

The International Journal of Engineering Education

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- Since its inception in 1992, the NSF-sponsored Southeastern University and College Coalition for Engineering Education (SUCCEED) has successfully induced large numbers of engineering faculty members to participate in instructional development programs and to adopt proven but (in engineering) non-traditional instructional methods. This paper briefly reviews the events in engineering education that led to the formation of SUCCEED, outlines the coalition's faculty development program structure, summarizes the program assessment data, and discusses possible implications for reform of engineering education.*
- Ram M. Narayanan** 241–251 Academic Leadership Strategies for Engineering Faculty
- The faculty member of today confronts some unique challenges in order to succeed. The attainment of tenure and subsequent career advances call for excellence in the triple missions of higher education, viz., research, teaching, and service. Although these responsibilities appear to be in conflict, it is indeed possible to succeed in all three missions by appropriate management of strategies and time. This paper provides one faculty member's personal perspective on achieving success in the research, teaching, and service missions, primarily in a doctorate-granting research university environment.*
- John V. Farr and Donald N. Merino** 252–259 Educating Entry-level Engineers: Are Broad-based Business/Managerial Skills a Key to Sustaining the US Innovation-based Economy?
- Fewer college-bound students are entering engineering in the United States than at any time in the last fifteen years. This can be attributed to relatively low entry-level salaries of traditional engineering, the perception that there is limited opportunity for significant long-term earning potential, and they are not being provided with the necessary business and entrepreneurial acumen. This paper presents a comparison of how our university is incorporating management and business topics throughout the curriculum with other leading engineering institutions to develop more entrepreneurial engineers. We also present study results justifying the focus of our efforts and some important lessons learned.*
- Kees van Overveld, René Ahn, Isabelle Reymen and Maxim Ivashkov** 260–271 Teaching Creativity in a Technological Design Context
- We want to teach creativity techniques to prospective technological designers in a domain-independent way. To facilitate this, we adopt a format and nomenclature that is close to the terminology used by engineers. Central notions are concepts, attributes and values. A crucial role is played by, what we call, productive attributes: attributes that come with a set of values that can easily be enumerated. In this paper we show how this format supports several creativity techniques and how it allows engineers to explore option spaces in a structured manner. We briefly discuss some practical experiences with our approach.*
- Mechanical Engineering*
- Tarsicio Beléndez, Cristian Neipp and Augusto Beléndez** 272–281 Cables Under Concentrated Loads: A Laboratory Project for an Engineering Mechanics Course
- Cables are one of the common structures studied in a first-year engineering mechanics course (statics), since the flexible cable is one of the usual methods of supporting loads. For example, the suspension bridge has been used for many centuries and is perhaps the best example of the use of cables in engineering. In this paper, we describe a simple laboratory experiment, appropriate for undergraduate students, to analyze a cable under the action of a system of concentrated external forces. The shape of the cable is measured using graduated rules. The resultant of the system of applied forces and its line of action, reactions at supports and tensions in the segments of the cable are obtained using three different procedures—experimental, graphical and analytical—with good agreement being found between them all.*
- Control Engineering*
- Sheng-Jen ("Tony") Hsieh and Patricia Yee Hsieh** 282–296 Animations and Intelligent Tutoring Systems for Programmable Logic Controller Education
- Programmable logic controller (PLC) technology is central to the development of modern automated manufacturing systems. However, due to limited equipment availability, high student/faculty ratios, limited lab access, and limited resources to support students outside labs and the classroom, many educational institutions do not provide the resources necessary to help students to become proficient with PLC technology. To alleviate some of these problems, an Integrated Virtual Learning System (IVLS) is being developed to teach about PLCs. The IVLS will be used to teach information students need to know about equipment before using it, so that lab time can be spent more productively and efficiently. In addition, unlike a human instructor, it will be available anytime, anywhere there is a computer connected to the Internet. IVLS lessons have thus far been developed to teach PLC applications; information flow from an external input device to a PLC processor image table to output devices; and PLC timer instructions. Three different timer instructions—Timer-on Delay (TON), Timer-Off Delay (TOF) and Retentive Timer On (RTO)—are covered. The lessons were developed using a combination of intelligent tutoring system, animation and presentation development tools. An evaluation of the lessons on timer instructions was conducted with 90 undergraduate manufacturing engineering students. Students made statistically significant learning gains as a result of taking the lessons, and rated them positively in terms of ease of use and understanding, clear objectives, amount of interaction, ability to motivate, relevance, and pace.*

