ana Isabel; Ferrández Vega; Daniel	
<i>Use of kahoot on mobile devices into the university course of the Building Degree of the Superior Technical Building School: a practical analysis.</i>	47
Piña Ramírez, Carolina; Porras Amores, César; Vidales Barriguete, Alejandra; Aguilera Benito, Patricia; Morales Segura, Mónica	
<i>Escape rooms for teaching english in science areas.</i>	49
Dorado Escribano, Guadalupe	
<i>A romance of a MOOC on Analysis of Experimental Data Course.</i>	51
Tejado, E.; Palacios, T.; Pastor, J.Y.	
<i>Materials selection: a project-based learning new methodology.</i>	53
Palacios, T.; Tejado, E.; Pastor, J.Y.	
<i>Integration of 3D printing technology in Engineering Degree teaching methods</i>	55
Carpio de los Pinos, Antonio J.; Castillo García, Fernando J.; Rodríguez Rosa, David; Carpio de los Pinos, Carmen	
<i>The education in the university with the new technologies</i>	57
Valiente López, Mercedes; Sanz Contreras, M ^a Carmen	

<i>Implementation in Moodle of structural analysis exercises with personalized statement for each student</i>	59
Rodríguez Jerónimo, Gracia; Suárez Medina, Francisco Javier; Granados Romera, Juan José; Vallecillo Capilla, Ángel	
<i>Beyond the classroom: use of mini non-formal videos as a reinforcement to university teaching in computer sciences.</i>	61
Borrás Gené, Oriol	
<i>Application of Kolb's experiential learning theory in the optimal use of daylight in building</i>	63
González Redondo, Mercedes; García García, Alfonso	
<i>New webpage for teaching Building Materials based on Technical Assessments of innovative construction products DIT, ETE and DIT plus.</i>	65
Lahoz Ruiz, Eduardo; Ruiz González, Marina	
<i>Interactive Digital Systems in the teaching of physics</i>	67
González Redondo, Mercedes; García García, Alfonso	
<i>The route of the ingenious. From experience to theory. A multidisciplinary experience in the building engineering school.</i>	69
Méndez Serrano, José Antonio; Comino Mateos, Lucía; García Rodríguez, Francisca; Gómez Cobos, Emilio	
<i>Developing the Flipped Classroom learning strategy: tools and resources.</i>	71
Piña Ramírez, Carolina; García Andrés, Marina	
<i>La enseñanza de construcción mediante videos de obra</i>	73
Pinilla Melo, Javier; Vega Sánchez, Sergio; García Morales, Soledad	
<i>BIM multidisciplinary implantation in GIE through participation in International Competitions-BIM Valladolid 2017</i>	75
Valverde Cantero, David; Alfaro González, Jesús; Cañizares Montón, Josemanuel; González Arteaga, Jesús; Martínez Carpintero, Jesús Ángel; Pérez González, Pedro Enrique	
<i>Understanding historical construction using dynamic cad geometry tools</i>	77
Mencías-Carrizosa, David	
<i>Requirements for the proper training in matters of prevention of the worker with exposure to asbestos</i>	79
Romero Barriuso, A.; Villena Escribano, B.M.; González García, M.N.; Segarra Cañamares, M.; Rodríguez Sáiz, A.	
<i>Geometriy Landscapes</i>	81
García Olea, Alberto; López-Zaldívar, Oscar; Lozano-Díez, Rafael Vicente	
<i>Learning based on projects: construction of a photovoltaic drone in training cycles</i>	83
Pablo Díaz, Jorge; Rioja, David; Vígara, Daniel; Ferrández, Daniel; Morón, Carlos	
<i>Improving the performance of math students in secondary through the game</i>	85
Perezagua, David; Ferrández, Daniel; Morón, Carlos; Vega, Gabriela	

<i>The implications of academic guidance in pre-university courses</i>	87
Ferrández, Daniel; Morón, Carlos; Saiz, Pablo; Sanjuán, Rodrigo	
<i>Computer tools applied to the study of structural concrete</i>	89
Jorge Hosokawa, Kenzo; Prieto, María Isabel; Cobo, Alfonso	
<i>The Building Materials Exhibition as a gaming experience for teaching construction</i>	91
Sanz, David; Pinilla, Javier; Lahoz, Eduardo; Moreno, Esther	
<i>Análisis de la interacción de los alumnos de intercambio erasmus en los resultados de grupo. Caso de la asignatura de Construcción Popular.</i>	93
García López de la Osa, Gregorio; González Rodrigo, Sonsoles; Izquierdo Gracia, Pilar Cristina; Martínez Pérez, Inmaculada; Tendero Caballero, Ricardo; Valiente López, Mercedes	
<i>Project-based learning applied to sustainable construction.</i>	95
Cenzano, Silvia; Revuelta, Marta; Verdú, Amparo; Carrasco, Fidel	
<i>First formal training experiences in the BIM environment. The case of the degree in building of the UPM.</i>	97
Lozano-Díez, Rafael Vicente; López-Zaldívar, Oscar; Herrero del Cura, Sofía; Mayor Lobo, Pablo Luis	
<i>Virtual and remote laboratory for the integrated analysis of energy efficiency and comfort in building</i>	99
Martínez, Inmaculada; Laera, Rossana; Pereda, Luis de; Tendero, Ricardo	
<i>Transdisciplinarity in the context of the application to the building of sustainable development models</i>	101
Tendero Caballero, Ricardo; Martínez Pérez, Inmaculada ; Serrano Pérez, Bárbara	
<i>Study and recovery of Puno ancestral ethnic engineering</i>	103
Vitulas, Yasmani T.; Gamio, Andrea; González, M ^a de las Nieves; Verdú, Amparo	
<i>The landscape as a tool for educational innovation in the transformation of schoolyards in green infrastructure</i>	105
Fernández Pablos, Eva; Verdú Vázquez, Amparo; López Zaldívar, Oscar; Aláez Bejarano, Sara; Lozano Díez, Rafael Vicente	
<i>ÍNDICE DE AUTORES</i>	107

DOES SIZE MATTER IN DOING INNOVATIONS IN EDUCATION?

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Keywords: *Engineering education, Experiential learning, Flipped classroom, Gamification*

Abstract

The aim of this paper is to present different implemented innovations in education focused on the specific course “Industrial Constructions” at Escuela Técnica Superior de Ingenieros Industriales (ETSII) Universidad Politécnica de Madrid (UPM), that for more than ten years have been adopted, in order to propose a more adequate framework for learning and evaluation. This paper reports on the outcomes of a research study to clarify the role of class size and identify other constraints to the success of innovative actions.

The research covers several years and it includes different number of students’ groups through that period. The course has been included in diverse educative programs over time, but also varied innovative actions have been implemented as well, including experiential learning with practical perspective and magisterial lessons approach, and experiential learning combined with flipped classroom and gamification, etc. The linear perspective of the research allows to compare different instances as well as the conclusions and feelings from teachers’ perspective in accordance. It is not claimed a fully rigorous statistical robustness in the comparison because there are many uncontrolled variables, therefore, it is highlighted that the comparison is a qualitative one, with high added value from the teacher’s perspective.

The analysis shows some expected results regarding the size of the groups but also other interesting results regarding motivation and students’ skills that can contribute to enhance teachers’ perspective in their selection of the best methodology.

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FREE SOFTWARE AS A RESEARCH TOOL: EMPLOYMENT OF THERM AND GEOGEBRA FOR A PHD THESIS

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Key words: *free software, research, parametric design, numerical simulation*

Abstract

Currently, internet is broadly acknowledged as a valuable source for research and teaching, with a range of scientific publishers editing online. For PhD researchers, the net provides access to a great number of bibliographical resources and specific software. PhD candidates are therefore impelled to properly utilize the data sources and materials available at their campus or, even more, to provide future researchers with tools. The first step to take profit of internet resources is to know which open access tools are available that can be applied to each research, both at University and with remote access. In this sense, international nets for knowledge have been created and permit the access to research and educational software, some of them developed by Universities and research centres.

It is important that both tutors and PhD candidates have an overall knowledge of the tools and bibliography that are being used in the field of research, specially in the case of numerical investigations in which experimental methods (manufacture and testing of specimens) play a secondary role. Free software allows specialized use and is available to a larger number of researchers.

This paper presents an example of how two free software tools, Therm and GeoGebra, have been essential to the development of the Doctoral Thesis of Alfonso Barba Pérez. Alfonso Barba's research is focused in design optimisation of industrial precast concrete buildings. Numerical simulation is essential in this case as one of the studied parameters is the optimum reduction of material cost for the construction of the structure and the balance between the thermoacoustic behaviour and the cost of façades. These two departure points led to two parallel research lines, one of parametric structural analysis and another of thermoacoustic properties of multi-layered panels. Research was based on the regulatory frame of the Spanish codes EHE-08 [1], and a series of documents from the Código Técnico de la Edificación including the DB-HE [2].

In Spain, thermal transmittance of heterogeneous façades must be done according to the DB-HE/3 (thermal bridges); this document indicates the necessity of evaluating the heat flux through finite element modelling (FEM). For the research, the free software Therm was chosen. FEM software Therm was

specifically designed by the Lawrence Berkeley National Laboratory and was created for the simulation of thermal bridges including the calculation of linear thermal transmittance and the risk of surface moisture. Since its creation, it has become one of the most popular softwares within its file, and is employed by educators and researchers worldwide. Access to the software is obtained with a simple log in method in Therm's page, where tutorials are also available to ease the learning. Given the good acceptance of the tool, the Spanish group Aurea Consulting has developed an open access library of materials for Therm based on the specifications by the CTE. An example of the results obtained from Therm software is presented in Figure 1.



Fig. 1: Example of thermal bridge simulation with Therm

Together with the thermoacoustic simulation, Alfonso Barba's research required parametrization of the precast concrete structures (span length, spacing, reinforcement and dimensions of purlins, beams and pillars). This was done in two steps. First, a database from existing industrial buildings and projects was collected and analysed statistically. Then, a general mathematical expression for material cost optimisation was developed that put in relation the span length and spacing of each element with their material cost. The minimum of such expression was obtained thanks to the computing possibilities of the free software GeoGebra. GeoGebra is a tool for Mathematics which is widely employed at all the educational levels because of its ease of use and great computing capacity. From its origin, it was conceived for education; as a consequence, in its webpage a number of tutorials as well as question and answer forums can be found. For the research here, the use of Geogebra has allowed a relatively simple identification of the absolute minimum for a complex mathematical expression and the graphic and numerical control of individual parameters, which are represented as sliders. This graphic is crucial for the better understanding of the optimization process and the individual affection of each variable.

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COMPUTATIONAL TOOLS FOR PROBLEMS RESOLUTION IN HYDRAULIC ENGINEERING SUBJECTS

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Keywords: *programming languages; spreadsheets; hydraulics; computational skills.*

Abstract

Traditionally, practical activities of the disciplines related to hydraulics and irrigation have relied on the use of spreadsheets. The complexity of many of the expressions used in these disciplines (Richards, Colebrook-White or Laplace equations, for example) requires the use of numerical methods and other mathematical techniques that are complex and inefficient to implement in these spreadsheets. The complexity of the resolution process means that on many occasions the student does not focus their attention on the hydraulic concept itself or on the resolution method. In this context, certain programming languages allow a more efficient resolution that would make it easier for students to focus their attention on the hydraulic and computational questions and not on the difficulties inherent to the tool used. In the present work the results of the application of different computational methods (traditional spreadsheet, visual basic programming on spreadsheet, python in Jupyter notebook) for the resolution of concrete questions that involve complex mathematical expressions related to the subjects of hydraulics and risks are presented.

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ASSESSING THE IMPACTS OF EXPERIENTIAL LEARNING ON PLANT PROTECTION SUBJECT

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Keywords: *real-world problems; motivation; independent learning; reflectional capacity.*

Abstract

Experiential learning consist on any learning that supports students in applying their knowledge and conceptual understanding to a real-world problem or authentic situations, where the instructor directs and facilitates learning [1]. The subject of Plant Protection within the Degree in Agricultural Engineering at the Technical University of Madrid (UPM) aims to train students in the basic concepts of crops protection. This work presents the assessment of the impacts of the experiential learning on Plant Protection subject on both, students and teachers. The proposed experiential learning consisted in the monitoring of the phytosanitary status of two crops located in the experimental field belonging to the School of Agricultural, Food and Biosystems Engineering (ETSIAAB, UPM). Fieldwork was carried out in groups of 5 or 6 students who monitored the crop and based on that, performed different activities. During the experience, students were evaluated by using different rubrics. Regarding the results, this methodology seems to be very positive for both students and teachers, not only improving the motivation and independent learning, but also the reflectional capacity of the students. In general, though more workload hours, the methodology was more useful and formative.

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ALTERNATIVE PROFESSIONAL OUTINGS FOR BUILDING ENGINEERING: TEACHING IN THE VOCATIONAL EDUCATION AND TRAINING CYCLES

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Keywords: *Competencies; Interdisciplinarity; Professional outings; Specialization; Teaching.*

Abstract

In recent years, there has appeared a need to diversify professional outings - both for Technical Architects and for Building graduates or Building Engineers - towards alternative sectors to traditional ones.

The professors who practice in the teachings leading to titles of Technicians and non-university Superior Technicians within the branch of Building and Civil Works are graduated professionals of the guild and usually with experience in the exercise of the free profession.

