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Ahmad Ibrahim

A Scoping Literature Review of Early-Career Engineering Faculty Educational Development 1615–1634
Marcus Vinicius Melo De Lyra, Adam R. Carberry and Benjamin Ahn

Early-career faculty encounter diverse experiences in both their professional and personal lives. Higher education offers support, such as educational development, to improve teaching and learning skills. In engineering education, these educational development resources have been posited as a critical strategy for providing opportunities for faculty reflection and sharing new pedagogical approaches. This study examines the current literature on the educational development of early-career faculty in engineering education. The purpose was to map the literature about the resources offered to this population, their needs, and motivations for participating in such development resources in the US. We employed a scoping review methodology to search engineering education databases and identified 30 qualifying papers. Our findings showed that conference proceedings are a key forum for discussions on faculty educational development. Resources were mainly single-use, short-term opportunities aimed at teaching undergraduates. Themes about faculty needs highlighted their lack of prior instructional training, the absence of educational development, and the need for resource investment to prevent turnover. Early-career faculty's motivation to use these resources aligned with adult education literature. This scoping review contributes to the field by synthesizing the literature on educational development for early-career engineering faculty and offering recommendations for effective practices and future research.

Keywords: early-career faculty; instructional development; scoping review

Identifying Early and Evolving Predictors of Engineering Students' Attrition at a Hispanic-Serving Institution 1635–1649
Lydia Ross, Amanda Davis Simpfenderfer, Junzhao Wang and Travis Terpkosh

Undergraduate engineering programs continue to face high dropout rates, especially in the early years and among students from historically marginalized groups. While earlier studies have found links among students' backgrounds, academic performance, and leaving school, less is known about how these factors change as students progress through their studies. In this study, we use over twenty years of data from 25,088 students at a large Hispanic-Serving Institution to track engineering attrition during the first few terms (Terms 2–6). We use a term-based machine learning method, specifically conditional inference trees that account for class imbalance, to examine how student backgrounds and academic performance together predict who leaves and when. Our results show that demographic factors like race, first-generation status, and Pell (a federal financial aid provided by the U.S. federal government to undergraduates) eligibility matter most in the earliest terms. Later, cumulative GPA and grades in key courses become the main predictors. These findings suggest that the reasons students leave shift over time, from early structural challenges to later academic hurdles.

Keywords: engineering attrition; machine learning; equity; academic performance; persistence

The AI Paradox in Engineering Education: High Institutional Demand, Moderate Adoption, and Growing Concern among Technical Faculty 1650–1659
Enrique Barra, Daniel López-Fernández, Javier Conde, Jorge Dueñas-Lerín and Anabel Pilicita

This study examines the "AI Paradox" within the context of engineering education, characterized by the tension between high institutional demand for artificial intelligence and the moderate, cautious adoption observed among technical faculty. While universities prioritize AI as a catalyst for efficiency, engineering and technology educators navigate this transition amidst pedagogical uncertainty and growing concerns regarding student learning. This research analyses the adoption habits, risk perceptions, and regulatory preferences of 380 university educators from a leading technical university in Spain using a mixed-methods approach. Data from a two-wave survey (May and December 2025) combined descriptive statistics and independent-sample t-tests for ten Likert-scale items with thematic qualitative analysis. Results indicate moderate levels of daily professional AI use ($M = 3.20$) and a near-unanimous demand for institutional training ($M = 4.84$). While instructional adoption remained stable, there was a statistically significant increase in the belief that AI use harms student learning, rising from $M = 2.71$ to $M = 3.16$ ($p < 0.001$). Qualitative data revealed a maturation of use toward sophisticated applications in instructional design for engineering subjects, technical coding support (e.g., Python and MATLAB), and specialized research. Disaggregated results show that younger faculty (under 30) are the most proactive adopters, while Information and Communication Technology (ICT) degrees lead in pedagogical restructuring. The study concludes that engineering faculty engage with AI pragmatically, rejecting broad prohibitions in favour of AI literacy and pedagogical redesign. The findings emphasize that institutional support in engineering schools must shift from general advocacy toward developing robust frameworks that address the declining effectiveness of traditional assessment methods while supporting emerging disciplinary use cases.

