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Contents

Contributions in: Soft Skills, Entrepreneurial Skills, Graduate Program, Academic Performance, Gender, Educational Technologies, Role Identity, Women, First Year Students, Leaning Environment, Problem Solving, STEM, Big Data, Innovation, Active Learning, Design Process, Leadership, PBL, Student Outcomes, Conceptual Questions, Learning Style, Persistence, Software Engineering, Analog Circuits, Architecture Engineering, Mechanics, Robotics, Digital Circuits, Aerospace Engineering

Soft skills, like communication and teamwork, are vitally important for an engineer's success in the workplace. Despite this, there is a perceived shortage of soft skills among engineers, particularly engineers of the youngest generational cohorts, the Millennials. This paper aims to evaluate the overlap between soft skills and the more concrete and the more enthusing category, entrepreneurial skills. An exploration of the literature reveals commonalities between soft and entrepreneurial skills and highlights the effects of the terminology differences on different generational cohorts. The paper concludes with five literature-supported assumptions about the current state of soft skills in engineering and how improvements can be made by rebranding soft skills as entrepreneurial skills.

Keywords: soft skills; entrepreneurial skills; engineering success; skill gaps; skill comparisons; engineering management; millennials

In education projects, students sometimes have difficulty conveying their knowledge when asked to solve real problems especially when a software product is generated as an outcome. Faculty accumulated nearly 12 years of experience running a graduate software engineering capstone course perceived the need to better assist students on the learning process. Course adaptations are required, particularly considering the heterogeneity of student's background and work experience, as well as the use of current technologies and tools. The paper outlines an evolved graduate software engineering capstone course for part-time graduate professional students. The capstone course is intended to create a meaningful student experience while providing a productive environment to apply knowledge learned from the program. Moreover, the new proposal emphasizes agile methodologies and code as the primary artifact. Our main contribution is to present the evolution of this capstone course, from inception to coding, testing and deployment. The course revision includes new artifacts, such as a work breakdown structure and burndown chart, as means to improve the course learning outcomes based on lessons learned and student experience. For evaluation purposes, we selected groups of most recent capstone course sections totaling 175 students. Two learning objectives of the program were evaluated: teamwork and critical thinking. Critical thinking was assessed via the project plan artifact. Teamwork was assessed through discussion forums, team test plans and reports. The results were positive; however, they indicate that not all elements of project planning are present in the studio course.

Keywords: software engineering; education; capstone project; agile; graduate program

The goal of this study is to model the relationships among four variables—*early activity, time-pressure reactivity, underlying performance, and class performance*. The specific research questions are: *Does procrastination mediate the relationship between earliness and academic performance? Do gender differences affect procrastination and academic performance?* This study identifies a set of relationships among four variables using structural equation models. Each variable in the model is rooted in objective measurements through course website datasets and parametric empirical Bayes estimation obtained from 59 undergraduate engineering students. We found that the degree of procrastination, termed time-pressure reactivity in this model, mediates the relationship between early activity and academic performance. We also found significant gender differences among the four variables: female students showed earlier activity and less procrastination, as well as greater academic performance, than male students. In practice, our findings suggest that the measurement of students' time logged on to access course website material can help researchers to estimate students' short-term and long-term academic performance, as mediated through the individualized degree of procrastination.

Keywords: academic performance; time pressure; structural equation approach; gender difference

This paper evaluates the impact of the early adoption of Industry 4.0 tools and methods (industrial systems that enable many innovative functionalities through their networking and their access to the cyber world) on engineering education. The proposed analysis considers two points of view: professors (teaching) and students (learning). In this context, two experiences were conducted: an advanced correction and validation system with real-time feedback and a virtual learning environment supported by a remote laboratory. In this paper two objectives are addressed: first the paper describes the proposed Industry 4.0 education tools, based on e-learning and cyber-physical technologies; second the performance of these tools is evaluated in a real context, where

more than one hundred students were involved. The experience was deployed in subjects related to microcontroller programming in Telecommunication Engineering and Bioengineering degree programs. Results were evaluated using statistical methods. First evidences of the improvement in the students' motivation, their academic results and their acquisition of Industry 4.0 competencies were obtained.