For many industrial engineering students, the basic principles of craft production and mass production are easy to grasp and understand; however, students less familiar with manufacturing often have a difficult time appreciating the subtle differences between the two. Explaining the differences between the two using examples and cases is relatively straightforward and easy, but many students have a difficult time comprehending the importance of the learning effect, why bottlenecks occur, or how quality can decrease during mass production. In this paper, the author's experiences with a paper airplane production activity to contrast craft and mass production are discussed. This activity provides a simple, yet dramatic, approach to demonstrate the benefits and drawbacks of craft and mass production in the classroom. After discussing the merits of hands-on activities and the paper airplane production activity itself, sample results are presented along with an evaluation of its impact on students' understanding of the two production methods.

Web-based Learning

T. Özer, M. Kenworthy, J. G. Brisson, E. G. Cravalho and G. H. McKinley 305–315 On Developments in Interactive Web-based Learning Modules in a Thermal-Fluids Engineering Course

The main objective of this study is to investigate how the traditional lecture format in engineering education might be complemented and enhanced by computer-based teaching and learning methods. We consider the development of Web-based learning modules for 2.005 Thermal-Fluids Engineering I, a second year Mechanical Engineering course at Massachusetts Institute of Technology (MIT). These modules are the result of an initiative known as the I-Campus project which seeks to comprehensively transform the traditional education structure. The new engineering education methodologies that are introduced in this paper deal particularly with heat transfer interactions in thermal-fluids systems.

Engineering Design

Vincent Wilczynski and John J. Jennings 316–327 Creating Virtual Teams for Engineering Design

Virtual teams for engineering design are becoming more commonly used in industry and the engineering education community must prepare graduates to be employed in such work environments. It is widely understood that successful design is often a highly collaborative team-based activity. To be effective, a virtual team must be able to communicate, collaborate and coordinate, all at a distance. However, the same set of skills that guide design teamwork for a team where all members are in one location is different from that set of skills needed to lead virtual teams. This paper presents communication, collaboration and coordination tools necessary for a virtual team and identifies the skills needed to guide virtual teams to success. Collectively, the team organization, web-based collaboration tools, and virtual project management techniques provide a template to create virtual teams for engineering design.

Guy Prudhomme, Jean François Boujut and Daniel Brissaud 328–337 Toward Reflective Practice in Engineering Design Education

Today engineering design practices are radically changing through the development of collaborative work, which requires new specific skills. From an educational point of view specific courses have been set up, including projects and teamwork. However, few efforts have been devoted to the definition of a framework for analysing and characterising collaborative practices in engineering design education. Our aim in this paper is to propose a framework, based on four basic concepts, which allows the characterisation of specific collaborative situations in order to provide engineering students with a more accurate feedback. We stress here the importance of developing reflective practices as a basic skill for collaboration. Our research method is based on a longstanding qualitative analysis of groups of students working on a design game at a graduate level.

Markus Meier 338–345 Best Practice in Product Design: Concept Outlines and Experiences in Project-Oriented Product Design Education

For six years, the ETH Zurich in Switzerland has carried out a project-oriented training exercise on a course entitled 'Product Design'. An international evaluation nominated this course as being both successful and one of the best-practice courses. This paper describes the course in terms of concept, structure and content, and also describes experiences with project-oriented training exercises on this theme.

Biomedical Engineering

Paul H. King and Richard Fries 346–353 Designing Biomedical Engineering Design Courses

This paper discusses an attempt at obtaining a definition for design course content for capstone Biomedical Engineering design courses as currently taught in the United States. The data discussed in this paper have been obtained from a questionnaire developed by the authors and responded to by both academics teaching senior design and by personnel in industry. As is to be expected in an environment where industrial internships are not common, there are some disjoints between industrial needs and academic perceptions. These discrepancies as well as likenesses in perception will be discussed in this paper.