Keywords: engineering education; faculty perceptions; AI adoption; technology adoption

Investigating the Influence of Curriculum Systems on Chinese Engineering Students' Sustainability Skills 1660–1666
Mengting Qian, Weijie Gao, Zeqing Xu and Huiming Fan

Education for sustainable development is central to cultivating 21st-century engineering talent. Drawing on the Knowledge–Attitude–Behavior (KAB) framework, this study examines how sustainability curriculum systems relate to Chinese engineering students' sustainability skills, and the mediating roles of sustainability knowledge and attitudes. Using stratified random sampling, survey data were collected from 389 engineering students at East China University of Science and Technology in Shanghai, China, and mediation effects were tested with PROCESS Model 6 and bias-corrected percentile bootstrapping. Curriculum systems were significantly and positively associated with students' sustainability knowledge, attitudes, and skills. Knowledge and attitudes each

independently mediated the curriculum–skills relationship and also operated sequentially as a chain mediation, with the total indirect effect accounting for 78.22% of the total effect. The findings support the applicability of KAB theory in sustainability education, clarify how curriculum systems promote skill development, and offer practical recommendations for optimizing engineering curriculum design.

Keywords: education for sustainable development; curriculum system; engineering students; knowledge–attitude–behavior theory

Engineering Program Restructuring to Address Enrollment Decline: Curriculum Modularization and Faculty Reorganization 1667–1678

Liangxu Chen, Qian Liu and Lipeng Wang

Declining student enrollment has become an increasing challenge for applied engineering faculties, particularly in traditional built-environment disciplines such as civil engineering and architecture. While many institutions respond by introducing new technology-labeled programs, such expansion strategies may intensify curriculum fragmentation and resource pressure when institutional capacity is limited. This study examines an alternative approach based on coordinated program restructuring within an application-oriented undergraduate engineering faculty in China. Using a qualitative institutional case study design, the research analyzes institutional curriculum plans, enrollment records, teaching-hour arrangements, faculty workload documents, and restructuring reports related to civil engineering, architecture, and urban design programs. The case data show that total registered enrollment in civil engineering and architecture decreased from 359 students in 2021 to 222 students in 2025, while combined post-transfer enrollment declined from 363 to 184 students over the same period. In response, the institution reorganized related programs through curriculum modularization, shared foundational and platform modules, and module-based faculty deployment. The teaching-hour analysis indicates that restructuring did not primarily reduce student-side learning requirements; instead, it redistributed overlapping teaching hours from isolated program-specific delivery toward shared or coordinated module-based delivery. Civil engineering was adjusted from 180 credits and 3,580 teaching hours to 173 credits and 3,612 teaching hours, architecture retained a design-intensive modular structure, and urban design was developed as a bridging program supported by shared built-environment curriculum resources. The findings suggest that curriculum modularization and faculty reorganization can improve teaching efficiency, reduce duplicated course delivery, and strengthen institutional adaptability under enrollment decline. This study contributes to engineering education management by demonstrating how internal program restructuring may provide a sustainable alternative to expansion-oriented responses in applied engineering education, supporting resource-efficient and resilient engineering education systems in line with the broader aims of SDG 4 on quality education.