This professional teacher must be in possession of capacities and competences that range from the most strictly technical to those of a more social nature, such as an adequate pedagogical training [1].

Just as professionals have to update themselves according to the demands of the labor market and the social changes of the time, the studies that lead to these professions must carry out the same revision, adapting and expanding disciplines as they are required.

This educational complement can be obtained by other means, but it is the responsibility of the competent institution to have the best and most complete educational offer linked to the various professional branches [2].

This research aims to highlight the need for guidance and adequate pedagogical training for future graduates in Building Engineering who intend to choose teaching in Vocational Training of the Building and Civil Engineering family as an alternative professional exit to those traditionally considered.

The main objective is to propose a proposal that responds to the needs previously raised, such as the possible implementation of an optional or module of free configuration within the Degree Plan, as an approach or contact with the development of the teaching profession.

For this, an investigation of deductive and comparative analytical character is carried out. The various related fields that influence the main objective of the

research are analyzed and contribute to justify the proposals adopted as a result of the deduction or interpretation of said analysis.

The features that characterize Vocational Training in Spain and in the rest of Europe were analyzed, as well as the different social, economic and political situations in the country that have influenced the formation of the current education system. Based on this, the possible needs of professional education can be deduced from the particular interpretation of the previous analysis of the different scenarios shown. Finally, possible improvement proposals are established in relation to the needs deduced and the recommendations that are considered relevant and feasible are established, subject to application.

It is concluded that the progress of a society is marked by the ability to react and adapt to emerging needs within the specific framework of higher education [3].

The model and the quality of education determine to a large extent the progress and personal, social and professional well-being of people, in consonance with the new social and productive demands of the labor market.

For this reason, the updating and adaptation of the educational system is as significant as the remodeling of the figure of the teacher, its role and, consequently, its competences.

This research supports the efficient and adequate education of those students who opt for teaching as a professional alternative to the traditional specialty, and it serves as means to demonstrate those needs that can be given a better and more adequate response in front of the changes that cause them.

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HYBRID ACTIONS IN THE LANDSCAPE

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Keywords: *Landscape, hybrid, action, art, architecture, contemporary.*

Abstract

THE TEAM AND OUR METHODOLOGY

Hybrid Actions in the Landscape is a teaching innovation program for future architects and master's degrees in advanced studies in architecture and landscape that we started together with the Professor D. Dario Gazapo in 2006.

The Hybrid Accomplices are a research group of international students based - new students every year- at the Superior Technical School of Architecture of Madrid, Spain, connected with the Cultural Landscape Research Group GIPC-UPM.

We explore and look for innovation in landscape studies integrating Architecture, Territory, Urbanism, History, Arts and Social Sciences.

These days it is vital to re-think the Architecture and be aware of all the possibilities of his expansive field. So, we tend to hybridize this and other disciplines. The Hybrid Effects in Landscape subject tries to interweave work, thoughts and operating skills of the architect in order to reinterpret the contemporary landscape.

Our process of action begins with a decision, a choice of a theoretical and mental site in which everyone of us proceeds to move back and forth and appropriate the dawn of our new landscape.

I.-Reveal our own reference framework from a specific look.

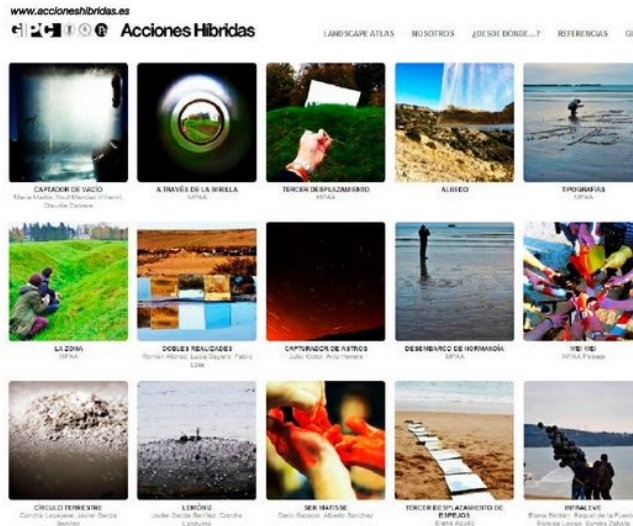
II.-Choose a proper look to get introduced through an investigation methodology.

III.-Build an analysis framework in between the diverse strategies of landscape interpretation.

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DESIGNING MASTER COURSES FOR STUDENTS WITH DIFFERENT BACKGROUNDS

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Keywords: *Learning methodology, students with different backgrounds*

INTRODUCTION

The creation of new degrees and masters at the Universidad Politécnica de Madrid (UPM) is facing new challenges [1] like the design of mandatory subjects of the first course in professional Masters. Firstly, the students come from different degrees and with different background, which makes the content design and methodology selection very difficult [2] [3]. Secondly, students come from the last years of the degree with a strong specialization. A general course in Master with common contents produces a decrement in the student motivation. This article describes the process of designing a new mandatory Master subject dealing with these two problems.

DEVELOPMENT

In a first phase, a procedure has been developed to design the content and the teaching methodology of mandatory Master subjects integrating students with different backgrounds:

1. Firstly, we must study the students' backgrounds, calculating their relevance.
2. Secondly, it is necessary to analyze the course syllabus of the subjects of each itinerary in the previous degree to know the knowledge and skills acquired by each student.
3. Next, we must analyze the teaching methodologies used in previous courses. We have observed that there is a greater tendency towards practical aspects, although an excessive laboratory load (with mandatory attendance) can be counterproductive.
4. Finally, it is necessary to analyze the competences that the students must acquire in order to define the content.

In the second phase, this procedure has been used in the subject "User Equipment and Terminals", a mandatory subject of the University Master's Degree in Telecommunications Engineering (MUIT).

Several meetings have been hold with the management of ETSIT and the Electronic Engineering Department to analyze the context and define a content proposal, identifying 6 main topics:

- Description of the electronic equipment supply systems [4].
- Power consumption and dissipation [5] [6].

- Low level software design [7].
- Human-computer interface design [8].
- Aspects of electromagnetic compatibility [9].
- Calculation and modeling of the reliability of electronic equipment [10].

Regarding the teaching methodology, we have considered theoretical and practical sessions with practical exams (including exercises). Additionally, we promote the knowledge application in some available electronic systems.

During this course, we have evaluated the new subject (content and methodology). The teachers have reported a higher satisfaction in the interviews. Also, a significant improvement has been obtained in the overall assessment by the students in the surveys: From 4.6 to 7.2 (0-10 scale). The best aspect has been the practical approach for the exams.

CONCLUSIONS

The main conclusions are:

- It is important to hold meetings with teachers (from other subjects) and students before designing the subject.
- In the content proposal for the subject "User Equipment and Terminals", a certain balance has been achieved with respect to the different backgrounds: all students have found some chapters more related to their background (resulting more motivating and interesting), and also, some topics further away from their knowledge, needing a greater investment of time and effort.
- Another positive aspect has been the orientation to 100% practical exams with exercises.

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BASICS OF STRUCTURAL ENGINEERING FOR THE DEVELOPMENT OF COOPERATION PROJECTS FOR DEVELOPMENT AID

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Keywords: *Service learning, community service, cooperation projects, structural behavior, water and sanitation*

Abstract

Learning based on projects is identified as an optimal methodology, and if these projects are oriented to community service projects, such as those that fall within the scope of development cooperation, valuable values will also be provided, both professional and personal to the students.

A double scope will be accomplished if the above learning initiative is applied to structural engineering, identifying the basic knowledge of structural theory and structural engineering that the student must have for the development of projects oriented to cooperation: Firstly, learning through projects with the consequent added value provided by social projects. In addition, as providing the usual structures that are developed in this type of projects are basic structures (e.g. water tanks, both supported on the ground and elevated, small bridges or footbridges, buildings of a height or two at the most, etc), the basic knowledge that is intended to identify will allow the student to effectively develop this type of project completely. That is to say, the required knowledge is sufficiently robust to be able to cope successfully with this type of projects and also to be able to develop in the next professional future, other types of structural projects of greater scope.

The communication includes the identification of the basic contents that must be taught to the student to be able to develop this type of projects, as identification of the loads on the structure, including possible seismic loads, notions of design, calculation and dimensioning of deposits, walls, walkways and small residential structures, of different shapes and in different boundary conditions, formed by both bar elements and plate elements and including different materials, such as steel, concrete, wood or masonry.

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ESTABLISHMENT OF PARAMETRIC OBJECTS TO SUPPORT MULTI BIM TASKS

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Keywords: *BIM, Floors, Walls, Parametric modelling, nD/BIM models*

Abstract

The project and the construction processes of a building require adequate interdisciplinary relationships. It requires from the stakeholders a constant need of communication to provide a sustained decision-making. To fill in the gaps of current working methods regarding collaborative processes and the possible errors that may occur, a working methodology Building Information Modelling (BIM) has been emerging. This methodology is based on collaborative processes, high level of communication and spatial visualization of the project, with accurate and updated information.

The present study identifies the main capabilities of the BIM methodology's implementation in the project's development, with focus on parametric modeling, and obtaining precise and updated information related to building components, namely wall and floors, throughout the design, construction and post-occupation management phases. The work carried out involves the creation of a BIM model and a library of parametric objects representative of the walls [1] and floors [2] constructive solutions, considered the most significant on the national market. The information pinpointed in the model, together with the parameters added to the objects are used in the development of tasks supported in the BIM model. These tasks include automatic generation of technical drawings, extraction of quantities, cost estimation, support for planning and simulation of construction, energy, sustainability and environmental impact studies, as well as support for management and maintenance of facilities.

In order to design floors and walls parametric objects frequently used in current buildings, a basic study was carried out, regarding the characterization of the national construction directed to both construction components, which led to the selection of a large group of constructive systems (composition by distinct layers material) associated to functional and behavioural characteristics, used in the enrichment of the new elements of a generated library of objects.

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VR+BIM IMPROVING DESIGN COMMUNICATION

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Keywords: BIM, VR, Interaction, Walkthrough, Retrieving data

Abstract

Building Information Modelling (BIM) methodology enables project stakeholders to create information-rich virtual models that help better visualize building projects. BIM concerns the development process of a computer generated model representing all disciplines of a building design, and its use in several tasks as design simulation, construction planning or facilities management. The resulting product, a Building Information Model, is a data-rich, intelligent and parametric digital representation of the building project. An actual BIM subject that requires research, practical application and software adaptation, is the integration of BIM with Virtual Reality (VR) technology. Current VR devices allow the user to visualize a virtual world and to interact with the virtual space and its components. VR technology can improve BIM methodology, as it allows interaction with 3D/BIM models in two essential ways: Walkthrough is the most popular as the user can view the 3D model in a virtual environment in real time from multiple perspectives of the building, from inside or outside [1]; Consulting data concerns the possibility to retrieve information centralized in a BIM model, namely, data associated with parameters that compose the parametric objects used in the modelling process [2].

The current target, concerning integrating VR and BIM, is the study of how to use or adapt those VR devices and how to establish links for the presentation of information contained in a BIM model. This is bringing BIM data into a VR environment. Following this perspective, commercial software houses have been developing advanced VR+BIM products. The present reflection involves the link of VR to BIM. Regarding current digital 3D modelling technologies, added to design information and provided in mobile equipment, students and professionals can use advanced capabilities of interaction like VR technology, improving the use BIM methodology.

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PROGRAMME FOR TRAINING UNIVERSITY TEACHERS IN UNIVERSITY OF GRANADA

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Keywords: *teacher learning, university education, experienced professors, beginning professors*

Abstract

INTRODUCTION. In university teaching career, after passing the criteria that enable the value of professors in the different selection processes, what tools are available to train them? Does the transmission capacity of the university professor is guaranteed? Is the beginning professor disoriented?. The systems change and the university hires "suitable" professionals of any area but ignoring the transmission process. How to generate teaching strategies? How to achieve confidence and security to teach if I have no experience? Am I accompanied in my learning as professor?. **METHOD.** The Vice-rectorate for Quality Assurance at the University of Granada convenes an annual program (for the last six academic years) in which the help of experienced professors is requested. A coordinator of them sets, according to the schools, a training program with which, after its development, the beginning professors will acquire tools to incorporate in their teaching work. They are subject to the acceptance of the Vice-rectorate, and the approved ones will develop in a single academic year. **RESULTS.** These will highlight that the mentioned programs, in many cases, are independent of the degree to which they are attached, and on the other hand, the positive aspects of the experience will be displayed both educational and social level of the agents involved. It's possible to get the creation and/or consolidation of permanent teaching groups. **DISCUSSION.** A field of reflection opens on the need for such programs in the early stages of the beginning professor and the desirable need of the seductive power of a teacher with his students.

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FLIPPED CLASSROOM OF SUSTAINABILITY SUBJECT IN THE UNIVERSITY

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Keywords: *academic performance; core competences; flipped classroom; learning domains; motivation.*

Abstract

In the academic year 2016/17, a flipped classroom experience was carried out in the Subject Sustainable Production which is lectured in the Degree in Technology of the Agricultural and Food Industries, in the Agricultural Engineering School (ETSIAAB) of the Polytechnic University of Madrid (UPM).

The flipped classroom methodology is relatively new, since this designation was firstly used in 1998, but it was popularized by two teachers from a US institute in 2007. The flipped classroom is a pedagogical model that raises the need to transfer part of the teaching and learning process outside the classroom in order to use class time for the development of more complex cognitive processes that enhance a better and meaningful learning [1].

