THURSDAY SESSIONS

Session T1A: Plenary

Chair: Cherrice Traver, Union College

Time and place: Thursday, October 23, 8:00 am - 9:30 am. Saratoga Ballroom

Session T2A: Classroom Technology 1

Chair: John Demel, The Ohio State University

Time and place: Thursday, October 23, 10:00 am - 11:30 am. Phila

TECHNOLOGY AND LEARNING-CENTERED EDUCATION: RESEARCH-BASED SUPPORT FOR HOW THE TABLET PC EMBODIES THE SEVEN PRINCIPLES OF GOOD PRACTICE IN UNDERGRADUATE EDUCATION

Jamie Cromack

Student learning improves when faculty use learning-centered teaching practices, and a symbiotic relationship exists between technology and learning-centered education. One technological tool, the Tablet PC, offers university faculty a powerful way to enhance student learning. The Seven Principles for Good Practice in Undergraduate Education offer a framework for learning-centered education, and this paper illustrates the Seven Principles through research data focused on innovative and pedagogically appropriate uses of Tablet PCs. Examples include assessment research data from MIT, DePauw, Rose-Hulman Institute of Technology, University of Washington, Pace University, University of Michigan and Virginia Tech.

WORK IN PROGRESS - STRUCTURE EDITING OF HANDWRITTEN MATHEMATICS

Alexandra Mendes

This project aims to develop a pen-based software tool that will assist in the process of doing mathematics by providing structured manipulation of handwritten mathematical expressions. The tool will be used to support the teaching of the dynamics of problem solving in a way that combines the advantages of the traditional blackboard style of teaching with the flexibility and accuracy of computer software. It will provide not only a simpler way to input mathematics - by allowing the recognition of handwritten mathematics - but also enhance students’ understanding of the calculational techniques and facilitate the process of doing mathematics - by providing structure editing. Some of the most important features of this tool are the accurate selection and copy of expressions, the automatic application of algebraic rules and the use of gestures to apply them, and also the combined writing of mathematics and text. These features will have a major impact on writing, doing, and presenting mathematics. This project includes the required technical developments and also the application and testing of the tool in concrete situations, namely in mathematics and computing science courses.

A MATLAB-BASED TEACHING OF THE TWO-STUB SMITH CHART APPLICATION FOR ELECTROMAGNETICS CLASS

Fong Mak and Ramakrishnan Sundaram

This paper specifically presents a Matlab-based teaching approach to the two-stub Smith chart problem that is typically covered in an undergraduate course on electromagnetic fields. Matlab provides a powerful computation and display platform by means of which fundamental and advanced concepts relating to transmissions can be understood and implemented. The paper restates the solving techniques of a two-stub Smith chart problem in terms of a process consisting of steps. These steps can be implemented as modules written in Matlab scripts. This modular approach using Matlab enhances the students’ understanding of the Smith chart technique as a solution process with the specific objectives of each module clearly identified. Furthermore, the computations are more accurate and the results can be displayed and interpreted in a more effective manner. The students taking the course completed an on-line survey to rate the effectiveness of the Matlab tool in solving the two-stub transmission problem. The responses to the survey reaffirmed the belief that solutions to problems involving concepts that can be challenging to grasp are learned more effectively when the steps of the solution are associated with processing modules comprising clearly defined input-output relationships.

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WORK IN PROGRESS - A GAME-BASED LEARNING SYSTEM FOR SOFTWARE ENGINEERING EDUCATION

Wei-Fan Chen, Wen-Hsiung Wu, Tsung-Li Wang and Chung-Ho Su

This study develops and evaluates a game-based learning system for a software engineering course. The game-based system adopts a role-playing strategy proposed by a digital game-based learning model and is designed based on the educational theory of Technological Pedagogical Content Knowledge that integrates pedagogical knowledge, content knowledge, and technological knowledge. By using the system, students learn about the process of software development in a team-based environment. In this learning environment, learners play different characters, such as a project leader, a system analyst, a system designer, or a programmer. The learners are also able to conduct collaborative activities with other team members during the software development process. To evaluate the effectiveness of the system, thirty-four undergraduate students in a software engineering course were recruited to evaluate the system via a questionnaire. The survey results indicated that students had a positive learning attitude toward the system usage.

AUTOMATIC CAPTURE AND PRESENTATION CREATION FROM MULTIMEDIA LECTURES

Paul E. Dickson, W. Richards Adrion and Allen R. Hanson

For more than a decade, the RIPPLES group at the University of Massachusetts Amherst has developed and deployed content delivery systems to support on-campus and distance education. This has been an effective but expensive approach because of its dependence on content captured by human operators and substantial production effort. Presentations Automatically Organized from Lectures (PAOL) is a classroom-capture system that is transparent to and places no constraints (teaching style or pedagogy) on a lecturer. PAOL is unique no other system can capture unconstrained computer-based materials, capture whiteboard writing and drawing, and produce a speaker video without requiring preinstalled software, electronic whiteboards, or special training. PAOL uses high-resolution cameras, a computer screen capture device, and a wireless microphone to automatically create multimedia Flash presentations, which include a digitally edited instructor video, enhanced images of all material presented by computer or written/drawn on a whiteboard, and an index to support navigation. The PAOL system has been used extensively during system development in several varied settings. We report on usability studies to determine the most effective presentation formats and interfaces and our efforts to capture a full course to further evaluate the impact on teaching and learning.

Session T2B: Laboratory Experiences 1

Chair: Amalia Rusu, Fairfield University

Time and place: Thursday, October 23, 10:00 am. - 11:30 am. Broadway 1

A SCHEDULING SYSTEM FOR SHARED ONLINE LABORATORY RESOURCES

Yaoye Li, Sven K. Esche and Constantin Chassapis

Online educational laboratories are increasingly deployed in traditional on-campus as well as Web-based distance-learning classes around the world. Recently, various educational institutions have attempted to leverage their online laboratory developments by broadly sharing them across institutional boundaries. While virtual experiments represent scalable software simulations, hardware-based remote experiments can only be used by one person or group of persons at a time. This paper describes the design and prototype implementation of a scheduling system for shared online laboratory resources, which can be employed to coordinate reservations of usage time for multiple geographically dispersed users. This scheduling system facilitates various priority levels for user requests, thus allowing different modes of usage, such as experimental demonstrations during a live class by an instructor and experiments carried out either individually by one user or collaboratively by multiple users. This software module can also be integrated into a more general resource management system, which enables the standardized description of and efficient search for online resources. Collectively, such tools have the potential for leading to fundamental changes in engineering and science laboratory education.

WORK IN PROGRESS - ON INTRODUCING EXPERIMENTS IN A NUMERICAL METHODS COURSE

Autar Kaw, Ali Yalcin, Brian Demenezes and Eric Allard

Several experiments have been developed and implemented in an undergraduate course in Numerical Methods. Most mathematical procedures that are taught in the course are covered in the analysis and interpretation of the data...
collected in these experiments. This paper describes the implementation of these experiments and how they are used in the course. Assessment data from two semesters for this WIP will be available at the time of the presentation.

**WEB-BASED SOFTWARE PROGRAMMABLE E-LEARNING PLATFORM FOR POWER ELECTRONICS COURSES**

Shun-Chung Wang, Yi-Hua Liu, Yih Chien Chen, Juing Huei Su and Wei-Sibge Liaw

This paper presents a Web-based learning platform for power electronics courses. The proposed platform consists of a software reconfigurable power electronics testbed, a Web-based distance laboratory and an interactive e-learning platform. The reconfigurable power electronics testbed can be configured by the student via a Web-based interface. The internet accessible distance laboratory system permits the instructors and students to remotely conduct experiments over the Internet. The integrated interactive multimedia material can assist to the educational environment of power electronics courses. The advantages of the proposed platform include flexibility, friendly user interface, provision for distance waveform measurements and removal of laboratory time and space constraint. Positive response from students indicates that the presented platform is extremely useful for power electronics courses.

**INTERNET-BASED TEACHING EVOLUTION IN COMPUTER ARCHITECTURE**

Manuel Castro, Eugenio Lopez, Elio Sancristobal, Sergio Martin, Gabriel Diaz, Juan Peire, Jose M. Gomez and Paloma Lopez

The DIEEC (Electrical and Computer Engineering Department) of UNED (Spanish University for Distance Education) in Spain is elaborating different tools to teach in Computer Architecture subject by using new technologies. DIPSEIL (Distributed Internet-based Performance Support Environment for Individualized Learning) is one of the projects where we are experimenting with teaching by task in Internet. We present this project and their advantages. By the other side we are elaborating lots of resources and evaluating them to incorporate Virtual and Remote Labs integrated in Learning Management Systems (LMS) or Educational Platforms. Lots of the decisions of this Web-Labs are the suggestions that students suggest in the DIPSEIL Architecture course.

**WORK IN PROGRESS - CONNECTING LABORATORY EXPERIMENTS TO THEORY THROUGH SIMULATION**

William M. Clark and David DiBiasio

We are using COMSOL Multiphysics, a commercial finite element modeling software package, to develop simulations of equipment in our unit operations laboratory including a heat exchanger, a gas permeation membrane, and a fluid flow experiment. Our hypothesis is that computer simulations showing the solutions to the differential equations that govern the fluid flow, heat transfer, and mass transfer within the equipment will solidify the link between experiment and theory and provide improved learning. Students in one lab section who used the simulations were compared to those in a control section who did not. A diagnostic quiz given before and after each lab provided a quantitative measure of improvement in learning via the lab experience for both groups. Content analysis of written and oral reports was used to measure any difference in higher level thinking demonstrated by the two groups. Student attitudes towards the simulations were assessed by surveys and end-of-course evaluations. Results so far, in the second year of a three-year project, indicate improvements in student satisfaction and learning but little change in critical thinking that can be attributed to the simulations.
warm-up assignments, and interactive classroom teaching and learning. Students briefly preview the new materials delivered through web-based multimedia, and then respond electronically to carefully constructed warm-up exercises which are due before class. The instructor reviews students’ responses and adjusts the classroom lesson based on students’ concerns and questions. The preview materials, with the instructor’s explanations added, are produced using Flash multimedia authoring tool. This provides an on-line learning tool to prepare the students for the warm-up exercises. Anonymous surveys, questionnaires before, in the middle and after the implementation of the project are conducted to assess the effectiveness and outcomes of this project.

THE EFFECTS OF EMPHASIZING COMPUTATIONAL THINKING IN AN INTRODUCTORY PROGRAMMING COURSE
Stephen Davies

In many introductory programming courses, the surface features of the programming language can distract and intimidate students so much that they fail to concentrate on what is really the brainy task: solving the problem conceptually. To counter this, we devised a form of structured pseudocode, designed to highlight and facilitate algorithmic construction so that the complexities of the programming language can be deferred until proficiency in design has been reached. Students taught with this experimental approach are not introduced to the language itself, or the compiler, until the last few weeks of the semester. A controlled experiment comparing this approach with a traditional language-based pedagogy has revealed that by the end of the course, students’ programming skills, even on language-specific tasks, is every bit as strong as students taught traditionally, and that their comfort level with modularity (writing functions) is increased. Additionally, we found that students appear to strongly prefer such an approach, citing mostly emotive benefits, and that these effects may be particularly strong among women.

TEACHING ABSTRACTION IN DISTRIBUTED SYSTEMS WITH CATS
Maria Feldgen and Osvaldo Clua

Designing and building a distributed system is a classic challenge within computer science. Models in distributed systems are rather complex, especially due to the inherent dynamics and intertwining actions occurring at different locations. These models are abstractions used for understanding and analyzing large and complex problems by simplifying the object of study and postulating a set of rules to define its behavior. Therefore, abstraction is a key skill to distributed systems and to computing. To develop students abstract reasoning skills we use an inductive learning approach and several classroom assessment techniques (CAT). We introduce each level of abstraction with concrete, practical examples of a case-study, relating the abstract concept to students’ concrete experiences. For the reflection on the concept we use CATs with the techniques of argumentative essay writing recommended for undergraduates in Liberal Studies and English courses. This paper presents the learning approach we use while keeping up with ever-rising participants with low attendance rates. The conducted classroom research and the analysis of findings and outcomes are described.

WORK IN PROGRESS ANALYZING THE GAP BETWEEN DIAGRAMS AND CODE IN COMPUTER SCIENCE
Stephen Davies

Students in sophomore computer science ("CS 2") are required to study the properties of a number of standard data structures; that is, common patterns of organizing data in a computer program. Typically, students are first presented with diagrams that graphically depict the data structure, and then shown sample code that actually implements it. We have observed, however, that there is a sizable gap between these two representations, and that many students who master the former have great difficulty translating that knowledge into the latter. We suspect that our pedagogy could be made more effective by treating diagrams themselves as formal entities, and providing students with a way of mapping operations on the "easy" (pictorial) domain into the "hard" (programmatic) domain. To help develop this technique, we carried out a semester-long experiment in which students demonstrated their understanding of the material both in diagrams and in code. The goal was to ascertain the kinds of mistakes that are often made, and how a technique like this could be most effective.
IMPACT OF LEARNING TRANSFORMATION ON PERFORMANCE IN A CROSS-DISCIPLINARY PROJECT-BASED COURSE
Rob Gorbet, Vivian Schoner and Gail Spencer

FINE392: Technology Art Studio is an innovative course developed in collaboration with Engineering and Fine Arts at the University of Waterloo, which crosses disciplinary boundaries and provides a unique multi-disciplinary experience for senior engineering students. In the course, students form interdisciplinary pairs and collaborate on technology-mediated sculptural works. Our previous work has shown that the interdisciplinary collaboration can act as a catalyst for transformative learning, and that the emergence of learning transformations is dependent on the success of the collaboration. In this paper we investigate the relationship between learning transformation, collaboration, and student project grades. We note that the success of the collaboration seems only loosely connected to project quality and grade level. We include a discussion of factors we believe contribute to this somewhat non-intuitive result. We further discuss how these factors may be mitigated through course design to better allow successful groups to achieve the full potential of their collaboration.

Session T2D: First Year Courses 1
Chair: Russ Meier, Milwaukee School of Engineering
Time and place: Thursday, October 23, 10:00 am. - 11:30 am. Broadway 3

EARLY BIRD: PREPARING ENGINEERING FRESHMEN FOR ENGINEERING CHALLENGES
Sabina Jeschke, Marc Wilke, Akiko Kato, Olivier Frédéric Pfeiffer and Erhard Zorn

Mathematical knowledge and abilities are among the most important tools of engineers and are often needed in introductory classes before the relevant topics can be offered in the mathematics classes. The most common compromise consisting of a quick introduction to the relevant mathematics in the non-mathematical classes themselves is neither very satisfying for students and teachers nor is it particularly successful. We introduce the Early Bird project allowing interested freshmen to utilize the often unused period between Abitur (German high-school graduation) and beginning of studies in the winter term by attending the mathematics modules of Algebra and Calculus I, before the official start of the first semester. As a result students of engineering have the necessary in-depth mathematical knowledge at their disposal considerably earlier. They can reduce the duration of their education in mathematics by one semester by moving forward the advanced courses of higher semesters correspondingly. Teaching both Calculus I and Algebra within one course allows for a better coordination of the content. Compared to the standard courses taught to freshmen, the curriculum of the course is modified to better address the applications of mathematics in the field of engineering. Additionally, the course covers ordinary differential equation as well as an introduction to numeric software.

NEW DIRECTIONS IN FRESHMAN ENGINEERING DESIGN AT THE UNIVERSITY OF MARYLAND
Kevin M. Calabro, Kenneth T. Kiger, Wesley Lawson and Guangming Zhang

The University of Maryland has a well established, project-based Introduction to Engineering Design (ENES 100) course which is taken by approximately 750 freshman engineering students each year. This paper explores the formation of this course through the NSF sponsored ECSEL program, with an emphasis placed on the evolution of this course over the past two decades. While the ECSEL program revolutionized how the introductory course was taught, the long-term implementation suffered from several shortcomings related to the challenges of teaching to such a large student cohort. In 2006, ENES 100 became the first Keystone Course offered by the newly formed Keystone program. Since its inception, the Keystone program has revitalized ENES 100 by making three major changes. The first change was to switch the focus of the course from simple design-build construction projects to the design-build of complex systems. The second change emphasized the product development theme of the course. The final change was to unify the course among each of the 20 sections taught each year. Initial results indicate that students are responding favorably to the changes made by the Keystone program.

WORK IN PROGRESS ENGINEERING EDUCATION INNOVATION CENTER
Robert J. Gustafson

To further enhance our efforts in providing the highest quality engineering education, Ohio State has established the Engineering Education Innovation Center (EEIC). The EEIC is the focal point for the College’s innovative
ENHANCING STUDENT LEARNING THROUGH SELF-ASSESSMENT

Amber Kemppainen and Gretchen Hein

First year engineering courses at Michigan Technological University have instruction and activities that address students various learning styles. Traditionally, these courses have focused on increasing active learning through in-class examples, team exercises and design projects. Despite these activities, there have been several course topics where the students continue to have difficulty applying the principles to an engineering problem. To address this issue, in the fall of 2007, self-assessments were introduced to enhance the resources available for students. The assessments were a series of non-graded questions designed for students to explore the course topics in greater detail on their own time. As this was not part of the overall course requirements, student participation was voluntary. The questions applied lecture material to real world applications. The self-assessments were administered through Blackboard CE. Students were able to log into Blackboard, complete the assessment and receive immediate feedback regarding their performance. To enhance their understanding of the material, they could repeat this process multiple times. This paper will discuss student responses to this learning approach as well as assessment data to determine the effectiveness of this method as a teaching tool.