Keywords: engineering education; program restructuring; curriculum modularization; faculty reorganization; enrollment decline; institutional sustainability

Predicting First-Semester Engineering Calculus Performance with Suite of Non-Cognitive Factors 1679–1693

Gholam Abbas Sattar-Shamsabadi II, Iouliana Ossipova, Patricia A. S. Ralston and Thomas R. Tretter

Success in first-semester calculus is essential for long-term retention in engineering disciplines and frequently predicted using cognitive measures. Yet, cognitive metrics alone account for a relatively small amount of the variance in student academic performance. This study employs structural equation modeling to evaluate a suite of non-cognitive factors, specifically: conscientiousness, academic mindsets (sense of belonging uncertainty and self-efficacy), metacognitive learning strategies, and time management, to determine how they interact to predict academic performance, as measured by final exam scores, for a cohort of 230 first-year engineering students. The model incorporates self-reported and instructor-observed academic behaviors as mediating outcomes between the non-cognitive factors and performance outcomes. Instructor-observed behaviors are those the instructor assesses based on student work throughout the semester. Non-cognitive factors and self-reported academic behaviors were measured via end-of-semester surveys, while observed academic behaviors were determined from homework scores and class participation scores. Findings indicate that conscientiousness and self-efficacy significantly predict observed academic behaviors, which in turn strongly predict final exam performance. In contrast, belonging uncertainty and time management did not directly predict observed academic behaviors, and self-reported academic behaviors were not predictive of academic performance (i.e., final exam scores). The findings accentuate the central mediating role of academic behaviors in linking non-cognitive factors to performance and highlight the limitations of self-report measures for first-year students as well as the importance of incorporating observed behavioral indicators into predictive models. This model establishes a foundation for future studies that could include interventions that strengthen students' engagement, self-regulation, and persistence to improve early engineering calculus success.

Keywords: non-cognitive factors; academic mindsets; belonging; self-efficacy; conscientiousness; metacognitive learning strategies; time management; academic behaviors; structural equation modeling; first year engineering students, calculus performance

From Seville to the Moon: A Manufacturing Engineering Design Project-Based on the April Fair 1694–1701

J. L. Endrino

This paper reports the implementation of a project-based learning activity in a third-year manufacturing engineering course to introduce students to the challenges of future extraterrestrial manufacturing technologies. A total of 54 engineering students participated in a design project in which they were asked to develop a lunar adaptation of Seville's traditional April Fair. Working in teams, students proposed infrastructure concepts, identified suitable manufacturing processes, and created preliminary CAD models of selected components. AI-assisted image-generation tools were used during the conceptual design stage, while SolidWorks was employed to translate selected ideas into engineering representations. To evaluate the activity's outcomes, survey responses were collected after the final project presentations. Students were asked to identify manufacturing technologies they considered most appropriate for lunar production systems and to assess the educational value of the project. Additive manufacturing was the most frequently selected technology (21.6%), followed by rolling (16.2%) and forging (13.5%), reflecting a preference for flexible manufacturing approaches that could operate under lunar constraints. Students also reported positive effects on teamwork, creativity, real-world engineering skills, and technical communication. The results indicate that culturally inspired engineering challenges can provide an engaging framework for introducing advanced manufacturing concepts while encouraging design thinking and problem-solving in undergraduate engineering education.

Keywords: fabrication; project-based learning; conceptualization; additive manufacturing

Personality-Grouping Interactions in Engineering Project-Based Learning 1702–1711

Yu-Sheng Lin and Yu-Hsuan Lin

Teamwork is central to project- and problem-based learning (PjBL/PBL) in engineering, yet empirical evidence remains limited on how team formation methods and student personality characteristics jointly relate to contribution equity and academic outcomes. This study examined whether grouping method and two personality frameworks: Holland's vocational orientations (RIASEC) and DiSC behavioural styles, are associated with students' contribution patterns and performance in project-based mechanical engineering courses in Taiwan. Data were collected from 201 undergraduates across five classes, with personality data from 149 students and contribution and satisfaction measures from up to 173 students. Grouping method was not directly associated with contribution equity or grades, although self-selected teams reported higher satisfaction with team formation and discussion processes. Holland orientations were selectively related to outcomes, whereas DiSC showed weak associations after controlling for class effects. The findings indicate that course context and assessment design may outweigh simple grouping rules.