Keywords: Industry 4.0; engineering education; educational technologies; virtual learning environment; automatic feedback

Dina Verdín, Allison Godwin, Adam Kirn, Lisa Benson and **Geoff Potvin**   1037–1051   Engineering Role Identity Fosters Grit Differently for Women First- and Continuing-Generation College Students

This study examined two distinct groups of women in engineering (i.e., first-generation and continuing-generation college students) to understand how the engineering role identity constructs of interest, recognition, and performance/competence fostered grit– perseverance of effort and grit–consistency of interest. A survey was administered to first-year engineering students at four institutions across the United States. The sample of women was $n = 675$, from which $n = 144$ were identified as first-generation college students and $n = 531$ were identified as continuing-generation college students. Using existing instruments, two structural equation models were created to test the relationships between engineering role identity constructs and grit. The model of first-generation college students had high interest in engineering, which, in turn, was predictive of their grit–consistency of interest, while their beliefs about performing well and understanding engineering content was predictive of their grit–perseverance of effort. In the model of continuing-generation college students, being recognized as someone that can do engineering was predictive of grit–perseverance of effort while seeing oneself as an engineer was predictive of their grit–consistency of interest. The results of this work highlight different aspects of identity that may foster grit for women in engineering depending upon their parents' level of education.

Keywords: first-generation college students; women; engineering role identity; grit; structural equation modeling

Emily Dringenberg and **Amy Kramer**   1052–1063   The Influence of Both a Basic and an In-Depth Introduction of Growth Mindset on First-Year Engineering Students' Intelligence Beliefs

Growth mindset is a popular educational theory with empirical ties to motivation and persistence. Despite its popularity, the implementation of the theory in practice risks being over-simplified in the ways it is introduced to students and measured with established survey items. This oversimplification provides a limited research-based understanding of the complex ways in which students react to the theory or the influence that learning about the theory has on their personal beliefs. To expand prior work in this area, we conducted the current study by collecting both quantitative (survey) and qualitative (written reflections) data from first-year engineering students about their intelligence beliefs for (1) a sample of students who received a brief, in-class introduction to the theory (n = 66), and (2) a sub-sample of students who engaged in a more in-depth intervention (n = 6). Our findings show that neither the in-class introduction nor the more in-depth intervention had a statistically significant influence on students' intelligence beliefs, but the in-depth intervention did provide students with a more nuanced understanding of growth mindset theory. Many participants linked growth mindset exclusively to valuing effort. Implications of this study for engineering educators include that given the complexity of growth mindset, a brief introduction into mindset theory is not adequate for significant change in beliefs. Implications also include that survey items alone may not be indicative of growth mindset and qualitative approaches may be necessary for researchers to gain a more holistic understanding of students' intelligence beliefs.

Keywords: growth mindset; engineering; first-year

Ronit Shmallo, Tammar Shrot and **Lior Aronshtam**   1064–1073   The Effects of Applying Assessment FOR and AS Learning in Theoretical Engineering Courses

The paper presents research conducted with college students (N = 85) studying for their bachelor's degree in engineering. The study followed the teaching of two theoretical engineering courses, which were previously taught in a teacher-centered paradigm where the assessment of the students was based on Assessment of Learning. The goal was to enrich the assessment practices and to examine whether Assessment for, and as Learning will increase students' achievement and motivation. Instead of using a final exam as the main tool for students' assessment, we integrated Assessment for, and as Learning during their studies. We included significant and challenging tasks to be carried out in diverse learning environments, such as Learning from Mistakes approach, Project Oriented approach, and Collaborative Learning. The results were positive. We present the students' achievement compared to previous years, together with the students' opinions about the applied assessments. We summarize with several suggestions for educators about the integration of different means of assessments during the teaching process.

Keywords: assessment for, and as learning; engineering education; learning environments

Sean L. Gestson, Mathew S. Barner, Masoud Ghodrat Abadi, David S. Hurwitz and **Shane Brown**   1074–1093   Problem Solving Personas of Civil Engineering Practitioners Using Eye Tracking Techniques

Engineering practitioners solve problems in various ways; it is plausible that they often rely on graphs, figures, formulas and other representations to reach a solution. How and why engineering practitioners use representations to solve problems can characterize certain problem-solving behaviors, which can be used to determine particular types of problem solvers. The purpose of this research was to determine the relationship between time spent referring to various representations and the justifications for the decisions made during the problem-solving process of engineering practitioners. A persona-based approach was used to characterize the problem-solving behavior of 16 engineering practitioners. Utilizing eye tracking and retrospective interview techniques, the problem-solving process of engineering practitioners was explored. Three unique problem-solver personas were developed that describe the behaviors of engineering practitioners; a *committed* problem solver, an *evaluative* problem, and an *indecisive* problem solver. The three personas suggest that there are different types of engineering practitioner problem solvers. This study contributes to engineering education research by expanding on problem-solving research to look for reasons *why* decisions are made during the problem-solving process. Understanding more about how the differences between problem solvers affect the way they approach a problem and engage with the material presents a more holistic view of the problem-solving process of engineering practitioners.