WORK IN PROGRESS GETTING OFF THE HIGH HORSE, STUDENT OVER CONFIDENCE WITH COMPUTATIONAL TOOLS

Brett H. Hamlin and Amy E. Monte

Michigan Technological University is one of the nation’s largest engineering schools (900+ first year students) and houses a large common first year engineering curriculum. The goal of this curriculum is to introduce many of the fundamental components of engineering. One of these goals is the use of modern computational and programming tools to solve engineering problems. This paper focuses on the students’ confidence with the use of computational tools. On the first day of class in the Fall of 2007, students were surveyed on their proficiency with the use of spreadsheets. Students self reported levels of proficiency from expert to no experience. Students were then asked a simple question regarding a spreadsheet cell equation. Only twenty percent of the students selected the correct answer, even though eighty percent ranked themselves as either: familiar, proficient, or expert spreadsheet users. Even more troubling is the fact that only one third of the self reported expert users selected the correct answer. A gender bias was noted, women under estimated their skills, while the opposite occurred for men. This study is significant because it lays the groundwork for creating an assessment plan to identify the preparedness of incoming students and skill at the end of the course.

THE FOREIGN LANGUAGE ENGINEERING WRITER - WHAT MAKES A READABLE REPORT?

David F. Dalton

Writing in a foreign language brings its own set of complex difficulties, not least that the structure, notions and productive skills required by different genres are commonly often not understood by writers writing in their native languages. They have to be taught. The purpose of this exploratory research is to analyze some of the linguistic and organizational elements of a typical degree-level document (memo report) produced in one of the engineering programmes at the Petroleum Institute in Abu Dhabi, UAE with a view to describing some salient features which contribute to its level of success (readability) as judged by the subject teacher grading the document. Texts were
analyzed according to specified linguistic features and use, style and organization. Successful application of these features was a factor in the response of the content teacher to the quality of the report. Recommendations are made as to how the readability of such documents might be improved by better preparing students to produce them, in particular by developing a better understanding of the relevant genre.

**AN INTERNATIONAL FACILITY DESIGN PROJECT**

Thomas Lacksonen and Berna Dengiz

This paper describes an international facilities design project for Manufacturing and Industrial Engineering students. American and Turkish engineering students collaborated to create and implement the re-design of a Turkish wheelchair manufacturing facility. The company needed engineering assistance to improve the efficiency and increase the capacity of their existing factory. Turkish Industrial Engineering students went on-site to collect data and draw the existing facility layout. American Manufacturing Engineering students analyzed the data and developed new layout designs. Four American students traveled to Turkey between semesters to implement the initial phases of their design. In the second semester, the Turkish students simulated the new layout to see the performance improvements, completing their project. Student learning outcomes were positive for both groups of students. The paper explains critical steps in identifying projects and partners. Lessons are shown about successes and shortcomings in planning, operating, and communicating with design teams across cultures.

**INSTRUCTOR OR PROJECT MANAGER: WHAT IS THE RIGHT BALANCE AS SOFTWARE ENGINEERING EDUCATION GOES GLOBAL?**

Olly Gotel, Vidya Kulkarni and Christelle Scharff

This paper reflects upon three years of experience of running Global Software Development projects for students distributed across three countries. The paper focuses almost exclusively on the instructors’ perspective of such projects and articulates the various Project Management concerns that instructors from the participating institutions need to consider and agree upon to both collaborate on such an international initiative and to run the constituent student projects. Each decision made has implications for instructor workload, institutional relationships and the kind of pedagogical experience that students will receive. The paper uses the Project Management Body of Knowledge as a framework through which to delineate the concerns and types of decision that need to be taken, to explain some of the challenges we faced and strategies we developed to overcome them. The paper seeks to provide guidance to other instructors who are considering the Global Software Development path for their student Software Engineering projects, based upon our experiences of uniting over one hundred students and seven instructors, and suggests critical questions that need to be examined a priori to any such new effort.

**ACTION PLAN FOR THE ENGINEER FORMATION: GUIDELINES FOR SUCCESS**

Claudio da Rocha Brito and Melany M Ciampi

The most important factor of engineer formation for this era is the capability to solve problems taking into account the promotion of sustainable development. The awareness of the importance of engineers as the main beam of progress has to be recognized by the educational institutions in order to form the engineer prepared to work for the development of science, technology and society. This work discusses an important issue as the engineer formation under the perspective of the present international paradigm of education. COPEC Council of Researches in Education and Sciences has a history of action in engineering education, conceiving and implementing projects with success. Although it is not an easy task the implementation of programs with permanent attention to the changes in world scenario concerning the political, economical and social aspects of the country and the globe is the way to assure the future of engineering as well as the development of science and technology. COPEC as an organization that works for the future of education has established some guides to be applied on the design of engineering programs. The guidelines are the result of researches as well experience designing and implementing engineering programs for many different engineering institutions.

**SOCIAL ENGINEERING PROGRAM TO PROMOTE CIVILIZATION PROCESS**

Melany M. Ciampi and Claudio da Rocha Brito

COPEC-OPASS educational program design team has designed an engineering program with the objective to form engineers to act in more effective and accurate ways in order to solve social problems and avoid future ones. It is a Social Engineering Program, under graduation, five years duration, full time students, it is based on the humanities and social sciences such as philosophy, psychology, and, especially, economics, and thus deals with
theories concerning the basic laws of humans and society. The objectives of the Social Engineering Program are to educate advanced researchers and administrators who work in areas related to policy, design and planning in national land and socio-economic systems and to develop the integrated theories and methods of these areas. It has been designed in a way to satisfy the education law of the country. This innovative curricula, teamwork approach, and leadership-building experiences will develop the engineering leaders of tomorrow. The design and implementation of this program comes to add to the efforts of the different sectors of the community to solve the social problems, which have been perpetuated by decades such as environmental issues, overpopulation, and the raising urban problems.

Session T2F: Assessment 1
Chair: Shane Brown, Washington State University
Time and place: Thursday, October 23, 10:00 am. - 11:30 am.

ASSESSMENT BY PEERS AN EFFECTIVE LEARNING TECHNIQUE
Mauricio Dziedzic, Paulo Roberto Janissek and Ana Paula Bender

Assessment by peers is a powerful technique to engage students in active learning, and to make them reflect about their own work. On the other hand, the usual problem with such a technique is that students tend to be excessively lenient towards their colleagues, which threatens to turn the exercise pointless when assessment by peers is used as part of a grade. Thus, the present work describes a successful experience in which assessment by peers was employed as a learning technique in a graduate course in Faculty Development to evaluate oral presentations. A seminar assessment form was developed by the instructors and used to give immediate feedback to the students on their performance. The same form is used by the students to assess their peers. This assessment by peers is not used by the instructors to compose the grades on the course, but as a tool to enhance awareness of the students to the quality of their own work. It was verified that the quality of the seminars improved faster when peer assessment was employed, and that the assessment by the students approached the assessment by the instructors as the course progressed.

ENERGY LITERACY AMONG MIDDLE AND HIGH SCHOOL YOUTH
Jan DeWaters and Susan Powers

An energy literacy survey for middle and high school students has been developed according to established psychometric principles and methodologies. The survey measures energy-related knowledge, attitudes and behaviors and is correlated to established benchmarks that define energy literacy as determined by a panel of energy- and energy-education specialists. Results from a pilot of the survey among 955 New York State students indicate low levels of energy-related knowledge, with fewer than 1% of the students scoring above 80%. Attitude and behavior scores are slightly better, suggesting that while students may recognize the existence of an energy problem, they generally lack the knowledge and capabilities to effectively contribute toward a solution. Results support the need for development and implementation of energy education programs as part of the regular school curriculum.

DEPARTMENT WIDE APPLICATION OF EMBEDDED INDICATORS
Kevin C. Bower and William J. Davis

The Department of Civil & Environmental Engineering has adopted a sample-based embedded indicator plan to systematically evaluate course goals and program outcomes on a course-by-course basis using a common framework and standard measures with the intention of creating a comprehensive assessment of student learning. The approach is predicated on the Accreditation Board for Engineering and Technology assessment criterion, American Society of Civil Engineers Body of Knowledge (BOK-I) guidelines for assessment of program outcomes, and Bloom’s Taxonomy of cognitive educational objectives. Embedded indicators were generally defined as assessment tools used to specifically measure a collectively determined course goal at an appropriately pre-assigned level of Bloom’s cognitive performance. The paper provides an analysis of a populated matrix using data from three semesters (Fall 2006 through Fall 2008), including 33 course offerings and 83 course sections taught by nine faculty and two adjunct professors. Findings from this analysis will be summarized along with suggested steps to address problem areas, recommendations for optimizing the sampling process, and means to expand the process to include the entire 132 credit hour undergraduate curriculum. The entire process was established and is being implemented within a small-school environment by department faculty without benefit of support staff.
WORK IN PROGRESS - AN EMPIRICAL STUDY OF VIRTUAL DISSECTION AND STUDENT ENGAGEMENT
Marie C. Paretti, Yanfeng Li, Lisa D. McNair, Deborah Moore-Russo and Janis Terpenny

This paper reports preliminary results from a study of physical and virtual dissection activities. Nine universities are developing virtual dissection tools to supplement and/or replace physical dissections. Student engagement was measured using the Situational Intrinsic Motivational Scale (SIMS). We describe the assessment methodology and preliminary findings. The results highlight the role virtual dissection can play in engaging students in engineering.

WORK IN PROGRESS - THE EVOLVING ROLE OF AN ADVISORY BOARD FOR CONTINUAL IMPROVEMENT
Daniel K. Jones

Ongoing accreditation by TAC/ABET requires that an active advisory board provides input from industry to improve the program. Over the past few years, the processes used to interact with board members have evolved to increase their participation. The meetings have been restructured, and processes are under development for obtaining feedback outside of meetings. Employers of recent graduates are another valuable source of feedback. Employers, especially first-line supervisors, are in a position to provide direct assessment of program outcomes. A survey is being developed to obtain anonymous feedback using an on-line questionnaire. An initial trial had been conducted by members of the advisory board. After completing the survey, members are providing feedback on the questions and results, and they are recommending improvements. After revisions, a link to the survey will be emailed to employers of recent graduates. Employers will be asked to complete the survey anonymously on-line. The goal is to obtain candid feedback that may be used to identify improvements.

Session T2G: Embracing Diversity and Innovation
Chair: Michael C. Loui, University of Illinois at Urbana-Champaign
Time and place: Thursday, October 23, 10:00 am - 11:30 am

WORK IN PROGRESS - ALIGNING EDUCATIONAL EXPERIENCES WITH WAYS OF KNOWING ENGINEERING: UNDERSTANDING THE ENGINEERING PROFESSION
Kevin J. B. Anderson and Sandra Shaw Courter

Engineering practice in the United States is changing and education needs to match those changes. One strategy for improving engineering education is to utilize a better understanding of the engineering profession. By the completion of this three year NSF project in 2010, a more refined and updated picture of engineering practice will emerge. To investigate engineering practice, we will triangulate data from surveys, interviews and ethnographic observations. To date, pilot data has been collected from thirteen surveys and three interviews. By October 2008, it is expected that five hundred surveys, forty interviews, and studies of two engineering firms will be complete. Data collected so far indicates that engineers have a strong, core identification as analytic thinkers and problem solvers. It also indicates engineers desire to express creativity and learn new things in their work. As this study will examine the epistemic frame of engineering what makes an engineer, an engineer the research group plans to have practicing engineers evaluate how well it succeeds in documenting what it means to be an engineer. Just as these practicing engineers provide feedback on this study, we hope our work will strengthen the ties between engineering practice and engineering education.

INNOVATIVE ADMINISTRATION SUPPORTS INNOVATIVE EDUCATION
James Nelson, Jenna Carpenter, Stan Napper and Bala Ramachandran

Louisiana Tech University’s College of Engineering and Science has over ten years experience operating under an innovative multidisciplinary administrative structure which has created a supportive environment for numerous education reform initiatives. The traditional departmental structure was dismantled in favor of a much more flexible approach which has helped remove barriers between departments and promoted collaboration between engineering and science programs. The new administrative structure relies heavily on multidisciplinary teams and has been a key factor in the successful establishment of our first Integrated Engineering Curriculum in 1997, followed by our Integrated Science Curriculum in 2002. Other innovations implemented since that time include the first undergraduate nanosystems engineering degree program in the US; multidisciplinary design courses which include engineering, business, and technical writing students; a freshman enrichment program; the Living with the Lab
curriculum (the most recent version of our Integrated Engineering Curriculum); and a program whereby engineering and science majors complete the Master of Arts in Teaching and become certified K-12 teachers. The College currently has $3.5 million in NSF funding for STEM projects. Much of the lasting success of these education reform efforts can be attributed to the supportive, interdisciplinary approaches the College uses in all of its core functions, including undergraduate education, research, and graduate education.

WORK IN PROGRESS - INSPIRED: PROMOTING DIVERSITY, RETENTION, OUTREACH AND GLOBALIZATION READINESS

Peggy Doerschuk, Jiangjiang Liu and Judith Mann

The Increasing Student Participation in Research Development Program (INSPIRED), funded by a National Science Foundation Broadening Participation in Computing Grant, is designed to increase the participation of women and minorities in computing. This is needed to meet the growing demand for computer scientists and to strengthen the discipline by the infusion of their diverse ideas and perspectives. INSPIRED engages and develops students through an enriched research experience that includes mentoring, tutoring, and other support. INSPIRED is innovative in two respects. First, teams include students from all levels, freshmen through graduate students, and students can participate in multiple years. Secondly, the teams of students form the nucleus of a set of activities that are designed to retain and attract more students to computer science. Through involvement in outreach programs, INSPIRED students inspire others to enter and stay in the field. Working in diverse teams that include men and women from different cultures helps prepare students for the global workforce.

EDUCATIONAL RESEARCH PRIORITIES IN ENGINEERING

Jeremy D. Garrett, Donnie S. Coleman, Lesa Austin and John G. Wells

The purpose of this study was to determine the research priorities and publication trends in engineering education in the USA over the interval of 1996 to 2006, through an examination of the key peer-reviewed journals, professional organizations, government documents, and interviews with experts in the field. Analysis of the data identified engineering epistemologies, learning mechanisms, learning systems, diversity and inclusiveness, and assessment as the research priorities of the field of engineering education over the last decade. Analysis of the publication record of three key journals in the field revealed that the publication trends over that time interval were: 1) teaching, learning and assessment processes, 2) teachers and learners, and 3) courses, laboratories, curricula, instructional materials, and learning technologies. A comparison of research priorities versus publishing trends identified the following areas as deficiencies in the research base: 1) educational management and goal systems, 2) political, economic, and social influences on engineering education, and 3) diffusion of educational innovations.

ENGINEERING COURSE DESIGN BASED ON QUALITY FUNCTION DEPLOYMENT (QFD) PRINCIPLES: INCORPORATION OF DIVERSE CONSTITUENCIES AND CONTINUOUS IMPROVEMENT

Anoop Desai and Jean-Claude Thomassian

This paper presents a systematic methodology that is essentially based on incorporating basic Quality Function Deployment (QFD) principles into engineering course design. The aforementioned principles have been widely used in industry in conjunction with the basic philosophy of lean thinking so as to achieve the twin goals of quality enhancement and cost minimization. It is the authors intention to extend an identical thought process to the field of education in an engineering setting. In the authors view, this extension will enable incorporation of the voices of widely varying stakeholders including the community, industry, academicians etc into the basic course structure. This is especially important if the university in question is a regional university that caters to the needs of local communities as well as employers. Another advantage of implementing this thought process includes rigorous control of instruction quality across a wide spectrum of instructors thereby infusing much needed objectivity into basic course design. This advantage is afforded by the basic QFD methodology which is involved with quality at all stages, starting with its building phase and ending in an ongoing continuous improvement process. A pilot study is presented at the end in order to illustrate practical utility of the methodology.
COUNTER HACK: CREATING A CONTEXT FOR A CYBER FORENSICS COURSE
Lori L. DeLooze

A typical hacker follows the hacker methodology by going through the following distinct phases: Footprinting, Probing, Gaining Access, Escalating Privileges, Exploiting, Covering Tracks and Installing Backdoors. This hacker methodology is used to direct the overall forensic process. Many of these phases leave artifacts that can be examined by a forensic investigator to piece together an incident. We designed a cyber forensic course that begins with a background of computer media and file systems, and then looks at static files, network logs and volatile system data. Students who understand how a typical hacker operates will be able to discover appropriate clues, and may even be able to prevent future destruction or disruption.

BIO-BASED SENIOR CHEMICAL ENGINEERING LABORATORY COURSE
Gennaro J. Maffia, Thomas E Twardowski and Tara Dawn Iracki

In the senior chemical engineering laboratory course, chemical engineering principles are applied to the evaluation and reporting of the performance of bench scale and pilot scale process equipment. Over the past two years the experiments have been revamped to reflect the emphasis on biological engineering in the workplace of many of the recent chemical engineering graduates. Such emphasis is also reflected in current ABET guidelines. The new experiments are thematic based and use the protein processing techniques that are part of the authors' individual collagen research programs. This thematic approach is all within the context of the fluid, heat and mass transfer content of the coursework. The key experiments that are performed include: drying, calorimetry (DSC), milling, centrifugation, dispersion, blending, vacuum systems (ovens and lyophillizers), convective heat transfer (for heating and freezing), viscometry, particle settling, microscopy, protein kinetics (crosslinking, denaturing, and modification), controlled release diffusion studies, and gel extraction. Several of the experiments are grouped as a modular approach to the manufacture of a bio-based product. As an example, artificial tissue for direct application or as a coating is produced in a process that covers several weeks and requires many different unit operations. Experimental data as well as pedagogical data is presented from the initial two years of the offering of modification of this course.

