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Contributions in: COVID-19, Persistence, Self-Learning, MOOC, First-Year Engineering, PBL, Industrial Practice, Diversity, Equity, and Inclusion, Engineering Design, Engineering Ethics, Accreditation, Double Minority Status, Dropout, Assessment, Adaptability, Learning and Engagement, Academic Performance, Student Success, STEM, School Culture, Mechanical, Electromechanical, Civil, Electric, Computing, Material Engineering

cornerstone course was successful at some points (such as electrical components technical skills, prototyping, and motivation with engineering). However, its potential reported from the literature was not fully obtained. Based on the data gathered, a set of lessons learned from the experience was elaborated as a guideline for future cornerstone implementations. The paper contributes to the cornerstone design literature by reporting an in-depth analysis of a cornerstone course application in a diversified context and country.

Keywords: Cornerstone design course; design thinking; introduction to engineering

The curriculum challenges presented to first-year engineering instructors at a Southwestern institution in the United States as well as the need to highlight the process of theory-building in engineering education motivated a team to conduct an umbrella research project related to the enculturation of engineering students. This umbrella project has generated six conference papers and this manuscript constitutes the last of the series focusing on the changes that students experience and perceive over time, once exposed to the first-year engineering curriculum, and how these changes inform a theory of enculturation. The research questions investigated how students perceive their enculturation, once they have progressed in their engineering programs, and how the results constitute a theory of enculturation. Eight sophomore and junior level engineering students of diverse backgrounds participated in semi-structured interviews and focus groups. Their perceptions were analyzed via quantitative and qualitative strategies of inquiry (i.e. content analysis and open coding) and the resulting themes and associated frequencies were examined to constitute a theory. Informed by prior enculturation studies, this research identified eight dimensions and five themes, thirteen units in total. These thirteen units were organized in extrinsic and intrinsic factors that characterize a theory of enculturation to engineering during the first-year experience and hypothesized on how these units operate to produce professional engineers. This theory of enculturation emphasizes the role of the support systems of schools of engineering which in turn provides a framework that instructors and administrators can utilize when planning or modifying these support systems.

Keywords: enculturation; engineering profession; first-year engineering; professional engineer; theory building

Increasingly volatile and complex manufacturing environments make the continuous development of engineering professionals' knowledge and competences in changeable and reconfigurable manufacturing a major source of competitiveness in manufacturing companies. Enablers of this include modular and platform-based product and manufacturing system design, as well as industry 4.0 related technologies and digitalisation. Therefore, this paper focuses on Continuing Engineering Education (CEE) in changeable and reconfigurable manufacturing and investigates the implications of applying a university-industry collaborative approach to Problem-based Learning (PBL) for CEE in company-settings. The paper builds on a four-year CEE initiative from Swedish manufacturing industry and includes insights from implementing a CEE course in changeable manufacturing, which was designed based on PBL principles and run as an industry-university cooperation for four consecutive years. Implications addressed in the paper relates to (1) PBL as a suitable approach for CEE, (2) Research transfer to industry through PBL-based CEE, and (3) industry-university collaboration for CEE, which provides valuable insights on how to conduct successful CEE in knowledge fields that are fast evolving in order to enable fast industry transitions.

Keywords: continuing engineering education; problem-based learning; professional development; changeable manufacturing; reconfigurable manufacturing

In this study, we use the EPIC-I (exposure, persuasion, identification, commitment, and implementation) framework as a lens for viewing instructor perceptions of including diversity, equity, and inclusion (DEI) activities in engineering and computer science undergraduate courses. The results provided evidence of three findings: (a) evidence existed of faculty participation at all levels of EPIC-I, (b) in moving through the EPIC-I framework, the evidence became scanter, and (c) although both groups were small, approximately equal numbers of participants were openly negative as were actively implementing additional DEI supporting activities in their classes. Implications and future work are discussed.

Keywords: engineering education; instructors; diversity

Education researchers have observed a disconnect between the goals of the current educational system and the practical application of professional skills outside the classroom. Skills such as creative thinking, knowledge of engineering science, global thinking, and cross-cultural communication should be honed in addition to technical engineering skills. These skills are often taught in engineering design courses. The purpose of this study is to evaluate student learning of market concepts in a design course, with an emphasis on the use of a market simulation tool to forecast consumer choice among competing products, by analyzing written reflections, course surveys, and project reports. Specifically, we assess the self-reported learning value of using an interactive market simulation tool in the classroom. The study employed a descriptive case study to understand the value of a market simulator in an engineering design course. Several sources of data from student reflection assignments, the "lessons learned" segment of the final report, and class surveys were collected at multiple points in the semester and analyzed through a combination of qualitative and quantitative approaches. Based on Kember's level of reflection framework, we found that students' levels of reflection changed from mostly level 2 (understanding) to level 3 (reflection) between the fifth and thirteenth weeks of the course. We did observe a decrease in mentions of the value of the market simulator and an increase in acknowledging difficulties, which may show how students' response to the market simulator changes as they reflect again and become more aware of the complexity of the design process as it relates to the market. The key takeaways in the teams' final reports showed parallels with the course objectives. Our results show reflective practice is an effective instructional strategy for students to develop holistic self-regulated learning and professional skills. Themes that pertain to the concepts in the design course emerged and became significant indicators of understanding and critical reflection of the design process as a whole. Team reports on "lessons learned" signify that prior reflective practice encourages students to be more aware of their learning outcomes and the importance of the use of learning tools to achieve these goals.