There were proposed some activities prior to class in the classroom, activities in the classroom and after class. These activities were given to the teacher and then they were evaluated. At the end of the course a survey was made among the students to assess the experience followed. The academic results were compared with the previous courses in which a traditional methodology was followed.

The results indicate that this methodology improved the academic performance, as well as the degree of learning of the specific and also core competences. The students remarked the methodology as useful and formative, although the workload was great. However, the time dedicated to the proposed activities did not exceed the hourly load for ECTS credit assigned to out-of-class activities. However, it meant a greater work load for the teachers, both in the preparation of the materials and in the evaluation of the activities.

In addition, a good design of the previous activities is necessary, in order to achieve knowledge and comprehension levels of Bloom's taxonomy on cognitive domain of learning [2], as well for classroom activities and homework ones, where application and analysis levels must be worked.

The satisfactory results of this experience allow us to continue the application of this methodology in the future, in the same subject and also in other ones that are taught by the professors of our Educational Group.

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REFLECTIONS ABOUT INCORPORATION OF BIM METHODOLOGY ON CIVIL ENGINEERING STUDIES

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Keywords: *Civil Engineering, BIM, construction, innovation, teaching programme.*

Abstract

The industrialization and the modernisation of the productive model in the construction industry has always been a tough challenge since building sequences and procedures cannot be systematised given that the product is made-to-measure. Nevertheless, after the severe impact of the financial crisis in 2007, the awareness of the need of updating the sector appeared. Thus, new project methodologies were developed taking advantage of the possibilities of emerging technologies which integrate, from the first steps of the project, the management of all the life cycle of the constructive works [1, 2]. This new approach have been consolidated with the implementation of the methodology known as *Building Information Modelling* (BIM) in several countries [3]. Therefore, university syllabus of architecture and building degrees have already included the use of BIM [4-7]. Nevertheless, there is still pending the implementation of BIM in most of the Civil Engineering syllabus [8-10]. In the case of the Master degrees in Civil Engineering, new considerations are needed in order to prepare future engineers to the use of BIM for infrastructure and civil engineering projects in their professional career [11-12].

In the case of Spain, the use of BIM will be introduced in civil engineering projects [13] for the public administration from 2019. Hence, several private companies offer specific master degrees for civil engineers that incorporate this new methodology. However, in the correspondent studies of *Ingeniería de Caminos, Canales y Puertos* there is not a clear path to be followed in order to implement BIM in the university syllabus. In order to satisfy this demand, the Civil Engineering School (Escuela de Caminos, Canales y Puertos) of Universidad Politécnica de Madrid has decided to create a new specific subject to be included in the Master degree.

The aim of this study is to analyse the influence that the incorporation of a new module regarding BIM may suppose compared with other proposals offered by

other Universities. Consequently, the significance of the study is to propose a roadmap to incorporate the learning of BIM methodologies in the appropriate level for an adequate professional future development of the students.

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PROJECT OF TEACHING INNOVATION: THE WORK IN THE CLASSROOM

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Keywords: *Classroom, teaching, innovation, University, video.*

Abstract

The economic situation experienced in recent years has been primed with considerably construction sector. The closures and lower promotion of works, both public and private, is undermining the possibility of internships and visits to works by students that presents technical careers. These teaching activities "in situ" are fundamental in the process of knowledge of the processes and construction techniques that complement the theoretical training received in the classroom.

The teaching innovation project entitled "The work in the classroom", began in September 2014 and was completed in June 2016. It includes the subjects of the Degree in Building: Descriptive Geometry and Direct Procedures of the Technical School Higher Degree in Building Engineering from the University of Granada. The project has transferred real work interventions to the classroom, with the aim of improving and complementing the theoretical training of students without needing to change their location. The people in charge of the project have made recordings of the processes and constructive systems carried out in real interventions, that later have been exposed during the development of the classes. The students, and before the possibility of checking in the classroom the direct application of theoretical knowledge, have felt more receptive and motivated which has had a considerable influence on the improvement of their competences and the results obtained in their evaluation. Through the development of this teaching innovation project it has been possible to reduce the percentage of suspended / non-presented students in a value that ranges between 15-18% respectively in the subject of Geometry and Direct Procedures.

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THE IMPLEMENTATION OF INSTAGRAM AS A SOCIAL NETWORK IN THE HIGHER TECHNICAL SCHOOL OF BUILDING ENGINEERING OF THE UNIVERSITY OF GRANADA

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Keywords: *Innovation, Instagram, Communication, Social Networks and TIC.*

Abstract

The European Higher Education Area allowed the establishment of the European credit transfer system (ECTS) and the effective accreditation of the quality of the degrees. According to this new system, the universities and their teaching staff are responsible for the search and introduction of new techniques or systems that improve the process of communication and acquisition of knowledge by students. In this sense, the use of Information and Communication Technologies (TIC) in university education systems has been a common topic of discussion and debate during the last decade, although there is no denying that they predict an extraordinary way forward. , by the Universities and their faculty, to achieve the quality objectives established in the Framework Document for the Integration of the Spanish University System in the European Higher Education Area.

Following these objectives, in February 2011, the Technical School of Building Engineering of the University of Granada, created the profiles in Social Networks @ etsie.ugr, (Facebook) and @etsie_ugr (Twitter). According to the Annual Study of Social Networks IAB-Elogia of April 2016, these two networks are known by 100% and 94% of Internet users respectively, have an average rating of 7.5 and 7.0 points over 10 respectively and the age range of its users between 40-50 years for Facebook and between 30-40 years for Twitter.

Instagram was founded in 2010 and according to the report of Social Networks reviewed is known by 84% of Internet users, has an average rating of 7.6 and the age range of its users between 16-30 years. Profile that is more significantly adapted to students who are studying at Spanish universities and specifically at the School of Engineering of Building Engineering.

For this reason, in November 2017 the ETSIE opted for the implementation and implementation of this Social Network with the etsie_ugr profile. The objective pursued was not only to improve the information that is transferred to the students of the School but also to increase its corporate image among future university students.

After two months since its implementation, the data obtained have been completely successful, especially when compared with those of the previous

Social Networks. The profile of Instagram etsie_ugr, has obtained an average of 141 followers per month, a figure much higher than the 18 average followers obtained on Twitter or 22 on Facebook. They have achieved 314 likes on average per month in contrast to the 70 on Twitter or 22 on Facebook.

The objective of this paper is to explain the impact that the Instagram Social Network is having and compare its results with the rest of the Social Networks with which it lives in the School of Building Engineering of the University of Granada.

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A TOOL FOR FLIPPED CLASSROOM LEARNING AND SELF ASSESSMENT IN CONTINUUM MECHANICS

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Keywords: *Flipped classroom, self-assessment, student performance, significant learning, Continuum Mechanics*

Abstract

Undergraduate students are digital natives, so well prepared for the use of ICT; this is why we consider appropriate offering adequate computer-based tools to be used as supplementary material for their learning. A self-assessment instrument may help students to detect early some shortcomings or weaknesses in their knowledge on fundamentals and principles. Hence, corrective measures can be implemented to boost their training and skills acquisition. In this work, we present a freely available web-based framework, written in HTML5 and JavaScript. It contains a repository of problems on Continuum Mechanics, so that students can learn at their own pace. After choosing any problem from the collection, they can freely set values for the data and can obtain at once both graphical and numerical results. Thus, students can try to solve such problem on their own and then check and compare their solution with the web page. This may also include some links with supplementary material, short videos or markers of augmented reality.

This support system for the flipped classroom is supplemented with a set of MatLab apps. These help the students to perform numerical experimentation on the meaning and scope of mathematical formulations and expressions that belong to subjects related with time-dependent processes, such as those imparted in Dynamics or Hydraulics. These apps are valuable for understanding how the response of a system depends on either the input actions or boundary conditions.

This framework can be easily implemented in undergraduate Engineering and Architecture courses, such as Hydraulics, Statics, Dynamics or Structural Analysis, among others. Furthermore, it can be applied as a tool for flipped classroom or self-assessment.

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A COLLABORATIVE METHODOLOGY BETWEEN TEACHERS APPLIED TO THE IMPLEMENTATION OF BIM IN DEGREE OF INDUSTRIAL ENGINEERING

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Keywords: *BIM, Collaborative Methodology, Teaching, Technical Projects*

Abstract

This study attempts to show an initiative performed by a teaching team from the School of Industrial Engineering (EII) of the University of Valladolid, in relation to the implementation of the BIM methodology in official teaching of projects subjects in industrial engineering degrees.

The implementation of the BIM methodology in projects subjects in the School of Industrial Engineering has required from the beginning, in the 2013-2014 academic year, the use of a solid collaborative learning system among students, which had been previously used by the teaching team. In this system students are an active part in their own learning, reaching knowledge through teamwork in a collaborative way. Through this method, students are able to perceive that work is being done to expanding general knowledge and improving interpersonal relationships.

However, now it is exposed the way in which the teachers involved, as an active part of the experience, have organized the educational practices through their own collaborative methodology applied among the members of the teaching team.

The experience is carried out on two subjects, *Projects/ Technical Office* of 2nd year of the degrees in Engineering in Industrial Technologies, Electrical Engineering, Engineering in Industrial Electronic and Automatic, Mechanical Engineering, Chemical Engineering and Engineering in Industrial Organization; and *Industrial Technical Projects* of the 4th year of degree in Industrial Technology Engineering.

Both obligatory subjects are located in the fourth and eighth quarter and represent 4.5 and 6 ECTS respectively. As these subjects have duration of four months, the time to develop the work is only of 15 academics weeks. Given this short time and the fact that students have little knowledge of BIM, it is really complicated to develop the technical project. These subjects are taught jointly and simultaneously by the four professors who are members of the team, using specific principles of internal collaboration to achieve the objectives proposed in the implementation of BIM. This requires, fundamentally, a high degree of specialization of the teaching staff in various aspects of the technical project and BIM technology, in addition to a high coordination and planning of roles and tasks, carrying out a direct work with students. At all times students, who are protagonists of their learning and the acquisition of skills and abilities, find the necessary support in different specific fields among the teachers involved.

It is recognized that the use of the BIM methodology in the development of technical projects involves a high employment of time in the design and modeling phase. With the application of our collaborative methodology among professors, a substantial improvement is achieved through strategies focused on the achievement of objectives. Each team of students is able to organize its work pace, which let them reach high levels of development of their project before deadline.

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STUDENTS EVALUATION OF TEACHING AND GENDER BIAS IN THE DEGREES OF ARCHITECTURE AND BUILDING ENGINEERING

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Keywords: *gender bias, students evaluation of teaching, technology degrees, building and architecture*

ABSTRACT

The enrolment of women in building and architecture studies does not reflect accurately their actual contribution to this professional field. In contrast to other engineering degrees [1], the contribution of female students to the overall registration is higher and somewhat similar to the presence of male students. However, the percentage of women that work in the field of building engineering and architecture is quite low [2] and the prospects of a trend change are scant [3]. On the other hand, the percentage of women teaching in architecture and building schools is clearly lower than that of female students.

Student surveys are the most common method to assess the quality of teaching in higher education [4]. This is somehow controversial [5], as some countries and/or universities use these results to take actions on the career progress of their faculty. Among the opposing arguments against this methodology, the possible existence of bias -and in particular gender bias- might invalidate the quality assessment results [6].

The main objective of this work is to analyze the status of the female faculty at the School of Architecture (ETSAE) of Universidad Politécnica de Cartagena, and evaluate how the students evaluation of their teaching activities compare to those of the male faculty members. A methodology to analyze the results of the surveys during the academic year 2015-16 is presented, that aims to quantify the influence of gender in the quality performance indicators of the quality assessment. Undergraduate and graduate programs at ETSAE are evaluated, and the extension of this methodology to other degrees at UPCT is discussed.

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SIMILARITIES AND DIFFERENCES IN THE TEACHING OF DESCRIPTIVE GEOMETRY. TRADITIONAL REPRESENTATION SYSTEMS VERSUS 3D COMPUTER TOOLS

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Keywords: *Descriptive Geometry; CAD; 3D.*

Abstract

Some of the Representation Systems in Descriptive Geometry have had a close relationship since its inception, not only with the description of three-dimensional objects, but also with the resolution of geometric problems linked to the definition of those objects themselves.

The Monge Double Projection, nowadays also called Dihedral System, is probably the most successful among these systems. In essence, it was established to bring order to other methods developed in the Stereotomy treatises.

However, the development of 3D graphic software has been an extraordinary step forward in that regard. As a matter of fact is closely linked to the appearance of new and remarkable geometries in the field of Architecture.

Although these powerful programs were developed two or three decades ago, their presence in our technical schools and especially in the subjects of Geometry, is surprisingly, very scarce.

In the ETSEM this is the second year we have conducted a pilot course in which we have approached geometry teaching by using 3D tools. This approaching [1, 2] is based on an almost literal transposition of the classical programmes of study in the field of Descriptive Geometry to a 3D course.

The experience so far has been enormously instructive, particularly in the convergences and disagreements that have occurred between traditional resources and those derived from a three-dimensional geometry. This fact has been what has given rise to a good amount of characteristic exercises both in the resolution procedures of certain geometric problems and in the same basic approach of those problems

According to our last findings, this paper makes a new revision of some of the similarities and differences between the traditional Descriptive Geometry and that of three-dimensional graphic programs.