Keywords: problem solving; personas; eye tracking; retrospective interview

David A. Delaine, Jose Roberto Cardoso and **Joachim Walther**   1094–1109   An Investigation of Inter-Stakeholder Dynamics Supportive of STEM, Community-Based Learning

Community-based learning (CBL) allows universities to leverage educational interactions with various non-university stakeholders. In a STEM context, CBL often includes service-learning, outreach, mentorship programs, pre-college research fairs, and internships where experiential education commonly provides the pedagogical foundation. Such initiatives are predominantly university-centered and the emphasis is on student or programmatic outcomes. This approach limits the potential synergistic benefits of CBL and can minimize the role of, and outcomes for, non-university stakeholders. The study presented here seeks to further knowledge of how inter-stakeholder dynamics can support STEM CBL outcomes through a qualitative exploration of the interdependencies between stakeholders. Thirty stakeholders from various groups across CBL initiatives organized around a large, public university in South America were interviewed. Interview data was analyzed using a constant comparative method to reveal emergent findings. Findings include characteristics and mechanisms of the relationships that support positive outcomes amongst STEM CBL stakeholders. The findings are structured in three categories: (i) shared purpose; (ii) holistic awareness; and (iii) linked commitment. The empirical findings describing the interdependencies between CBL stakeholders can broaden the current STEM CBL discourse and inform approaches that generate beneficial outcomes for all stakeholders. The extent to which STEM CBL and the supporting

relationships are understood in contexts outside the U.S. is limited, a gap in the literature that is addressed through the South American context of this study. Results indicate that an understanding of the inter-stakeholder dynamics can be leveraged to enhance STEM CBL programs by supporting outcomes for all stakeholders.

Keywords: STEM community-based learning; multi-stakeholder; experiential education; community engagement

Fatih Gurcan 1110–1115 Extraction of Core Competencies for Big Data: Implications for Competency-Based Engineering Education

Big data industry is an innovative and dynamic working environment based on highly qualified workforce. As the big data phenomenon advances, the demands of the industry for the workforce having these skills and competencies have increased considerably in recent times. Accordingly, the engineering education programs today need to adapt these skills and competencies into their programs. Focusing on this issue, this study aims to extract the core competencies in-demand by the industry. These competencies are the critical ones to better guide the curriculum developers of the engineering education programs. The methodology of the study is based on topic modeling analysis of online job advertisements using Latent Dirichlet Allocation, a generative approach for probabilistic topic models, to automatically discover the trending topics in big data jobs. As a result, domain-specific competencies, developer competencies, soft competencies, business-oriented competencies and analytical competencies are discovered, which revealed that big data competencies contain a wide spectrum of knowledge domains and skill sets based on a multidisciplinary background. The findings of the study are very critical to guide the industry, academia, and big data communities for bridging the gap between the requirements of the industry and the engineering education programs.

Keywords: big data competencies; competency-based engineering education; big data curriculum; topic modeling; Latent Dirichlet Allocation

Zhaohui Ye, Chengying Hua and **Jian Qin** 1116–1128 Integrating of Creativity and Self-Study in Analog Electronic Technology Education Through Project-Based Design

This paper presents a method of analog electronics experimentation that increases the number and types of project-based design experiments including circuit design and system design. Students are free to choose different experiments or design innovative circuits by themselves. At the same time, the lecture content has also been tailored to add an introduction to the history and development of analog circuits, an introduction to modern analog integrated circuit chips, and electronic systems. During two years of practical teaching, questionnaire surveys were conducted, the results of which showed that the effects of approach were very good. Most students believe that the method has a good influence creativity, self-study capability, and hands-on skills. In addition, the university's teaching evaluation results prove that the reform method was indeed conducive.