Keywords: market simulator; engineering design; professional skills; reflection

This research aimed to investigate the current situation of engineering ethics education in China via the viewpoints of engineering students. Integrating social attributes of engineering, the pedagogy applied in engineering ethics education was illustrated. On this basis, a survey covering students' ethical awareness, theoretical knowledge, and problem-solving ability was designed and conducted in a representative engineering university of China. In total, 608 questionnaires from engineering postgraduates were collected to quantitively present students' awareness and theoretical knowledge on engineering ethics, while 196 responses to five

designed engineering scenarios were received to review students' abilities to solve ethical problems. By comprehensive statistical analysis, the research results showed that the engineering ethics education contributed to a positive impact on students. Specifically, after systematic course education, participants perceived positive awareness, acquired sufficient knowledge, and enhanced problem-solving abilities to make appropriate ethical decisions in practice. Notably, there was a substantial difference in the engineering ethical awareness between students with and without work experience, indicating that the exposure to practical work environment influenced the establishment of ethical attitudes. Further, evaluations on the engineering ethics course highlighted the necessity of unique and creative teaching strategies and a preference for learning ethics principles in practice. The research finding can be referred as the theoretical basis for the design and implementation of engineering ethics education in China.

Keywords: engineering ethics education; engineering postgraduate; pedagogy; education situation of China

A Successful Framework for the Accreditation of an Electrical Engineering and Automation Program 1167–1180

Yu Gao, Lei Yu and Liang Chen

The academic accreditation for an engineering program in higher education institution is helpful to enhance comprehensive qualities of graduates. Taking the Electrical Engineering and Automation (EEA) Program as an example, a framework is constructed based on the concept of Outcome Based Education (OBE) for a high quality measurement, which ensures the program to satisfy the requirement of engineering education accreditation. Particular steps are designed by taking into account the evaluation methods for educational objectives and students' outcomes. Then, a closed-loop continuous improvement process is applied to develop the program based on the assessment result of students' performances in collage and society. The achievement level of the program outcomes is evaluated by efficient methods periodically, and the assessment results are presented in the paper. The situation of graduates' competencies developed by the program is indicated, and improvements of the program are implemented based on shortcomings. In this research, work experiences for the engineering education accreditation are shown, which can be studied by institutions and universities offering corresponding programs.

Keywords: accreditation; education; outcomes; evaluation; continuous improvement

Stereotypes and Stereotype Threats Experienced by Latinx Engineering Undergraduates 1181–1195

Elizabeth Turochy, Linnel Marie S. Ballesteros, Toby Nii Tairo Nelson, Michael Perez, Kyle Estes, Cristina Poleacovschi, Erin Doran and Timothy Yuen

Latinx engineering students often experience stereotype threats in their programs. Stereotype threats not only affect student self-esteem but can influence academic performance and persistence in engineering programs. Our research aims to increase understanding of the specific types of stereotyping and stereotype threats experienced by Latinx engineering students. We also analyze how these stereotypes and stereotype threats are experienced across different demographic groups, class standing, engineering major, and institutional context. Our research analyzes various stereotypes and stereotype threats that Latinx undergraduate engineering students face using data collected from interviews and surveys across three universities, two Predominately White Institutions (hereafter, PWI) and one Hispanic Serving Institution (hereafter, HSI). A content analysis of the 28 interviews and Ordinary Least Squares (OLS) regression analysis were conducted on our 156 survey responses. Nine major stereotype and stereotype threat themes related to engineering identity were identified. Findings showed that Latinx undergraduate engineering students commonly experienced both ethnicity and gender stereotype threats, particularly in the form of ''assumed behaviors'' and ''assumed academic abilities''. Regression analyses also suggest that female gender identity is a statistically reliable predictor of students experiencing both gender and ethnicity stereotype threats. Latinx undergraduate engineering students commonly experience stereotyping and stereotype threat along ethnic and gender lines, with female identifiers systematically more susceptible to both. The implications of this research are significant, as both identity categories of this intersectional group – female and Latinx – are already underrepresented in engineering educational programs and professions. This research expands the literature on the impact of stereotypes and stereotype threat on Latinx undergraduate engineering students' persistence and success in this major and emphasizes the need to foster inclusion and diversity within engineering programs.