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FLIP TEACHING DEVELOPMENT AND APPLICATION IN HEAT AND MASS TRANSFER

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Keywords: *Flip teaching, problem-based learning, internet, computers*

Abstract

A Flip Teaching methodology has been developed and applied into an obligatory subject of the 2nd course titled "Heat and Mass transfer" of the Energetic Engineering Bachelor at the School of Mines and Energy at the Universidad Politécnica de Madrid.

The flip teaching model is based on the separation of the receptive phases of the student [1]. Receptive, reflective and retentive are carried out in independent way by the timing the student considers effective, counting for that with audiovisual stimulus as well as notes and exercises in Moodle. The reactive phases: creative, expressive and practical must be done at classroom, with the guide and supervision of the teacher in individual or cooperative way.

For that purpose, there are two groups, the control and the experimental one. At the beginning, the control group has material prepared by the teacher such as power point presentations, a textbook, and problem repository. For the control group, the class activities consist on the theory explanation and problems resolution although with a minimal implication of the student.

Meanwhile, the experimental group has short videos on Youtube, and short tests on Moodle. These activities are integrated in the class with the explanation by the teacher of the errors detected in the tests, for about ten minutes. On the other hand, the classes on the experimental group are dedicated to make and resolve problems and exercises by small random groups being more participative. The role of the teacher in this case is to be a guide or "partner" solving the student doubts [2].

This work aims to decrease of absenteeism in class and the increase of the percentage of submitted to examination as well as the measurement of the impact learning and the use of a connection tool of the web-class resources.

The effect of the methodology is measured in the learning impact through the partial exams of two parts (conduction and convection) of the subject which account for the 66% of it. The result is that the mean value of the grades are higher for the group that has the flipped methodology than the control group.

Also, the dispersion of the notes is less ensuring a better level of students. The students attendance to classes and exams is also higher.

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LA FORMACIÓN EN COMPETENCIAS EN MATERIA DE ACCESIBILIDAD Y DISCAPACIDAD, COMO ÍNDICE DE CALIDAD DE LA DOCENCIA Y LA INVESTIGACIÓN EN LA UNIVERSIDAD

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Palabras Claves. *accesibilidad, formación curricular, universidad, competencias, aprendizaje.*

Resumen

El Real Decreto 1393/2007 reconoce la obligatoriedad de inclusión en materias de igualdad y accesibilidad, en la formación curricular de todas aquellas titulaciones de educación superior que así lo requieran. Considerando como punto de partida éste compromiso, se analiza la necesidad de desarrollar políticas universitarias, para garantizar la inclusión de la formación en accesibilidad universal y diseño para todos, como índice de calidad de la docencia y la investigación, como garantía de cumplimiento de los derechos de las personas con discapacidad, tratándose asimismo, la necesidad emergente de su incorporación, en las titulaciones técnicas universitarias, como garantía de inclusión de las personas con discapacidad. El objetivo es mostrar los resultados obtenidos, en aquellas titulaciones que se han implantado éstas asignaturas, así como la metodología utilizada para su incorporación en los distintos niveles, grado-posgrado y doctorado. Por otra parte se valoran como incide en los técnicos de la edificación, la formación en ésta materia y las oportunidades profesionales que les ofrece. Por último se muestra algunas experiencias pilotos desarrolladas en la ETSEM, de formación transversal en materia de accesibilidad en la edificación, como alternativa de aprendizaje, valorando los resultados obtenidos desde una perspectiva opcional para su incorporación.

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TRAINING AND INNOVATION SKILLS. A WINDOW FOR THE PROFESSION

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Keywords: *innovation-skills, teaching-activity, professional-activity, building-engineer*

Abstract

The issues related to the construction sector, in the last years has caused the loss of contact and relationship, between the professional and the academic sector, moving further away the interest of the former because they have to find solutions, for the loss of activity and economic solvency, harming the latter because to offer quality formation, is necessary to have contact with reality and have all sort of experiences where all parties are involved.

The contact with reality and the development of new practices, in the field of university teaching, was presented in this paper and they were proposed in the innovation project, as the first teaching need, approaching its application from a multidisciplinary perspective with which to get professional skills when applied in those subject that implied subject taught in degree and master, related to previous edited studies, reports, instrumental techniques, documentary techniques, in which the teacher teaches subjects intersecting different work dynamics that have been developed and that have previous experiences of performance [1], [2], [3], [4].

The proposed objectives are established in a double aspect, the one oriented to the teaching activity and the one oriented to the training and professional activity, For this purpose In the project, a procedure is designed in which the academic development is combined with the skills and experience acquired during its realization, with concrete cases, in a direct and real form, trying to convey that beyond the academic success, the companies and in general the labour market are looking for professionals with important technical knowledge and competent capacity oriented to obtaining results.

The methodology consisted in the development of 3 phases, each of them with different actions and procedures, all linked to professional development in the context of engineering and architecture, generating diverse documentation.

The improvement of the results obtained in the evaluation carried out after the application of the methodology described, during the three previous courses has allowed to conclude after the analysis carried out that the knowledge and the practical application of the competences constitutes a magnificent practice and teaching achievement, in able to provide our students with theoretical and practical training in areas common to the subjects in which they are applied, in order to prepare future skilled professionals in the domain of the most specific,

efficient and demanded activities, advocating for the main requirements of our University: quality and excellence.

The research presented in this paper is part of Project Previous Studies and Reports on Built Heritage Laboratory of the Unidad de Calidad, Innovación y Prospectiva of University of Granada.

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LEARNING MATHEMATICS THROUGH MAGIC

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Keywords: *Mathematics, secondary education, magic, mathemagic, algebra.*

Abstract

Cycle change experimented by the student who start Compulsory Secondary Education (CSE) mean san important change in terms of their education, both in contents of different subjects and in used learning methodologies. In the subject of mathematics, this change is even more significant, due to the introduction of abstract concepts, mainly in algebra, making learning process more complicated. This paper describes the experience carried out with the students of the first course of CSE, in a concerted school of Entrevias quarter in Puente de Vallecas district, introducing magic as a learning tool. The main objective of the paper is to show didactic possibilities of the mathemagic, both to the students and to the teachers, and to increase the motivation of the students for the mathematics, improving their academic performance. The results show a clear improvement of motivation in students in the themes of the subject presented through mathemagic. Playful element of the experience and participation of the students in the development of the sessions, make mathemagic a very interesting tool that can be used as a learning methodology in mathematics.

USE OF KAHOOT ON MOBILE DEVICES INTO THE UNIVERSITY COURSE OF THE BUILDING DEGREE OF THE SUPERIOR TECHNICAL BUILDING SCHOOL: A PRACTICAL ANALYSIS

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Key Words: *Gamification, kahoot, collaborative learning, virtual education, big group of students.*

Abstract

During the past years, university teachers have started to find that a new kind of student has appeared in their classes, the so-called "digital native student" [1]. Since these learners are different from those of the past, the necessity for seeking resources within the field of new technologies has arisen.

This research is based on the use of gamification as a support strategy to enhance student's motivation, effort and concentration in the classroom. For this purpose, the use of game-based learning platforms through the use of mobile applications has been proposed. Subsequently this type of tools are easy to engage the students make them participate actively in activities that generally will require more effort on their part.

The constant presence of information and communication technologies in almost all areas of personal and social life is generating a profound change in our current society. According to the *Mobile Report in Spain and El Mundo newspaper 2016*, carried out by Ditrendia, in 2015, 98% of young people aged 10 to 14 already had a last generation mobile phone with an internet connection. According to the data collected by Reig and Vílchez [2], 85% of Internet users between 16 and 24 years of age connect to the internet daily and almost three out of every four young people connect more than two hours a day. In particular, the incursion of Smartphones has a special impact in Spain, being the largest in Europe. According to a study carried out in 2013, it is indicated that while the average in European countries such as England, Italy, France or Germany is 57%, in Spain it already reached 66%. At age 14, 83% of Spanish children have a Smartphone. [3]

The information above denotes that the use of mobile devices stand out as one of the technologies that will be the protagonist in education in the near future

[4]. Since its popularity cannot be denied the idea of using it in our favor and turn it into a teaching tool has become a reality.

For this reason it has been proposed to carry out tests in Kahoot format when the theoretical explanations are completed. These tests will be carried out in different groups and in two different subjects with the aim of verifying the efficiency of gamification as a teaching resource. During the investigation, traditional written surveys and tests will be carried out to obtain data to create a quantitative assessment of the experience. At the same time, the motivation, predisposition and an approaching to the student to certain subjects of the Technical School will be studied qualitatively of Building will be tested.

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ESCAPE ROOMS FOR TEACHING ENGLISH IN SCIENCE AREAS

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Keywords: *escape rooms, English, science areas, emotional content.*

Abstract

Nowadays, students must face at different and challenging situations due to the society in which they are living in and they seek practical solutions for their needs. Therefore, teachers and professors should “escape” from the outdated teaching methods, rethink their strategies and adapt their classes to this circumstance. That is the reason why new trends in education are to be experienced and evaluated.

Following that, an important aspect of education that should not be underestimated is the emotional content. According to Pavlenko (2007), the emotional content in the classroom is not as high as in other contexts so it should be the teacher or professor’s duty to include the emotional content in classes.

Another significant aspect in education is the need of duties that involve working in teams and incorporating and mixing aspects from different subjects in a unique project work. This is yet another directive which lays bare the incomprehension formulated by students about the weak linkage between subjects.

Among the broad array of proceedings that can be carried out in classes in order to solve the above-mentioned challenges, escape rooms seem to be a valuable tool. Escape rooms are believed to begin in Japan in 2007 although the origins of this game have not been well certified. What it is being continuously documented is the impact and scope that they have in the educational world and it is our firm belief that escape rooms or escape games will help students to understand better the knowledge at the same time that they include a deep emotional content.

The project presented here consists on an educational experience in Secondary Education that aims at continuous improvement in Teaching Methodology at the same time that it contributes to enlarge the students’ interest toward higher studies. It could also be carried out in a Higher Education or University context.

Teachers and professors have been preparing “escape rooms” as a new trend for education but the new aspect of this project is the possibility to have “escape rooms” elaborated by the students themselves. This would lead to a better assimilation and comprehension of specific concepts or subjects.

Students of science areas will be challenged to document themselves about different concepts studied in class and create an escape room in English. Students must use English as the language used for communication throughout the entire game and creators of the game are to give explanations about the specific activities if a group is not able to escape the room.

This activity will entail a wide range of factors needed not only for learning a foreign language but also science areas. Creativity, collaboration, problem solving or critical thinking are some of these aspects to be worked while the establishment and successful launch of these escape rooms.

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A ROMANCE OF A MOOC ON ANALYSIS OF EXPERIMENTAL DATA COURSE

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Abstract

Are your experimental results believable? Are they “accurate”? Can you handle all the numerical data around you?

To answer those questions it is essential to have the right tools for a simple analytical insight of the results, while optimizing the measurement process. Engineering and science undergraduates perform routine error calculations in the physics laboratory towards this end; nevertheless this knowledge is restricted to official university students. Hence, opening the understanding of these techniques to the entire world will be of a great interest. Massive open online courses (MOOCs) have global reach, unlimited participation, and free access over the internet via a combination of social networking and video podcasts. Regarding those strengths, we have developed an Analysis of Experimental Data MOOC.

This talk addresses the development, from the very beginning of this MOOC as well as recommendations based on our experience and on the research we conducted to prepare for our MOOC design.

”To err is human; to describe the error properly is sublime.”

-- Cliff Swartz, *Physics Today* 37 (1999), 388.

MATERIALS SELECTION: A PROJECT-BASED LEARNING NEW METHODOLOGY

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Abstract

A new pedagogical approach called the project-based learning was implemented. Here, we report our experience with students of a Materials Selection Course where they had to work in randomly-selected teams to conduct a project. The goal of the project was to select a material to manufacture an already existing product by introducing an improvement (mechanical, physical, environmental...).

The adopted teaching approach was based on the project-based learning methodology, a student-centred pedagogy that involves a dynamic classroom methodology to gain knowledge and skills through active exploration of real challenges. It allows to enhance collaboration among members of the same team as well as the competition among different teams of students.

As a result, we have observed a higher level of involvement of the students than in previous years and therefore the development of very interesting projects.

INTEGRATION OF 3D PRINTING TECHNOLOGY IN ENGINEERING DEGREE TEACHING METHODS

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Keywords: *tactile exploration; 3d print; 3D scanning; inclusion; teaching*

Abstract

This article is based on two fundamental concepts. The first one consists on the need of converting 2D technical information to a 3D representation [1]. The second one, is the nowadays scenario in which 3D printing techniques are applied on different degrees, bachelor or subjects of university studies, in particular, on the Electrical and Electronics Bachelor of University of Castilla-La Mancha. This new technology, called Additive Manufacturing (AM), is applied, among others, to the medical, aeronautical or automotive sectors; although it is advancing and joining to other ones such as videogames, manufacturing or customized pieces, spare parts, or, even, in the design sector as jewelry, art or textiles or furniture [2].

Technological need of 3D printing in the teaching sector, and its consequent range of possibilities in the different areas of teaching of the Degree in Electronic and Industrial Engineering is proposed. It is important to consider, not only the reading comprehension through texts, the visual comprehension through images, or the auditory comprehension through audio; but also haptic touch or understanding through 3D shapes representation [3].

