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# Aligning Biomedical Engineering Education with Industry: Graduate Needs and Curricula in Australia

Zachery Quince and Patcharin Chen

Biomedical engineering degrees have gained popularity in Australia however, there is a limited understanding through various research whether the biomedical engineering degrees offered in Australia are aligned with industry needs and if they are effectively preparing graduates for the workforce. This study aims to identify the current landscape of undergraduate biomedical engineering education in Australia and the alignment between the current curriculum and industry needs. The biomedical engineering curriculum was mapped across 11 institutions that currently offer the major. Three months of job searches were conducted to compare to the curriculum. During the jobs audit, 68 positions were identified as suitable for biomedical engineering graduates with limited experience. Most of the positions did not require a four-year biomedical engineering degree, in any stream (mechanical, electrical & chemical), does not currently fit the job market for biomedical engineers in Australia however, it does align with US and European requirements. Whilst the four-year biomedical engineering degrees do not align with the curriculum with the current job market, it is recommended that institutions should start offering two-year technician degrees in biomedical engineering and place more emphasis on medical device servicing and maintenance, as well as networking and computer architecture, in the curriculum during the first two years of a four-year degree.

Keywords: biomedical engineering; industry alignment; curriculum review

### Toward Measures of Faculty Adaptability to Curricular Change

Hadi Ali, Jennifer Bekki, Rod D. Roscoe and Ann McKenna

Calls for curricular change assume immediate adoption from faculty, overlooking their independent decision-making agency. Understanding of the response behavior of faculty members at the individual level can shed important insights into how to effectively enact and sustain change proposals. Quantitative measures are lacking to assess faculty adaptability to change. We synthesized a conceptual framework to measure faculty adaptability to curricular change. We focus on both *self-efficacy* and *willingness* to adapt during change along three phases of adaptability as self-regulation: planning, adjusting and reflecting. We developed and administered measures with two major groups who were engaged in curricular change contexts: those who self-identify as teaching-focused faculty (Group A, 53 participants) and those who self-identify as research-focused faculty (Group B, 102 participants). Faculty participants did not report significant differences in *self-efficacy* in adaptability; however, Group A participants reported statistically significant higher *willingness* to plan, adjust and reflect during curricular change. Furthermore, all faculty participants reported low *self-efficacy* in reflecting, which might limit the sustainability of adaptation during change. This work provides a first step toward measures of faculty adaptability. In addition, this study highlights the importance of being aware of faculty *willingness* to engage in curricular change based on their roles and responsibilities. Creative ways are needed to encourage *self-efficacy* in reflecting to sustain adaptability during change. There is an opportunity to systematically assess the validity of this instrument in different curricular change contexts.

Keywords: adaptability; curricular change; faculty roles; self-regulation

#### Using a Storytelling Intervention to Develop Professional Identity in Undergraduate Engineering Courses: 586–597 An Exploratory Study

Eric Jankowski, Sara Adams, Krishna Pakala, Anne Hamby, Amber Warrington, Ulises Trujillo Garcia, Sam Schauer, Liz Neeley, Brooke Heller and Patrick R. Lowenthal

Undergraduate engineering students often struggle to identify as engineers due to a disconnect between their lived experiences and the world of engineering. Research suggests that storytelling, including listening to, writing, and reflecting on personal narratives, can help students shape their self-identification with their field. Storytelling can also reinforce beliefs about who can succeed in engineering, which may enhance retention and inclusion in Science, Technology, Engineering, and Mathematics. The results highlight the benefits of allowing engineering students to engage with personal storytelling as a means to connect their lived experiences with their professional aspirations. Through the personal stories they crafted, students were able to reflect on how their own stories of belonging, resilience, and overcoming hardships aligned – or sometimes did not align – with the dominant narrative of the engineering profession. The storytelling invention needs to be investigated in other courses and subjects as well as with a larger sample of students to better understand its efficacy.

