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Part I
Special Issue
Trends in Agricultural, Biosystems and Biological Engineering Education (II)
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Higher education in Slovenia is facing a decline in interest in the study of engineering and science, despite the fact that job opportunities for engineers have continually increased in recent years. In addition, the scientific and technical knowledge of students entering higher education has been observed to be rather theoretical and fragmented with a weak association to technological issues. This article presents an action designed to improve this situation. At a grammar school in Slovenia, inquiry based teaching has been introduced to biology laboratory lessons. The aim of these lessons is to study biological processes in fishponds, focusing on the concentration of dissolved oxygen. Students are asked to predict the outcome in four different situations that may arise in a fishpond. To verify their hypotheses, the students are required to design and analyse computer supported measurements in an aquarium that refelects the processes in the fishpond. Feedback from students during lessons, as well as their responses to a questionnaire administered afterwards are encouraging. Although computerised school laboratory and inquiry-based teaching is not foreseen in the official curriculum, certain prescribed learning goals were fulfilled. Furthermore, students achieved knowledge and skills that are not anticipated in the curriculum, but may be of equal or greater importance.

Keywords: school science laboratory; data acquisition; plant physiology; model experiments; biology teaching; inquiry-based teaching; problem-based teaching

This paper reports an endeavor to outfit a laboratory for a new course that teaches physical process variable measurements, signal conditioning, data acquisition using computers, data processing, and transmission and communication of measurement results. Major effort was spent on designing and building new instrumentation test stands. Each test stand has a computer, a data acquisition system, various transducers for pressure, flow, and temperature, and several other process control components such as valves, a pressure accumulator, a heat exchanger and heaters. The test stands are self-contained, modular, movable, and can be used wherever there is electric power. Internet connection allows monitoring and control of the test stands from anywhere in the world. Students write graphical programs to acquire, process, and present data. Students have applied the skills gained in the course to research and industry. The course has helped one of its students win an international scholarship. Initiated at Purdue University, the course has been taught at a university in Brazil.

Keywords: sensors; data acquisition; agricultural engineering

Part II

Contributions in: Engineering Education Research, Engineering Design, Engineering Ethics, Control Engineering, Industrial Engineering and Geotechnical Engineering

Many papers have been written on the teaching and learning value of the 'freshmen engineering experience' (FEE), where FEE is an experimental, design project based course that provides a stimulating introduction to engineering for freshmen students. The research has largely focused on the pedagogical benefits obtained via the problem-based learning techniques implicit in well designed FEEs. Less well reported are the accompanying issues of pass and retention rates, integration with K-12 outreach programs, contributions towards national rankings and their overall strategic importance in engineering programs. This paper reviews the broad value and strategic role of FEE programs in the framework of engineering education.

Keywords: freshmen experience; design; retention; integration; internationalization

A Project Management (PM) training approach is presented based on the solution of real-life projects by groups of students in their last year at the School of Engineering of the University of Zaragoza. The training dynamics simulates the functioning of a consulting firm, where students are the consultants and the teachers work as mentors, sharing a common methodology to help the student groups to successfully bring their projects to completion. The 'problems' to be solved are proposed by real customers. During the academic years 2003/04 and 2004/05, 41 customers and 240 students have taken part in the course, with very satisfactory results. With the ultimate goal of increasing the satisfaction of all participants in this course, our priority has evolved in this period and we currently seek to ensure that no project group ends in failure. The results of this experience are based mainly on the analysis of 'failed' groups (5 out of 41 cases), the periodic group self-assessment sessions and the feedback received from students. According to this research, coordination within a project group appears to be a key aspect in influencing the results obtained. Those groups with an assigned 'coordinator' worked better. It is also worth pointing out that, as the project advanced, it was noted that all of the groups felt more confident and more optimistic about the quality of their work and the level of satisfaction expected from the customer, regardless of the actual results. Also, the vast majority of the groups grossly underestimated the time needed to complete the work. The paper concludes by describing future lines of work and collaboration in the model framework presented.

Keywords: cooperative learning; project management; Project Management Office; experiential learning; newly formed groups

Teaching design in engineering is a complex but challenging task requiring the development of numerous attributes by the students. Furthermore, with the increasing diversity of subjects taught in civil engineering less time is available for addressing individual subjects, let alone individual attributes. There is also the tension caused by the need to impart a deeper long-term training for engineering problem solvers while maintaining the short-term training of the essential but straightforward prescriptive design tools and skills. It is shown that it is still possible to develop design courses that train and, more importantly, assess a student's problem solving abilities by implementing assessment schemes that acknowledge and reward higher level learning while still maintaining an element that ensures the basic skills have been mastered.