Keywords: analog circuit; creativity; design projects; experimental research; innovation

Octavio Mattasoglio Neto, Rui M. Lima and **Diana Mesquita** 1129–1140 Changing an Engineering Curriculum through a Co-Construction Process: A Case Study

The objective of this work is to present a co-construction process of an Engineering curriculum, which used different active learning approaches to motivate students by addressing realistic problems faced by engineers, right from the beginning of the program. Idealized by the rectory of the institution, in a top-down decision, the new curriculum established certain guidelines for these new approaches. In a bottom-up contribution to the curriculum, teachers had to devise, implement and conduct activities. At an early stage, these activities were classified into three types: Projects, Engineering Practices, and Workshops. To analyze the implementation of this new curriculum, a qualitative approach was used during and data were collected through interviews, focus groups, and questionnaires. The results indicate that teachers who devised the activities played an important role in determining several aspects aimed at formalizing the new curriculum in a co-construction process, increasing the accuracy of the ideas presented in the idealization phase. Despite the benefits of these experiences, the results suggest that the potential of the new curriculum was not entirely fulfilled at this initial phase, particularly regarding the development of soft skills. Therefore, adjustments are needed to take full advantage of the changes.

Keywords: curricular change; project-based learning; engineering education; active learning; curriculum co-construction

Olivera Dulić, Milena Krklješ and **Viktorija Aladžić** 1141–1156 Teaching Design to Civil and Architectural Engineering Students—a Diagram-Based Approach

In contrast to the extensive theoretical field that investigates the concept of the architectural diagram, certain aspects of the diagram's practical applications have been overlooked. Therefore, the research presented examines the potential of using diagrams as a specific form of graphic representation for teaching design to civil and architectural engineering students, through an empirical experiment conducted in a studio course environment. The research is based on the mixed methods approach, where the efficiency of the diagrams is tested through quantitative and qualitative analyses of sketchbooks, questionnaires and course observations. Through the application of diagrams, an emphasis is placed on the design process versus the final product of designing, thus deepening the understanding of the complexity of the architectural discipline. The results obtained show that diagrams support and improve the design process for novices, thus confirming their significant role in education, but also evidencing their importance as a means for developing complex design skills. Furthermore, our results demonstrate that the reorganization of the course positively influences learning and design processes, as well as their outcomes, whereas new modes of representation have a significant contribution.

Keywords: architectural engineering; civil engineering; engineering education; design process; design studio; diagramming techniques

Douglas W. Stamps and **John K. Layer** 1157–1169 Leadership Development through Sequential Progressive Mentoring in a Project-Based Learning Environment

Data from a survey instrument was used to determine the impact that sequential progressive mentoring in an integrated sequence of design courses had on leadership development. The scope of the research study included all undergraduate freshmen through senior students in a mechanical engineering program for five consecutive years (sample size equals 539). Several key findings were obtained from the survey instrument data. The integrated sequence of design courses had a significant impact on the development of professional skills that increased as students progressed through the sequence indicating that the mastering of these skills required multiple experiences. Leadership development through sequential progressive mentoring benefited both the mentor and the protégé and the benefits increased with time spent on the relationship. The survey instrument items also became self-reported manifest variables that were indexed to the latent variables for leadership experience, past mentored experience, past integrated design experience, skill development, and program culture. Structural equation modeling was performed to delineate relationships between leadership experience and the other latent variables. The modeling showed that the senior leadership experience correlated with the students' skill development and past mentored experiences and not with past integrated design experience in the absence of a mentor. These results were invariant to any particular class or project type.

Keywords: leadership; mentoring; experiential learning; structural equation modeling; project based learning

Paul Bazelais, David John Lemay and **Tenzin Doleck** 1170–1175 Exploring the Role of Testing in Student Outcomes: Evidence from a Mechanics Course

Assessments have become increasingly prevalent in education. While many affordances of assessments are offered in the literature, there is mixed evidence on how assessments affect students' learning and performance. Moreover, a testing effect has been identified in lab-based studies where more testing is associated with better performance; however, less is known about the effects of

testing on performance in situ. The present study employs data from two Mechanics courses to analyze the effects of testing on performance. We compare two sections—experimental condition with testing (N = 36) and control condition with homework (N = 38)—of the Mechanics course, to examine the relative importance of testing. We find a strong effect for regular testing on student mid-term and final exam performance. The findings have broad implications for the growing testing effect literature.