Keywords: story; storytelling; narrative; engineering identity; belongingness; engineering undergraduate

#### An Examination of Individual Attributes and their Impact on Team Creative Design Outputs

598-615

Aoran Peng, Samuel Hunter and Scarlett R. Miller

While teaming is a vital component of engineering, it is important to remember that there is no team without individuals, and individual behavior can drive team outputs. One of the individual factors that may manifest itself at the team level is individual risk-taking attitudes, which can be impacted by personality and preferences for creativity. However, a gap exists in research on the impact of team composition in these factors on creative outputs, as previous research has found that team composition plays a key role in team performance. The current work builds upon a previous work, and was developed to examine how the diversity of team

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personality and preferences for creativity impact the likelihood of concept screening events falling into one of the four categories of Signal Detection Theory. The results of this study show that for the population studied here, no team with the same composition was able to obtain "good" decisions in all four categories (increased hit, decreased Type I error, decreased Type II error, increased correct rejections). The team compositions studied here were only related to the likelihood of making good decisions in two or three of the four categories. This serves as empirical evidence supporting the complicated nature of the impact of team composition and provides some support for educators and instructors for a better understanding of team creative performance.

Keywords: design education, design methodology, design teams, design theory, design theory and methodology

#### Development of Low-Cost PLC Training Kit for Enhancing Industry-Relevant Skills and Certification: PLC-CertX

616–626

# Natt Siriwattananon, Nuchchada Kohpeisansukwattana, Pongthep Poungthong, Vitsanu Nittayathammakul and Songtham Deewanichsakul

The growing demand for automation skills necessitates the development of accessible training tools, particularly in developing countries with limited resources. This study presents the design, development, and evaluation of PLC-CertX, a low-cost training kit aimed at enhancing industry-relevant skills and certification among vocational and undergraduate students in Thailand. The research methodology applied developmental research, utilizing Richey and Klein's Type I research procedure to guide the systematic process of analyzing, developing, and evaluating the kit. The study's results identified three key findings: (1) The developed PLC-CertX training kit enables hands-on learning and provides practical experience in controlling and monitoring automation systems; (2) Expert evaluations from specialists in the industrial and educational sectors rated the kit with an overall mean score of 4.67 (SD = 0.45) in the "Very Good" category; and (3) A posttest-only cohort comparison revealed a 14.09% Center, authorized by the Department of Skill Development, increased by 21.37% after using the kit. Thus, PLC-CertX is an effective and scalable solution for technical education in resource-constrained environments.

Keywords: PLC training kit; vocational education; certification; industry skills; automation; skill standard testing

# Evolution and Trends in China's New Engineering Education Research

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658-666

667-679

#### Yaoguang Shi

This study employs scientometric analysis to examine the evolution and trends of New Engineering Education (NEE) research in China from 2017 to 2023. Leveraging the Chinese Social Sciences Citation Index (CSSCI) database and CiteSpace software, this research conducts a visual analysis of NEE-related scholarly publications. The findings reveal a notable increase in NEE research literature post-2017, indicating a surge in academic interest in NEE models, curriculum systems, and instructional methods. Research focus on the conceptualization and connotation of NEE, curriculum and teaching reforms, practical teaching, and industry-education synergy. The results reveal that NEE research in China is transitioning from a period of rapid growth to a phase of maturity and in-depth development. Engineering educators, social science scholars, and administrative staff are major contributors to NEE research in China. Future developmental trends may encompass the adjustment and optimization of disciplinary and professional structures, along with the promotion of a novel classification and development system. This research offers a comprehensive perspective on the current state and prospective direction of NEE research in China, enriching the global repository of engineering education scholarship.

Keywords: knowledge map; new engineering education; visual analysis; China

### The Impact of Outcome-Based Education on College Students' Self-Efficacy and Learning Engagement

#### Dekui Li, Yi Li, Fan Zhou, Chengyou Li and Shubo Du

The impact of Outcome-Based Education (OBE) elements – learning objectives, assessment feedback, and teaching methods – on college students' self-efficacy and learning engagement was investigated through a survey conducted among 416 second and thirdyear students at the School of Computer Science, Liaocheng University. Results demonstrate that clear learning objectives and high-quality assessment feedback significantly enhance self-efficacy, leading to increased cognitive, emotional, and behavioral engagement. In contrast, the influence of teaching methods on learning engagement is less pronounced, indicating a need for further refinement in their design and implementation. The mediating role of self-efficacy between OBE perception and learning engagement is highlighted, emphasizing the importance of effectively applying OBE principles in higher education. The findings contribute new empirical insights to educational psychology and provide practical guidance for future educational strategies.