WORK IN PROGRESS - SPREADSHEET IMPLEMENTATION PROGRAMMING PROJECT COURSE
Richard Perry

Development of a course and textbook focusing on implementation of a spreadsheet program is proposed. The semester-long course will be suitable as a senior elective or graduate course for students with a background in C programming, Unix, and data structures. It will bring together aspects of compiler construction, parser design using Flex and Bison, parse trees, linked lists, function tables, function callbacks, symbol tables, and functional programming. The emphasis will be on the computational internals, so the spreadsheet will operate in "batch" mode, with simple text output, and a separate backend processor will be used to create a web-based GUI.

SPOKEN POLYMER
Thomas E. Twardowski and Nadine C. McHenry

An innovative approach to teaching introductory polymer science and engineering as a new language was considered. The class was designed around the theory that engineering communication draws from a language substantially separate from conversational language, and that by teaching the students the fundamentals of that language along with the appropriate technical content early acquisition of rigorous physical knowledge could be achieved. Two content-rigorous engineering classes have been taught using a language course format, with units on polymer grammar, vocabulary and practical discussion. The target demographic was pre-engineering and introductory engineering and technical students at the university level, particularly students without the traditional introductory math/chemistry/physics training cycle. A new pedagogy was required, including complete word definitions, novel technical grammar, the specific roles of symbols and self-correction. The approach was applied twice to teach introductory polymer science to student bodies with mixed preparation levels, resulting in performance substantially equivalent to traditional polymers courses taught at the college junior level. The language concept
improved student scientific communication skills, problem-solving ability, especially learning from context, and in general accelerated learning. In particular, the students could express practical knowledge in written form.

**Session T2J: Special Session - Enhancing Student Learning Using SCALE-UP Format**

Chair: Lisa C. Benson, Clemson University

*Time and place: Thursday, October 23, 10:00 am. - 11:30 am.*

**SPECIAL SESSION - ENHANCING STUDENT LEARNING USING SCALE-UP FORMAT**

Lisa Benson, William Moss, Scott Schiff, Sherrill Biggers, Marisa Orr and Matthew W. Ohland

SCALE-UP (Student-Centered Activities for Large Enrollment Undergraduate Programs) is a specialized active learning format that relies largely upon social interaction among students, instructor, and learning assistants. The instructor and learning assistants serve as facilitators of guided inquiry by asking students leading questions as they work through class assignments. On-going, real time formative assessments ensure that the instructor is constantly aware of which students are mastering the material and which are struggling. The SCALE-UP format is currently used at our institution in the General Engineering program (all sections of the first year courses), Math Sciences (all sections of first year calculus, and one section of second year calculus), Civil Engineering (one section of engineering statics), Mechanical Engineering (all sections of engineering statics and dynamics), as well as in courses in Horticulture, Nursing, English, and Computer Science. This special session focuses on strategies for successful implementation of this pedagogical innovation. These include development of student activities, formative assessments, training for instructors and learning assistants, and the physical features of the learning environment.

**Session T3A: Active Learning 1**

Chair: Timothy Ellis, Nova Southeastern University

*Time and place: Thursday, October 23, 2:30 pm. - 4:00 pm.*

**WORK IN PROGRESS - ADVANCED PROGRAMMING THROUGH PROBLEM-BASED LEARNING**

Sergio Martin, Elio Sancristobal, Rosario Gil, Antonio Colmenar, Pablo Losada, Nuria Oliva, Manuel Castro and Juan Peire

The way people learn out of university has much more in common with self-learning and problems-guided learning than with the classical way of teaching, with a teacher speaking in a class and all the students listening with a passive attitude. This paper proposes an exercise to motivate students to learn and use some advanced programming concepts such as the use of well-formed and valid XML documents; how to transform these documents into "human-readable" documents with XSLT style-sheets; communication protocols such as TCP/IP; application level protocols such as HTTP 1.1; and mash-up systems. The problem is intended to improve the mobility in universities with very spread and distributed campuses such as Universities for Distance Education, where this exercise is proposed. For that reason, this subject is especially motivating for these students, due to the fact they suffer the consequences of study in a university where mobility plays a relevant role. Through this exercise students will guide their own learning, constructing the mental structures and understanding the programming concepts needed to solve the future programming problems they will find in their careers.

**ADDRESSING ENGINEERING EDUCATORS’ CONCERNS: COLLABORATIVE LEARNING AND ACHIEVEMENT**

Wen-Ting Chung, Glenda Stump, Jonathan Hilpert, Jenefer Husman, Wonsik Kim and Ji Eun Lee

Recent calls for engineering education reform have included collaborative learning as a means to prepare students for future careers in engineering. The purpose of this study was to examine the effects of collaboration and self-efficacy on undergraduate engineering students' achievement. The results indicated significant positive correlations between collaborative learning and course grade ($r = .29$) and self-efficacy and course grade ($r = .44$). The combination of collaboration and self-efficacy accounted for 22% of the variance in course grade. Collaborative learning remained a significant predictor of course grade over and above self-efficacy. The results showed that students engaging in collaboration with peers achieved at higher levels than those who did not. In a field where individual work and competition has traditionally been valued, opportunities for collaboration may be beneficial to students’ academic achievement.
IMPORTANT LESSONS IN ENGINEERING EDUCATION LEARNED FROM SEVEN YEARS OF EXPERIENCE IN UNDERGRADUATE ACADEMIC SUPPORT PROGRAMS

Jia-Ling Lin and Donald C. Woolston

A deep understanding of how and why students struggle in core courses in science and math when they enter engineering programs helps us respond to demands for academic support services. The success in applying student centered instructional approaches, in particular, the Supplementary Instruction (SI) Program in the College of Engineering, teaches us important lessons in engineering education: to teach is to engage, and, to engage is to connect. Peer-led SI sessions integrate features of subject- and problem-based learning to foster a supportive learning community. SI has not only facilitated the learning of course material but also promoted a spirit of inquiry and a culture of joyful learning. The learning outcomes show that SI has made a positive impact on students learning, which in turn has helped to increase engineering retention. Future plans to incorporate technology and advance SI are presented.

WORK IN PROGRESS - SCALABLE, INQUIRY-BASED, MULTIMODAL MODULES FOR ENGINEERING MECHANICS CURRICULUM

Javier A. Kypuros and Constantine Tarawneh

Students struggle to conceptualize Engineering Mechanics fundamentals because they cannot successfully visualize or intuitively comprehend the effects of external loads on mechanisms. Traditionally, Engineering Mechanics courses have been primarily lecture-based with little experimentation. The authors contend that through the use of scalable, inquiry-based, multimodal modules, lower-division engineering students can more effectively interpret Engineering Mechanics concepts. An emphasis should be placed on engendering properly conceived intuition and critical thinking, and contextualizing concepts and fundamentals before and in parallel to developing Calculus-based skills. The authors hypothesize that by utilizing simple, inquiry-based exercises, instructors can better diminish misconceptions and improve concept mastery. This paper presents plans for implementation and assessment of scalable, inquiry-based, multimodal modules for Statics and Dynamics.

NO COMPUTERS? NO PROBLEM! ACTIVE AND COOPERATIVE LEARNING IN AN INTRODUCTORY COMPUTER SCIENCE COURSE

Cheryl A. Dugas

This paper describes the use of active and cooperative learning techniques in an introductory computer science (Java) course. During classroom sessions, the instructor had a computer/projector, but students had no computer access. The challenge was to teach programming to students who were not at computers. One technique involved completion of short programming exercises in small heterogeneous teams. A typical two-hour class might consist of several brief periods of instruction interspersed with 10- or 20-minute periods of team work. Teams shared their solutions with classmates using the whiteboard or overhead projector. The instructor demonstrated a working solution using the instructor s computer/projector, and later put it on the class website for the students use. Another active/cooperative learning technique used was a daily quiz, which was completed by the student during class. Students were encouraged to work together on the quiz, or to ask questions about it during class. The quiz was used as an outline and reinforcement of the day s topics, as well as a feedback mechanism for the instructor. Students also found the quizzes helpful as study tools. Both uses of active and cooperative learning served to make the sessions more valuable and enjoyable than in an ordinary lecture-format class.

Session T3B: Computer Science and Robotics in Introductory Courses

Chair: Kenneth S. Manning, Adirondack Community College
Time and place: Thursday, October 23, 2:30 pm. - 4:00 pm. Broadway 1

STUDENT OPINIONS OF ALICE IN CS1

Daniel C. Cliburn

Alice is a novel programming environment for building 3D virtual worlds. The graphical programming interface of Alice allows beginning programmers to learn about concepts such as object-oriented design and recursion without the need to struggle with syntax errors. This paper discusses the opinions of Alice from 84 students who took an introductory programming course (CS1) that covered both Alice and Java in the same term. Fifty students (59.5%) responded on the survey that the prior experience with Alice helped them to learn Java later in the term. Fifty-six
students (66.7%) recommended continued use of Alice in the course although many suggested reducing the amount of time spent on Alice. While these numbers could be interpreted as a positive result, they have actually discouraged our department from continuing to use Alice in CS1. The number of students who were not sure that Alice was helping with their understanding of Java later in the term was simply too great to justify continued coverage of Alice in the course.

**SCRATCH: APPLICATIONS IN COMPUTER SCIENCE 1**

Inés Friss de Kereki

Programming is a complex intellectual activity. We observed through the years that it is difficult for some students to understand the logic of a program and to familiarize themselves with the control structures. In order to help smooth this initial relationship with programming, we tried Scratch (a programming language designed for young people, developed by MIT's Media Lab). We analyze the use of Scratch in two Computer Science 1 courses: one in university degree and other in vocational studies. We use this tool in the very first weeks of those courses with the purpose of improving students' programming experiences and motivation, and also to detect its influence, if any, in scores and dropout rates in comparison with normal courses. We developed detailed lab guides, exercises, tests and questions forms. We contrast the results with normal courses and found that students who used Scratch expressed higher motivation but there was no statistically evidence of differences neither in dropout rates nor obtained scores. In this paper we present the detailed courses, the experimentation and the results. We offer some conclusions and reflections over the particular value of including this kind of tool. We include suggestions with the intention of improving Scratch.

**A HANDS-ON OVERVIEW COURSE FOR COMPUTER SCIENCE AND MODERN INFORMATION TECHNOLOGIES**

Lixin Tao and Li-Chiou Chen

This paper describes the logics and experience in piloting a new project-based program overview course to introduce the fundamental computer science concepts, methodologies and technologies underpinning the latest information technologies for students who have just completed CS2 or the equivalent. The course focuses on recurring great computing ideas, motivates computing students with the modern real-world challenges and their innovative solution technologies based on creative application of the great ideas, and shortens the prerequisite chains for subsequent computing courses to support more current and flexible computing curricula. The assessment data indicate that students who have taken this program overview course are better motivated and prepared for follow-up courses and real-world IT challenges.

**TEACHING THE INTRODUCTORY COMPUTER PROGRAMMING COURSE FOR ENGINEERS USING MATLAB**

Asad Azemi and Laura L. Pauley

The introductory computer programming course for engineers is usually taught using the C++ programming language. This work describes our efforts during the past four years, as a pilot project, which can be used in an evaluation process by those departments that would like to substitute Matlab for C++. Those who would like to continue the current practice, but are looking for more challenging problems or projects involving Matlab can also use the project outcome. In order to increase student involvement in the learning process and further improve learning outcomes, the implementation plan included various hardware and software projects, not all at the same time. Robotics projects were added to illustrate an application of programming; which students can relate to and enjoy, as well as helping them improve their software and algorithm design skills for real-time applications. Software projects included the design of simple games and applications using Matlab's Graphical User Interface (GUI) tool. A discussion of the advantages and disadvantages of conducting a computer programming course in this format, including four different course formats that we have used are included.

**MANAGEMENT OF A LARGE TEAM-DESIGN AND ROBOTICS-ORIENTED SOPHOMORE DESIGN CLASS**

John T. Tester

DDevelopment and implementation of innovative, team-oriented, undergraduate design experiences can stimulate innovation in the engineering curriculum. However, combining team design with a hands-on technical realization experience can become unwieldy for an engineering program, due to the management of materials, students and
instructors. Northern Arizona University has developed a management scheme for one of their large team design classes which allows for a controlled environment in which the class can be presented, yet flexible enough to incorporate ongoing changes each semester. The interdisciplinary sophomore design course EGR 286 is a relatively large class size for a single session, enrolling up to seventy students. It requires the coordination of over twenty student teams, each using separately assigned, university-owned, Lego® Mindstorm kits and accessories. The teams are eventually merged into a smaller number of larger teams by mid-semester. The assignments and anonymous student peer evaluations are managed through the adaptation of a distance-learning web-based system. The logistics of the team assignments, kit issue, student teaching assistants and computing/laptop management are addressed. The management scheme has resulted in an ability to allow several different instructors to teach the class with less difficulty. Another result is that the management structure allows for new projects and even new equipment to be implemented without changing the underlying teaching objectives.

Session T3C: Distance Learning 1

Chair: Maxine Cohen, Nova Southeastern University

Time and place: Thursday, October 23, 2:30 pm - 4:00 pm.

TCP LIVE: EXPERIENTIAL LEARNING ON THE GLOBAL INTERNET

Colin Allison, Alan Miller, Kristoffer Getchell, Iain Oliver and Andrew Morrey

Providing support for experiential learning about computer networking poses difficulties for both students and lecturers: the low level nature of network programming and monitoring requires systems-level skills that are often absent in undergraduates; the time available in any given module is limited; the view from the class's laboratory is constrained by firewalls and provides only one perspective onto the Internet; the adaptive nature of TCP is often invisible when seen only on a LAN. We have sought to address these challenges by exploiting Planet Lab (www.planet-lab.org) for educational purposes. Planet Lab is a networking research facility consisting of nodes at over 400 sites across the world, which are exempt from institutional firewall restrictions, and which are shareable amongst all members. We have developed a framework with an appropriate set of graphical user interfaces that runs on Planet Lab and allows students to experiment with core Internet protocols. TCP Live is a particular application that uses the framework. This paper describes the structure of the framework and its use to support experiential learning about TCP.

WORK IN PROGRESS - LEARNING THROUGH ROLE PLAY GAMES

Ricardo Batista and Carlos Vaz de Carvalho

It is commonly accepted that the educational environment has been undergoing considerable change due to the use of the Information and Communication tools. But learning depends upon actions such as experimenting, visualizing and demonstrating through which the learner succeeds in constructing his own knowledge. Although it is not easy to achieve these actions through current ICT supported learning approaches, Role Playing Games (RPG) may well develop such capacities. The creation of an interactive computer game with RPG characteristics, about the 500th anniversary of the city of Funchal, the capital of Madeira Island, is invested with compelling educational/pedagogical implications, aiming clearly at teaching history and social relations through playing. Players interpret different characters in different settings/scenarios, experiencing adventures, meeting challenges and trying to reach multiple and simultaneous goals in the areas of education, entertainment and social integration along the first 150 years of the history of Funchal. Through this process they will live and understand all the social and historical factors of that epoch.

DESIGN OF QUESTIONS AND DISTRACTERS FOR A DYNAMIC, ALGORITHM-BASED SUITE OF PHYSICS PROBLEMS FOR ENGINEERING STUDENTS

Luis Neri Vitela, Victor Robledo - Rella, Enrique Espinosa and Julieta Noguez

We discuss a method to design problem sets for publication in an on-line tool built to coach engineering students in solving quizzes and exams during an undergraduate Physics course. This tool contributes to reinforce the student's skills when approaching and solving problems. The coach is dynamic because values in formulas for a given problem are unique to every student. We present criteria and guidelines followed to design appropriate distracters for each problem, which may give the teacher insight on common mistakes. If the difference between the answer given by the student and the correct answer is larger than a given offset, then the coach issues feedback to guide them in finding
the source of the mistake. We have undertaken a field study with first year university students. We present our results and discuss the usefulness of this tool to assist students through their own learning process.

**HIGH DEFINITION VIDEO SUPPORT FOR NATURAL INTERACTION THROUGH DISTANCE LEARNING**

Randal Abler, Sean Brennan and Joel Jackson

Using High Definition video distance learning allows large areas of the classroom to be captured at a resolution approaching human visual acuity. This allows instructors and students to interact with significantly less constraints then the classic television based distance learning design. Hi Definition Television (HDTV) is becoming commonplace. This drives cost down, but more significantly it creates an increase in student expectation as HDTV replaces standard television in the home. Implementing a useful distance learning classroom based on HDTV requires significant attention to layout in order to achieve a pedagogically functional classroom, especially when applications beyond a simple lecture are considered. The classrooms considered here use two channel video in each direction, as well as stereo audio. This paper will discuss the issues in capturing an entire instructional area (whiteboard and podium) using multiple HD cameras. Careful attention to audio design is also critical to natural interaction.

**ENGINEERING EDUCATION FOR EVERYONE A DISTANCE EDUCATION EXPERIMENT AT IIT BOMBAY**

Kannan M. Moudgalya, Deepak B. Phatak and R. K. Shevgaonkar

Distance education at IIT Bombay is carried out through live and free transmission of its own courses, through satellite, video conference and webcast. Distance education is a partial solution to improve the dismal state of engineering education in India. Optionally, the transmission is also available under value added modes, using powerful features, such as, video course on demand and the learning management system, moodle. A brief description of the nonthesis master’s degree, known as postgraduate diploma of IIT Bombay, PGDIIT, available through the distance mode, is given. The article concludes with a summary of the national programme on technology enhanced learning, NPTEL, a joint effort of all IITs and IISc. The students, staff and faculty of IIT Bombay enthusiastically support distance education.