Keywords: testing effect; learning outcomes; STEM education; pre-university; physics; academic performance

Vytautas Štuikys, Renata Burbaitė, Vida Drąsutė, Giedrius Ziberkas and **Sigitas Drąsutis**   1176–1193   A Framework for Introducing Personalisation into STEM-Driven Computer Science Education

Currently two approaches, personalised learning and STEM, are intensively researched worldwide; however, we still know little about how they should or could be integrated seamlessly. This paper is just about that, proposing a framework for introducing personalised learning in STEM-driven Computer Science (CS) education. We motivate the framework by presenting the methodology and theoretical background for creating personalised content. This framework outlines basic activities relevant to personalised learning in STEM and focuses on the content personalisation and learner's knowledge assessment and self-assessment. We propose a generic structure of Personalised Learning Objects (PLOs) in three categories: component-based LO, generative LO and smart LO (the latter is a combination of the first two). The generic structure integrates those entities with the assessment modules and specifies the distributed interface for connecting them with digital libraries. Firstly, we have developed the learner's assessment model that integrates attributes defined by the revised BLOOM taxonomy and computational thinking skills with the adequate tasks. Then, using this model and applying meta-programming techniques, we have implemented the assessment modules and integrated them with PLOs. We illustrate and motivate this approach by presenting two case studies taken from the real educational setting at the high school. Finally, we evaluate our approach. As STEM relates to technology and engineering disciplines and CS-based modules are within most engineering curricula, our approach contributes to engineering education too.

Keywords: STEM-driven CS education; robotics; personalisation; personalised content

Ezgi Pehlivanli-Kadayifci   1194–1205   Exploring the Hidden Curriculum of Gender in Engineering Education: A Case of an Engineering Faculty in Turkey

This study explores the hidden curriculum of gender in engineering by focusing on an engineering faculty as an example in Turkey. Numerical existence of women engineers in Turkey, do not represent for qualitative information about gendered culture of this profession. Participants in this study, reported to face with gendered expectations, jokes, ignorance, and exclusion from social networks throughout university education. Mentioned conditions in engineering education are examined, where not only students but also faculty members learn to not notice the production and reproduction of gender differences in engineering education. The engineering faculty is thus perceived as an environment in which to learn how to become an engineer in the sense that the graduate will both fulfill the academic requirements and adopt the gendered social roles learned in engineering education. The findings of this research revealed that women experience several disadvantages because institutional structures value certain roles while individuals in engineering education learn to ignore the presence of such perceptions that tend to favor the dominant ideal types.

Keywords: gender; hidden curriculum; higher education; engineering; Turkey

Neusa Maria Franco Oliveira, Roberto d'Amore, Tertuliano Pinto, Ligia Urbina and **Wilson Cabral Souza Jr.**   1206–1214   Interdisciplinary Learning: An Electronic and Computer Engineering Case Study to Solve Environmental Problems

Environment and sustainability, and Principles of Economics are subjects present in engineering courses in Brazil. To attract the student's attentions to these subjects and promote entrepreneurship fomenting, an experiment was developed with electronic and computer engineering students aiming to use interdisciplinary and project-based learning approach. The students, fifty-six students in the first version and fifty-seven in the second one, formed mixed teams, with the goal of developing a prototype and a business plan to solve a specific environmental problem. During the prototype development, the teams presented technical reviews based in system engineering approach, which exposes the student to real industrial practices, even though assessed by grades. It was a four-month experience ending with the team presentation to professional experts in evaluating start-ups proposals. The experiment was successfully applied in two academic years with minor adjustments between its first and second versions. The article presents the interdisciplinary approach of the experiment, the assessment method, and feedback given by the students, instructors and invited professionals.

Keywords: interdisciplinary; engineering curriculum; environment; sustainability; economics; project-based learning

Branislav M. Notaroš, Ryan McCullough, Pranav S. Athalye and **Anthony A. Maciejewski**   1215–1223   New Partially Flipped Electromagnetics Classroom Approach Using Conceptual Questions