Keywords: Outcome-Based Education (OBE); self-efficacy; learning engagement

#### "Trying to Fit the New Square Peg into The Old Round Hole": Adaptation During a Time of Transition to Online Teaching 649–657 Kacey Beddoes and Grace Panther

The coming decades are poised to see large shifts in the higher education landscape that will introduce new challenges for teaching staff and administrators. Shifts to online education are but one example. This article explores engineering teaching staff discourses about teaching while transitioning to online courses. Interviews were conducted at a large university in the United States over three semesters. When they were asked about their biggest concerns moving to online education, how they addressed those concerns, interactions and discussions with colleagues, and changes they were making to teaching, the dominant discourse that emerged concerned cheating or academic dishonesty. *Fairness* emerged as the rationale for this discourse. These findings are discussed and problematized by cross-disciplinary comparisons, and considerations of equity as well as authentic assessment.

Keywords: assessment; cheating; equity; fairness; online; faculty; staff

# Impact of Team-Building Activities and Personality on Student Learning Outcomes in Capstone Design Course

Hrushikesh Godbole, Elizabeth A. DeBartolo and Shun Takai

This research explores the impact of team-building activities (TBAs) and student personality traits on student outcomes in engineering capstone courses. Using students' self-reported data consisting of 137 senior engineering students from 32 student teams and corresponding student learning outcomes spanning two years, we analyze whether students' personality types, based on the DISC model, influence their selection of TBAs, and whether both the personality traits and TBAs affect student outcomes in teamwork and problem-solving. Cramer's V analysis and regression analysis were used to assess these. Findings indicate that activity-based TBAs are associated with better problem-solving outcomes while personality traits had no statistically significant correlation on either outcome. This research provides insights into how TBAs can be structured to improve educational outcomes in large capstone design.

Keywords: capstone design; team building; student outcomes; personality type

# Fostering Multi-Institutional Collaboration in Engineering Research Centers: An Analysis through the Lens of Communities of Practice

#### Hwangbo Bae and Joi-Lynn Mondisa

An effective Community of Practice (CoP) enhances the professional development of student trainees and their work performance. Although efforts have been made towards fostering CoP in the engineering fields, there is still a need to improve students' social learning experiences in the context of the United States' Engineering Research Centers (ERCs). The goal of this study is to provide practical implications for researchers and program managers to strengthen and improve ERC operations. Using qualitative research methods, this study investigates the experiences of ERC members, including faculty, students, postdoctoral researchers, and staff members, to understand how collaboration and knowledge exchange are facilitated across institutional boundaries. The findings reveal that motivation for work, regular meetings, project-based collaboration, and dissemination activities are critical mechanisms for sustaining engagement and momentum in the center. The study also highlights that community and practice aspects of the ERC need improvements in order to resemble features of CoP. This study has practical implications for ERC educators and leaders to make deliberate efforts to standardize protocols and better integrate members from diverse backgrounds, which may foster a more efficient and inclusive CoP. These findings offer valuable recommendations for ERC leadership to strengthen collaborative research and organizational performance.

Keywords: engineering research center; multi-institutional collaboration; interdisciplinary research; organizational performance; Communities of Practice

# What Constitutes the Ideal Learning Environment for International Students Pursuing Engineering Studies in Japan? 680–687 Yutaro Ohashi 680–687

As the number of international students at Japanese institutions of higher education continues to increase, the author conducted a questionnaire survey and interviews with 16 international students studying at technical universities to investigate the ideal learning environment for international students in the field of engineering. The interviews were transcribed and analyzed using the case-code matrix qualitative analysis method. The results of the analysis yielded nine categories, with the "attractiveness of Japan" and "partnership program" cited as reasons for studying abroad. Conversely, the "language barrier," "lack of project-based learning opportunity," "lack of clear information," and "isolation" were identified as challenges. In order to facilitate the internal internationalization of Japanese universities, it is essential to address the following issues: enhancing the English proficiency of Japanese students, expanding the opportunities for exchange between Japanese and international students within and beyond the classroom and research, and expanding the opportunities for project-based learning international students.

Keywords: international students; internationalization of the university; diversification of the student body; Japan

# The Effect of Peer Learning Environment on Academic Achievement and Character Education: A Case Study from688–696Engineering Mechanics Course688–696

#### Xiaoyu Guo, Bin Sha, Tengfei Ma, Zihan Suo

This study integrated peer learning, character education, and problem-based learning methodologies into an engineering mechanics course. A quasi-experimental research design was implemented, involving quantitative analysis of undergraduate engineering students (N = 25 in the experimental group and N = 28 in the control group) from a Chinese university. Data collection was conducted using five measurement scales: the Critical Thinking Scale, Social Avoidance Scale, Learning Achievement Scale, Classroom Evaluation Scale, and Peer Learning Effectiveness Scale. The experimental results revealed that while students demonstrated a positive attitude toward the peer learning approach, they expressed reservations about the grouping methodology. Quantitative analysis indicated that the experimental class achieved significantly higher final exam scores (M = 7.2 points, p = 0.040) and overall evaluation scores (M = 6.2 points, p = 0.068) compared to the control group. Furthermore, peer learning serves as an effective approach to strengthen character education while enhancing essential generic skills, including problem-solving, communication and expression, teamwork, time management, and teacher-student interaction. Finally, social avoidance tendencies and a preference for independent learning emerged as significant barriers to effective peer learning implementation.