There are areas in the field of teaching that require advanced methodologies to improve student learning. Thus, the discipline of technical drawing that commonly represents figures 2D format. The application of 3D technology facilitates the abstract and complex understanding that involves the geometric representation of figures. Students often have difficulties in visual perception of figures, so it is difficult to determine the geometric properties and their 2D representation, and even by argumentation [4].

This article presents the different alternatives, possibilities and complexities that have been observed to integrate 3D technology in teaching; with real cases in university areas of technical drawing, electronics and robotics. We point out the special relevance of introducing this technology into technical bachelor such as

engineering, computing science, or architecture, for which this communication wants to serve as an impulse [5 & 6].

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THE EDUCATION IN THE UNIVERSITY WITH THE NEW TECHNOLOGIES

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Keywords: *Educational innovations, new technologies, teamwork, education in the university.*

Abstract

The education in the University is in a very delicate moment. A better learning planning is necessary, in order that the education is more effective. We need a new range of study plans ... etc. that are based on a complete formation. And this implies the utilization of the new technologies and the adjustment of the previous teaching systems to the evolution of the means. The drawing and the building have been necessarily united since the construction planification became so precise.

We can modify our teaching with the new technologies. Or using traditional methods with other approaches. At these moments the difference between drawing by computer and the BIM Objects in 3D BIM is synonymous of Building Information Modelling (Shaped with Information for the Construction). Whereas CAD's program uses only 2D or 3D geometry in without differentiating the elements, the BIM programs uses libraries of intelligent and parametrical objects, interprets the logical interaction between the different types of objects and stores the information relating to these objects.

The BIM marks a new age for the Architecture, Engineering and Construction professionals - AEC (Architecture, Engineering and Construction), that not only they will save time on having created and to modify their projects but also they will facilitate the top-level of interaction with their collaborators, partners or colleagues, on having shared specific contents of every speciality in the same BIM model.

That's the reason why it seems important to us, to analyse the studies that had been realized in these field or that were realized, this way to obtain a few future lines of action to face the challenge that the integration to the European Space of Top Education and the world Promotion of an European system of Top Education takes us

We are going to study the different educational methodologies in which we are working now, compiling the educational experiences developed in the Technical

Top School of Building, Technical University of Madrid (UPM), applied to several Educational different Units.

The importance of the student's preparation in the technological area is day after day more obvious. The preparation of our pupils in the communication and information technologies is essential, not only because they will be an object of its curriculum in later studies, but because they will be a fundamental tool in its professional work in whatever its dedication.

We must introduce our pupils in subjects as, Computer science or virtual presentations, as well as in the development of the teamwork. It is necessary to prepare them for the needs that the society demands and the development of his professional exercise. Simulating the reality it is possible to take better decisions in the project stage, since this way also foresee many of the problems that will arise in the life cycle of the building.

Before Revit it was projected in 2D and 3D, but with the BIM new concepts joined: · 4D-BIM: incorporation of the factor time in the project ·

5D-BIM: costs of the construction related to the time and the permanence of the building ·

6D-BIM: the building maintenance along his useful life

The University must be capable of providing qualified graduates to develop the reality and current requirements that the professional exercise demands. It is necessary that the future professionals are prepared in the knowledge and utilization of the distance learning, making them easier the possibility of being prepared in this topic.

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IMPLEMENTATION IN MOODLE OF STRUCTURAL ANALYSIS EXERCISES WITH PERSONALIZED STATEMENT FOR EACH STUDENT

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Keywords: structural analysis, E-learning, Moodle (Prado2), Python, spreadsheets

Abstract

The training of Civil Engineering and Architecture students in structural analysis, involves they comprehend calculation procedures for real structural elements sizing.

This work exposes the methodological experience developed through the Teaching Support Resource Platform of University of Granada based on Moodle (Prado2). The objective of this methodology is to improve the teaching-learning process in Structures Analysis disciplines. This teaching methodology consists in the resolution by the students of practical exercises with personalized starting data. Once the students have solved and sent them through Moodle (Prado2), the teacher exposes their solution in class. Then a debate with high student participation is established.

Each of the proposed exercises is resolved with a different procedure, and the used formulas can be enough complexity. For this, the creation in Moodle of questionnaires with calculated questions is difficult.

For this reason, before the questionnaires in Moodle are prepared, a template with a Spreadsheet application (Excel) is created. In this spreadsheet all the variants (different values of the variables) of the problem are generated. Then, with a Python script, all the variants are translated into the Moodle import XML format.

Then, in Moodle, the questionnaires of questions with nested answers (Cloze) or with multiple answers are prepared.

The implementation in Moodle of the practical exercises is beneficial for the teacher, in relation to the evaluation of the students works, because the correction of the exercises is more agile, and the results treatment can be easily managed.

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BEYOND THE CLASSROOM: USE OF MINI NON-FORMAL VIDEOS AS A REINFORCEMENT TO UNIVERSITY TEACHING IN COMPUTER SCIENCES

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Keywords: *video, non-formal learning, STEM, computer sciences, Learner Autonomy*

Abstract

The broad curricular program of the subjects, in the current degree programs, and the associated activities suppose a temporary limitation for the teacher at the time of teaching more accurately the contents of technical subjects in degrees of engineering, which also require the resolution of problems and the dedication of laboratory hours focused on the realization of practices. For the specific case of first year subjects, it is an additional challenge to adapt the student that comes from middle school, and needs more guidance from the teacher. It is also important to know the profile of the student [1,2], the vast majority included within what is known as generation Z [2], to try to motivate and awaken interest in the subject, making use of tools such as video that are common in their day to day [3].

This experience exposes a teaching practice related to the subject "Introduction to programming" of the first grade course, within the area of computer science. The main objective sought is to improve the academic results of the subject, which require basic computational thinking skills that most students lack, as reflected in the results of previous academic years. To achieve this goal, the use of video has been chosen as a reinforcement to teaching practice. A total of 22 videos of theory and practice have been recorded, with different purposes from the review to the delivery of specific aspects of the subject, have helped and guided the student throughout the course. These videos, of short duration, are based on characteristics of non-formal learning, making use of non-institutional platforms, but framed within a formal university subject. They allow student, accustomed to viewing videos on the internet [3], to review the most complex contents and repeat them as many times as necessary, allowing them to face the resolution of practices or the study of the subject. Teacher, on the one hand, allows him to emphasize aspects that he considers have not been solved in class or can be improved, and on the other perform a greater number of exercises or tutorials that would be complex to do during class for lack of time.

Throughout the communication will be presented the detailed development of the experience carried out, the classification of the videos made and a study, through surveys raised to the students, besides the analysis of the visualization

of the different videos in the moments key of the subject, in particular the delivery of practices and the different evaluation tests.

The results of subject and in particular the use of videos have shown an acceptance for students who used them throughout the course and a remarkable learning perception, in addition to obtaining satisfactory results in the number of students who passed subject.

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APPLICATION OF KOLB'S EXPERIENTIAL LEARNING THEORY IN THE OPTIMAL USE OF DAYLIGHT IN BUILDING

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Keywords: *Experiential learning, optimal use of daylight in buildings, educational research, learning by doing*

Abstract

A didactic proposal on theory and calculation of daylighting for students of Architecture and Building is presented based on the experiential learning of David Kolb. The fundamental bases to take maximum advantage of daylight in buildings are taught and thus be able to reduce the consumption in artificial light, with the consequent energy saving. This proposal is developed following the four stages of Kolb's learning cycle: concrete experience, reflective observation, abstract conceptualization and active experimentation.

This project has been carried out with a small group of students of Degree in Fundamentals of Architecture (UPM) in the subject "Experimental Workshop 2: Lighting Projects in Buildings". Students have performed a qualitative and quantitative study of daylight in different buildings, using scale models built by them. LI-210 photometric sensors have been used to measure illuminance in the models. Subsequently, students have made some changes in the openings of the building to improve the use of daylighting inside and have quantified the increase in daylighting achieved with this change.

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NEW WEBPAGE FOR TEACHING BUILDING MATERIALS BASED ON TECHNICAL ASSESSMENTS OF INNOVATIVE CONSTRUCTION PRODUCTS DIT, ETE AND DIT PLUS

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Keywords: *web, teaching, Building Materials, innovation*

Abstract

Teaching Building Materials is a subject where continuous update is required, as the industry constantly innovates. Technical Assessment of innovative construction products, is an activity led in Spain by IETcc since 1963. DIT, ETE and DIT plus are documents issued by IETcc for these non-standardized products resulting from voluntary favourable technical assessments. But nevertheless, it is a subject not well known by Architecture or Engineering undergraduate students.

To save this gap several seminars have been carried out. Even a brand new webpage <http://dit.ietcc.csic.es> have been recently launched. Nevertheless, its potential as a teaching tool for Building Materials has not been considered.

This webpage provides not only information about the history of the innovation assessment, but also, about what questions the mentioned Documents purposes and how to obtain them. Also, its free download is allowed. This permits users, once confirmed that the product is not standardized, to solve doubts about prescription, installation or applicable Regulations.

In particular, an example is presented regarding the technical assessment of cladding kits made of aluminium composite panels. Once finding criteria are set, like work unit (façade) or type of Document, the webpage show among others, the main following information: Existing Documents in pdf format DIT, ETE and DIT plus, even in English version, and particularly, the so called "PIA", Puntos de Interés Arquitectónico or Point of Architectural Interest" where images of existing buildings can be found in order to illustrate the final result of the product or kit once installed.

A further development is intended to be allowed this web page, which would may include, as examples, build-up videos, test laboratory photographs. The use of this webpage will not only to avoid barriers to innovation but to promote innovation since the early stages of the formation of the future actors in the Building sector.

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INTERACTIVE DIGITAL SYSTEMS IN THE TEACHING OF PHYSICS

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Keywords: *Interactive Digital Systems (SDI), Teaching, Physics.*

Abstract

In recent years, and responding to different proposals [1-3], the use of Interactive Digital Systems (SDI) in teaching has been implanted. The initial objectives for the introduction of these media in teaching were to improve the attention levels of students and make the classes more dynamic and interactive. All this without significantly increasing the workload of teachers.

As a result of the above, it was aiming to improve the throughput of students by improving both the ratio of approved students to students registered and a significant reduction in school absenteeism and dropout rates [4-6].

However, the results have not reached the desired objectives, although improvements have been achieved with respect to the usual expository methods.

On the other hand, the use of these SDI has required the implementation of training plans for teachers [7], since, although the use of the system is not complicated, it is necessary to habituate teachers to manage these media and generate content for them to obtain its optimal performance for use in the classes.

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THE ROUTE OF THE INGENIOUS. FROM EXPERIENCE TO THEORY. A MULTIDISCIPLINARY EXPERIENCE IN THE BUILDING ENGINEERING SCHOOL.

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Keywords: *innovation, cooperative learning, coordination, neuroeducation, coaching*

Abstract

Learning is experience, all the rest is just information. Albert Einstein. In our Schools ¿do we inform or do we create experiences? The great inventions and theories that we daily use were brought to light after much observation, analysis and experiments, until the final desired result was reached. Many paths were explored before coming to a positive result. Nowadays, the teaching that is offered (at least in our experience) is mainly carried out in the opposite direction to the process described, from theories, then it comes the memorizing and finally putting them into practice doing practical exercises.

What are the differences between the inventors and our students? What would happen if we taught our students by inspiring them to be passionate about what they do?, motivated by what they are going to discover and the use that this is going to have for them in their personal and professional fields and for society?

This paper describes the experience and the results of the aforementioned teaching innovation project, which has been carried out in the Building Engineering School of the University of Granada. The processes or methodological initiatives to improve the teaching, the academic results and the personal growth of each participant are the following:

- Coordinated teaching based on projects [1] of the five subjects of the term. The chronograms are balanced and a unique architectonic model as a practical object is used for all the subjects. The individual evaluation of each student is complemented with an oral defense of the common project of each subject.
- Class adaptation based on neuroeducation in order to evoke curiosity, attention and memorizing [2].
- Coaching Training Workshops. Cooperative learning among equals, "I win when my colleagues win", time-management, ways of being in the classroom and in life, the art of reaching emotions in public, decision taking and conflict management.

- Individual process of coaching to strengthen virtues and abilities and identify limiting beliefs by transforming them to thus facilitate the achievement of both personal and academic goals.

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DEVELOPING THE FLIPPED CLASSROOM LEARNING STRATEGY: TOOLS AND RESOURCES.

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Key Words: *Interactive Learning, Education, Apps, Innovation*

Abstract:

In a fast-moving world where society and technology are evolving so fast, the education system must adapt to the necessities and changes to not fall behind of our fast-moving world. New methodological and educational models and learning strategies have emerged in the recent years in order to make a significant progress into the educational field. However, this rapid technology growth has become a big challenge for teaching professionals. In line with the active implementation of technology into the educational field, new online tools and applications have been created to become the perfect partners for both teachers and students. In the present study, different online tools are provided in order to help teachers developing the learning strategy of "Flipped Classroom" into the class.

Among other proposals, this model proposes using gamification in class, videos and multimedia and online material with the main objective of the first cognitive levels of learning will be addressed by the student [1], thus the student is able to review contents and keep learning outside the classroom.

Pow toon is an online application to create animated presentations with music, objects, text and image designed by the user [2], each presentation can be exported to YouTube.