Keywords: project-based learning; team formation; personality; Holland RIASEC; DiSC; contribution equity

A Literature Review of Factors Related to Students' Perceptions of Professional Skills 1712–1726
Emily Buten and Aaron W. Johnson

Professional skills such as communication, teamwork, and creativity are essential for engineering practice, yet engineering students often perceive these skills as less important than professional engineers do. This literature review examines what pre-college characteristics and college experiences have been linked to engineering students' perceptions of professional skills. Using a systematic search of five databases, a total of 63 empirical peer-reviewed articles met the inclusion criteria and 39 were analyzed for evidence related to students' backgrounds and college experiences. Gender was the clearest pre-college factor associated with students' perceptions, with women generally reporting higher perceived importance of professional skills. Curricular experiences, disciplinary differences, work experiences, international experiences, and institutional type were also associated with differences in perceived importance or self-assessed ability, although findings were often mixed or limited. The review highlights major gaps in existing research, particularly regarding peer environments, and a need for research that examines how multiple factors interact to shape engineering students' motivation to develop professional skills.

Keywords: literature review; professional skills; student perception; college experience

A Structured Approach to Satellite Systems Engineering Education Using a CubeSat Training Kit 1727–1737
Masahiko Yamazaki and Nagisa Sone

As the global space sector expands, there is an increasing need for educational approaches that enable learners to acquire both practical engineering skills and systems-level understanding of satellite development. This paper presents and evaluates a structured satellite systems engineering curriculum using HEPTA-SAT, a CubeSat training kit designed to guide learners through subsystem assembly, integration, testing, mission design, and teaching practice. The curriculum was implemented in short- and mid-term training programs involving university students, early-career researchers, and engineers from space-related organizations. Its educational effectiveness was assessed using a mixed-methods approach based on pre- and post-training self-assessments and qualitative feedback. Two paired datasets were analyzed: participants in the CubeSat Leader Training Program (n = 8) and student-role participants in a teaching-practice workshop conducted by newly trained instructors (n = 14). The results showed significant improvements in self-assessed understanding for both groups, with the CLTP group increasing from 31.3 to 42.7 out of 45 points and the student-role group increasing from 17.3 to 34.6 points. Qualitative responses indicated that hands-on assembly, iterative testing, mission-oriented learning, and near-peer instruction helped learners connect component-level tasks with system-level concepts. These findings suggest that a staged, hands-on CubeSat curriculum can provide an effective and adaptable model for satellite systems engineering education within limited training periods.

Keywords: CubeSat education; hands-on learning; space engineering; curriculum; satellite

Predictive Modeling of Freshman Engineering Retention: Roles of Early Academic Performance and Generational Status 1738–1752
Thanh Loc Nguyen and Ning Fang

Student retention remains a persistent challenge in engineering. Existing models for predicting retention often rely on pre-matriculation metrics and static frameworks, which fail to capture the dynamic role of early academic performance in shaping retention outcomes. To address this critical gap, the present study employs sequential binary logistic regression to develop two predictive models using fall-to-fall retention data from 2,478 first-time engineering freshmen. Results reveal a retention paradox: Despite significantly lower first-term grade point averages (GPAs) and credit accumulation, First-Generation College Students (FGCSs) persisted at rates comparable to those of Continuing-Generation College Students (CGCSs). Incorporating second-semester data in Model 2 nearly doubled the explanatory power of Model 1, which is built upon the first-semester data only. This suggests that early academic integration outweighs pre-college characteristics in predicting student retention. First-term GPA emerged as the strongest predictor for FGCSs, while Calculus II served as the critical gatekeeper, with course withdrawal reducing retention odds by over 86%. In contrast to FGCSs, CGCS retention reveals a more complex interplay among academic performance, demographic factors, and gender. These findings underscore the need to prioritize dynamic, performance-based models alongside static admission metrics and to track first-year academic milestones in real time to proactively enhance student retention.