Keywords: engineering education; cooperative learning method; curriculum ideological and political education; social phobia

# Factors Hindering the Persistence of Chinese STEM Students Studying in Spain Ruoshi Wang

697-706

The proportion of Asian STEM students in European higher education institutions continues to be insufficient, exacerbating the decrease in internationalization in the job market and impacting the global competitiveness and international cooperation opportunities of the host countries. On one hand, the low proportion of international students is related to the limited enrollment quotas for each university. On the other hand, it is also related to stereotypes and hostility within the STEM environment.

This study provides new evidence demonstrating significant differences in the faculty-student relationships, coping strategies, social support, well-being, community belonging, and academic satisfaction of Chinese STEM and non-STEM students studying in Spain. Additionally, the study explores the differences in well-being, community belonging, and academic satisfaction between STEM and non-STEM students in relation to their intentions to drop out, providing new data on dropout intentions among international students.

The research is based on a cross-sectional survey of 489 Chinese students studying in Spain and employs descriptive and inferential statistical methods to analyze the dataset. The results show that STEM students score significantly lower than non-STEM students in faculty-student relationships, coping strategies, social support, well-being, community belonging, and academic satisfaction. Furthermore, female STEM students score significantly lower than female non-STEM students in these six variables. Male STEM students also score significantly lower than female STEM students in faculty-student relationships, well-being, community belonging, and academic satisfaction.

Among students who have considered dropping out, STEM students significantly outnumber non-STEM students. There are six main reasons for dropping out, namely: It's too hard for students; students don't find it interesting; students feel like they don't belong at this university; students have felt excluded or discriminated against; students are not satisfied with how the classes are taught; and there is not a good university environment among students. STEM students outnumber non-STEM students significantly in the first five reasons, while non-STEM students significantly outnumber STEM students in the sixth reason.

Keywords: Chinese students; STEM education; well-being; academic satisfaction; dropout

# "Normal" & "Ambiguous": How Undergraduate Engineering Students Describe Stress

707-720

### Karin J. Jensen, Andrea J. Kunze, Thomas E. Romanchek, Kelly J. Cross and Joseph F. Mirabelli

Mental health of undergraduate engineering students is a growing concern. While some studies have measured undergraduate engineering student mental health and characterized stressors, more work is needed to understand how undergraduate engineering students describe and communicate about stress, including its relation to mental health. Our research sought to address the following research questions: (1) How do undergraduate engineering students describe stress and stressors? and (2) How do undergraduate engineering students describe the relationship between stress and mental health? We conducted and analyzed 30 semi-structured interviews with undergraduate engineering students at one institution in the United States. In interviews, we asked students about how they describe stress, including words they use to talk about stress, and how stress is related to mental health. We implemented a content analysis to analyze words students use to describe stress and a thematic analysis to analyze student descriptions of stress and ways to communicate about stress across three main categories: emotional, physical, and motivational. Student descriptions and descriptions, formental health concepts such as stress and anxiety varied significantly, and were sometimes ucofflated, suggesting student descriptions, communication, and understanding regarding these topics may not be precise. Underlying these descriptions, however, was a consistent assumption that stress and other mental health issues were closely related, if not the same. The varying definitions of stress and common use of the term by engineering students may preclude students from

receiving needed support. Understanding how students describe and communicate about stress will be critical to developing proactive interventions that engage students to support their mental health.

