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From the Editor

This is our thirteenth issue – 115 papers published and over 500 submissions. In addition, PRISM is now featuring "AEE Advances" – one page overviews of important articles in the October and February issues. The vast majority of these papers document a proven "advance" in engineering education, with a few others providing reviews of "advances." In this way we have stayed true to our goal of publishing a wide range of articles that inform the broader engineering education community concerning methodology, pedagogy and technology that can be implemented either within or outside of the classroom. In contrast, we have neither sought out nor published articles that primarily describe research studies, leaving those to other journals, especially our much older sister publication the *Journal of Engineering Education*. Please see our *JEE* guest editorial on "boundaries" [http://advances.asee.org/?page_id=441] for a more thorough discussion on this subject.

This issue presents eight papers that cover a range of topics, addressing applications from middle school through all four college years and across multiple disciplines. Of special note are two papers describing two online collections – a concept warehouse and an assessment instrument catalog. Another paper describes a successful implementation of the Emporium Model; that is, a variation of flipping the classroom, which is attracting considerable interest among engineering educators. Two papers utilize animation and computer graphics - one utilizes animation creatively to better teach basic electronic principles, while the other develops virtual environments for teaching aspects of surveying. Both papers document improvements over more traditional instructional methods. Specifically:

Kristen Billiar from Worcester Polytechnic Institute and three of his colleagues describe developing creative STEM curriculum that not only instructs but also excites both K-12 students and teachers. Specifically, they demonstrate how the engineering design process can be used in a creative, effective manner to develop coursework. Their learner-centered approach that utilizes problem-based learning methodology with authentic problems facilitates conceptual learning. Their process has been developed in collaboration with 15 middle school teachers over three years; the result is a set of curricular modules that have been used with 2,000 students. Their article describes how teachers can utilize the engineering design process to develop problem-based curricular units and in doing so better learn the process.

Roxanne Toto and Thomas Colledge from Penn State along with two other colleagues focus on instruction in the use of 3D parametric solid modeling. They propose that to be effective, faculty who teach engineering design should utilize instructional practices that promote strategic thinking. However, this is difficult if assessment is based on the inspection of the artifact produced and

not the student's strategic thinking throughout the construction process. Their paper examines the impact of three instructional strategies on first year engineering design students' strategic thinking combined with the use of a 3D parametric modeling software package. Their findings suggest that 1) expertly modeling the design construction process may improve confidence, but doesn't impact ability or proficiency with the software; 2) object construction is more effective than engaging with and completing software tutorials for supporting the development of CAD software declarative command knowledge; 3) engaging with and completing the software tutorials supports the development of procedural command knowledge more effectively than constructing a design object and; 4) constructing a design object supports the development of strategic use of the software more effectively than expertly guided modeled design processes.

Masoud Rais-Rohani and Andrew Walters from Mississippi State University describe how a lecture-based engineering mechanics course can be redesigned using the Emporium (flipped) model. In their revised course students view the lecture material outside of class via asynchronous online delivery, and perform the other activities including assignments and tests either individually or in groups inside the classroom. Computer- and experiment-based assignments are used to engage students in active and collaborative learning. The instructor and learning assistants supervise in-class activities, offering guidance when requested. Following a successful pilot, all sections were converted to the Emporium model and coordinated by a single instructor. They compare learning outcomes under the Emporium-based model to a lecture-based approach over a one-semester pilot and seven-semester full implementation and found comparable learning outcomes and student success rates compared to the traditional instruction approach. Nor was there an apparent drop-off in longer term retention. Although they found that motivating students in this format was challenging, they did report somewhat lower instructional costs.

Brent K. Jesiek and two colleagues from Purdue describe the NSF funded International Research and Education in Engineering (IREE) 2010 China, a summer engineering research abroad program that attracted a relatively large number of students from across the country. Their paper describes the creative orientation strategies, which were developed to improve student readiness for global practice, and presents mixed-method assessment strategies, including measures for global engineering competency among key learning outcomes. Not surprisingly, their findings are consistent with a much larger study (Georgetown Consortium Project), which found that learning is maximized in well-structured programs with proactive interventions. The Jesiek study suggests that the largest gains in global engineering competency will occur for those students who are able to have multiple, in-depth exposures to different engineering cultures.

Hazar Dib, Nicoletta Adamo-Villani, and Stephen Garver from Purdue's Building Construction Management and Computer Graphics Technology programs describe the design, development

and initial evaluation of an interactive virtual environment to assist undergraduate students in learning the concepts of differential leveling. Their virtual environment includes realistic terrains and leveling instruments that look, operate, and produce comparable results to the actual physical ones. The goal is to integrate their tool into surveying courses for preparation, revision and assessment. Their pilot findings document that the virtual environment is both engaging and useful for teaching/learning differential leveling. Results from a second, summative study found that the virtual environment led to an increase in subjects' declarative and procedural knowledge. However, when compared to traditional practice, although interacting with the virtual environment led to significantly higher declarative knowledge gains, differences in procedural knowledge gains between students who used the virtual environment compared to students who had practiced in the field were not significant.

Aharon Gero and Wishah Zoabi from the Technion - Israel Institute of Technology and Nissim Sabag From ORT Braude College (Israel) have provided this issue's international contribution. Their paper focuses on teaching the principle of operation of the bipolar junction transistor – a basis for electronics studies. The instructional difficulty is due to both the device's complexity and the students' limited background. To address this challenge, they have developed a learning unit using computer animation appropriate for the students' background, which qualitatively describes the processes occurring in the transistor. As part of their research, they examined the characteristics of students at a two-year college learning these concepts. Using both quantitative and qualitative instruments, they found a significant achievement gap between students who used their animation and those who only used static diagrams. In addition, students who used the animation expressed significantly more positive attitudes towards electronics than did their comparison peers.

Milo D. Koretsky from Oregon State and six colleagues from across the US detail the innovative *AIChE Concept Warehouse*, a web-based instructional tool that enables chemical engineering faculty to better provide concept-based instruction. The *Warehouse* currently includes approximately 2,000 concept questions and 10 concept inventories pertinent to core chemical engineering curriculum. All items are available for faculty use both for both in-class concept-based clicker questions (or ConcepTests) and stand-alone concept inventories. They can be accessed either online or off. The tool has been designed to be versatile, enabling it to best fit the instructor's teaching philosophy and the program's educational environment. The authors propose that their computer-based approach is generic and should be applicable to other engineering disciplines.

Sarah Brooks, Shane Brown and two Washington State colleagues provide a second form of online inventory as part of an study in diffusion of innovation (DI). Their *Appraisal System for Superior Engineering Education Evaluation-instrument Sharing and Scholarship (ASSESS)* is a user-driven,

web-based catalogue of assessment instrument information. Their paper focuses on developing an understanding of ASSESS' adoptability. Interviews with potential users enabled the team to explore various perspectives about ASSESS. They have concluded that the innovation's *Use as an Alternative* and its *Functionality of Design* were the primary categories important for its adoption, both of which relate to three DI characteristics: *Relative Advantage*, *Complexity*, and *Compatibility*. They recommend that developers of engineering education technological innovations focus on these two categories and three DI characteristics, especially if adoption is a concern.