We propose using Conceptual Questions to assess class pre-work and improve students' grasp of core concepts of the reading material, as well as facilitate problem-based learning, in electromagnetics classes of the junior year of the electrical engineering program. We also investigate the effectiveness and impact of a teaching method based on the combined use of Conceptual Questions and partially flipped classroom on students' academic performance in an electromagnetics course. Best practices in engineering education require the students to engage very intensely in the assigned pre-work, which must be meaningfully motivated and assessed. A general way to address this need is the use of Conceptual Questions, namely, multiple-choice questions that focus on understanding and mastery of core concepts in electromagnetics, while requiring no or very little calculations, in class pre-work. According to our approach, prior to each classroom meeting, students complete an online, timed quiz with a set of meticulously designed Conceptual Questions concerning the preassigned reading topics, which enables the implementation of a partially flipped classroom instruction of electromagnetics. This study discusses and evaluates such use of conceptual quizzes, with the impact on students' learning, attitude, and success, analyzed and assessed in multiple ways. Student performance on midterm and final exams and overall class scores (in a class with 83 students), including both the D/F/W and the A-level grade rates, as well as their results on the Electromagnetics Concept Inventory assessment instrument, have shown substantial improvements under the proposed method when compared to the traditional pedagogical approach of previous years. Overall, this is one of the most extensive applications of such questions in the electromagnetics area, and likely any electrical-engineering area.

Keywords: conceptual questions; conceptual understanding; pre-work assessment; online assessment system; conceptual quizzes; active learning; partially flipped classroom; engineering electromagnetics teaching/learning

Andrej Trost and **Andrej Žemva**   1224–1237   A Web-Based Tool for Learning Digital Circuit High-Level Modeling

Modeling of increasingly complex digital circuits requires high-level design tools and languages. Design tools based on standard hardware description languages need substantial training which limits their usage in a typical digital system design course. In this paper, we propose a small hardware description language SHDL for circuit modeling and present a novel web-based educational tool. The SHDL includes similar high-level modeling semantics to VHDL but has substantially simplified syntax. The web-based SHDL modeling and simulation tool enables quick introduction to language-based circuit modeling. The SHDL model is automatically translated to the equivalent VHDL model. The proposed tool enables conducting more laboratory and self-learning circuit design experiments important for comprehending the design process. A one-semester laboratory hardware modeling lessons are described and educational experience with the new methodology is discussed.

Keywords: teaching digital design; high-level model; hardware description language; educational web tool

Changing the way in which students work in the university environment is necessary. Thus, conventional classes based on problem solving were eliminated. Instead, active dynamics were used. With them, students participated in a closer way to the way how later they will have to do it into the working world. This new methodology to face the engineering problems was called "problems without data". Its implementation was done using an App. Students had to choose, for a certain problem, what data have to buy to be able to solve it successfully. In the same way, this paper explains how to introduce this new methodology in the classroom. A series of stages were shown so that the reader can transform their conventional engineering problems in new ones adapted to the new methodology proposed. Statistical studies proved that the university students that use PWD methodology improved their academic results.

Keywords: engineering problems; higher education; ICTs; problems without data

The aim of this research is to explore the learning styles of architecture students and correlate their learning styles with their performance in construction management courses. A second purpose is to determine whether the learning styles of architecture students change with the effect of architectural education from the first year to the last year of education. The data were collected by administering the Kolb learning style inventory II, survey to students in an undergraduate architecture program. The questionnaire was administered to students by direct contact, and data were collected from 55 participants. The obtained data were analyzed statistically using by SPSS 18 software. There was a statistically significant relationship found between learning styles and performance scores in construction management courses, and converger students are more successful at construction management courses. At the end of the research project, primary learning style of the architecture students was found to be the accommodator, and the research also found that a student's learning style changes and is shaped by the architectural education.

Keywords: architectural education; learning style; construction management education

The purpose of this study is to improve the persistence and academic outcomes of undergraduate students majoring in aerospace engineering (AE) by studying their pre-university academic abilities, demographic characteristics, and early experiences at a university. To explore significant factors that predict students' persistence and academic success, data were collected from first-year AE students from 2011 to 2016 at a large Midwestern university in the United States. Two data sets were analyzed: data from a Registrar's Office on students' demographic characteristics and data from an online survey, derived from Tinto's model of institutional departure, completed by students within 4 to 6 weeks of joining the university. Logistics regression analyses were run to highlight the factors that affected students' persistence and academic success in AE. High school preparation was positively related to predicting academic success and persistence for AE students. Coping with academic work, satisfaction with academic life, and being a part of a learning community were also important factors for AE students' academic success and persistence. Social experiences at the university did not impact students' persistence and students' academic outcomes. Early personalized interventions may help students persist in the AE program.

Keywords: persistence; academic success; aerospace engineering; undergraduate