**Session T3D: K-12 Initiatives in Computer Science, Service-Learning and Professional Development**

**BE A COMPUTER SCIENTIST FOR A WEEK THE MCGILL GAME PROGRAMMING GURU SUMMER CAMP**

Alexandre Denault, Jörg Kienzle and Joseph Vybihal

Motivating high school students to consider Computer Science as their future field of study at the university level is a challenging endeavor. This paper describes the McGill Computer Science Summer Camp targeted at high school students from grade 10 to 11 (ages 15 to 17). We first motivate our choice of using computer games as the main camp theme, and then present the teaching methodology used throughout the camp. A day-by-day breakdown of the camp is provided, as to better illustrate the distribution of the material throughout the week and the evaluation methods used to track the progress of the students. We also present the game environment we developed in which the students exercise their problem solving skills during the lab sessions. We conclude by illustrating the positive effect of the camp, using a combination of code analysis and evaluation questionnaire filled out by the students and their parents.

**DIGITAL ARTS FOR COMPUTING OUTREACH**

Karen Davis, Laura Greene-White, Ted Ferdinand and Mark Santangelo

In this paper, we describe a partnership between University of Cincinnati (UC) and the Cincinnati Arts and Technology Center (CATC) faculty with the goal of introducing high school students to computing in a fun but challenging way. We developed and delivered a summer workshop that leverages the successful experiences at CATC in promoting student engagement and accomplishment with a college experience using computers to create an original, digital artwork based on the Harlem Renaissance movement. In the workshop, the students viewed the work of artists in a computer lab and discussed artistic themes and techniques. The students toured the UC campus and
used disposable cameras to collect their own photo images of people and architecture. In the digital media studio at CATC, students used their images (developed digitally) to construct photo collages using sophisticated filtering and other artistic techniques in Adobe Photoshop. A gallery exhibit of student work was held in the student center at UC at the culmination of the workshop. Nineteen students participated: 10 females and 9 males; 10 were African-American, 2 Hispanic, 6 white, and 1 other. The workshop was assessed with pre- and post-surveys that investigated computer usage and confidence using computers.

**CAN SERVICE-LEARNING IN K-12 MATH AND SCIENCE CLASSES AFFECT A STUDENT’S PERCEPTION OF ENGINEERING AND THEIR CAREER INTERESTS?**

Margaret Pinnell, Rebecca Blust, Jayne Brahler and Margy Stevens

The objective of a National Science Foundation (NSF) sponsored grant entitled, Making Connections: Resources for K-12 Service-learning and Experiential Learning in STEM Disciplines was to encourage K-12 educators to incorporate service-learning into the science and math curriculum by providing an easy-to-use resource. It was hoped that the use of service-learning in the science and math curriculum would help promote the entry of women and minorities into the Science, Technology, Engineering and Mathematics (STEM) fields, increase the potential pool of engineers and scientists in the United States, contribute to the development of STEM educators and enhance cultural sensitivity, ethics and social responsibility in future STEM workers. As part of this grant, 60 local K-12 teachers were asked to use the website, facilitate an activity identified on the website and assess the usefulness of the website as well as the perceived affect the activity had on the students. All participants were asked to fill out a survey to assess the usefulness of the website as well as the perceived impact of service-learning in enhanced student interest in STEM. A subset of this group facilitated well developed career interest inventory tools prior to and after facilitating the activity in an effort to determine if the activity had an affect on the students perception of engineering or the resultant career choices. This paper will focus on the survey, assessment tools and will present the results obtained from the survey.

**WORK IN PROGRESS - DEVELOPING A CULTURE OF LEARNING BEFITTING THE DYNAMIC WORLD OF COMPUTING**

Cecile Yehezkel and Bruria Haberman

In recent years, the field of computing has undergone rapid development and the dynamics of the field has posed challenges in attempting to bridge the gap between school activities and the "real world" of computing. In attempting to meet this challenge, we developed a program aimed at exposing talented high-school students "directly by leading experts" to state-of-the-art computing. The program includes enrichment lectures and software development projects under the supervision of experts. In the last four years, 600 students participated in enrichment activities; of these students, 86 students accomplished high-level software projects. A long-term formative evaluation of the program has been conducted regarding students’ attitudes towards the "different-from-school" style of learning, and their performance in developing projects.

**HIGH SCHOOL TEACHER CHANGE, STRATEGIES, AND ACTIONS IN A PROFESSIONAL DEVELOPMENT PROJECT CONNECTING MATHEMATICS, SCIENCE, AND ENGINEERING**

Stephen Krause, Robert Culbertson, Mike Oehrtman and Marilyn Carlson

Project Pathways, an NSF Math Science Partnership professional development project, uses four semester-long courses and professional learning communities (PLCs) with the goal of enhancing teacher knowledge, skills and practice. The unifying concept of function is applied to promote conceptual competence in core content subjects and key problem solving processes. Modules integrating math, science, and engineering are delivered in team-based studio labs complemented by associated PLCs. The research question here is, "What is the effect of a function-driven joint high school math/science teacher based professional development project on teacher change, strategies, and actions?" The relevance is that it addresses issues about student math and science achievement and the STEM pipeline. Teacher change was evaluated using qualitative analysis of post-class question responses for five factors: creating a math/science teacher culture of collaboration; deepening content understanding by use of function; integrating math, science and engineering; developing inquiry strategies and materials and; promoting metacognition on student thinking for effective learning. For 27 responses, 24 showed positive change shown by shifts for one or more of five factors. Overall, the project created function-infused courses linked with multifaceted, synergistic PLCs that facilitated teacher change, strategies, and actions for improved practice.
RE-ENGINEERING THE ELECTRICAL ENGINEERING EDUCATION FOR AN INNOVATIVE DIPLOMA CURRICULUM AT UNIVERSITI TEKNOLOGI MARA

Yoot Khuang Lee, Wahidah Mansor, Md Mahfudz Md Zan, Yusof Md Salleh, Norashimah Khadri, Badrul Hisham Mat Tahir, Kartini Salam, Rosni Abu Kassim and Wan Noraini Wan Abdullah

The revolution looks to ensue after the ICT Revolution will be the Knowledge Revolution, as such human capital development becomes ever more important. Recently, the Faculty of Electrical Engineering of University Teknologi MARA has been revising its Diploma curriculum to realign with the effort of the Malaysian government to standardize the total credit hours and regulate the composition of Humanity-Skill-Theory learning. The revised curriculum is built upon past experience, peer comparison, feedback from users and recipients, and literature on future of Electrical Engineering education. It synergizes disciplines in Electrical Engineering, Mathematics, Science, Computing, Language, Entrepreneurship and Religion/Humanity Science. Curricular innovation are featured by seven key elements: modular program structure, continuity in education, commitment to experiential learning, integration of technology and education, integration of research and education, a compromise of general and specialized education, and disciplinary diversity. This paper addresses the research, design and implementation of these elements to bring curricular innovation and improvement. The consequence is a curriculum that optimizes the compromise between the accelerating rate of change in technology innovation and the realistic rate of change of curricular content and scope, and challenges the delivery of Engineers with the attributes of adaptability, flexibility and autonomous capability to learn.

INFORMATION DESIGN: A CURRICULUM FOR THE 21ST CENTURY

James C. McKim, Gerry Derksen, Hemant Patwardhan, Cara Peters and Marilyn Sarow

In Fall, 2007, Winthrop University began accepting students to a new degree program entitled Information Design. This is an intensely interdisciplinary program spanning four departments and three colleges. The four departments are Computer Science and Marketing from the College of Business, Design from the College of Visual and Performing Arts and Mass Communication from the College of Arts and Sciences. The program consists of four specialties and a set of core courses and seminars. The specialties are: Web Application Design, offered by Computer Science; Interactive Media, offered by Design; Digital Commerce, offered by Marketing; and Digital Mass Media, offered by Mass Communications. Each student takes all the core courses and seminars, and selects a specialty. The core courses consist of one or two introductory courses from each specialty. In addition, a freshman seminar helps students understand the different specialties, a later seminar introduces cutting edge topics in the field, and a senior seminar requires synthesis across the disciplines. In the latter students will work in teams to solve a problem for a local company or nonprofit. The ideal team will be four students, one from each specialty. The core courses are highly integrated, with each (except the first, of course) requiring one or more of the others as prerequisites or corequisites. There is also substantial overlap among the specialties. We expect assessment criteria will ensure that this degree of integration is maintained over time. This paper includes a detailed description of the program, a summary of its origins (largely industry driven) and a description of the assessment criteria.

WORK IN PROGRESS - CURRICULUM VISUALIZATION

Paul Gestwicki

CurricVis is a work-in-progress curriculum visualization application. The structure of a curriculum is modeled as a directed graph whose nodes represent courses and whose edges represent relationships between courses. Various graphical styles are used to encode details such as co-requisites and electives. Diagrams are automatically generated based on a curricular knowledge base. This approach has many benefits over manually-created visualizations: they require less maintenance and promote visual exploration of curriculum modifications. The CurricVis prototype has been used to generate visualizations of Computer Science curricula, including degree programs for majors and minors. The resulting visualizations have been valuable in advising current students as well as explaining the curriculum to prospective students. They have also been used to facilitate curriculum discussion in departmental committees. More user-friendly data entry and visualization generation interfaces are currently under development.
Future work includes integration with Web-based course catalogs and student transcripts, path highlighting for computer-assisted advising, and the integration of more advanced information visualization techniques for large-scale curriculum visualization.

**CRAFTING A CURRICULUM IN COMPUTER ARCHITECTURE**  
Alan Clements

The ACM and IEEE Computer Societies have served the academic community by creating Computing Curricula 2001 (CC2001), to help universities construct undergraduate curricula. CC2001 is now being revised to better reflect trends in computer science. I was asked to update the architecture curriculum. This paper discusses how the architecture curriculum was arrived at and what forces shaped it. Revising the curriculum involved getting feedback from CC2001 users, participating in conference calls, emails, and face-to-face meetings. Those who read the revised CC2001 report will not be aware of these activities and will see only a final result; they will not be aware of decisions taken after much debate as to what should be included in the architecture body of knowledge.

**A COORDINATION PROTOCOL FOR HIGHER EDUCATION DEGREES**  
Andrés Terrasa, Eduardo Vendrell and Emilio Sanchis

When a higher education institution creates a new curriculum for a given degree, the design process itself ensures a correct balance and coordination among the subjects in the degree, not only about the contents and learning outcomes of each subject, but also in the learning weight of all the subjects in each semester. However, it is common that, as time goes on, the degree evolves. This evolution may be produced, for example, in order to cope with scientific or technological advances, or simply because teachers may favor the contents, methodologies, assessment techniques, etc., which they know best. The problem is that this evolution is normally carried out in the context of each individual subject, which progressively makes the entire curriculum to lose its initial balance. This paper introduces a coordination protocol designed to regain the balance among the subjects in a degree, while this degree is being taught.
number of users, functionality, and scope. Today, faculty can plan their teaching load, work with colleagues to find mutually beneficial schedules, and easily retrieve historical information in preparation for annual reviews, promotion, or tenure appointments. Department administrators can manage course information, prepare information for certification agencies, assign faculty to courses, and monitor faculty loads. Staff and students also benefit from interfaces permitting access to appropriate information to assist them in their planning activities. Utilizing Web 2.0 technologies, the application is enjoyable to use and gives all of the disparate users a satisfying experience.

**PROMOTING UNDERSTANDING IN THE CLASSROOM: COMPARISON OF THE STRENGTH DEPLOYMENT INVENTORY, LEARNING STYLES INVENTORY, AND MYERS-BRIGGS**

**Claribel Bonilla, Susan M. Lord and Leonard A. Perry**

Given the importance of teamwork in engineering, engineering educators have explored using many different assessment tools to help individuals understand themselves and others. Among the most popular of these assessments are the Myers-Briggs Type Indicator (MBTI®) and the Index of Learning Styles (ILS). Another potentially powerful assessment tool is the Strength Deployment Inventory (SDI). Whereas other tools measure behavior, the SDI provides insight into one’s underlying motivations both when things are going well and in conflict. In this study, we gave the SDI as well as the ILS and the MBTI assessment to twenty-five undergraduate engineering students. Here we present the results of these assessments and explore comparisons between the three assessment tools. For the steps in our sample, we showed that Extroverts on the MBTI tend to be more Red or Assertive on the SDI while Introverts on the MBTI tend to be more Green or Analytical on the SDI. Also, when under conflict, such as may arise on a team project, students’ behavior changes and is influenced by their MBTI type. This information might help instructors enhance students’ team experiences.

**COURSE DEVELOPMENT IN INTERDISCIPLINARY CONTROLS AND MECHATRONICS**

**Robert Rabb, John R. Rogers and David Chang**

As the future of engineering education emphasizes more interdisciplinary work, one logical starting point for this evolution is for faculty from different academic departments to work together. Engineering educators cannot ignore the real world’s shifting focus to interdisciplinary engineering, and they should adapt as well. Similar to the total engineering process as a team effort, the engineering education process also benefits from excellent communications among a diversity of team members. This paper highlights a classical dynamical modeling and controls course with students from two different disciplines: electrical engineering and mechanical engineering. Faculties from both departments teach every semester. Sections are assigned to individual instructors but all activities are planned jointly. Course administration is the role of a course director and this role alternates between the two departments each semester. Responsibilities throughout the semester are shared between the instructors. This organizational structure is important, allowing the interdisciplinary faculty team to synchronize their efforts, each contributing their individual strengths and resources to promote student learning and faculty development. The approach is being applied to the development of a new course, Mechatronics. This paper provides details that illustrate the structure and benefits of this interdisciplinary administrative model.

**STEPPING STONES: CAPACITY BUILDING IN ENGINEERING EDUCATION**

**Arnold Pears, Sally Fincher, Robin Adams and Mats Daniels**

CeTUSS (www.CeTUSS.se) is an engineering education center established by the Swedish Council for Renewal of Higher Education in 2004. During 2006/2007 CeTUSS funded "Stepping Stones", a multi-phase (project based) initiative for tertiary engineering educators at Swedish Universities. The aim was to build a community of engineering educators and to increase their familiarity with evaluation and research approaches for assessing the impact of classroom interventions. Stepping Stones was based on the earlier US, UK and Australian initiatives; the Scaffolding, Bootstrapping and BRACE programmes. The approach uses a joint, multi-method, research study to raise awareness of relevant theory, while simultaneously supporting community development. Community building is achieved through joint work and shared experiences which promote convergence on a common set of values and ideals in relation to scholarship of teaching and learning. Investigative "capacity" was enhanced by drawing together a Swedish pool of engineering education expertise. Stepping Stones consisted of three phases. The first phase was a week long workshop examining relevant theory and empirical study design in engineering education research. This workshop introduced an "experiment kit", a protocol detailing experimental design of the project that participants jointly implemented in phase two. During phase two the participants gathered data in their own classrooms, contributing to a joint corpus of material for analysis in phase three. During the data collection process participants administered and validated a variety of instruments; surveys and interviews (including photo elicitation), and concept
Session T3G: Panel Session - Historical Visions: Enhancing Engineering Education through the History of Technology

Chair: Atsushi Akera, Rensselaer Polytechnic Institute

Time and place: Thursday, October 23, 2:30 pm. - 4:00 pm.

PANEL SESSION - HISTORICAL VISIONS: ENHANCING ENGINEERING EDUCATION THROUGH THE HISTORY OF TECHNOLOGY

Atsushi Akera, David Hemmendinger, J. Douglass Klein, Frederik Nebeker and Aristotle Tympas

This panel is organized by the Prometheans SIG of the Society for the History of Technology (SHOT) and by the International Network for Engineering Studies (INES). This panel introduces the FIE audience to our work in utilizing history, and humanistic-social perspectives more generally, to enhance engineering education. Specifically, we will use this panel to demonstrate and discuss how the history of technology can be used to help teach engineering to engineering students. Beginning with an overview by Atsushi Akera, Director of the First Year Studies Program at Rensselaer and co-editor of Using History to Teach Computer Science and Related Disciplines, the individual panelists, J. Douglass Klein (Union College), Frederik Nebeker (IEEE History Center, Rutgers), and Aristotle Tympas (University of Athens, Greece) will briefly describe the specific pedagogic techniques and strategies they use before opening up the panel to general discussion on the efficacy of these and other techniques.

Session T3H: CS Courses and Labs 2

Chair: Gymama Slaughter, Virginia State University

Time and place: Thursday, October 23, 2:30 pm. - 4:00 pm.

LABORATORY SET-UP FOR REAL-TIME STUDY OF ELECTRIC DRIVES WITH INTEGRATED INTERFACES FOR TEST AND MEASUREMENT

Fong Mak, Ram Sundaram, Varun Santhaseelan and Sunil Tandle

This paper presents a real-time instrumentation setup for laboratory experiments in the course on electric drives that is adapted to incorporate the integrated response and analysis interfaces developed in the course on test and measurement. The experimental setup is modeled after the one proposed by the University of Minnesota. However, the setup along with the modification to the model with the electric drives assembly as hardware-in-the-loop (HIL) is first correctly executed under the RT-LAB real-time system solution. The paper focuses on the design and validation of the electric drives experiments with RT-LAB solution and the LabVIEW API capability provided by RT-LAB that allows user-designed virtual instrumentation-based human-machine interfaces. With this setup, students are not only able to use the same laboratory platform for electric drives studies in the electric drives class, but are also able to study LabVIEW design as part of the Test and Measurement class. The intention is to further develop this setup as a central laboratory platform for use in other courses such as electronics system design, and control. However, for this paper, the focus is on the illustration of how this setup can benefit the subject matter in two courses: electric drives and test and measurement.