Edpuzzle is a free online platform that allows you to edit and modify your own videos or using Internet videos to adapt them to the needs of the classroom [3]. It allows to add development questions or test type, comments and modifications in any video.

Plickers is free tool to check the degree of assimilation of the contents by the students by providing the teacher with a formative evaluation [4], without the need for the use of technology in the classroom by the students.

Rubric Maker is an online tool for the creation of personalized rubrics at all educational levels. It allows you to create the rubric from templates or create them with your own content.

Goconqr is a free and personalized online study tool that helps greatly improve learning. These tools allow you to create, share and discover mental maps, study cards, online notes and tests.

It is verified that the use of online tools improves educational efficiency in the use of the Flipped Classroom methodological model. These tools imply an improvement when communicating with the students, teaching the contents and it changes the traditional role of the teacher. They also have the advantage that they are applicable to all levels of education. It is concluded that the main contribution of these tools is the help they provide to both teachers and students. These tools are useful not only for the feedback they report to the teacher but also for the self-assessment that they provide to the students. These platforms are very effective to analyze and get reports of general class performance and to identify the weaknesses of the students with the aim to focus on strengthening knowledge that has not been assimilated.

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LA ENSEÑANZA DE CONSTRUCCION MEDIANTE VIDEOS DE OBRA

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Palabras Clave: Videos, Visitas Obra, Dirección de Obra, TICs

Resumen

Tradicionalmente en la Escuela de Arquitectura se ha enseñado la arquitectura mediante la combinación de contenidos teóricos muy variados, y de desarrollo de prácticas que obligan a los alumnos a enfrentarse al proceso de concebir, proyectar, analizar, dimensionar y resolver constructivamente los edificios, organizados mediante asignaturas troncales de Proyectos y Construcción que vertebran el resto de la formación recibida (urbanismo, estructuras, instalaciones,...).

La enseñanza de la construcción, tanto en la Escuela de Arquitectura como de Edificación, se ha articulado mediante asignaturas más teóricas como Materiales de Construcción, con otras más orientadas a conocer cómo resolver los distintos sistemas constructivos, y otras eminentemente prácticas orientadas a resolver constructivamente los propios proyectos de los alumnos. Siempre se ha considerado una necesidad y una carencia el que los alumnos realicen visitas de obra durante la ejecución de los distintos sistemas constructivos para que visualicen cómo se ejecutan realmente, cuánto miden, cuánto pesan, cuánto manchan, cuánto cuestan... Como decía Germán Samper “la mejor manera de aprender arquitectura es con la presencia de las obras de arquitectura”[1].

Las rígidas medidas de Seguridad y Salud en la obras, las dificultades derivadas de cumplir con la normativa actual, las dificultades logísticas, los riesgos inherentes a deambular por la obra con tanta gente joven inexperta, sin las protecciones adecuadas,... hace que esta práctica, aun reconociendo que sería conveniente, no se lleve casi nunca a la práctica.

La presente comunicación expone los resultados del Proyecto de Innovación Educativa ARCHITECT – Visitas de Obras, en el que se han elaborado videos para suplir la falta de visitas de obra con los alumnos.

Para dar respuesta a los diferentes niveles de formación a lo largo del grado y master, se han elaborados videos de 2 tipos:

- **Videos de sistemas constructivos.** Se han montado videos a partir de fotos de obra aportadas por los profesores participantes en el proyecto. Los videos se han subtitulado y se han acompañado con una voz en off que explica el proceso de montaje del sistema.
- **Videos de problemas técnicos de obra.** Estos videos se organizan en 3 partes, una primera en la que se exponen imágenes o videos de obra con en los que existe algún defecto que puede provocar futuros daños, en una segunda parte se explica el defecto, y en al final se explica la solución técnica.

Los videos de sistemas descriptivos están pensados para los cursos de construcción del grado (Construcción, 1, 2 y 3), mientras que los videos de problemas técnicos de obra se reservan para los niveles más avanzados de master (Dirección de obra en. Master Habilitante).

Todos los videos se suben a la plataforma Innova basada en i-cloud de la UPM, que es accesible a todos los alumnos y miembros participantes. Los primeros videos ya han sido utilizados por los alumnos en la asignatura Construcción 1 y en la asignatura Dirección de Obras. Se han aplicado los videos descriptivos en la asignatura de Construcción I, y los videos de problemas técnicos y visitas de obra en la asignatura de Dirección Facultativa de obra, con resultados muy positivos por parte de los alumnos, que lo consideran una herramienta docente poderosa, y atractiva

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BIM MULTIDISCIPLINARY IMPLANTATION IN GIE THROUGH PARTICIPATION IN INTERNATIONAL COMPETITIONS-BIM VALLADOLID 2017

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Keywords: BIM, teaching, Collaborative work, multidisciplinary

Abstract

BIM methodology and its implementation in the teaching of Building Engineering -GIE- has been a strategic issue in the recent years for the Polytechnic School of Cuenca -EPCu- as can be confirmed by the various academic and research initiatives put in place. Among the latter highlights the creation of BIM-Lab within the UCLM's Technological Institute of Construction and Telecommunications -ITCT- and participation, through the group Cu-BIM, in national and international competitions as BIM COMPETITION [1].

The participation in those kind of competitions [2], far from a competitive spirit, comes from the needs to put into practice the knowledge acquired and taught by students and professors in the regulated teaching. The configuration of a multidisciplinary team with students, professors, graduates and professionals added extra value to an attractive BIM challenge. The allocation of different roles, the choice of applications, the definition and redefinition of the workflows and, above all, the realization of a "real" work in a collaborative way implies a huge stimulus for the students who will also have continuity with the materialization of various end of degree works -TFG-.

Winning the first prize in the 2017 edition only reinforces the good feelings once the work in the contest was over. For the teaching staff, in addition to the stimulating of the experience, taking part in this challenge has involved the implementation of a methodology that must inexorably do back to the GIE curriculum [3] and which is linked to the multidisciplinary subject as TFG [4]. For the professional future this type of activities, developed in a flat learning format -without hierarchies among professors, students, experts and graduates- has been a very enriching experience within its training itinerary, in addition to an excellent way to generate synergies and future professional options.

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UNDERSTANDING HISTORICAL CONSTRUCTION USING DYNAMIC CAD GEOMETRY TOOLS

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Keywords: *Analytic Geometry, Masonry, Historical constructions, CAD, Thrust*

Abstract

The use of computer tools for teaching purposes is a more common reality in technical education, both engineering and architecture. Its use to teach other concepts can be lost frequently trying to understand and manage complex tools away from design environments [1]. The mathematical bases behind structures are abstract concepts that are difficult to learn especially in design issues, and are not easily to assimilate disconnected from constructive realities.

The proposed paper shows how to use the application of analytic geometry software to understand the equilibrium of masonry structures, by drawing the curves and surfaces that describe the line of thrust using the same CAD environment. This is the method that has traditionally been used for the design of these structures [2]. Graphics and analytical forms of geometry are displayed at the same time, allows to show the interaction of geometry (expressed mathematically and graphically very easily and immediately and to understand their relationships [3]. The use of this type of software, besides being intuitive and very easy to use compared to the traditional method of teaching using vector drawing.

This use allows learning, in a very direct way, the different parameters involved in equilibrium in this type of structures, the weight of the material, the horizontal thrust, the point loads, the way point ... and how they affect stability or the collapse of this structural type [4]. The different ways that loads can go must be evaluated easily using analytic geometry. The kinds of structures that can be implemented using this tool are both the usual ones in the teaching of the mechanics of old masonry and free form structures. In all of them an analytical and graphic approach can be obtained

In most cases it is necessary to separate the teaching of the tool from the concepts that derive from its use. Teach how to drawing should be separated from teach a CAD software and teach how to constructive design a building from a BIM software, i.e [5]. Therefore, the challenge that arises for the future is to use of interactive digital tools with the aim of learning and understanding structural concepts, not only software. This is the case of the use of CAD tools through analytical geometry which is presented in this paper, in order to understand in an intuitive and simple way how of historical masonry structures works. The use of the same CAD design environment allows a very direct

relationship between geometric and structural concepts to interact and understand their behavior.

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REQUIREMENTS FOR THE PROPER TRAINING IN MATTERS OF PREVENTION OF THE WORKER WITH EXPOSURE TO ASBESTOS

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Keywords: *Training; Asbestos; Prevention; Royal Decree 396/2006; UNE 17130-1:2014 standard*

ABSTRACT

Nowadays, in Spain, asbestos and the use of asbestos-containing products are forbidden since December 2001 (ahead of the maximum period foreseen by the EU), through the Ministerial Order [1] approved on December 7th, 2001 (direct transposition of the Directive 1999/177/CE), which modifies Annex I of Royal Decree 1406/1989, of November 10th, which imposes limitations on the marketing and use apply of certain dangerous substances and preparations. This prohibition affects both the storage of asbestos, as well as the transformation and the use of it.

This change made by legislation enacted as a result of the classification of asbestos as a category 1 for carcinogenicity (C1), in accordance with the provisions of the Royal Decree 363/1995, of March 10th, which approves the Regulation on notification of new substances and classification, packaging and labelling of dangerous substances. Nevertheless, until the entry into force of Royal Decree 1299/2006 [2], the list of asbestos-related occupational diseases was not established.

The promulgation of Royal Decree 396/2003 [3], of March 31st, was the first specific regulation on minimum health and safety requirements for the protection of workers from risks resulting from exposure to asbestos, which allowed the establishment of specific guidelines in the field of Occupational Risk-Prevention in asbestos-related works. In accordance with this regulation, the obligation to establish preventive planning in those asbestos-related work is determined.

Similarly, article 13rd of Royal Decree 396/2003 [3] also contains the obligation to include contents and recommendations for safe work practices for handling asbestos in the workers' training manuals [4]. UNE 17130-1:2014 Standard [5] establishes the schedule of training for the safe work practices for handling asbestos and asbestos-related products, as shown in Table 1.

	Previous training	First refresher training	Awareness training	Refresher training
Employer and Manager	20 hours	6 hours	6 hours	20 hours
Supervisor	20 hours	6 hours	6 hours	20 hours
Staff / Employee	20 hours	6 hours	6 hours	20 hours

Table 1. Estimated length of the training course for safe work practices for handling asbestos according to UNE 17130-1:2014 Standard; being, **previous training**: before the first intervention and exposure to asbestos, **first refresher training**: the one carried out after a maximum of 6 months after having received the previous training, **awareness training**: yearly or whenever there are changes in the work procedures, **refresher training**: when more than a year has passed since the last time you worked with asbestos. Source: Instituto Nacional de Seguridad e Higiene en el Trabajo.

As can be observed, the regulation of asbestos-related work is increasingly demanding, so it is necessary to establish specific training protocols for workers to ensure their safety. As an approach to this, the qualification of workers with specialized training of this carcinogenic material is established.

On the other hand, in addition to requiring firms that handle with asbestos to be listed in the Registry of Firms with Risk of Asbestos (RERA, for its acronym in Spanish), it is necessary a very rigorous protocol regarding the planning of the works and the consideration of collective and individual protection actions according to their nature and the risks to which workers will be exposed.

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GEOMETRIY LANDSCAPES

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Keywords: Kahn, Timeless, ruin, Silence, Light

ABSTRACT

In the year 1950, the Estonian born architect origin but settled in the United States, Louis I. Kahn, thanks to the scholarship from the American Academy of Rome, comes into contact with the old European architecture, within the values of the classical tradition. The discovery of the city of Rome in the United States through a trip to the past of buildings of a timeless nature [1], and the order of the project of the Yale Art Gallery, which he began to sketch in Italy, suppose the discovery of the concept of mass, of ruin, of an architecture that emerges as a transfer received from The Enlightenment. In this way, a monumental architecture that will be reflected in his projects emerges after his trip to Rome, influenced by a classical geometry, and referenced to a human scale, where man is the center of the universe. Louis I. Kahn architecture is completely unrelated to the modern movement of the early twentieth century. This is visible in a series of buildings that are presented as monuments and remain exactly in the same location nestled in the same nature for centuries, in a geometry of unstoppable stillness where the Silence and the Light command, in an emphatic architecture that does not scream, homogeneous, monolithic, that almost does not speak.

The key of reflections in the search for the origins of Kahn, was going to be the verb and the word, in a series of forms as images anchored in the memory, as it was the materialization of poetry. As a an agreement between thoughts and feelings, as an interpretation reflected in the need for each element, each material, is shown as it is build, as it has been conceived. This leads to the extreme importance of the joint of the material, in the history of the trace of a constructive process, in the origin of the ornament, in a spatial manifestation between project and constructive

process. The material continuity of the work and the thoughts of Kahn are manifested in an overall image of the building as a whole, in a material experience as we are approaching the constructed work, the perfect unity of the



KAHN, Louis I. "Point Counterpoint II. El barco sinfónico de Kahn". (1.961)

material, the combination of related materials, achieving a great homogeneity, in a natural way of a mixture of materials, of a hierarchy.

In 1960, Kahn received one of the most ambitious commissions of his career, a boat designed for the tour of the Seine and the Thames of the American Wind Symphony Orchestra, an American orchestra traveling in Europe, a building which undoubtedly constitutes a tribute, a journey of classical geometry from Rome to the United States.