Keywords: mental health; undergraduate; qualitative; thematic analysis; content analysis; word cloud

# Predictive Analysis of Engineering Students' Enrollment in Entrepreneurship Education Courses

Prateek Shekhar and Carlos Felipe Rodriguez-Hernandez

721-736

Entrepreneurship education (EE) courses have grown in engineering education to prepare graduates to be competitive in today's innovation economy. While literature provides empirical support for the benefits of EE courses, there is minimal research examining students' enrollment in EE courses. The present study is conducted with institutional records of 12,045 undergraduate engineering students at a public research university in the United States. The first objective is to evaluate the performance of the decision trees (CART), random forest, and XGBoost algorithms when predicting engineering students' enrollment in EE courses. The second objective is to examine the variable importance of the engineering students' academic (undergraduate GPA, high school GPA, SAT scores, major), demographic (sex and underrepresented minority status), and socioeconomic (family income and parents' educational level) backgrounds in predicting their enrollment in EE courses. The results indicate that ensemble methods, random forest and XGboost, perform better than CART on all the evaluated performance metrics (accuracy, specificity, recall, precision, and the F1 score). Furthermore, the results suggest that variables measuring students' academic background held the highest predictive importance, followed by the variables pertaining to students' socioeconomic and demographic backgrounds. Educational practitioners, administrators, and policymakers may use the research results to strategize resources and efforts to initiate or revise entrepreneurship programming for engineering students. The study lays the groundwork for an evaluative examination of the relatively under-utilized machine learning methods in engineering education research, encouraging further methodological inquiry on the topic.

Keywords: entrepreneurship education; engineering; machine learning

### Integrating Innovative Teaching Methods into Civil Engineering Education: A Case Study

737–752

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#### Weijing Yao, Chengjun Wang, Haiming Chen and Yushan Liu

To enhance students' innovation capabilities, this study investigates the integration of innovation methods into civil engineering education through a case study at Anhui University of Science and Technology, China. The *Technical Innovation in Urban Underground Space Engineering* course was designed with a structured approach, incorporating innovation methods, intellectual property protection, and discipline-specific applications. The course employs a combination of experimental approaches, competitions, and a hybrid online-offline format, ensuring alignment with industry needs and fostering student engagement. The effectiveness of this approach was evaluated through a survey of 139 students majoring in Urban Underground Space Engineering. A teaching effectiveness survey was conducted to evaluate the impact, revealing high student satisfaction and increased participation in academic competitions and research projects. The findings demonstrate the effectiveness of structured innovation education in civil engineering and provide a reference for similar course development in higher education.

Keywords: innovative methods; innovative course; urban underground space engineering; teaching design; teaching effect

#### Factors Influencing Student Engagement in Online Computer Science Courses

Navid Yaghoubisharif, Shane A. Brown and Allyson Barlow

Student engagement is widely recognized as a critical factor influencing the success of engineering students in both traditional and online learning environments. Research indicates that engaged students develop a deeper understanding of course content, acquire practical skills, and maintain motivation in their field. Despite the theoretical importance of engagement, applying these concepts to specific online STEM courses presents challenges, particularly in mitigating student disengagement. This study addresses the need to better understand the characteristics of online STEM courses and student experiences that influence engagement. The study aims to identify the key factors influencing student engagement in online STEM education. By examining students' experiences and perceptions, the research seeks to provide insights into the strategies and activities that promote active learning and foster a sense of community in online courses. In-depth interviews were conducted with 33 undergraduate students enrolled in online computer science courses at Oregon State University. The interviews were transcribed and analyzed using thematic analysis to identify emerging themes and patterns related to student engagement. The findings reveal two main themes influencing student engagement in STEM courses: course characteristics & structure, and human interactions in learning. Course characteristics & structure, including resources, content delivery format, and course difficulty, impacted student engagement. Human interactions, both student-student and student-instructor/TA, played a crucial role in fostering engagement and a sense of community. The insights gained contribute to the understanding of effective teaching practices in online computer science education and provide valuable recommendations for designing engaging and inclusive online learning experiences that promote student success. The study highlights the importance of well-structured courses, diverse learning resources, effective human interactions, and appropriate course difficulty in maintaining and enhancing student engagement in online computer science education.

*Keywords:* online STEM education; student engagement; qualitative research; thematic analysis; learning strategies; course design; peer interaction; digital learning environments; educational resources

### Military Terrain Expertise in the South African Army Engineer Corps: Competency Gaps and Curriculum Innovation 770–785