TEACHING CONCEPTS IN FUZZY LOGIC USING LOW COST ROBOTS, PDAS, AND CUSTOM SOFTWARE


Fuzzy logic is a topic traditionally taught in artificial intelligence, machine learning, and robotics courses. Students receive the necessary mathematical and theoretical foundation in lecture format. The final learning experience may require that students create and code their own fuzzy logic application that solves a real world problem. This can be an issue when the target is a Bioengineering course that introduces classical control theory, fuzzy logic, neural networks, genetic algorithms and genetic programming through the use of a low cost robot, Personal Digital Assistant (PDA) handheld computer, and custom PDA software. In this course, the concepts and
theories discussed in lecture are reinforced and extended in a corresponding laboratory through the use of wireless robots and PDAs. Fuzzy logic libraries and software modules for laptops and desktop computers are readily available, however, when it comes to handheld computers no such libraries exist. Students are able to spend more time experimenting with different fuzzy logic controllers when a custom fuzzy logic library and PDA graphical user interface are utilized. In this paper we introduce and discuss a unique low cost wireless robot, a custom fuzzy logic library, a custom fuzzy logic GUI for the PDA, and the implementation results for the fuzzy logic section in a newly created Bioengineering course. Diagnostic and summative assessment in the form of a pre-test and post-test was administered for each section of the course, however, only the results for the fuzzy logic section will be provided.

ON TEACHING CIRCUIT RELIABILITY
Azam Beg and Walid Ibrahim

Integrated circuits in the coming years are expected to be based on nano-scaled devices, such as single electron transistors, self-assembled DNA, carbon nano-tubes, and resonant tunnel diodes. Future designs based on such nano-devices will exhibit high integration densities, and might be either low power or fast switching but not both. Unfortunately, nano-devices suffer heavily from fabrication inconsistencies, and transient and permanent failures due to external causes. Therefore, circuit reliability will have to be added to the design space currently consisting of timing, area, and power. This also means that the reliability calculation/estimation could soon be an important topic in the undergraduate/graduate courses on circuit design. Probability transfer matrix numerical method has been used as an exact way to calculate the reliability of a circuit. Traditionally, the matrices are created manually, making the process tedious, time-consuming, and error-prone. This paper proposes an automatic tool (AutoPTMate) for generating ready-to-use MATLAB m-files for calculating the circuit s reliability. The tool allows users to significantly speed-up the reliability assessment of a large number of circuits. The first potential users of such a tool are members of academia and R&D community.

BRAIN-MACHINE INTERFACES: A TEAM-TAUGHT SEMINAR BRIDGING DISCIPLINES AND FOSTERING DISCUSSIONS
AnnMarie Polsenberg Thomas and J. Roxanne Prichard

This paper describes an honors seminar on Brain-Machine Interfaces (BMIs) taught at the University of Saint Thomas, in Saint Paul, MN. Team taught by professors in psychology and engineering, the seminar examined the applications and limitations of brain-machine interfaces from both neuroscience and engineering perspectives. The first half of the course consisted of lectures and instructor-facilitated discussions about the mechanics of brain circuitry, diseases and disorders of the nervous system, and basic electrical recording techniques. In the second half of the course, students presented formal lectures on innovations in BMI technology and discussed the ethics of such technology. Students were evaluated on weekly writing assignments, discussions, and formal oral presentations. Overall, the focus on BMI technology captivated students because of its immediate relevance to medical and military technology, and encouraged extensive and critical dialogues about the need for interdisciplinary groups to monitor this technology. This paper describes the course structure and content, quantitative and qualitative student feedback, and offers guidelines for designing a similar course.

Session T3J: Special Session - Model-Eliciting Activities: Motivating Students to Apply and Integrate Upper-Level Content in Engineering

Chair: Tamara J. Moore, University of Minnesota

Time and place: Thursday, October 23, 2:30 pm. - 4:00 pm. Highrock

MODEL-ELICITING ACTIVITIES: MOTIVATING STUDENTS TO APPLY AND INTEGRATE UPPER-LEVEL CONTENT IN ENGINEERING
Tamara J. Moore, Ronald L. Miller, Brian Self, Eric Hamilton, Larry Shuman, Mary Besterfield-Sacre and Brant G. Miller

This interactive session is for engineering faculty interested in curriculum reform, real-world engineering problem-solving aimed at upper-level content, and addressing ABET Criteria. Participants will take part in a Model-Eliciting Activity (MEA) group problem-solving session and learn the fundamental principles for developing an MEA. Participants will gain an understanding of the process involved in making advanced engineering content
accessible to undergraduate students through a well-formulated MEA. They will also learn about new and innovative ways to integrate ethics into the classroom and use problem-solving as a means to elicit misconceptions.

Session T4A: Technology and Simulation in Education

Chair: Rasha Morsi, Norfolk State University

Time and place: Thursday, October 23, 4:30 pm. - 6:00 pm. Phila

A REVIEW OF APPLICATIONS OF COMPUTER GAMES IN EDUCATION AND TRAINING
Felipe Arango, El-Sayed Aziz, Sven K. Esche and Constantin Chassapis

Scientists, engineers and educators are increasingly using environments enabled by advanced cyberinfrastructure tools for their research, formal and informal education and training, career development and life-long learning. For instance, academic institutions as well as private training and education companies have recently started to explore the potential of commercially available multi-player computer game engines for the development of virtual environments for instructional purposes. Most of these developments are still in their early stages and are focused mainly on investigating the suitability of interactive games for remote user interaction, content distribution and collaborative activities. Some of the ongoing projects have additional research objectives, such as the analysis of patterns of human behavior and the study of the collaboration between users and their interaction with virtual environments. A few other developments are aimed at utilizing computer game technologies as a platform for personnel training and educational laboratory simulations. This paper provides a review of the current state of computer game applications, with a special focus on education and training implementations.

H-SICAS, A HANDHELD ALGORITHM ANIMATION AND SIMULATION TOOL TO SUPPORT INITIAL PROGRAMMING LEARNING
Maria José Marcelino, Todor Mihaylov and António José Mendes

Mobile devices, like PDAs and smart phones, are small, cheap and light machines capable of being used anytime anywhere. These and other characteristics make them very attractive from an educational point of view. As they have become more and more common and widespread, a crescent interest in developing software applications for them has raised too. Indeed, at present, we find quite easily many applications for them in various areas, including education. However, this is not yet the case for the area of programming learning. Programming learning can be quite difficult for the novice learner and during the years several approaches and tools have been proposed. Some were developed for desktop environments while others for Web-based environments. With the emergence of mobile devices it seems that the next step will include them. This led us to the development of H-SICAS, a handheld algorithm animation and simulation tool. This tool can be used to support initial stages of programming learning, using a procedural approach, and is based on SICAS, a desktop tool developed to achieve similar objectives that has been used with our students with some success. However, this involved several adaptations to be accomplished.

WORK IN PROGRESS - LEARNING ENABLED SOCIAL NETWORK
Robert M. Weiner, Robert D. Hannafin and John C. Bennett

The Learning Enabled Social Network seeks to discover how to harness the power of social networking to enhance learning and promote the science, technology, engineering, and math disciplines. Through student-driven, communities of learning, we hope to engage students in authentic problem solving and be accountable to each other for their work. Teachers will participate in the community as equal partners with the students. Assessments will be performance based and post facto using traditional methods, like written exams, outside the environment. Log data will be examined in an effort to link student paths with performance. A pilot study conducted this fall with communities of professional engineers, teachers, college engineering students, and high school science students will investigate how sustainable energy can be provided to various regions of the world. The outcomes of this study will inform future designs with the ultimate goal of creating an online environment capable mediating the formation of learning communities based solely on student s interest and need.
WORK IN PROGRESS - TABLET PCS AS INTERACTIVE WEB-BASED INSTRUCTION TOOLS IN A FIRST YEAR ENGINEERING COURSE

Lisa C. Benson and Roy P. Pargas

This paper presents pedagogical experiments conducted using MessageGrid, a web-based system that enables instructors to interact electronically with their students, and Tablet PCs. These combined technologies make active learning a reality in the classroom while maintaining the necessary pace of the course. All students, including those who are reluctant to participate in class, are able to share their work and receive feedback from the instructor. The goal of this research is to measurably improve the success of at-risk students in a first-year engineering course, which can ultimately improve retention. We examine the outcomes of using MessageGrid to allow students to go public with their work, demonstrating their mastery of course material. Because this is easily implemented using a Tablet PC, and can be done anonymously through the use of MessageGrid, students overcome their fears associated with making this commitment. Grades on assignments related to topics taught with and without Tablet PCs are compared, as well as student responses to questions related to how they understand course materials.

NEESIT MACBOOK ACCELEROMETER AND VIDEO SENSOR PLATFORM (ISEISMOGRAPH) FOR EDUCATION AND RESEARCH

Lelli Van Den Einde, Wei Deng, Patrick Wilson, Ahmed Elgamal and Paul Hubbard

Current Macintosh laptop computers are equipped with a 3-axis accelerometer that detects sudden shock and impact and enables the hard drive to freeze and save its contents. In addition, the newer Intel-based MacBook and MacBookPro laptops have built-in iSight video cameras for use in video conferencing communications. The Network for Earthquake Engineering Simulation (NEES) Cyberinfrastructure Center (NEESit) has exploited these capabilities and has developed an educational and research platform for measurement and recording of vibrations and dynamic response. The system employs the NEESit Real-time data Viewer (RDV) that enables the real-time streaming of acceleration data synchronized with video, and automatically saves data into a database repository (NEEScentral). Through NEEScentral, earthquake engineering students and research collaborators worldwide can access the recorded data online and engage in joint projects, potentially at a worldwide scale. The following paper provides an overview of the information technology framework for the NEESit MacBook Accelerometer and Video Sensor Platform (iSeismograph) and its capabilities, and provides an example of its potential for collaboration through a classroom application for undergraduate education in earthquake engineering.
and extensible system. Since 2005, collaborators at Pace University and Cornell College have been working to adapt WeBWorK to extend its reach to Computer Science. This paper reports on a global experiment undertaken with Computer Science students and faculty from three continents based on the use of WeBWorK. Students in the US, Cambodia, India, Senegal and Thailand were presented with a set of programming exercises in a controlled environment. The intention was to explore the impact of diverse cultures, distinct first languages and differences in prior everyday exposure to the Internet and use of pedagogical tools on the usability and perceived value of such tools in Computer Science education. The study poses an important question with regard to the global uptake of everyday and typically US-centric educational technology. It provides findings likely to be of value to academic institutions interested in its adoption and companies interested in its commercialization.

THE EDUCATIONAL USES OF MATHEMATICAL ONTOLOGY AND THE SEARCHING TOOL
Noriko Kitani and Shuichi Yukita

In Japan, a huge number of entrance examination questions and school textbook exercises are accumulated in databases at various educational institutions and companies in education industry. These databases are now becoming more and more indispensable educational resources for teachers, educational researchers, and learners. However, since these resources are stored in a wide variety of forms, we can not search useful data at the semantic level. To tackle the problem, we constructed mathematical ontology and developed the problem searching tool based on this ontology in our previous work. We use standard ontology technologies which were developed for shared use and reuse of knowledge. The ontology captures one or more experts conceptual representation of a domain expressed in terms of concepts and the relationships among the concepts. We analyzed that the features of this technology could be the answer to solve above mentioned problem. In this paper, we describe an overview of the mathematical ontology and the searching tool, focusing on newly added functions, and demonstrate effective utilization of this tool in the field of mathematics education.

LESSONS LEARNED FROM THE APPLICATION OF ONLINE HOMEWORK GENERATION MODULES IN A SIGNALS AND SYSTEMS COURSE
Steve Warren, Nidhi Tare and Andrew Bennett

Online engineering education tools present students with flexible access to local/distance learning resources and offer an opportunity to maintain student engagement via the use of dynamic interfaces. This paper addresses lessons learned from the creation and use of online homework generation modules in an electrical engineering signals and systems course. The nine modules address complex number calculations, complex conversions, signal graphing, zero input response, unit impulse response, Fourier series, and fast Fourier transforms. The primary goal was to create an innovative and engaging set of online learning experiences that would allow faculty to assess the transfer of mathematical knowledge from calculus and differential equations courses to subsequent electrical engineering courses. These modules offer student-specific problem generation and automatic grading, where the latter accelerates the feedback cycle and provides tool scalability to large numbers of students. The tools are easily upgradeable and offer the opportunity to track, through a database, elements of the student learning process that often go unrecorded but yield a rich data set for correlating performance on related subjects in current, previous, or subsequent semesters. The modules have been employed nine semesters to date, and student survey data from these experiences supplement data stored in the database files and data recorded from written examinations. Student reactions to these tools have been generally positive, where the ease of answer entry plays a large role in the experience. Quantitative correlations between module scores, grades on written examinations, and performance in previous mathematics courses have demonstrated variable clarity, but qualitative assessments of the technology-facilitated environment point to a clear increase in student learning and engagement. Instructor benefits are apparent with regard to grading time saved, grading consistency, confidence in student accountability for work submitted, and information regarding when/where students work that is difficult to obtain any other way.

WORK IN PROGRESS - VIRTUAL BUSINESS SCHOOL AND ENTERPRISE RESOURCE PLANNING SYSTEM INTEGRATION IN ENERGORPROJEKT GROUP
Vladan Pantovic, Marko Savkovic and Dusan Starcevic

Enterprise Resource Planning (ERP) system is very important management tool, but the new economy requires new methods of management - not only management of traditional resources, but primarily knowledge. This paper provides a description of a redesign process - from classical web based training towards the portal oriented corporate education system. Portal of "Virtual Business School" in Energoprojekt Group is good framework for integration of corporate lifelong learning system and ERP human resources module (HR). Key inputs are obtained using the results
of online testing of employees. Online testing enables quick feedback from employees dispersed all over the world. Planned integration of the existing corporate university with the HR module of ERP solutions are going to further upgrade the education of employees, as well as the ERP system itself. On the basis of analyses obtained from the employees’ knowledge assessment, the management will be able to make adequate decisions in order to manage the development of the employees.

Session T4C: Design Experiences 1

Chair: Frank Peters, Iowa State University

Time and place: Thursday, October 23, 4:30 pm - 6:00 pm

Broadway 2

APPLYING PHYSICS TO AN UNDERGRADUATE UAS DESIGN

Andrew Bellochio, Bobby Crawford and Lynn Byers

The Department of Civil and Mechanical Engineering at the United States Military Academy requires its graduates to complete an integrative capstone design in their senior year. One of these projects involves the design, construction, testing, and demonstration of a small, highly autonomous, Uninhabited Aerial System (UAS). This particular capstone option was added to the list of available capstone projects in the fall of 2005. In the past, while students have been able to complete the design process relatively well, an area of deficiency for all capstone design teams has been the physical modeling of their design before construction. This paper will describe the progression of physical modeling and analysis for the systems air vehicles over the course of the three years of the project's existence. In the first year, the two teams did little or no modeling. During the second year of the project, with three different teams, some modeling was attempted, but not verified through testing once the designs were constructed. At the start of the third year, one of the faculty advisors developed a detailed procedure for aerodynamic modeling and performance analysis, called the Alpha 60 Laboratory. To augment the previous year’s design pedagogy with an inductive learning component, the students were required to complete the laboratory on an existing airframe. They were then required to apply the same analysis to each alternative developed through the engineering design process. Upon selection and construction of their final design, the students will be required to validate their analytical predictions through flight testing. Preliminary results have shown marked improvement in the detail of the analysis and the level of the students' understanding of the underlying physics. An assessment of the laboratory's impact on this year's designs will also be presented.

FINAL YEAR PROJECTS WITH INVOLVEMENT OF INDUSTRY AND HIGH SCHOOLS

Andrew Nafalski and Zorica Nedic

In the final year of undergraduate degree programs in the School of Electrical and Information Engineering at the University of South Australia (UniSA), students accomplish hands-on design projects that account for a quarter of the year's academic credit load. The majority of the projects, depending on a year - between 60% and 80% - are industry sponsored, i.e. industry defines the project specification and provides industry supervisor(s) and resources in cash and/or in-kind contributions. This gives students an opportunity to develop links with industry and build up their skills, knowledge and industry-relevant practical experience in a specialised engineering field, facilitating their rapid industrial employment. Recently also high school students have been involved in these projects, as reported in the paper. The program has been successfully running for the past 3 years and proved to bring benefits to high school students, university students and also to companies that participate in the program.

WORK IN PROGRESS - STRATIFYING THE INTRODUCTION TO ENGINEERING DESIGN COURSE

Kenneth S. Manning

The Introduction to Engineering Design (IED) course must be a down-to-earth, meaningful and engaging encounter for the students, must meet the academic needs of the program, and must be manageable and affordable, all within a three or four credit hour framework. Commonly, this course is taken once in either the freshman or sophomore year. We are in the planning stages to split the IED course over our two-years, rather than keeping it in its current single-year form. The current IED will be combined with an existing one-hour Freshman Seminar (FS) course, required of freshman and meant to expose new students to college life in general, and to the engineering educational requirements. This FS course will be expanded to overlap some of the work done in the more-involved IED, allowing both our first- and second-year students to work together in each of their two years. The FS course will continue to introduce freshman to college, but will also have them work on current projects with sophomore students.
in IED as part of the design teams. Each project will have a layered team of the more experienced 2nd year students working with the newer 1st year students, more reflective of the situation in industry. Time in the 2nd year will be spent without the freshmen from FS, to allow a more in-depth look at engineering management, ethics, and economics for the sophomores.

