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Special Issue
Active Learning Experiences in Engineering Education

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The Architecture, Construction, Engineering and Operation (ACEO) industries are in urgent need for students with the capabilities to successfully implement BIM projects with sound strategies. Educators notice that project-based learning (PBL) can help students to understand the practice and challenges of the industries. But few researches paid attention to implement the PBL approach that could cultivate the expected BIM competences using capstone and real-world projects. In order to respond the problem, this research proposes a process framework of BIM project execution planning (BIM-PEP) for capstone with the integration of PBL and real world project information, The BIM-PEP includes steps of implementation and team roles, learning schedule, response collection and evaluation criteria. This research uses case studies to collect data for the group and instructions responses of the framework implementation. The results indicate that the students are able to conduct the chosen BIM uses according to process mapping in the early phases of PBL following the procedure of BIM-PEP. The responses also show the strengths of BIM management and technology and point out the possible improvements such as flexible capstone schedule and early preparation. This research provides a novel method of process framework and a case study for BIM-PEP capstone, which embodies the knowledge body of BIM education and PBL pedagogy to enhance student competences of engineering education. It provides a sound foundation for the instruction of BIM education in university teaching.

Keywords: project based learning; BIM project execution plan; construction and engineering management; capstone; student engagement

The aim of the study is to investigate barriers and motivators faced by American Indian students wishing to transfer from 2-year pre-engineering associate degree program to a 4-year bachelor's degree program using the active learning approach of photovoice and photo-elicitation. Five community college pre-engineering students participated in the study, which required them to meet with a faculty mentor about every 2 weeks and respond to four photovoice prompts. For each prompt students were required to take two pictures and write narratives explaining them. The photos and narratives were qualitatively assessed to identify four emerging themes related to enrolling and persisting in engineering education: (1) scheduling and prioritizing, (2) routine and structure, (3) family and community, and (4) avoidance motivation. This paper makes several contributions. First, it provides an example of how to apply photovoice and photo-elicitation to engineering education as an active learning approach to increase communication skills and reflection. Second, it highlights how the approach can be used to improve student success for non-traditional, underrepresented students. Third, the findings provide evidence for improved resiliency and increased student satisfaction when this active learning approach is combined with mentoring and applied to engineering education through the non-traditional pedagogical approach of photovoice and photo-elicitation.

Keywords: qualitative; Native American; minority; pictures; narrative

The purpose of this article is to describe and evaluate a framework for active learning to enhance research skills among engineering students. Following a tradition of experiential learning, we have developed a conceptual framework to support such learning. We use the term 'PROE' to refer to the framework suitable to characterize a research design in terms of four related aspects: purpose, research, outcome, and evaluation. The PROE framework is a model *of* as well as *for* research. It can be used to design, redesign, and evaluate a research process by involving not only the ability to apply specific techniques and follow specific procedures but also the higher-order competences of alignment and adjustment. As such, it is an educational framework, actively promoting the teaching-learning research activities in engineering education. We evaluate and discuss the effects on student learning by looking at data from personal observations, course evaluations, and student research projects. Thus, we contribute to the field of active learning in engineering education with a presentation of PROE as an educational framework for active learning to advance research in engineering education as well as an evaluation of the students' and our own (as lecturers) learning experiences.

Keywords: engineering research; teaching-research nexus; research design; alignment; adjustment

Similarities between the characteristics of project-based learning (PBL) and those of engineering practice make curricula incorporating PBL ideal for undergraduate engineering coursework. Given the suitability of PBL for engineering coursework, the present work explores students' epistemological stances within a PBL environment. Through semi-structured interviews with students enrolled in a project-based introductory civil engineering course, the present work explores how students mediate their engagement through practical and formal epistemological lenses. In particular, this report finds that students initially struggle to find academic authenticity in the project-based learning environment, suggesting there are tensions between both propagated and fabricated knowledge and between students' formal and practical epistemologies in engineering during their engagement in PBL. By the conclusion of the course, however, many students resolve this epistemological tension, finding value in active learning and identifying learning outcomes from the course syllabus.

Keywords: project-based learning; civil engineering; personal epistemology

This paper presents a case-study, quasi-experiment in the framework of Architectural Engineering (AE) Bachelor (BA) degree in the United Arab Emirates University (UAEU) and the Architecture (Arch) BA at the American University of Ras Al Khaimah (AURAK). To analyze the best approach to introduce Building Information Modelling (BIM) tools into Academia, we evaluated three different approaches by introducing a new BIM tool (Revit) into a construction course. These ICT tools (Information and Communication Technologies), are currently required by the Architectural, Engineering and Construction (AEC) industry. We tested the students' performance, submissions and opinions of the course methods in order to evaluate these approaches. In this study, we compared the students' performance in the Building Components course (BCC) at UAEU and in the Construction III course (CIII) at AURAK, analyzing how these new course designs affected the students. We tested the BCC course during six semesters and the CIII for two semesters. To achieve a better understanding of the impact of the course on the students, we used the grades of the students to quantify their performance, compared their submissions and interviewed three random students from each semester. There are few studies on the architectural introduction of Revit and BIM into the Architectural curriculum, even though these tools are currently necessary in the Architectural, Engineering and Construction industry. Based on the data obtained from the academic files, the interviews with the students and the analytic study of the data, we created a set of recommendations to introduce Revit into construction courses in the AEC curriculum while preventing a drop in the performance, skills and knowledge acquisition of the students.