Keywords: first-generation college students (FGCSs); continuing-generation college students (CGCSs); freshman engineering retention; first-term grade point average (GPA); calculus progression; logistic regression

A Dual-Theory Framework for Blended Learning in a Computer Vision Course: A Case Study 1753–1769
Yunyu Shi, Xian Tang, Xiang Liu and Jingwen Zhao

Blended learning in engineering education often suffers from fragmented instructional design and limited support for students with diverse learning readiness. To address these challenges, instructional design should be guided by learning theories that explain how students process complex information and develop higher-order learning abilities. Cognitive Load Theory (CLT) provides a basis for reducing unnecessary cognitive burden through structured task sequencing and coherent organization of learning resources. Hierarchical Teaching Theory (HTT) complements this perspective by supporting progressive learning design. It helps accommodate differences in students' readiness and guides learning from foundational understanding to advanced application and design-oriented thinking. The framework was implemented in a Computer Vision course and evaluated through a historical cohort comparison and multi-source data, including learning platform records, questionnaires, and qualitative feedback. Results show that the implementation cohort achieved higher overall performance, with the mean score increasing from 71.44 to 74.75, and significant improvement in comprehensive analysis tasks (42.82% to 64.53%). Platform data indicate high completion rates for online tests (94.93%) and laboratory report submissions (93.58%), while questionnaire results show generally positive student perceptions. The findings suggest that integrating CLT-based phase coherence with HTT-based hierarchical progression can support higher-order learning development and analytical problem-solving abilities.

Keywords: Blended learning; Cognitive Load Theory; Hierarchical Teaching Theory; Computer Vision; engineering education; task design

Comparison and Application of Metaverse Platforms for Problem-Based Learning in Online Education 1770–1783
Jae-Kyoung Lee

This study compared and analyzed the suitability of four metaverse platforms for online PBL curricula. It also examined whether team activities conducted by learners using these platforms contributed to enhancing learning concentration and the overall learning environment. The curricula 'Engineering Communication' and 'Science Technology and Engineering Ethics' were selected for this study, as they were suitable for incorporating metaverse platforms into team activities and assignments. The instructional process encompassed the foundational contents and operational aspects of the four metaverse platforms integrated into the curricula, thereby facilitating the implementation of metaverse-based team activities aligned with the assigned project topics. The analysis for total 64 teams (159 learners) of two curricula revealed several shortcomings in the outcomes of metaverse-based team activities, indicating the need for greater instructional support and guidance. A satisfaction survey on metaverse-based learning activities showed that over 80% of learners expressed increased interest in this new learning method. Moreover, learners reported a high level of satisfaction with the progression of the curriculum and the team activities conducted through metaverse platforms. Finally, Gathertown and ZEP were identified as the most suitable metaverse platforms for PBL curricula, due to their ease of use for both instructors and learners, as well as their supportive environments for problem-solving activities.

Keywords: metaverse; problem-based learning; problem-solving; team activity

Undergraduate Perspectives and Metaphors Regarding Online Programming Education 1784–1797
İsmail Tonbuloğlu

The prevalence of emergency distance education during the COVID-19 pandemic significantly influenced programming education and increased the adoption of online programming courses. This transformation affected students' psychological processes, including motivation, cognitive load, and self-efficacy, highlighting the importance of examining online learning environments. Despite pandemic-related challenges, online programming education provided opportunities to develop practical skills and foundational programming knowledge. This qualitative case study examines undergraduate students' metaphorical perceptions and opinions regarding online education and online programming education within the framework of psychological distance theory and motivational perspectives. The sample consisted of 50 undergraduate students, and data were collected through semi-structured interviews. Findings indicate that online education contributed positively to learning by being efficient, comfortable, repeatable, sustainable, and time-saving, supporting autonomy and competence. However, it also showed limitations related to motivation, learning effort, and technical issues. These limitations suggest that psychological distance, associated with cognitive load and social isolation, negatively affected learning processes. Students' positive metaphors for online programming education emphasized comprehensive and supportive learning, individual-paced education, and flexible access and repetition. Negative metaphors highlighted inefficiency, exam security concerns, insufficient content, limited communication, and learning difficulties. Overall, the study deepens understanding of the psychological strengths and limitations of online programming education.