**WORK IN PROGRESS - SUSTAINABLE ENGINEERING DESIGN AT JAMES MADISON UNIVERSITY**

Eric C. Pappas and Ronald G. Kander

In August 2008, James Madison University will enroll its first engineering students into a unique engineering program focused on sustainable societies. A significant component of this integrated program is the six-semester 10-credit design laboratory sequence that stretches from the sophomore year to graduation. We present a divergence from the generally accepted approach to sustainability (normally referred to as sustainable engineering or environmental sustainability) and include instruction in creating sustainable societies. This paper addresses the following topics in the design curriculum in the engineering degree program: 1) Environmental Sustainability; 2) Creative and Critical Thinking, Decision Making, and Assessment; 3) Aesthetics of Design; 4) Economic and Social Sustainability; and 5) Design Ethics. The Design Program is interdisciplinary and will utilize faculty from business, art, and social science disciplines; and employ a variety of innovative instructional methodologies from the social sciences and humanities.

**MEASURING THE BENEFIT OF SERVICE ORIENTED STUDENT DESIGN PROJECTS**

Cecelia M. Wigal, Ed McMahon and Molly Littleton

The State of Tennessee Department of Education provides grant support to the University of Tennessee at Chattanooga (UTC) to design, prototype, test, evaluate and disseminate products, procedures, and services that apply adaptive and assistive technologies to children with special needs. Eight to sixteen projects have been completed by freshman and upper level students each year since the fall of 2005. The academic outcome of these projects is an opportunity for students to experience the design process, aid someone's ability to be independent, and learn how engineering can benefit our society. The students who participate in these projects informally express they are motivated by knowing they have designed a device that can improve the life of a child. A recent formal survey of those students who have participated in these projects confirms this statement. It also presents some interesting findings with respect to why students choose particular projects to participate in and what they believe they have learned from the projects that is most beneficial to them.

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**Session T4D: Student Retention 1**

Chair: Autar K. Kaw, University of South Florida

**Time and place: Thursday, October 23, 4:30 pm. - 6:00 pm.**

**FIRST GENERATION COLLEGE STUDENTS IN ENGINEERING: A QUALITATIVE INVESTIGATION OF BARRIERS TO ACADEMIC PLANS**

Michael J. Fernandez, Julie Martin Trenor, Katherine S. Zerda and Cassandra Cortes

While understanding factors that relate to the recruitment and retention of engineering students has garnered much attention in recent literature, little is known about the educational experiences of first generation college (FGC) students majoring in engineering. This work employed a social cognitive theoretical framework to qualitatively investigate the educational experiences of FGC engineering students at an urban research university. Semi-structured interviews were conducted with eight participants in this pilot study. Interview data were coded and content analyzed using NVivo software. Nearly sixty emergent themes were identified, including six major barriers: 1) lack of understanding of the college admissions process, 2) financial constraints, 3) difficulty of coursework, 4) lack of engineering role models, 5) role conflicts and 6) lack of parental understanding about higher education and/or engineering. These barriers are discussed in terms of developing effective recruitment and retention interventions for first generation college students majoring in engineering, and recommendations for future work are offered.
WORK IN PROGRESS - A DESIGN GUIDE TO RETAIN FEMALE (AND MALE) STUDENTS IN ENGINEERING
Linda Vanasupa, Katherine C. Chen, Stacey Breitenbach and Karen R. Bangs

Despite a rich body of research on factors contributing to attrition of women during the college, women continue to be underrepresented in the graduating classes of most traditional engineering disciplines. We present our Four-Domain Development Diagram (4DDD) in an attempt to enable a systems approach to managing all the factors that contribute to retention. This diagram makes explicit the connections between the learners’ response factors in the learning environment, including motivation, interest, and ultimately retention. Although we are only three years into our use of the diagrams’ relationships, we have seen a lower overall net attrition rate (male and female) from freshman year from ~50% to ~20%, seeing a net influx of female students, from numbers as low as 2 of 44 in the entering freshmen cohort to 6 out of 40 (now sophomores) in that same cohort. In this paper, we present the diagram, briefly introduce the theoretical underpinnings with preliminary quantitative and qualitative data.

ENGINEERING UNDERGRADUATE PERSISTENCE AND CONTRIBUTING FACTORS
Susan Haag and James Collofello

The engineers of 2020 must be technically sound in their disciplines, global citizens, as well as aspirational, ethical leaders. To foster a new generation of engineering talent, modern curricula must advance strong analytical skills, teamwork, professionalism, and leadership. However, new curriculum with poor student retention cannot be deemed successful. We believe we possess the key components of a successful program, such as well-designed curricula, dedicated faculty and strong support services, yet many students leave our School. There is widespread speculation about the reasons for leaving, including financial need and lack of academic preparedness. To address these national and local retention phenomena, an evaluation process was designed to obtain quantitative information about why our students leave. The study assessed student attitudes associated with educational experiences in their new major contrasted to their engineering experiences. Thus, information gained could be a basis for decision making for future processes and proposed improvements. Engineering is committed to the challenge of developing solutions to increase the overall retention rate and diversity of engineering graduates to meet both internal and external pressures for accountability and industry demands. This paper will address some of the viable solutions to counter the problems identified in our study as well as a discussion of how they have been implemented in our school.

PLUS TWO PEER-LED TEAM LEARNING IMPROVES STUDENT SUCCESS, RETENTION, AND TIMELY GRADUATION
James E. Becvar, A.E. Dreyfuss, Benjamin C. Flores and Walter E. Dickson

A Plus Two strategy has integrated Peer-Led Team Learning (PLTL) as a required component of first semester general chemistry at the University of Texas at El Paso (UTEP). Since fall 2000, the C-or-better passing rate has improved from the historic average near 53% to the current rate above 70%, translating into an additional 160 students successfully progressing each year into their science, engineering, and mathematics majors. In 2006 the Plus Two Peer-Led Chemistry Program at UTEP earned the Star Award from the Texas Higher Education Coordinating Board for its innovative active-learning curriculum intervention for improving student success, retention, and timely graduation in the engineering and science disciplines. Plus Two substitutes two hours of Workshop: small-group, active learning guided by an undergraduate STEM student (Peer Leader) for one hour of large section lecture per week in the three-credit-hour chemistry course. Retention of students for the four semesters subsequent to the Plus Two innovation improved from 70% to 75% and the number of students receiving undergraduate degrees within nine semesters jumped from approximately 34% to 47%. A National Science Foundation award (DUE - 0653270) entitled I-STAR: Integrated Student Success, Teaching, and Retention, has now extended the Plus Two strategy to six other large section lower division courses leading to STEM degrees at UTEP.

WORK IN PROGRESS - BUILDING COMMUNITY AMONG FIRST YEAR ENGINEERING STUDENTS
Eric W. Hansen, Ellen M. Stein and Vicki V. May

Engineering Workshops is a peer mentoring program we are developing that seeks to improve retention of first year students by drawing them into the engineering school community while they are still taking prerequisite calculus and physics courses. The goals of these workshops are: (1) to provide a facilitated opportunity for prospective engineering students to meet and form a support system; (2) to introduce first year students to the engineering school and its teamwork culture; and (3) to give them a motivational peek at how the math and physics they are studying is
used in engineering. Workshops meet weekly for at least two hours in the engineering building. Each is facilitated by a pair of upperclass engineering students. In the first four terms, weekly attendance has averaged 30 in all sessions (roughly 25% of prospective majors). Student responses in end-of-term surveys have been consistently positive, citing the benefits of meeting other engineering students and working in small groups.

Session T4E: Distance Learning 2

Chair: Perry Sprawls, Sprawls Educational Foundation

Time and place: Thursday, October 23, 4:30 pm - 6:00 pm.

SELF-PERCEPTION AND SELF-REPRESENTATION IN PARTICIPANTS OF AN ONLINE MASTERS PROGRAM TARGETING EDUCATION PRACTITIONERS

Frederic Fovet

This paper will examine the self-perception and self-representation modes developed by the participants of a 2 year online MEd program in Social, Emotional and Behaviour Difficulties (SEBD), through an analysis of the exchanges occurring on interactive bulletin boards within WebCT. The working hypothesis is that the participants willing to develop a full online persona through the interactive media, are the ones most likely to successfully complete the course in question. The paper will also draw other conclusions more specific to the domain of teacher training in Special Education, relating notably to the participants willingness to develop self-awareness through the online media and to the impact this has on their practice.

WORK IN PROGRESS - AN UNDERGRADUATE B-LEARNING EXPERIENCE FOR THE TEACHING OF POLITICS OF TELECOMMUNICATIONS AND INFORMATION SOCIETY

Antonio Perez Yuste, Rafael Herradón Díez, Juan Blanco Cotano and José Antonio Sánchez Fernández

The Telecommunications Act of 1998, approved by the Spanish House of Representatives, set up the beginning of the telecommunications market liberalization process in Spain and the establishment of a new economic and social model based on the Information Society Paradigm, as already highlighted by the European Commission in 1993. Taking advantage of the necessity for undergraduate students to have a subject related to this matter, a new course on Politics of Telecommunications and Information Society was initially designed by a group of five professors from the Technical University of Madrid, four of which still maintain the project alive after eight years. The resulting course is teaching at the Technical University of Madrid since 1999. The course was initially conceived as an e-learning initiative based on the well-known Moodle Learning Management System and it comprises the next four lessons: Information Society, Telecommunications Regulation in Spain, Telecommunication Standardization and Certification and, e-Commerce & Internet Security.

WORK IN PROGRESS - REMOTE EXPERIMENTATION LAB FOR STUDENTS WITH LEARNING DISABILITIES

Venkata S. Chivukula, Dmitry Veksler and Michael S. Shur

Recent advances in developing remote experimentation labs allow meeting the challenges of making them usable for learning disabled student, who experience difficulties in following the instructions to perform remote experiments. Many times, a confusion caused by the delays between initiating an action in the laboratory and the execution of that action and, as a result, the student does not know if he/she has done the experiment in the correct way. In this paper we address the problems faced by learning disabled individuals by adding new features in Automated Internet Measurement Lab (AIM-lab) at RPI including audio-visual instructions and feeds, voice/video conferencing, and text chat with fellow students. With the added new features in AIM-Lab, learning disabled students will benefit from performing the real-time experiments in a remote setting and therefore their learning process will be more effective than in traditional limited time lab sessions.

WORK IN PROGRESS - STUDENT LEARNING OUTCOMES IN AN ENGINEERING DISTANCE EDUCATION SETTING

Bassam Shaer and Andreas Fuchs

Distance education provides an avenue for students not close to a university center to complete an ABET accredited electrical engineering or computer engineering degree in a timely fashion. This paper describes a nontraditional situation in which students at remote locations attend lectures with students at the university center.
Interaction takes place between the instructor and students as well as between students at all locations via an interactive distance learning studio (IDLS). The IDLS supports two-way, real-time communication, which includes audio, video and lecture material, between multiple locations. The required facilities are presented, and the unique challenges faced by both students and faculty in this environment are discussed. Student learning outcomes will be investigated in order to validate the established lecture course delivery method.

Session T4F: Graduate Curricula

Chair: Susan K. Donohue, Center for the Advancement of Scholarship on Engineering Education

Time and place: Thursday, October 23, 4:30 pm. - 6:00 pm.

CREATING INNOVATIVE WRITING INSTRUCTION FOR COMPUTER SCIENCE GRADUATE STUDENTS

Janet L. Kayfetz and Kevin C. Almeroth

This paper describes the Academic Writing Course offered in the Computer Science Department at the University of California, Santa Barbara. We conceived the course to go farther than a generic writing course, and developed an innovative curriculum that specifically addresses the rigorous demands on Computer Science graduate students to produce research papers for acceptance at the best conferences. We focus on how the course design and execution address the challenges we observe in student writing, including the selection of content for a text, the organization of the content, the use of appropriate details and transitions, the discussion of data, rhetorical positioning, and readability, as well as the daunting process of drafting, redrafting, and editing. We also provide a qualitative assessment of the course’s impact based on feedback from student and faculty evaluations that suggests that students who attend the course are not only better writers but more effective collaborators with faculty advisors, and thus experience a smoother overall composing, editing, and submission process.

WORK IN PROGRESS - A MASTER OF DESIGN PROGRAM COLLABORATING WITH ELECTRONIC ENGINEERING AND TECHNOLOGY

Tom Ziming Qi

Like most postgraduate programs at design, the Master of Design in Unitec New Zealand is a multi-disciplinary programme that gives students the opportunity to sharpen their skills in collaboration with other design professionals. The degree is ‘by project’, which means that the student undertake a project based on an aspect of their design practice to date. There is no coursework, although the design project will be supported by a strong contemporary theoretical framework, which teaches students to design products in support of human activities and interactions. Normally, such an academic program intends to produce so called Industrial Designers, who are a cross between an engineer and an artist. The students study both function and form, and the connection between product and the user. Therefore, they do not need to design e.g. the circuits that control a motor. Since Electronic engineering and technology has been introduced to this program, questions have been asked: Is a student’s scientific research background useful in designing? This paper analyses three Master of Design students’ projects as examples to discover an innovative uses of Master of Design for Electronic engineering and technology graduates to acquire what industries needed.

WORK IN PROGRESS - USING CASE STUDIES TO INCREASE THE RETENTION OF FEMALE DOCTORAL STUDENTS IN STEM FIELDS

Jennifer M. Bekki, Bianca L. Bernstein, Karin Ellison, Arati Sridharan, Liza Hita and Quinn Spadola

This paper discusses part of the NSF funded project, CareerWISE: Internet-Delivered Resilience Training to Increase the Persistence of Women Ph.D. Students in STEM Fields. Research shows that rates of doctoral student attrition (i.e., beginning and then not completing a doctoral degree program) are substantially higher for women than for men, including in the physical sciences and engineering. The CareerWISE project addresses this problem through the development of a web-based resource consisting of training materials that will build the resilience skills, problem solving skills, and persistence of women in science and engineering PhD programs. CareerWISE is currently in the second of three years, and this paper focuses primarily on the portion of the project involving written case studies. The differences between the types of case studies traditionally used in science and engineering courses and the CareerWISE case studies are discussed, along with the plans for evaluating and integrating the cases with the other pieces of the CareerWISE project.
MOBILE LEARNING: MAJOR CHALLENGES FOR ENGINEERING EDUCATION

Poonsri Vate-U-Lan

There is a high demand for engineers to design, produce and develop mobile learning (mLearning) technology. However, there are only a limit number of courses which fully present the correct pathway to develop and construct mLearning courseware. This paper is a report based on documentary research and a needs assessment survey of mLearning, the whole concept being, in many ways, a work in progress, pending general adoption. The survey aims to explore how university students consider mLearning and how mLearning would be suited to their needs. The outcome of the survey reveals many crucial elements that should be applied to create a new curriculum in the engineering area. The participants of the survey were 296 university students in Thailand. The majority of respondents were Thai (91.2%). Almost all (97.4%) of the participants who would pay for mLearning courses believed that mLearning would enhance their present learning capabilities. MLearning will assuredly be accepted in the future, since 96.6 per cent of university students stated they wanted to use mLearning if they can access the material with no charge. The proposed mLearning sciences and technology program can be structured into three main areas: wireless technology, mobile education and application management.

THE PEDAGOGIC AND TECHNOLOGICAL EVOLUTION OF A MANUFACTURING SYSTEMS ENGINEERING (MSE) GRADUATE PROGRAM

Keith M. Gardiner

Graduate programs for a cross-disciplinary MS degree in Manufacturing Systems Engineering are in their twenty-fifth year since being stimulated by an innovative request for proposals (RFP) by the IBM Corporation. The RFP called for solutions to perceived gaps in engineering education. There is a continuing need for engineering professionals to gain appreciation of business issues, the importance of interpersonal communication, teamwork, information technologies and globalization. The Lehigh program, one of the five US proposals funded, has evolved both pedagogically and technologically since welcoming the first students in January, 1984. The program has migrated from dealing with twenty to thirty full-time on-campus students sent by their industry employers to catering for similar numbers of partial-release students and in the last decade to students that participate remotely. Classes are delivered by satellite and are available on-line; students employ a phone bridge to join live classroom discussions and to support their own presentations or those of their team colleagues. Digitized videos of class proceedings are available on customized BlackboardTM sites. Blogs, Discussion Board assignments and analysis of leading-edge technical releases empower the students of this classroom factory as they undertake research and share their industry experiences.

Session T4G: Panel Session - Reflections on International Accreditation

Chair: John Impagliazzo, Hofstra University

Time and place: Thursday, October 23, 4:30 pm. - 6:00 pm. Alabama

Panel Session - Reflections on International Accreditation


Program accreditation in computing, engineering, and technology has many international dimensions. Governments around the world have established agencies or commissions to monitor accreditation activities and professional societies and agencies have undertaken the task over many years. In the 2007-2008 academic year, ABET has stayed its substantial equivalence designation and has now engaged in formal accreditation activities beyond the United States. This panel seeks to explore and to present first-hand information regarding the issues and complexities surrounding international accreditation activities and report on their experiences in doing ABET international accreditation. Several panel members, many of whom serve on ABET committees that address these matters and have conducted international accreditation visits, will comment on their experiences, within confidentiality limits. The presentation will focus on the philosophical as well as the practical aspects of accreditation activities outside the United States.
Session T4J: Special Session - Continuing The FIE 2007 Conversation on: Can Philosophy of Engineering Education Improve The Practice of Engineering Education?