Keywords: stereotypes; stereotype threat; Latinx; double-minority status

Predicting Engineering Undergraduates Dropout: A Case Study in Chile 1196–1206

Claudia Martínez-Araneda, Mariella Gutiérrez Valenzuela and Michelle Bizama Varas

The main objective of this article is to present and validate a statistical model (N = 3,152) to predict the dropout of students from the School of Engineering of the Universidad Católica de la Santísima Concepción (UCSC) in Chile. Student droupout in engineering is a generalized and multifactorial phenomenon, even more so when the student can use his or her university access score for a period of two years. In the UCSC, a distinction is made between formal and nonformal droupout. The information collection methodology in this study included the survey administered by the Department of Evaluation, Measurement and Educational Registry of Chile (DEMRE) and input from the Directorate of Admission and Academic Registration of the UCSC. Within the analysis groups were students who formally resigned and were analyzed according to the reasons they gave for leaving; the other group was constituted by students who did not formalize their abandonment, deserters. Subsequently, a logistic regression analysis was applied to determine which variables would best explain the phenomenon of droupout. Among the main factors are gender (GENDER), program (AU), cumulative average score (PPA_SCORE), mathematics score of the university selection test (PSU_MATH_SCORE), mother education level (EDU_MOM), progression rate of student in engineering program (PROGRESSION_RATE) and socioeconomic quintile of student (QUINTILE). The performance of the prediction model shows an accuracy (88.53%) and precision (88.69%), which is a very encouraging result in relation to the performance of the studies reviewed in the literature.

Keywords: dropout; engineering; higher education

Development and Assessment of a New Approach to Teaching Parallel Databases 1207–1215

Weihong Zhao, Meruert Serik and Saule Zhumagulova

Software development, database management and parallel computing are deeply integrated and related technologies. Both types of technology are rapidly evolving and becoming more sophisticated, with resulting subtleties of their interaction learned directly in the workplace. Academic research focusing on developing programs or approaches to professional training in these areas in universities is relatively scarce. This study provides a theoretical background and practical approach to building parallel database programming skills by introducing software developers' best practices. The piloting of the proposed approach was attended by 64 third-year IT students in the experimental group, who were involved in 3-month training, with their learning pathway depending on the challenges they faced. Tasks were assigned and checked by instructors. The findings suggested that this approach can help to improve technology proficiency among students in accordance with the recognized professional competence level rather quickly. No one achieved such a result in the control group. The Student's t-test showed that the differences in scores between the control and experimental groups were statistically significant. Essentially, the research findings can be used to teach parallel databases and to strengthen ties with graduates' potential employers in the corresponding academic programs.

Keywords: parallel computing; programming; databases; programming language; student education; parallel computing education system

Preparatory, or "remedial" math and writing courses have long been studied as barriers to success in postsecondary education, particularly for disadvantaged students. The negative effects seem to be particularly pronounced at four-year institutions, like the one studied here. Prior work in this area has not had the granularity to determine at what point students who are not math ready leave engineering pathways. We set out to determine how performance in trigonometry courses affects further math and science course enrollment, as well as college graduation rates. We used logistic and linear regression to investigate outcomes for 3,615 engineering students at a public research university. We find that the probability of graduating with an engineering degree within 6 years or leaving the university with no degree depends on the grade received in trigonometry. We find that students who get an A in trigonometry are no more likely than calculus-ready students to leave the university but are still less likely to stay in engineering. We find that math-ready students are more likely to enroll in physics and calculus 2 than trigonometry students who get As. This work shows that preparatory math courses may serve as a barrier to persistence in engineering, even if students are successful in the courses, and that the primary point of attrition for these students appears to be after calculus 1.

Keywords: remedial math; persistence; equity; introductory STEM courses

The purpose of this study is to investigate the relationship between school culture (previous norms, values, and traditions) and the quality of life and the academic enthusiasm of students at Zhejiang College of Security Technology in the city of Wenzhou, China. The number of participants is 363 male students, they were selected using cluster-random sampling. Three standard questionnaires were utilized to collect data. With the use of SPSS software, Pearson's correlation coefficient and regression analysis were utilized to evaluate the data. The results show that the variables of school culture and quality of life at school jointly predicted 23.4% of the variance in academic enthusiasm. Also, the components of "relationship with teachers," "general satisfaction," and "opportunity" from the quality of life in school and the components of "student teacher relationships" and "educational opportunities" from the school culture played the most important role in predicting the academic enthusiasm of students. According to the results, it can be stated that the school's culture and quality of life have a significant impact on the academic enthusiasm of students.

Keywords: school culture; life quality in school; academic eagerness; Zhejiang College of Security Technology; Wenzhou City