Keywords: online programming; programming teaching; distance education; online education

Assessment Framework of the Digital Feasibility of Practical Sessions in Civil Engineering Education 1798–1811
Assel Tulebekova, Aliya Aldungarova, Natalya Denissova and Shyngys Zharassov

Practical activities play a critical role in civil engineering education by enabling students to connect theoretical knowledge with experimental observation and engineering analysis. However, practical training is often constrained by limited resources and equipment, motivating the integration of digital learning approaches. This study proposes a systematic framework for assessing the digital feasibility of practical training in civil engineering education. A comprehensive analysis of 39 civil engineering academic programs was conducted to identify core disciplinary modules, within which practical sessions were structured and evaluated. An expert-based assessment involving 20 domain experts was conducted using a competency-oriented KSA (Knowledge–Skills–Abilities) framework to quantify task complexity, combined with the Smart Readiness Index (SRI), proposed in this study, to evaluate digital feasibility. The results indicated that digital feasibility depends on both task complexity and the nature of practical activities, with the highest SRI values reaching approximately 0.90 in selected sessions. While an overall inverse relationship between complexity and SRI was observed, several deviations highlighted the influence of task-specific characteristics. Based on this analysis, 24 practical sessions were classified according to their suitability for fully digital or hybrid implementation formats. To validate the approach, a pilot implementation was conducted within the Construction Materials module with 43 undergraduate students. The findings demonstrated improved student performance in digitally supported environments, with particularly strong outcomes observed in hybrid configurations. The proposed platform architecture integrates simulation modules with real-time sensor data, enabling interactive and data-driven learning in civil engineering education.

Keywords: civil engineering education; practical training; digital feasibility assessment; KSA framework; Smart Readiness Index (SRI); simulation-based learning; sensor-based data acquisition

Quantifying Individual Differences in Visual Understanding: A Style Transfer-Based Perceptual Modeling Framework 1812–1825
Yan Ruan, and Xiaofei Li

Quantitative tools for analyzing individual differences in visual understanding are critically needed in disciplines that rely on visual literacy, including art and design education as well as engineering fields such as computer graphics, scientific visualization, and human-centered design. This study presents a style transfer-based perceptual modeling framework that integrates image generation, feature space construction, and perception mapping to enable scalable assessment of visual literacy. Using the AdaIN model, we generated a structured image set by transferring four artistic styles (Realism, Impressionism, Expressionism, Cubism) across five content categories. A 50-dimensional style space was constructed using multi-layer Gram matrices from VGG19, serving as an objective perceptual benchmark. In a case study with 30 undergraduate art education students, we collected style identification and similarity ratings, mapped subjective responses into the style space, and quantified perception deviation vectors to identify distinct understanding patterns via clustering. Results demonstrate that the generated images maintain content recognizability while effectively presenting style characteristics; the style space effectively distinguishes stylistic categories, with inter-class distances quantitatively reflecting art-historical relationships; student confusion patterns correlate significantly with objective style distances, validating the space as a predictor of perceptual difficulty; and clustering reveals three interpretable student understanding types, with no significant effect from content type. By providing a computable link between objective style features and subjective student perception, this framework offers a generalizable approach for diagnosing individual differences in visual understanding, with potential applicability to educational contexts where visual literacy is fundamental.