Keywords: architectural engineering; student performance; curriculum; BIM; Revit; educational assessment; academic analytics

The experience presented is part of the teaching of two subjects of the Mechanics discipline: Continuum Mechanics and Strength of Materials, in the field of Mechanical and Industrial Engineering. In the bachelor's degree at the ETSEIB-UPC, the first semester of the third academic year is devoted to Continuum Mechanics and the second one to Strength of Materials. Both subjects integrate theory and practice: applications, lab and coursework. The article focuses on the coursework or also named course project, which consists of designing/optimizing, analysing, manufacturing and testing a mechanical/structural element subject to stresses and strains. This paper aims at showing the benefits of combining practice, theory, simulation and experimentation, as well as some of the limitations and difficulties encountered in its implementation, such as the evaluation of the degree of involvement of each team member and the lack of correlation between the mark of the coursework and examinations' scores. An important conclusion is that students enjoy the project, get deeply involved and work hard, making the subject more attractive.

Keywords: active problem-based learning, hands-on learning experiences, innovation in engineering education

MOOCs have made it possible not only to provide quality open education for any learner worldwide, but also to rethink the way on-campus teaching is delivered. The materials produced for a MOOC can be consumed by on-campus students before arriving to the classroom, using class time to do activities that promote active learning, following this way a flipped classroom strategy. This paper presents the experience of redesigning a first-year engineering course with a large number of students (over 400 each year), in which MOOCs are reused, and a flipped classroom strategy is implemented, dedicating most of traditional lecture time to do hands-on, interactive activities. The results show an increase in students' motivation, both in the use of MOOC content outside the classroom, and in the realization of hands-on, interactive activities inside the classroom. In relation to the teacher, having information on students' previous work outside the classroom, and on students' work in the hands-on, interactive activities carried out inside the classroom, allows understanding better the differences between groups, tailoring the explanations during class time, and providing proper reinforcement activities to be done after class.

Keywords: flipped classroom; MOOCs; active learning; engineering education

All active methodologies have common objectives and processes. Their mission is to ensure that students participate actively in the learning process, cooperating with other students, reflecting, making decisions and creating knowledge. For this purpose, groups that work in a timely manner to carry out an activity or in a more stable way through work teams are usually formed. In both cases, active learning takes place within the groups. This work proposes fostering an active inter-team learning; that is, forming a meta-team where active learning takes place. The aim is checking if students who follow an active methodology, have the active habit; that is, if the work teams share knowledge among themselves and use it to improve their own knowledge. The proposed model contains a virtual layer that all teams can access, making possible the cooperation, the creation of new knowledge, reflection and decision making. This model is applicable to any active methodology and the proposed model has been applied to the Micro Flip Teaching methodology. This quasi experimental research methodology, based on quantitative and qualitative assessment, shows how the work teams, in an Engineering context, in this case, use this virtual layer and how that use impacts the academic performance of their members. Another conclusion of this work is that feedback must be included in active methodologies.

Keywords: active methodology; flip teaching; cooperative work; feedback

Moodle forums can be a great way to share course information, build community and allow students to easily share resources and ideas. However, students' day-to-day discussions are not happening in Moodle but in instant messaging applications' groups, such as WhatsApp or Telegram. This work explores how the students' motivation and engagement were affected by shifting the academic discussions from Moodle forums to Telegram groups, based on the results of 3 years of work, with two courses using forums and one using groups.

The results show that the students perceive the Telegram groups as much more dynamic, closer and faster than the forums; groups also allowed a greater interaction between students (cooperation in the development and solution of problems). Data also show a greater engagement and activity of the students who joined the Telegram group in contrast with those who used the Moodle forums. More than 90% of the students also indicated that they wish to continue to have Telegram class-groups in the future.

Keywords: Telegram groups; Moodle forums; digital communication

Optimizing room acoustics teaching for architects and building engineers is an unfinished business. Moreover, theoretical explanations about acoustic concepts hardly support the understanding of basic concepts of acoustics on these students. A basic BLA (Bipolar Laddering Assessment) experiment is presented with students showing that an active learning method can be accepted by them more easily when ''sonification'' is included in the course. This process, which converts data into non-speech audio to make acoustic concepts audible, is suggested as a possible solution for this problem. Additionally, the experiment indicates the basic guidelines for the improvement of a project-based pedagogy, which pretends to broaden architecture student's insight into acoustic problems.

Keywords: active learning; room acoustics; BLA; architectural education

This work presents the structure and results of an ongoing engineering faculty development program at a large private university in Chile. This program uses the conceptual change approach as a framework in a recursive way, and it is specially designed to promote and ensure the use of active and innovative methodologies. The development program consists of six steps that aim to strengthen a learning community that fosters interaction of professors with common problems, interests, and experiences in a way that the collegial work sustains over time the dynamic and improved incorporation of active methodologies for teaching and learning. For this paper, we focus on the structure and some results. The results are related to faculty, students and institutional perceptions. We have evidence that faculty in this program changes their own perceptions as instructors towards reflecting whether their role is less regarding to transmitting knowledge, notes, and presentations to students. In the case of students, after a survey in courses in which participants were implementing educational strategies from the program, students' view is positive towards the activities. Students indicated that they learned more and that those strategies should be used in other courses. Institutionally, the achievements of faculty in the program and the program itself received recognition by the university.

Keywords: active learning; engineering education