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LEARNING BASED ON PROJECTS: CONSTRUCTION OF A PHOTOVOLTAIC DRONE IN TRAINING CYCLES

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Keywords: *Higher Grade Training Cycle, Drone, solar energy, project based learning (PBL).*

Abstract

As is well known, the teaching in Professional Training is imminently practical. Students learn by making and assembling prototypes, strategies and skills they will perform in their future professional activity. It is for this reason that proposing academic challenges to students of training cycles, where students are forced to investigate and solve problems for themselves, prepares them for what they will find in their future working life.

Therefore, it is to create competent personnel, who at the time of integrating into the labor market are able to solve problems, be decisive, work as a team and collaborate for the benefit of the company to which they belong. In this way, at Salesianos Carabanchel, it has been working for a long time with the methodology of Project-Based Learning in these stages, since it allows contextualizing the student within a work environment, and also facilitates the realization of interdisciplinary projects, which relations several subjects belonging to the cycle. The main idea is that the students do not find the subjects as differentiated entities, but that they are able to relate the concepts they learn in them to build the kind of professional they want to be. to create competent personnel, who at the time of integrating into the labor market are able to solve problems, be decisive, work as a team and collaborate for the benefit of the company to which they belong. In this way, at Salesianos Carabanchel, it has been working for a long time with the methodology of Project-Based Learning in these stages, since it allows contextualizing the student within a work environment, and also facilitates the realization of interdisciplinary projects. which relations several subjects belonging to the cycle. The main idea is that the students do not find the subjects as differentiated entities, but that they are able to relate the concepts they learn in them to build the kind of professional they want to be.

As always with new technologies, the center is committed to training in renewable energies, being the only institution in the Community of Madrid that offers a CFGS of solar thermal energy and energy efficiency in its curriculum. Thus, taking advantage of this situation, the design and modeling of a photovoltaic drone has been carried out by the students of the cycle.

The prototype designed is a quadcopter, where the components that assemble said propellers have been designed for their design by means of a 3D printer. The control technology used has been the Arduino platform due to the cheapening of the final product and its ease of assembling code through its philosophy of free software. In addition, the Drone, has photovoltaic panels that provide greater autonomy to the battery and a thermal camera that will be used for the technical inspection of facades after parameterization of the flight algorithms.

This type of work shows how collaborative among all the teachers of the center, you can achieve surprising results and increase the performance of students, because if students are motivated, it is easier to advance the agenda and improve the level of class.

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IMPROVING THE PERFORMANCE OF MATH STUDENTS IN SECONDARY THROUGH THE GAME

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Keywords: *Mathematics, Compulsory Secondary Education (ESO), games, active methodologies.*

Abstract

For many of those who see mathematics from outside the teaching perspective, they find the subject boring and tedious. On the contrary, for mathematicians and lovers of this discipline, mathematics never ceases to be a game, which, despite its rules and formalities, once they are known and entertaining, it can even be fun [1].

If each day we offer our students the possibility of broadening their horizons and teaching them new things that are challenging for them, they will be involved in a teaching-learning process in which, if we manage to keep the initial motivation constant, the levels of performance and The use of hours in the classroom will be much more proliferated [2]. In this way, a well-chosen and organized game can be an auxiliary tool of great validity for the teacher, which will allow to explain concepts of high complexity and high degree of abstraction without de-motivating the majority, and providing a practical point of view to the students in tehe theoretical concepts.

There are many people who think that they are not able to devote themselves to mathematics, and that they would never direct their future towards a scientific-technological field. However, on many occasions, these same students solve complex puzzles that require a high degree of concentration, and are real experts in strategy games where abstraction and planning are essential to compete. For this reason, many researchers emphasize the importance of using recreational activities, and break with the traditional master class in the classroom in order to improve student performance [3-4].

In this work, an experience carried out in the Salesianos Carabanchel center of Madrid is presented, where by means of the use of board games it has been explained to the students of 4th ESO, totally new concepts for them, and complexes of understanding of first. This course has been chosen, since it is the end of the secondary stage, where students face their first great academic choice, having to choose between Baccalaureate or Vocational Training.

In this way, students are able to lose their fear of facing new problems, to work in the classroom, asking questions that they might not otherwise do because of ignorance or shame. Thus, it has been possible to appreciate a notable

improvement within the qualifications, which is directed towards a lower abandonment rate and a greater understanding of the subject.

Acknowledgment: The authors would like to thank the collaboration of the Universidad Politécnica de Madrid and the Salesianos Carabanchel center, for the time dedicated and their involvement in the innovation projects, always aimed at improving the learning and quality of their teaching.

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THE IMPLICATIONS OF ACADEMIC GUIDANCE IN PRE-UNIVERSITY COURSES

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Keywords: *Orientation, academic abandonment, Baccalaureate, personal-professional project.*

Abstract

Currently it is common to find students who start higher education in the university and during the first years they rethink their academic and professional future, leaving the university and beginning vocational training cycles of both intermediate and higher grade for various circumstances.

It is true that since the change of perspective of Vocational Training this has been revalued, mainly because of the good labor insertion rates with this type of qualifications, the flexibility of the training cycles, and its link with the university world in terms of validation. This is the reason why students consider a very valid alternative option to perform one of these cycles also included within the European Higher Education Area.

We found many reasons for the mobility of these students and we could group them into three types of reasons: for the economic situation; for the ignorance of the university studies (creating false expectations); or for the consideration of a lack of capacity to face the proposed contents. All these have in common the lack of motivation and a feeling of personal insecurity.

The orientation should be a guided process throughout the academic life of our students, and not limited to specific situations at the end of a stage. In this way the students who are finishing compulsory studies should be considered the realization of their first professional personal project reviewing it year after year so that it is getting closer to the reality that they are living; In this way, the decisions made are based on the real needs of the student and not on a personal desire at a specific moment of decision making.

Once the students finish compulsory education, there is a decrease in the orientation work of the students and it may be one of the main reasons why the students do not finish finding their professional path. We believe that many of these changes could have been avoided if an adequate reflection had been carried out on a personal level and guided by a professional. In the present work, the diverse reasons why students abandon university studies and if these could have been avoided with an adequate academic orientation are valued. In addition, a series of strategies are proposed in order to reduce the dropout rate by working from the elementary courses.

Acknowledgment: The authors would like to thank the collaboration of the Universidad Politécnica de Madrid and the Salesianos Carabanchel center, for the time dedicated and their involvement in the innovation projects, always aimed at improving the learning and quality of their teaching.

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COMPUTER TOOLS APPLIED TO THE STUDY OF STRUCTURAL CONCRETE

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Keywords: *concrete, app inventor, motivation, learning, educational innovation*

Abstract

The teaching of technical subjects involves a wide range of aspects, which makes them conducive to innovate in terms of teaching methodology, so that you can bring the reality of the building to the classroom and the resolution of problems that may arise in the same. In the subject "Structural Concrete" of the Building Degree of the Polytechnic University of Madrid, in addition to lectures by companies specialized in the construction sector, it has been tried to approach the student to a computer tool that can help him to decide in a moment given in the work, if a structural calculation is well done or not.

On the other hand, the increasing training of students in new technologies, makes its use as a tool for learning very interesting, in addition to the implicit motivation that supposes them. Taking into account these premises, it has been carried out at the level of small groups, computer applications that allow calculating the assembly of simple reinforced concrete structures, which can be used in their mobile phones.

The aim of this paper is to explain the work developed, its implementation and the assessment of students about their development and interest, by conducting a survey prepared for this purpose, where he has observed the interest that this type of experiences arouses in the student body

THE BUILDING MATERIALS EXHIBITION AS A GAMING EXPERIENCE FOR TEACHING CONSTRUCTION

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Key words: *exhibition, construction materials, collaborative learning, gaming, role play*

Abstract

Teaching Building Materials, has changed along last years in a substantial way. New study plans, internationalization of construction professions and the development, each time more accelerated, of new materials and manufacture procedures -- mainly those related to cut and 3D printing technology and tailor - designed materials, specific and particularized for a work -- obliges building academic and teachers to adapt to those changes not only for the curricula but also to teaching methods.

In this sense, the subject Building Materials and techniques of the UPM University Master Course on Architectural Construction and Techniques (MUCTA), the teachers' team have decided to focus the program as close as possible to the technological actuality in the field of Building materials. Under this strategy, we have been developing a great add value teaching experience: The building materials exhibition.

The students, set as three to five people groups choose one innovative product or a new prototype material, acts like commercial agents of materials, with products exhibitions, panels, brochures, videos and rest of common communication in this type of events. Students play (and from there gaming experience comes) roles like commercial, inventors, or exploiters of building materials patents; at the same time, they assume the role as visitors of the exhibition. During this session, teachers step back and students present, communicate, sell products to their colleagues, and collaborative and cooperative learning is produced.

Trough the Building Materials Exhibition, students can reach different learning results, both related to the Program content: Materials, technological innovation, advanced construction; those related to transversal competences: Searching information, critical assessment, team-work, oral communication, commercialization, etc. And as last but not least aspect, relations to

The result of the experience in teaching terms is quite satisfactory, due to it allows to reach learning objectives in an easier and more self-motivated way for the student; and even more important, it allows the acquired knowledge is better fixed due to the personal implication and the absolute practical focus of this teaching technique. In fact, most of students apply this skill for their Master final projects and furthermore they prescribe the studied products or materials.

ANÁLISIS DE LA INTERACCIÓN DE LOS ALUMNOS DE INTERCAMBIO ERASMUS EN LOS RESULTADOS DE GRUPO. CASO DE LA ASIGNATURA DE CONSTRUCCIÓN POPULAR

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Palabras Clave: *alumno, intercambio, grupo, erasmus / student, exchange, group, erasmus.*

Resumen

Este trabajo presenta los resultados del análisis realizado sobre los datos obtenidos del rendimiento de los alumnos en la asignatura optativa de Construcción Popular Española (también denominada vernácula y tradicional). Concretamente se han tratado los aspectos relacionados con la presencia de alumnos de intercambio en la misma.

La citada asignatura es de reciente creación, impartándose por primera vez en el curso 2013-2014. En lo referente a la presencia de alumnos de intercambio, se han incorporado en los dos últimos cursos, representando un porcentaje sustancial de los alumnos totales.

El atractivo de la asignatura para estos alumnos radica en el hecho de ser una asignatura optativa, siendo más elástica estructuralmente; tratar un contenido propiamente dedicado al ámbito español, que resulta especialmente indicado para un alumno universitario con curiosidad por una cultura diferente a la propia y que sin embargo se refiere a una tecnología universal como es la construcción, por lo tanto fácilmente integrable en sus propios conocimientos.

Para este trabajo se han tenido en cuenta los factores referidos a la interacción entre los alumnos que son de intercambio (concretamente los erasmus) y los que no lo son. Tratando de obtener conclusiones que permitan orientar al alumno de intercambio en el desarrollo de la asignatura, en la forma de afrontarla y de trabajo con el resto de los alumnos [1].

Para superar la asignatura de Construcción Popular Española es necesario realizar un trabajo individual y otro en grupo (equipo) [2]. El primero versará sobre un edificio de propio de este patrimonio, realizando un análisis pormenorizado de las características físicas del mismo y de las estrategias constructivas elegidas para enfrentarse o responder a los condicionantes del medio en el que se encuentra. En el segundo, el que deben realizar en grupo (trabajo de equipo), se les pide que elaboren un análisis de los factores ambientales, geográficos, geológicos, climáticos, históricos y económicos de una de las comarcas históricas de España y un catálogo de las soluciones constructivas que responden a estas características.

El trabajo en grupo (trabajo de equipo) es por tanto sustancial para superar esta asignatura [3], exigiendo de los alumnos una relación estrecha de trabajo, intercambio, discusión y colaboración. A priori no se exige que los grupos de trabajo sean mixtos, por lo tanto se forman equipos en los que los componentes son todos de intercambio, equipos con ambos tipos y equipos sin alumnos de intercambio.

Esta libertad permite ahora analizar resultados de equipos con diferentes composiciones. Para el análisis de conjunto se han tenido en cuenta factores como la proporción de alumnos de intercambio total, calificación individual, calificación media del grupo, calificación media discriminada, calificación media de los equipos en relación a su composición, etc.

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PROJECT-BASED LEARNING APPLIED TO SUSTAINABLE CONSTRUCTION

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Keywords: *Project-Based Learning, Sustainable Construction*

Abstract

The present study is part of a university research project on optimization and disclosure of sustainable building systems using blocks of plant fibre.

We are in a situation of ecological overreach characterized by a climatic destabilization, for the overconsumption of all kinds of biotic and abiotic resources and the annihilation of planetary diversity (Steffen et al, 2015; WWF, 2016).

However, accepting biophysical limits is not an easily assumable decision. The culture of progress has been constructed by denying these limits. So we are facing an extraordinary challenge, that some call "La Gran Encrucijada" (The great crossroads) (Pratts et al, 2016) or "El siglo de la Gran Prueba" (The century of the Great Test) (Riechmann, 2013).

One of the questions to be asked that determined the way forward in this project is, if high technologies are really sustainable and the high complexity in such a context. For this reason we preferred solutions based on light industry, on intermediate technologies with a very limited consumption of resources.

The mentioned project posed the following challenges:

- Have procedures, systems and materials that are truly sustainable.
- Disseminate knowledge about sustainable solutions for building.
- Implement and present as a broad research essay, the planning and construction of a small building, a prototype, which served as a complement and improvement of student training: "Cycle of project writing and prototype execution workshops".