Keywords: style transfer; perceptual modeling; individual differences; visual literacy; perceptual assessment

Industry-Driven Systematic Pedagogy for Electronic Control Course Cluster 1826–1836
Yabin Yan, Qiang Zhang, Yi Wang, Yaping Tian and Yufeng Zhang

This paper presents an industry-informed and interdisciplinary pedagogical framework for electronic control education to address challenges including curricular fragmentation, weak integration across courses, and the persistent theory-practice gap. Grounded in real-world engineering practice, the approach encompasses knowledge reconstruction, case repository development and teaching platform design. First, a knowledge framework centered on Model Based Design (MBD), the de facto standard in electronic control system development, is proposed to reconstruct disciplinary content through an integrated course cluster. Second, through the modern industry-academia partnership with Xuzhou Construction Machinery Group Co., Ltd. (XCMG), faculty and engineers co-develop a dynamic case repository synchronized with industrial advancements. Third, a teaching platform is developed to create an integrated visual learning environment for the knowledge framework and case repository by transforming engineering workflows from regional crane industry into instructional resources. This study involved 105 undergraduate students from diverse engineering disciplines who completed the full MBD development cycle: modeling, simulation, code generation, and hardware deployment. Quantitative and qualitative assessments demonstrate that this interdisciplinary pedagogy significantly enhances students' implementation skills and employability, offering a replicable model for engineering education reform.

Keywords: model based design; electronic control; teaching platform; interdisciplinary integration; engineering education

Implementation and Assessment of a Practical Integrated Circuit Design Teaching Model 1837–1851
Li Yan, Yin Shu Juan, Ni Xiao Ming, Wang Xiao Ni, Li Han and Wu Qiu Xin

This study proposes a sustainable teaching model for practical engineering courses by integrating the Outcome-Based Education (OBE) concept with the CDIO (Conceive-Design-Implement-Operate) framework, with a specific emphasis on environmental ethics. Using an integrated circuit design course as an example, the model was evaluated through a questionnaire survey (N = 102) and semi-structured interviews with 25 students (one full class) over two years. Results show that the model supports personalized teaching for diverse learners. Regarding environmental ethics education, 67.65% of students expressed strong agreement with its impact. Furthermore, 57.84% reported high satisfaction with their learning outcomes, while 9.8% were dissatisfied – a distribution not strictly correlated with academic performance. Interview findings reveal that most students experienced the course differently

than initially imagined, and the four CDIO phases provided a novel learning experience. A minority of students proposed innovative ideas, offering valuable student-centered perspectives for future instructional design. By defining key outcome-based issues under the OBE framework and specific CDIO phases, the model can be applied to various practical courses.

Keywords: engineering education; sustainable teaching model; practical courses; outcome-based education; Conceive-Design-Implement-Operate; environmental ethics; integrated circuit design

Thesis Completion as a Structural Bottleneck in Biomedical Engineering Education: A Diagnostic Study 1852–1861

Ernesto A. Ibarra-Ramirez, Gianna Frassati, Manuel Ceron, Mirna De Crespo and Jay Molino

Thesis or equivalent final-project requirements can become a bottleneck to degree completion for engineering students who have finished most of their coursework but still lack a degree. This cross-sectional diagnostic study examined a near-census of 80 long-delayed Biomedical Engineering students enrolled in an alternative completion pathway at a Panamanian university. A 30-item electronic questionnaire characterized Progression, barriers, supervision, time availability, preparedness, and institutional support. Descriptive statistics used valid denominators; sparse contingency tables were assessed with fixed-margin Monte Carlo exact tests, effect sizes, and prespecified sensitivity analyses. Active or advanced status was defined as work in development, final writing, or a completed and defended pathway manuscript. 54 respondents (67.5%) remained in early or interrupted stages; 58 of 79 (73.4%) had considered abandoning the requirement; and only 13 of 80 (16.3%) perceived progress as aligned with the time invested. Topic definition, limited time, and insufficient guidance accounted for 56 of 80 (70.0%) of the primary reasons for not continuing. Formal tutor assignment was associated with Progression (Monte Carlo $p < 0.001$; Cramér's $V = 0.44$). In an exploratory three-predictor logistic model, assigned tutoring (adjusted odds ratio [aOR] = 3.23, 95% CI 1.02-10.22) and at least five weekly hours of thesis work (aOR = 3.56, 95% CI 1.16-10.94) remained associated with active or advanced status. Findings do not establish causality, but they identify actionable design features for completion pathways: early supervision, protected time, explicit milestone structures, and targeted support for methodology and scientific writing.