#### K. P. Ngoepe, I. Henrico and H. A. P. Smit

This study investigates the critical competencies required for military terrain expertise within the South African Army Engineer Corps (SAEC), addressing significant gaps in existing training programs and advancing the discourse on military education reform. Using a qualitative research approach, the study analysed 32 sources, including military field manuals, academic literature, and training curricula from various defence forces. A Delphi panel of 11 military experts validated the competency framework, leading to the identification of 60 essential competencies necessary for SAEC officers to function as effective terrain experts. The research not only highlights the gaps – revealing that up to 97% of these competencies are not fully embedded in current training programs – but also explores how the newly proposed BMil in Applied Military Geoinformatics integrates these competencies. The BMil program aligns with South African Geomatics Council (SAGC) requirements for professional registration in Geographical Information Science (GISc) and incorporates scientific disciplines such as mathematics, statistics, and physics, which are foundational to engineering-related analyses. However, the focus of this programme is to equip officers with advanced geospatial analysis and technical skills, focusing on terrain analysis, spatial data management, and remote sensing technologies tailored for military applications. This research advocates for curriculum reforms that strengthen geospatial intelligence capabilities within the SAEC, ultimately enhancing operational readiness and strategic decision-making in complex military applications.

Keywords: military terrain expertise; South African Army Engineer Corps (SAEC); competency-based training; geospatial intelligence; operational effectiveness

#### Teaching Building Construction Technology Using a Participatory Learning Approach for Architectural Students: A Case Study

#### Zhantang Miao, Yuxi Yang and Jiangtao du

In recent years, the Participatory Learning Approach (PLA) has proven effective in teaching civil engineering, design, and other disciplines. However, its application in building construction, a fundamental course in architectural education, remains

underexplored. This study examines the impact of PLA on second-year architecture students in China by integrating theoretical instruction with hands-on participation in constructing a timber house. A questionnaire-based survey was conducted to gather student feedback and measure learning outcomes, assessing the effectiveness of this approach. Data analysis revealed that PLA significantly enhanced students' familiarity with timber construction, leading to improved academic performance and higher overall course satisfaction. Moreover, students expressed high levels of engagement, and their post-course achievements closely aligned with their initial expectations, demonstrating the educational value of PLA in building construction courses.

Keywords: participatory learning approach (PLA); building construction; undergraduate student; school of architecture; China

# Industry 4.0 and Industrial Engineering Education: Perspectives from Researchers

797-807

#### Mary Anny M. S. Lemstra and Marco Aurélio de Mesquita

The advent of Industry 4.0, driven by technologies such as the Internet of Things (IoT), Cyber-Physical Systems (CPS), Big Data and Analytics (BDA), and Artificial Intelligence (AI), is reshaping manufacturing and creating new demands for industrial engineering education. To address these changes, this study explores the integration of Industry 4.0 into undergraduate Industrial Engineering (IE) curricula through a literature review of 39 selected articles and a survey of 70 researchers. The study focuses on two key research questions: (1) What competencies do industrial engineers need for Industry 4.0? and (2) How can Industry 4.0 be effectively incorporated into IE programs? The results identify validated sets of essential soft and hard skills, with "systems thinking" and "problem-solving" ranking highest among soft skills and "data analysis" emerging as a critical hard skill. Additionally, respondents assessed ten key Industry 4.0 technologies regarding their priority and feasibility for inclusion in curricula. Major challenges include a shortage of trained teaching staff, while university-industry 4.0, advocating for active learning methods such as project-based and problem-based learning. Further action research in engineering education is recommended to validate and expand upon these findings.

Keywords: industry 4.0; digital transformation; competencies; engineering education

#### Establishing Quality Standards for Empirical Studies using Mixed-methods Designs in Engineering Education Research 808–820 Jutshi Agarwal and Gibin Raiu

Engineering Education Research (EER) is a relatively new field, requiring rigorous scholarship and archival venues to document advancements. While established standards exist for qualitative and quantitative research, EER has yet to establish clear quality standards for mixed-methods research. This article synthesizes recommendations for EER scholars for conducting mixed-methods research in engineering education, offering guidelines for executing and evaluating the mixed-methods studies. A systematic literature review was conducted across 17 engineering education journals, and the conference proceedings from ASEE and Frontiers in Education, focusing on articles providing guidelines for mixed-methods research from 2015–2022. Out of 448 identified articles, four relevant commentary articles met the selection criteria and formed the basis of this analysis. Key recommendations covered research questions formulation, rationale, methodological design, data collection and analysis, drawing inferences, and quality enhancement. Findings highlight the importance of transparent reporting of method of integration and a clear rationale for choosing mixed-methods designs. This review provides a rubric to guide the conduct and reporting of mixed-methods studies in engineering education, emphasizing the need for detailed methodological design, transparent integration of methods, and comprehensive reporting of both convergent and divergent findings to ensure high quality of mixed-method research.

Keywords: mixed-methods; quality standards; rigor; engineering education research

**Guide for Authors** 

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