The prototype also was directed to conduct research on sustainable construction. The method used is the one called BPL (Project-Based Learning). Figure 1 shows the prototype in the roof structure presentation phase.



Figure 1. Prototype of plant fibre Blocks (Revuelta, 2017)

For writing draft workshops they were held several conferences, some on drafting construction projects with straw bales and others on bioclimatic architecture. The students of the second year of the Degree in Architecture were asked, organized in groups, to prepare the drafts presenting: floor plans, elevations, sections and constructive section. A court decided which of the proposals would be developed and subsequently built. For this, the criteria initially prescribed to students were applied.

Subsequently, several writing workshops for the execution project were held with the fourth year students of the Degree in Building.

The prototype was built organizing workshops cycles with a weekly periodicity, guided by the authors of this article and construction professionals with vegetable fibre blocks.

Participants in the workshops were able to put into practice, with this method, the theoretical contents addressed in the classroom, as well as develop a practical vision of the need to use sustainable materials and bioclimatic construction techniques. The workshops helped them learn to manage these techniques and materials, tools, project management and safety and health at work.

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FIRST FORMAL TRAINING EXPERIENCES IN THE BIM ENVIRONMENT. THE CASE OF THE DEGREE IN BUILDING OF THE UPM

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Keywords: *BIM implementation, Building Degree, Educational innovation, BIM teaching*

Abstract

Directive 2014/24 / EU on public procurement establishes in 2014 at European level the need to use electronic systems (means of communication and tools to model building data) in contracting procedures of building works, services and supplies. In Spain, the Ministry of Development has established through its BIM commission, that as of December 2018 and July 2019, both public buildings and infrastructures under public ownership respectively, are projected in accordance with the BIM methodology [1]. Under this schedule it was essential for the Spanish University [2, 3] to respond by implementing new disciplines, or adapting the existing ones, to achieve skills and competencies for the proper training of future professionals, as it is demanded in other European universities [4, 5].

For this reason, the Department of Building Technology of the ETS de Edificación of Madrid, faced the difficulties of adapting existing disciplines and established a rigorous teacher training method, at an almost individual level. It was proposed a new optional subject that would allow interested students to get started on the BIM work methodology. This subject was organized with a triple purpose:

- Offer basic training in this regard to students for their immediate professional activity
- Obtaining minimum knowledge to be able to access higher BIM training stages
- Obtaining necessary skills to follow the academic tasks within the degree and double degree studies

Thus, this specific subject appears within the BIM environment and was named: "Introduction to BIM through modeling tools". After going through the National Agency for the Evaluation of Quality and Accreditation (ANECA), it was

approved and included in the Curriculum of Building Degree in the UPM, beginning its adequate training in the academic year 2016-17.

This experience has been the only formal training established in the School of Building in the field of BIM. Once implemented, our first objective is clear: To study its level of implementation and to gauge the level of satisfaction among the students. In other words: To discuss the fulfillment of the triple purpose for which it was created, as well as to study different proposals regarding teaching intensification made by the students themselves.

For this, a qualitative analysis run by the teaching staff of the subject was made, followed by a second quantitative analysis based on surveys carried out among the students.

The results obtained are highly satisfactory and announce a very high demand by the students in order to intensify and incorporate BIM teaching as an essential tool for their studies and their professional development.

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VIRTUAL AND REMOTE LABORATORY FOR THE INTEGRATED ANALYSIS OF ENERGY EFFICIENCY AND COMFORT IN BUILDING

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Keywords: *Virtual laboratory; Energy performance simulation; Building education; Remote building performance analysis; Integrated virtual model teaching.*

Abstract

The directives of the European Union regarding the construction of a European Higher Education Area, highlighted by the Bologna Declaration [1], have encouraged several innovative strategies for education, including as a European universities' research area, the development of Virtual and Remote Laboratories for the teaching of technical subjects [2, 3, 4].

The "Gabinete de Tele-Educación" of the "Universidad Politécnica de Madrid (UPM)" has created a platform built on OpenSim open source software, available for the different schools of technical degrees to request the development of a virtual and remote laboratories to train up their students.

The virtual laboratory allows students to carry out their practices from anywhere with an Internet connection, emulating face-to-face practices with the possibility of virtually accelerating processes that require extended deadlines in real life, improving the use of available resources and offering practices only possible in virtual format due to attendance or security matters.

The "Escuela Técnica Superior de Edificación (ETSEM)" of the UPM has proposed the development of a virtual laboratory based on the simulation of an existing real building which provides students with an accessible model in which they can understand the complex energy balance produces in the building and allows them to establish the possible integrated strategies that can be implemented to improve the building energy efficiency and the user comfort.

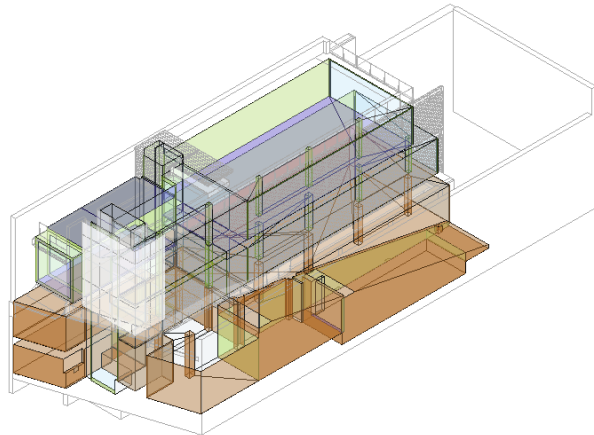


Fig. 1: *Modelo integrado de simulación del comportamiento energético de edificio existente / Integrated model for simulating the energy behaviour of an existing building.*

When the student enters into the virtual building, he can visualize its geometry, its physical and performance characterizations and its technological qualities. He also can analyze and implement strategies, either suggested or by his own, and receives the result of the real-time behavior of the building depending on the meteorological conditions in the period studied.

The practice that will be carried out with this virtual laboratory allows the unification of the latest trends, with better learning outcomes for the student, in educational innovation: the collaborative classroom, the inverted classroom and the use of augmented reality.

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TRANSDISCIPLINARITY IN THE CONTEXT OF THE APPLICATION TO THE BUILDING OF SUSTAINABLE DEVELOPMENT MODELS

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Keywords: *Sustainable Construction, Sustainability, Building, Transdisciplinarity, Case Study*

Abstract

The development of a European space for higher education, also known as the Bologna Process, and the achievement of its objectives requires the inclusion of paradigms that, without being new, require a new role in higher education.

The analysis of the analyzed experiences extends and multiplies the perception of the diversity that can already be observed within each institution and that deserves a coordination, acceptance and respect that is as productive as formative, evidencing its integration in the prosperity of the academic institutions. The overabundance of disciplines, approaches or objectives in very specific areas produced by the enormous segmentation of knowledge for the sake of specialization. This perception is multiplied when the geographic scope in which the academic activity is developed expands and are aware of other institutions of higher education in the European environment.

In this line, the European Community has reinforced the interest in promoting multidisciplinary approaches, (R 1292/2013), to reinforce interdisciplinarity and transdisciplinarity (COM (2006) 208 final) and to include interdisciplinary studies (2015/2039 (INI)) .

Topics related to environmental sciences and social sciences can be considered pioneers in the search for areas of confluence of different disciplines, so you can find more epistemological references, methodological and knowledge formation process in the disciplines related to these areas of knowledge .

Applied sciences and technologies, such as engineering, architecture or building, can take advantage of this experience for what is proposed to be applied within the area of architectural constructions and in a more specific way in their collaboration to sustainable development. In this new scientific-technical application are recognized, from its first definition, economic, social and environmental aspects to the extent that are vectors of development to achieve the satisfaction of human needs of a particular society and environmental ambience.

To facilitate the acquisition of skills in the understanding of complex and transdisciplinary concepts, two lines of work are proposed. The first one refers to the acquisition of theoretical knowledge and its application to the construction requirement, while the second one refers to the systems, models, products or processes definition in which the knowledge learned is materialized.

For the first proposed line, the one related to the knowledge of the transdisciplinary implications of the theoretical contents, a process is proposed in which the sessions of the contents' sharing, together with the study of the subject, are preceded by a virtual information exchange through questionnaires, emails and forums in which the fundamental aspects are discussed with the participation of professionals, entrepreneurs, experts, teachers and scientists in the areas of work, making the exchange of information a learning.

The debate conclusions of lessons learned, that are part of the theoretical session and of the consultation texts for the preparation of the evaluation tests, will be gathered and summarized in an informed document, of shearing writing between the professors and those students who have demonstrated its interest and solvency in the development of the topic, and will be made available to everyone as lessons learned, and for consideration in the evaluation processes.

In parallel to the theoretical content, the discipline requires the practical application of the acquired knowledge to one of the areas under study, through the development of a practical application evaluated from the point of view of its contribution to a more sustainable development (S+D). The involvement of professionals, entrepreneurs, experts, teachers and scientists from other areas in the questioning of the approach and in its final evaluation will require a dialogue that puts into practice what has been learned.

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STUDY AND RECOVERY OF PUNO ANCESTRAL ETHNIC ENGINEERING

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Keywords: cultural costumes, cultural identification, Putucos, communities.

Abstract

A practical research work has been proposed to 43 students of the Universidad Peruana Unión, grouped into 6 groups of variable size, from 4 to 10 students. The work consisted of collecting information about 3 to 5 Putucos per group located in the Peruvian highlands. The students have taken a field data collection with the help of a guide sheet, the students have interviewed the inhabitants of the homes under study and have expressed it in a written document and Power Point presentations.

The objective of this work is to make the new generations of Puneños reconcile with ancestral constructive traditions of the Peruvian highlands and especially



Figure 1: Field research. [1][2]

those who are going to direct their professional life to construction. In this way they learn from their ancestors, recognizing the quality of their ethnoengineering and how it led them to resist the highland climate. (Fig.1)

The methodology used for this recognition has been a form with the following main headings: tangibles, constructive process, distribution, customs, names of owners, others.

Each section, in turn, is broken down into subsections, to make a complete, organized and ordered data collection. (Table 1)

Table 1: Data collection of rural housing

DATA SHEET	
1. Tangible elements	
2. Constructive process	
3. Distribution	
4. Costums	
5. Name of Owners	
6. Others	

As conclusions of this work, it could be observed that although there are still Putucos in the Taraco area, some of them with an age of 70 years, many are used as kitchen or storage.

In several of the cases, the students could be part of the Ch'ampas extraction process, an autochthonous material used to build these buildings and the subsequent construction of the Putucos. As a result, this experience has been enriching for them since they were reunited with their culture and customs that they had forgotten.

The ultimate goal of the development of this work, is that future civil engineers can implement and improve this construction system in future rural buildings, thanks to the knowledge acquired in depth and in this way contribute to sustainable construction.

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THE LANDSCAPE AS A TOOL FOR EDUCATIONAL INNOVATION IN THE TRANSFORMATION OF SCHOOLYARDS IN GREEN INFRASTRUCTURE

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Keywords: *ecological design, green infrastructure, proximity ecology, project learning, participatory learning.*

Abstract

The approach of urban ecology to citizens is of vital importance to help solve the environmental challenges that arise in our time and its repercussion in the future. In this sense, education and awareness through the active participation of citizens, allow them to be active participants in this transformation. In this way the connection of citizens with nature in the city is favored, but for this it is necessary to identify and create multifunctional areas with educational, ecological and socioeconomic value (Fernández Pablos, 2015), that is, the creation of Green Infrastructure networks that favor the integration of social, economic and environmental policies and promote dialogue between different administrations and citizen participation (European Environmental Agency, 2011). Within the characterization of the creators or integrators of Green Infrastructures, the European Environmental Agency (European Environmental Agency, 2011) cites green areas in schools as multifunctional elements; however, at present the design of these spaces leaves insufficient space for the environmental function, contributing to the disconnection of children with their closest nature.

The current educational spaces offer great possibilities for intervention, through education projects from the landscape and educational innovation, linked to the school curriculum. Multidisciplinarity is a feature of the landscape study, so it is naturally integrated in the school curriculum transversely. Based on the concept of landscape understood as a system, the holistic study of space and the participation of the educational community to create a sustainable project in which students, parents and teachers, are the protagonists of the transformation of space. Through experimental and participatory learning, we work to design a friendly space that serves teachers to show natural processes, links with the character of the place, develop creativity and observation, encourage physical activity through work in contact with nature, work the perception of space, etc. (Christidou, Tsevreni, Epitropou, & Kittas, 2013).

The program developed by the company SERVAC SL in educational and therapeutic areas meets these long-term objectives, with a timing of activities adjusted to the school year and agreed with teachers, which begins with the analysis of the reality of the center through a workshop in which students can express how they perceive the playground and how they would like it to be (Figure 1). Gradually the schoolyard is transformed into a space for biodiversity by students, with the help of relatives who want to be involved in the project (Figure 2). One of the most important aspects is the understanding by the participants that it is a work by projects and collaborative, in which all participate in the accomplishment of tasks that, together, will contribute to enjoy a playground in which to learn and play in and with nature.



Figure 1. Example of proposal of 6th Primary CEIP Teresa Berganza students. Boadilla del Monte.



Figure 2. Development of workshops with students and parents. CEIP Teresa Berganza. Boadilla del Monte.

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