Chair: John Heywood, Trinity College

Time and place: Thursday, October 23, 4:30 pm. - 6:00 pm.

SPECIAL SESSION - CONTINUING THE FIE 2007 CONVERSATION ON: CAN PHILOSOPHY OF ENGINEERING EDUCATION IMPROVE THE PRACTICE OF ENGINEERING EDUCATION?

John Heywood, Roy McGrann and Karl Smith

The purpose of this special session is to continue the conversation began at FIE 2007 that asked the question Can philosophy of engineering education improve the practice of engineering education? The session is summarised on http://www.ws.binghamton.edu/PhilEngEd/ It has become clear that this debate fits in with a broader and international debate on philosophy of engineering that although not directed at the philosophy of education has outcomes that bear on the curriculum and instruction. Some one hundred papers on engineering philosophy have been published in the last three years. A paper summarising some of the features of these studies accompanies this discussion in the Proceedings. During the year Smith has revisited his suggested reading on the philosophy of education and that is also in the Proceedings. Together this work has enabled us to refocus the issues in order that as a group we can develop our thinking.
VIRTUAL GALLERY WALK, AN INNOVATIVE OUTLET FOR SHARING STUDENT RESEARCH WORK IN K-12 CLASSROOMS
Joshua Schendel, Chang Liu, David Chelberg and Teresa Franklin

This paper discusses a case study which aims to make research projects more engaging for middle school students by incorporating a variation to the traditional gallery walk workflow. The process begins by having the students conduct individual research on one of a finite list of topics and produce a poster that details what they have learned. We collect the research posters and transfer the media into the shared virtual world of Second Life, where a developer organizes the posters into a virtual museum of full-color high-quality panels displaying the students' creations. Students return to the computer lab, log in to the virtual world, and explore the virtual gallery. This gives students the opportunity to learn more about the other topics from their peers in an engaging, interactive, and fun way. We evaluate the effectiveness of this workflow by injecting quizzes on the topic material before the research phase, after the research phase, and after using the virtual gallery walk. As virtual worlds are rarely utilized in K-12 classrooms, the virtual gallery walk is innovative as a vehicle for student learning and as a possible outlet for sharing the work with community of other students active within Second Life.

GUIDED SLIDES: FLEXIBLE LECTURES USING A TABLET PC
Lester I. McCann

Numerous studies tout the effectiveness of guided lecture notes in improving the quality of student in-class notes, and subsequently improving student performance on quizzes and exams. We have extended this idea, producing electronic guided slides for use in a first semester discrete mathematics course taught for undergraduate computer science students. Using a tablet PC, the instructor augmented these slide outlines during lectures. The resulting slide images were posted on-line after each lecture for students to access. This paper reports our experiences with this method over two consecutive semesters. Survey feedback shows that students overwhelmingly support this lecture approach.

WORK IN PROGRESS - USING SCREENCASTS TO ENHANCE STUDENT LEARNING IN A LARGE LECTURE MATERIAL SCIENCE AND ENGINEERING COURSE
Tershia Pinder-Grover, Joanna Mirecki Millunchick and Crisca Bierwert

University lecturing is changing as a result of increasing student populations, increasing student diversity, and transformative technologies. One of the newest technological developments is the availability of screencasts, recordings that capture audio narration along with computer screen images. This study documents the strategic use of screencasts in a Material Science and Engineering (MSE) course, and examines their impact on student learning and satisfaction in the large lecture environment. Screencasts posted to the course management site included solutions to homework and quizzes and mini-lectures that explain topics identified by students as unclear. Survey results indicate that the majority of students responding found all of the screencasts helpful regardless of whether they found a concept difficult or not. But other data suggest that the impact on student learning could be even greater, as both faculty and students learn to utilize this new resource. Future course iterations will refine the uses of screencasts and continue analyzing their impact.

WORK IN PROGRESS CONNECTING ONLINE LABS AND HOMEWORK
Andrew G. Bennett, Rekha Natarajan, Silvia Onofrei and Jennifer Paulhus

Experts recognize connections between different representations of a topic that novices often fail to use. One aspect of this is that novices may fail to realize material learned in one context, e.g. a lab assignment, is useful in a different context, e.g. homework. As we move toward teaching in a connected online world, we should also move toward strengthening the connections between different aspects of a course. This could improve student learning in many courses, especially introductory courses. Using screen casting, we captured a digital video of work in an online lab assignment in an introductory math class. This video was then embedded into an online homework system, so that
when students made a mistake in the homework problems related to the material covered by the lab assignment, they were given the option to review the lab video. Over the first two semesters of use, about 1/3 of the students offered the video opted to follow the link. However, performance overall on the assignment did not change significantly, though speed of completion did improve somewhat. Further work is being done to try to decide when, if ever, such techniques will improve student learning.

WORK IN PROGRESS - MUSE MULTI-UNIVERSITY SYSTEMS EDUCATION  
Jeff Frolik, Tom Weller, Paul Flikkema and Wayne Shiroma

An undergraduate track in wireless sensor networks is being developed as a vehicle for learning systems thinking and as an example of complex-engineered designs. This track features (1) online tutorials, (2) a systems-centric, senior technical elective, (3) a culminating Capstone Design course emphasizing inter-university collaboration, and (4) a hardware/software testbed that is distributed across universities. The project is in its first year and results to date are presented.

Session F1B: Laboratory Experiences 2

Chair: Manuel Castro Gil, Universidad Nacional de Educación a Distancia

A PROJECT-BASED LABORATORY FOR LEARNING EMBEDDED SYSTEM DESIGNS WITH SUPPORT FROM THE INDUSTRY  
Chyi-Shyong Lee, Juing-Huei Su, Kuo-En Lin, Jia-Hao Chang and Gu-Hong Lin

A project-based laboratory for learning embedded system designs with support from the industry is presented in this paper. The aim of the laboratory is to motivate students to learn building blocks of embedded systems and practical control algorithms by constructing a following robot with quadratic interpolation technique to predict the position. In addition to the basic hardware and software skills, several specific hardware circuits and software algorithms are included for the final project of following robot construction. The students are allowed to discuss with the other groups of students to solve both the hardware and software problems in each experiment, although they have to answer the teacher's questions on their own to get the score. To enhance the learning outcomes, a racing contest for the students following robots is also organized to see how well the techniques learned in the laboratory are applied in the final project. The support from the local branch of Microchip Inc. lets students obtain microcontrollers at no cost. The feedbacks of students show that the final project of constructing following robots and the racing contest really motivate the students to learn and verify actively all the skills included in the laboratory.

AN ULTRASOUND-BASED LABORATORY EXPERIENCE TO ILLUSTRATE THE MAXIMUM POWER TRANSFER THEOREM  
Jordi Bonet-Dalmau and Pere Palà-Schönwälder

This paper aims to tackle both the challenge of illustrating the maximum power transfer theorem in a first-year course and the challenge of organizing courses with an extensive program that must be completed in a rather short time. This is the case for the three-year degree program leading to the Diploma in Electronic Systems for Telecommunications offered by the Technical University of Catalonia (UPC). In this degree program, an ultrasound-based laboratory experience was developed primarily to cover the topic of maximum power transfer in the second-semester Circuit Analysis course. In this experience, the range of an ultrasonic transmitter/receiver system, which starts out rather short, is improved by using an LC matching network. The measurement setup uses low-cost circuitry and standard instrumentation available in any basic electronics laboratory. During this experience, we realized that other topics could easily be introduced, including some related to the third-semester Radiofrequency course. Therefore, we added a largely descriptive section to illustrate some of the following topics: wavelength and propagation-speed measurement, directivity, standing waves, pulse-echo distance measurement and the effect of air movement and temperature on the propagation speed.

WORK IN PROGRESS - ONGROUND VERSUS DISTANCE RAPID PROTOTYPING PRACTICES  
Ismail Fidan

It is always a challenge for educators to provide students with an adequate laboratory experience at a time and place convenient for them. This applies to both conventional hands-on courses as well as to laboratory enhanced
distance courses. Traditional laboratory classes are scheduled only for a specified time period, when students attend a laboratory class located within their home institution. Considering the ability level of students, the allocated time period is usually not enough for all students to complete their assigned tasks satisfactorily and also gain sufficient experience through the practice. To address these issues, there are a number of projects that have been made to provide experimentation facilities over the Internet. Tennessee Tech University was able to establish a Rapid Prototyping Laboratory as part of a NSF CCLI grant in 2003. Students have used the lab in their in-ground practices until 2007. Starting 2007 this laboratory has been converted to a remotely accessible format with another CCLI grant. Now, various traditional and distance course students have been using the laboratory for little over one year. Instructional delivery and laboratory materials have been developed and dissemination has been made through the Tennessee Board of Regents institutions, and some other schools in Georgia and Nevada. Student learning assessments have been collected and tabulated with a survey instrument. Best practices and corrective actions have been executed based on the inputs received from the survey results. This WIP paper will report the current results received from the in-ground and distance rapid prototyping laboratory practices.

EXPERIENCES WITH A HYBRID ARCHITECTURE FOR REMOTE LABORATORIES
Steve Murray, David Lowe, Euan Lindsay, Vladimir Lasky and Dikai Liu

There is growing interest in the use of remote laboratories to access physical laboratory infrastructure. These laboratories can support additional practical components in courses, provide improved access at reduced cost, and encourage sharing of expensive resources. Effective design of remote laboratories requires attention to both the pedagogic design and the technical support, as well as how these elements interact. We discuss our experiences with a remote laboratory implementation based on a hybrid architecture. This architecture utilises a Web front-end allowing student access to an arbitration system, which permits students to select one of a number of experiments, before being allocated to a particular experimental station. The interaction with the equipment then occurs through a separate stand-alone application which runs on its own virtualized server which the user accesses via a remote desktop client. This hybrid architecture has many benefits, as well as some limitations. For example, it allows rich control and monitoring interfaces to be developed, but also requires students to understand a slightly more complex process for establishing the control. We discuss the reactions to this architecture by different cohorts of students as well as the extent to which the architecture facilitates evolution and expansion of the laboratories.

WORK IN PROGRESS - A DUAL MODE REMOTE LABORATORY SYSTEM SUPPORTING BOTH REAL-TIME AND BATCH CONTROLS BY MAKING USE OF VIRTUAL MACHINES
Norihiro Fujii and Nobuhiko Koike

This paper describes a dual mode remote laboratory system for an educational hardware experiment. There are two different approaches, namely real-time and batch modes, which control a laboratory system remotely. In the real-time mode, the spatially distributed hardware and test apparatuses are occupied by users during entire experiment periods exclusively. It gives the users interactive and real-laboratory like test environments, but the physical number of platforms will give the system usage limit. As for the batch mode approach, this mode resolves such shortcomings and achieves efficient equipment sharing among concurrent users, but the response-time is rather sacrificed. As neither of them does solve the problems, new remote laboratory environment which resolves the time restriction and the spatial restriction is proposed. The virtual machine (VM) technology has been employed to resolve these problems. As the VM controller allocates both real-time mode VMs and batch mode VMs dynamically, an efficient sharing of apparatuses and an improved interactivity can be achieved.

Session F1C: Knowledge Organization in Pedagogy
Chair: Deborah A. Trytten, University of Oklahoma
Time and place: Friday, October 24, 8:00 am - 9:30 am. Broadway 2

USING FEEDBACK CONTROL ENGINEERING FOR ANALYZING AND DESIGNING AN EFFECTIVE LECTURING MODEL
Mahmoud Abdulwahed, Zoltan K. Nagy and Richard Blanchard

Control theory has seldom been used as an analytical tool in pedagogical research for modeling, analyzing or designing effective educational processes, despite its proven benefits in other social sciences, especially economics and finance. In this paper, we use the elements of open-loop and closed-loop feedback systems for evaluating two
modes of teaching and lecturing. The first is the open-loop lecturing mode, which still dominates in many European universities, whereas the second is the so-called closed-loop lecturing with feedback and reflection. We provide mathematical models for both modes and apply control engineering techniques and tools to analyze the properties of the two lecturing modes. It is shown that the learning and information retention dynamics differs considerably between the two modes. Furthermore, we show how the closed-loop lecturing mode supersedes the open-loop lecturing mode. The simulation results demonstrate that with lecturing improved higher educational performance requires continuous feedback and reflection.

TEACHING ABSTRACTION TO NOVICES: PATTERN-BASED AND ADT-BASED PROBLEM-SOLVING PROCESSES

Bruria Haberman and Orna Muller

Abstraction is taught to computer-science students as part of a comprehensive curriculum. The students encounter the concept of abstraction in various contexts while learning the different modules, each of which emphasizes some specific aspects of the concept. In this paper we present two instructional approaches, both related to utilizing abstraction in problem-solving processes: (1) pattern-oriented instruction (POI), and (2) abstract data type (ADT)-oriented instruction. We present these methods with respect to their employment in teaching problem solving to novices, and elaborate on abstraction processes.

WORK IN PROGRESS - COMPARING THE RESULTS OF REFLECTIVE THINKING INTERVENTIONS AT IIT AND UPPSALA UNIVERSITY

Margaret Huyck, Daniel Ferguson and Elizabeth Howard

A common problem in higher education is the question of whether or not students are obtaining the skills they need to solve problems in the real world. At the Illinois Institute of Technology (IIT), an attempt to address this problem has led to the concept of Reflective Judgment, defined by Patricia M. King and Karen Strohm Kitchener (1994) as the ability to make good decisions about ill-structured problems, or problems that do not have a single right answer. At IIT, a written measure of Reflective Thinking has been developed using questions included in Reflections assignments. At Uppsala University, a similar interest in the question of how students learn has led educators to experiment with the use of Reflections assignments in their courses as a means of stimulating deeper learning. Comparing IIT’s scoring of student Reflections for Reflective Thinking to Uppsala’s interest in ill-structured problem solving and use of Reflections as an enhancement of the student learning process, it is clear that while these two universities have in common the use of Reflections and the goal of helping students develop advanced problem solving skills, they are taking two fairly distinct approaches. What is not clear is whether one approach is more effective than the other approach at enhancing students’ problem solving skills.

ORGANIZING THE LEARNING RESOURCES RELATED TO THE SUBJECT INTRODUCTION TO ARTIFICIAL INTELLIGENCE THROUGH CONCEPT MAPS

Ana Arruarte, Urko Rueda and Jon A. Elorriaga

Concept Mapping is a technique that allows information visualization. A Concept Map is a graphical way of representing and organizing knowledge. It is comprised of nodes and links, arranged in some spatial distribution to reflect the domain information. Nodes represent concepts, and links represent the relationship between concepts; both concepts and links are labeled and may be categorized. Inside the educational area concept maps can be used for supporting learning, for assessing learning, and also for organizing and presenting information. Introduction to Artificial Intelligence is a compulsory subject studied at the first term of the Computer Science degree in the University of the Basque Country. In this work a study carried out by 6 voluntary students with the aim of organizing all the learning resources (theoretical contents, laboratories, exercises,...) related to that subject by means of a concept map is presented. CM-ED is the Concept Map EDitor used to fulfill this objective. Representing the variety of learning resources related to the subject in a visual format makes it easier their organization and their later visualization and searching.

INSTRUCTING NON-MAJORS PROGRAMMING: KNOWLEDGE ORGANIZATION BY ILLUSTRATION

Carolyn Pe Rosiene

A typical approach to teaching programming is to start with the syntax of the construct, followed by showing some code examples, and then discussions move to how you can create more complex statements using the construct being introduced. We suggest re-organizing the approach and to make the syntax discussion more effective, show
actual code within the integrated design environment, then move back to the standard syntax discussion at the end. The introduction to the topic can then be wrapped up with students writing a short section of code to reinforce the concept. This approach was implemented due to an overwhelming response from students who would like fewer lectures and more labs. A moderate change from the way we teach could hook the student in, make them grasp the material quicker, and get them interested in problem-solving activities. This is especially important for the non-major, whose real interest lies elsewhere. This paper documents a technique which demonstrates that illustrating the programming construct and syntax is best delivered through an example, by showing students actual code samples, actual runs, demonstrations, and tests, before the syntax of the construct is introduced. By introducing the student to a well-structured illustration, students formulate a clearer idea of how the construct is implemented and sustains the student's knowledge organization of the material. This is supported with empirical data that shows students understanding and grasp of the material.

Session F1D: First Year Courses 2
Chair: Lisa C. Benson, Clemson University
Time and place: Friday, October 24, 8:00 am. - 9:30 am. Broadway 3

WORK IN PROGRESS - A FIRST-YEAR INTRODUCTION-TO-ENGINEERING COURSE ON SOCIETY S ENGINEERING GRAND CHALLENGES
Samira Azarin, Nicola Ferrier, Stephen M. Kennedy, Daniel Klingenberg, Kristyn Masters, Katherine D. McMahon, Jeffrey Russell and Susan C. Hagness

A new cross-disciplinary first-year course, Introduction to Society's Engineering Grand Challenges, has been developed as part of a college-wide initiative at the University of Wisconsin-Madison to transform undergraduate engineering education for 2010 and beyond. The inspiration for developing this new course was the National Academy of Engineering's Engineering Grand Challenges project. By emphasizing humanitarian applications in an introductory engineering course, we expect to not only inspire future generations of engineers and show students how the skills they will be learning can have a positive impact on quality of life, but also encourage more women to pursue engineering degrees. The course consists of an introductory module followed by two theme-based modules of the student's choosing, selected from the following themes: Engineering challenges that impact our lives on a personal scale, Engineering for the developing world, Engineering the megacity, Global engineering challenges, and Engineering beyond Planet Earth. The team-taught course is being offered for the first time in the spring of 2008. This paper presents an overview of the course, the expected outcomes, and the preliminary results from a survey-based assessment tool.