Keywords: assessment; learning; teaching; engineering design; fundamental principles

ME 6101 Engineering Design, is a graduate level course offered through the George W. Woodruff School of Mechanical Engineering at the Georgia Institute of Technology. To empower students to learn how to learn, the orchestrators of ME 6101 strive to offer an individual course in a group setting. In this paper, the techniques utilized to create this type of learning environment are described in terms parallel to those of the mass customization paradigm. Excerpts from students' essays are presented as anecdotal evidence that the concerted use of these methods aids and empowers students both in the internalization of course content and the development of critical analysis, abstraction, and synthesizing skills that will help them become lifelong learners.

Keywords: Engineering design education; Mass customization of education; Learning how to learn.

Multiple choice question (MCQ) tests involve an element of guesswork, which affects the reliability and interpretation of test scores. This article studies the probability of obtaining a certain score by pure guesswork and introduces a conversion scheme which converts raw test scores into standard percentage marks. The probabilistic analysis shows that the optimum number of choices of answers for MCQ questions is four, and for a four-choice question test, increasing from 8 questions to 18 and 48 questions reduces the probability of obtaining a converted mark above 40 by pure guesswork from about 5% to below 1% and 0.01%, respectively.

Keywords: MCQ; conversion scheme; probability; score; mark.

While many are familiar with the Johnstown Flood of 1889, another significant dam failure in Pennsylvania occurred twenty-two years later in Austin. This paper tells the story behind the design, construction and ultimate failure of this early concrete dam and the subsequent disaster in the town below it. Correspondence between the design engineer and the dam's owner along with other period documentation provide important insights into social responsibility leading to the question: how should society protect the public from the misuse of technology? The roles played by the town citizens, engineer, owner, state and Federal governments, and a professional engineering society are examined.

Keywords: ethics; social responsibility; dam failure

The paper presents three balancing mechanisms, which have been utilized as experimental systems in the control education of mechanical engineering students. Their uniqueness is the pneumatic drive, which makes them more affordable, simpler and more interesting to control. These balancing mechanisms are the inverted pendulum, the inverted wedge and the ball and beam, while the pneumatic infrastructure includes a variety of valves. This paper describes these experimental systems and some methods applied to control them.

Keywords: control education; experimental systems; mechatronics; pneumatics

Throughout this article we will outline a new software tool aimed at explaining the major features of proximity sensors, as well as their different types, to engineering students and automation experts. We propose an interactive multimedia application that shows the basics of this type of sensor, their electrical, physical, mechanical and operating characteristics, the types of electrical outputs, operating modes and configurations. Through a large number of simulations, animations, industrial system videos, links to manufacturer Web pages, catalogues and data sheets we introduce a comprehensive view of inductive, capacitive, optoelectronic, ultrasonic and magnetic sensors, micro-switches and limit detectors intended to work as proximity sensors in an industrial environment.

Keywords: e-Learning; multimedia; proximity sensors.

Since the academic year 1998/1999, industrial engineering students at the Universitat Jaume I in Castellón (Spain) have been encouraged to do their final year project as part of a work placement. This paper presents the findings from this experience. Once students have successfully completed more than 90% of the credits in core and compulsory subjects in their programme of studies, they then have a work placement in a public or private company in the industrial sector in the province of Castellón. During this period they receive the support and guidance of a supervisor in the company and a tutor at the University, both of whom are thoroughly familiar with the topic being dealt with in the placement. Students' final year projects are derived from the work they carried out during their stay at the company. Both students and members of the teaching staff rate this experience as being extremely positive, as can been seen from the results of the evaluation surveys.

Keywords: final year project; work placement; industrial engineering

Undergraduate soil mechanics/engineering/design can be made more interesting by appealing to students' team spirit and competitive nature. A scale-model Mechanically Stabilized Backfill (MSB) wall design/build competition has been developed and tested that generates enthusiasm, engages students in teams, implements design, and teaches about soils engineering. The competition has been used in local, regional and national competitions in the US with much success. The processes followed to develop the MSB wall competition can be adapted for use in other engineering education disciplines.

Keywords: competition; design; geotechnical.