Keywords: biomedical engineering; degree completion; thesis supervision; stop-out students; engineering education; alternative completion pathway

Enhancing Student's Energy Efficiency Literacy Through Short-Term Training: A Case Study in Vietnam 1862–1871

Ngo Hoang Ngoc Dung, Dang Thi Thanh Huyen, Ngo Tuan Anh, Tong Ton Kien, Nguyen Tran Hieu, Nguyen Tien Dung and Le Thi Thuy Linh

Integrating sustainability into higher education is critical for advancing energy-efficient building practices in emerging economies. This paper evaluates an educational intervention designed to embed sustainable construction principles into Vietnamese university curricula under the ''Vietnam–University Cooperation on Energy Efficiency in Buildings'' (VUCE) project – funded by the International Climate Initiative (IKI) and implemented by the German Energy Agency (dena). An initial review of the curricula at nearly 30 Vietnamese technical universities indicates that energy efficiency is only introduced within specific, major-based courses. A more comprehensive integration of this critical domain into higher education is essential to meet practical engineering requirements. A five-day intensive block seminar was conducted at the Hanoi University of Civil Engineering (HUCE) for a multidisciplinary cohort of 23 students. The curriculum comprised five core modules: operational principles, life cycle and green materials, tropical climate design, financing, and digitalization. Pre- and post-intervention surveys were utilized to quantify knowledge gains, expectations, and learning outcomes. Baseline results revealed a critical educational gap, with 93.3% of participants reporting no prior exposure to energy-efficient building concepts. Post-seminar data demonstrated substantial knowledge acquisition and competency development. Beyond theoretical literacy, students engaged in experiential learning components, including site analysis, interdisciplinary teamwork, and technical solution development utilizing energy performance simulations and building automation systems. Ultimately, the seminar successfully bridged localized knowledge gaps, fostered cross-disciplinary collaboration, and motivated students toward future careers in sustainable construction, providing a viable framework for capacity-building initiatives.

Keywords: short training; energy saving; buildings and construction; higher education

Development and Validation of an Entrepreneurial Mindset Teaching Practices Inventory (EM-TPI) for Engineering Faculty 1872–1889

Shukufe Rahman, Marcus Vinicius Melo de Lyra, Md Ulfat Tahsin, Benjamin Ahn, Bryant Hutson and Heather E. Dillon

In this study, we develop and validate the Entrepreneurial Mindset Teaching Practices Inventory (EM-TPI), an instrument designed to document and assess engineering professors' teaching practices that foster the Entrepreneurial Mindset (EM) in undergraduate engineering education. Grounded in Wieman and Gilbert's Teaching Practices Inventory and aligned with the Kern Entrepreneurial Engineering Network (KEEN) framework, the EM-TPI provides a teaching inventory to capture EM-oriented pedagogy across engineering courses. Expert review supported item-content alignment, while think-aloud interviews with seven ($n = 7$) engineering faculty members provided initial evidence of response processes concerning item interpretation, clarity, relevance, and usability. The finalized teaching inventory includes 30 items organized into five dimensions: (1) instructor prior experience with EM, (2) course characteristics, (3) in-class features and activities, (4) course assignments, and (5) demographics. Results indicate that the EM-TPI demonstrates strong content validity and potential practical utility for supporting instructor reflection, departmental evaluation, and research on EM implementation. The EM-TPI supports ongoing efforts to advance evidence-based, EM-oriented teaching and faculty development in engineering education.

Keywords: Entrepreneurial Mindset (EM); Teaching Practice Inventory; EM-oriented Pedagogy in Undergraduate Engineering Courses; Faculty Development

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