ENHANCING LEARNING OF LOW PERFORMING STUDENTS IN MULTI-SECTION FIRST YEAR LECTURE/LABORATORY CLASSES: COMPLETION OF A THREE YEAR STUDY
Mark Urban-Lurain and Jon Sticklen

A common instructional model for first year engineering is the lecture/laboratory model. The most common implementation is lecture introducing material of a given unit followed by laboratory sections used to provide hands-on experience. An alternative implementation reverses the order. Students read assigned material, then attend laboratory sections, then at the end of the cycle attend lecture. Lecture is used to generalize from the specifics students have applied in lab, and to demonstrate common student mistakes. The pedagogically larger picture is that lecture as wrap-up requires students to take more responsibility for their own learning, and to be more actively engaged in their learning. In fall, 2004, and fall, 2005, we conducted preliminary studies to compare lecture before versus lecture after models; results seemed to be promising. In fall, 2006, and spring, 2007, we replicated the study before drawing conclusions. In the current report we display our final round of research, the results from it, and our summary for the three year study we have undertaken. Our final round of testing produced results that are not consistent with our earlier reported results. A call for others to replicate the study is made.

A MANIPULATIVE RICH APPROACH TO FIRST YEAR ELECTRICAL ENGINEERING EDUCATION
Matthew Shuman, Donald Heer and Terri S. Fiez

Instruction of innovative engineering design skills has been identified as an important goal for engineering educators. Some universities choose to delay the design content of their curriculum until the senior year, when the designers can utilize the engineering concepts learned in lectures. This delay is unnecessary as the skills needed for
innovative designs can be learned independently from the engineering theories being implemented. The first year curriculum at OSU introduces three design courses, each with a manipulative rich laboratory provided by the TekBots program and staffed by freshman mentors. The three initial TekBots courses explore core topics to our incoming students, which include computer architecture, analog circuits, and digital circuits. Further enhancements to the first year electrical engineering course include curriculum development, increased collaboration with other departments, and development of a high school outreach program.

**WORK IN PROGRESS - WHAT DO SELECTION CRITERIA TELL US ABOUT OUR STUDENTS?**

Elizabeth Godfrey and A. Jonathan R. Godfrey

Perceptions that the cohort entering the BE degree is not as well prepared under new national qualifications in engineering pre-requisite subjects such as Calculus and Physics, led to the introduction in 2007 of Diagnostic testing in several core courses. The results brought into question the level of student preparedness and reliability of current selection criteria. This paper reports on the preliminary investigation of the relationships and predictive ability of cognitive variables such as aggregated high school qualification scores; individual subject and module scores; and diagnostic test scores with university results. The initial results of this investigation support the existing criteria. It is suggested that a quantitative model using partition tree techniques, might guide the selection process, especially to assist in discrimination of those applicants near the borderlines of admission criteria.

**DEI-CHECK AUTOMATING THE ASSESSMENT PROCESS TO IMPROVE THE INFORMATIVE FEEDBACK**

David Diez, Paloma Diaz, Ignacio Aedo and Camino Fernandez

Acquiring and developing programming knowledge is a highly complex process. It involves a variety of cognitive activities and mental depictions. Hence, programming courses are generally regarded as difficult, and often have the highest dropout taxes. Such problem is especially significant in introductory programming courses: novice programmers need to apply the programming concepts continuously to understand them. Besides, beginner students often fail to recognize their own deficiencies and oversights. In this context, early assessment and continuous feedback are essential activities to correct mistakes and confusions. The purpose of this paper is to present our experience in teaching introductory programming courses as a case study. The course design is based on a specific assessment tool for introductory programming exercises. The tool aims at improving the assessment activity, facilitating its management and automating the communication flow in order to reduce the assessment process time-span. The final goal of our work is to increase feedback and improve the rectification of errors and misunderstandings from learners. The paper includes both the description of our assessment tool and the evaluation of its features.

**Session F1E: New Competencies for Global Engineers 2**

Chair: Marie C. Paretti, Virginia Polytechnic Institute and State University

Time and place: Friday, October 24, 8:00 am. - 9:30 am. Broadway 4

**EXPLORING THE GLOBAL AEROSPACE MARKETPLACE - A FIRST PROJECT IN INTERNATIONAL COMMUNICATION FOR NON-NATIVE ENGLISH SPEAKERS**

Alexander Friess, Carol Briam, Linda Thompson, Hemdeep Dulthummon and William Snyder

While cultural diversity in the Middle East is a natural condition, there is also a certain commonality in the habits, communication, and process skills of the students throughout the region. Inherent features of Middle Eastern mentality, such as the importance of loyalty and personal relationship, the primarily verbal form of communication, and the less stringent definition of time, often undermine interpersonal rapport, especially so in the context of the aerospace industry which is primarily driven by western communication criteria. A freshman project aimed at exposing the students to the communication skills required in the global aerospace industry is presented here. The project consists of surveying the initiatives of the commercial aerospace industry to address increasing global environmental concerns, and takes place at the Dubai Air Show. The students, who are all non-native English speakers and of diverse Middle Eastern origin, are organized in teams that explore different branches of the industry with regards to environmental policies and strategies, and thereby, in addition to technical knowledge, acquire skills such as teamwork, professional communication and presentation skills in a global environment. The project learning outcomes focus on the development of these critical process skills for non-native English speakers.
WORK IN PROGRESS - GRADUATE EXCHANGE PROGRAM IN MICROELECTRONICS SYSTEM ENGINEERING

Mihaela Radu, Ana Rusu, Frederick Berry and Mats Brorsson

In today’s world, where new technologies emerge and advance at a very fast pace every year, many professional societies are discussing moving to a Master level program as a first professional degree, anticipating graduates with advances skills for tomorrow’s demanding and advanced industry. In this context, the education at the master level is becoming more and more important. Another key issue in today’s world is the impact of globalization process (needs of multinational corporations). The engineering education must address the impact of global hiring. The graduates entering the global workplace must possess besides the essential technical skills, also cultural, social and communication skills, enabling them to work and interact in international environments, bringing creativity and innovative development in multi-cultural groups. In this context, exchange programs between different universities, located in different countries and continents are flourishing, the universities trying to integrate study-abroad components in their programs. This paper is presenting as a Work in Progress, the first steps related to an exchange program at the graduate level in the area of Microelectronics, between two prestigious universities located in USA (Rose Hulman Institute of Technology, Terre Haute, IN) and Sweden (Royal Institute of Technology, Stockholm). A Joint Degree or Dual Degree program at the Master Level is envisaged in the near future.

WORK IN PROGRESS - ACHIEVING THE ABET PROFESSIONAL SKILLS USING SOLIDARITY PROJECTS

Javier Alonso López, David López, Josep-Llorenç Cruz, Carlos Álvarez, Daniel Jimenez-González, Agustín Fernández and Fermín Sánchez

Traditionally, engineering studies have focused on preparing students technically and given little importance to social or ethical aspects, nor the ability to work in multi-disciplinary teams. Currently though, these skills are an added value and have been included in most prestigious centre’s curricula. As a result, they have become a subject of study for the education community and the focus of numerous papers. Correspondingly, the Barcelona School of Informatics has developed a hardly explored initiative in order to inculcate these values and help students acquire these skills. This initiative gets them involved in what we call solidarity projects, where both students and professors get administrative and subsidized support to create cooperative work that will provide a solution to specific problems on developing countries and poor local areas. These projects may be introduced in some courses and during Bachelor and Master Thesis and have contributed towards the professional skills development of both students and professors involved.

WORK IN PROGRESS - ATTAINING AND MEASURING GLOBAL COMPETENCY FOR ENGINEERING GRADUATES

James Widmann and Linda Vanasupa

Downey et al. laid out a clear path of learning criteria and outcomes for global competence in their 2006 Journal of Engineering Education publication. We build on their work by integrating other disciplinary perspectives to expand upon the questions: How can global competency be learned?, and How can we assess it? In this work-in-progress paper, we propose an expanded framework for global competence and identify the use of Fink’s taxonomy of significant learning as a tool to consider how it can be achieved through careful design of classroom learning experiences. Drawing heavily from other models, our framework attempts to articulate the knowledge, skills, attitudes and experiences necessary for engineering students to attain global competency. The effectiveness of Fink’s taxonomy of significant learning for the design of learning experiences that promote global competency is being tested through a unique international capstone design experience with a quasi-control group and a test group in which Fink’s taxonomy will be used to target specific growth toward global competency. The ideas presented are derived from the international business community, cross-cultural research studies and engineering education research results. Assessment techniques and are also discussed in this work in progress.

CONTEXTUAL PREPARATION OF FUTURE ENGINEERS: A NON-WESTERN PERSPECTIVE

Mazen O. Hasna and John Impagliazzo

The advent of technological communication and modern travel has increased the likelihood that graduates from engineering programs will work in environments containing integrated cultures, customs, and languages. One may question whether these graduates are ready to face challenges beyond the realm of engineering problem solving and mathematics. This work calls attention to the need for preparing students, particularly those from western societies, to
the ways and customs of non-western peoples. It seeks to lift the conscience of engineering educators to address this need in greater depth and to motivate engineering programs to integrate better the topics of cultural understanding within the engineering curriculum.

Session F1F: Disciplinary Introductory Courses 1

Chair: Deborah Kilgore, University of Washington
Time and place: Friday, October 24, 8:00 am. - 9:30 am.

A MULTIDISCIPLINARY APPROACH TO INTRODUCTORY ENGINEERING DESIGN
Peter J. Robbie, Ian Baker, William Lotko and John P. Collier

Bachelor of Engineering students at Dartmouth College are required to complete Engineering Sciences 21: Introduction to Engineering, an introductory course that teaches a systematic, broadly applicable methodology for creative problem solving. During the 46 years that the course has been offered, Dartmouth engineers consider ES21 to be a career-changing experience in their education. Consistent with Dartmouth's liberal arts DNA, the course centers around a multidisciplinary project experience that requires integrative thinking in solving problems and that forces students to work outside their knowledge base. Working in groups of 4-5, students conceive, design and fabricate original prototype devices that address the needs of their chosen users. This experience teaches students how to bring engineering methods to bear on the solution of a societal problem. Evaluating and appropriately acting upon ethical issues that influence the engineering process, and exercising effective communication skills through development of written and oral reports are also essential parts of the course. Each group is required to estimate the production costs of their solution and develop a basic business plan for producing and marketing their product.

WORK IN PROGRESS - ASSESSMENT OF PEER-LED TEAM LEARNING IN AN ENGINEERING COURSE FOR FRESHMEN
Michael C. Loui and Brett A. Robbins

ECE 110 is required for freshmen majoring in electrical engineering or computer engineering at Illinois. In ECE 110 in Fall 2007, we organized optional supervised study sessions to implement peer-led team learning workshops. Each session met for 90 minutes per week. In the sessions, students worked on difficult problems selected from examinations given in previous semesters. We obtained ACT-Math scores and implicit consent from 208 of the 297 students who started the course; 43 of these attended sessions regularly six or more of the eleven sessions. The regular attendees scored significantly higher on the final examination than did the other students, even though their ACT-Math scores were slightly lower. Among electrical and computer engineering majors, regular attendance did not appear to affect decisions to remain in electrical or computer engineering. Regular attendees reported that in the study sessions, they improved their understanding of the material, and they made new friends.

HANDS-ON PROJECTS TO INTRODUCE ELECTRICAL AND COMPUTER ENGINEERING
Frank J. Mercede

Microcontrollers are low-cost, dedicated computer chips that are found in a wide variety of consumer products and commercial applications. With the availability of low-cost development kits with easy-to-use programming interfaces, projects were developed to provide a hands-on introduction to the hardware interfacing and software development of microcontrollers for simple applications. The intended audience of the projects is first- or second-year students with little or no experience with microcontrollers, programming, or electronics. Students construct the electronic interfaces and drivers of basic I/O devices and program a simple 8-pin microcontroller in the C programming language to control the I/O of various projects. The projects involve sequencing of lights, synthesis of sound, motor speed control, and sensor interfacing. The projects have been successfully tested over the last two years in our one-credit Introduction to Electrical and Computer Engineering course, taken by all first-semester Electrical and Computer Engineering sophomores; and, more recently, they are serving as the laboratory-component of our freshmen year Engineering and Programming Applications course.
PROGRAMMING IN GROUPS: A PROGRESSION LEARNING SCHEME FROM THE INDIVIDUAL TO THE GROUP

Thais Castro, Hugo Fuks and Alberto Castro

The technical literature in cognitive science informs that working in groups reaps more benefits than working alone. We are seeing a variety of innovative group programming methodologies like the agile methods. This work examines the findings of a pilot study carried out during the first academic semester of 2007. The subjects were 110 freshmen computing and engineering students taking their first programming course at the Federal University of Amazonas. Based on these findings, it is proposed a programming progression learning scheme, from individual (current practice) to group programming (the desired practice based on the literature review). Such transition is necessary for students are not used to programming in groups. In order to evaluate such progression learning scheme a case study is outlined.

INTRODUCTION TO THE ME CURRICULUM THROUGH PRODUCT ENGINEERING CASE STUDIES

EL-Sayed Aziz and Constantin Chassapis

Product engineering, through reverse engineering and team projects, is an effective way to introduce freshmen of diverse backgrounds to Mechanical Engineering (ME) and provide them with a world introductory exposure to product design, manufacturing and systems operation. This paper discusses several components of the Engineering Experiences course developed at Stevens Institute of Technology (SIT), which aims to provide entering students with hands-on experiences and exposures to the world of operating mechanical systems. Students from a variety of engineering majors work in teams to dissect products, analyze their function by applying appropriate operating principles, design alternatives by building simplified physical models of a system, develop technical drawings, exchange drawings with different groups to manufacture their product, test and operate the product. Examples of products studied in the class include gear pumps, sewing machines, engines, electric drills, electrical screw drivers, toys, etc. The range of products on the selection list provides a great deal of insight and helps students enhance their understanding of what the discipline has to offer. Student feedback confirms that the course helps them develop a clear overview of the different fields within ME, gives them a general idea of what mechanical engineering work is about, and how the upcoming curricular elements as they relate to especially engineering science contribute to the development of expertise especially important to the product engineering.

Session F1G: Panel Session - NSF Panels: A Reviewer’s Perspective

Chair: Ingrid Russell, University of Hartford
Time and place: Friday, October 24, 8:00 am. - 9:30 am. Alabama

PANEL SESSION - NSF PANELS: A REVIEWER’S PERSPECTIVE

Ingrid Russell, Duane Bailey, Stephen Cooper and Barbara M. Moskal

Funding in general and NSF funding in particular are becoming more competitive. Proposals are often vying for limited funds. In this environment, competitive proposals must reflect careful attention to program guidelines. NSF program directors have consistently been active in promoting funding opportunities and in providing pointers for writing successful proposals. While this outreach is invaluable, experienced reviewer perspectives would be helpful to guide future proposal writers. This panel is intended to present such a perspective and provide insights from experienced reviewers. The panelists are PIs on NSF grants and have several years experience as NSF panel reviewers at DUE and CISE. They will present their experiences, and provide pointers from a reviewer perspective. In addition to being an experienced PI and reviewer, one of the panelists is currently serving as a program director at NSF. He will reflect on other panelists presentations, and present the perspective of a program director.
SHARED PROJECTS WITH A MULTI-SUB-DISCIPLINARY FLAVOR - PROVIDING INTEGRATION AND CONTEXT IN A NEW ECE SPIRAL CURRICULUM

Mohan Krishnan, Mark J. Paulik, Sandra Yost and Tom Stoltz

A new spiral curriculum in Electrical Engineering was launched in the ECE Department of the University of Detroit Mercy in Fall 2005. The prime motivation was to address several critical issues: the lack of student motivation, the need to introduce the teaching of innovation across the curriculum, and adoption of effective teaching pedagogies that ensured learning. A key aspect of the curricular changes was the formulation and use of shared projects that highlighted the interdependencies between the various sub-disciplines of Electrical Engineering, thus enhancing the contextual setting of the curriculum. This paper provides technical details for these shared projects and reflects on our experience in their use.

WORK IN PROGRESS - A FULLY ONLINE BACHELOR OF ELECTRICAL ENGINEERING DEGREE

Charles Westgate, Pao-lo Liu and Wendy Tang

With the support of the Sloan Foundation and the State University of New York Learning Environments, faculty from three public electrical engineering programs have developed and offered undergraduate courses in electrical engineering with a goal of a fully online undergraduate degree program. This will be the first such program in the nation. To date, nine required or core courses and seven elective courses have been developed out of a total of 20 upper division courses. Prospective students will be expected to have completed associates degrees through community colleges or equivalent programs before they can enroll. The online program includes both lecture and laboratory courses, and accreditation by ABET will be sought. Discussions are underway on articulation with community colleges who already offer a variety of online courses at the lower division level. Courses are offered through the Blackboard course management system and consist of lectures in several formats. A unique electronics laboratory course requires students to design and test circuits using their computers to acquire and analyze data. The initial enrollments have been promising, and student performances compare well with those of traditional full-time students. The demographics of student inquiries suggest a national demand for the program.

WORK IN PROGRESS - JUST-IN-TIME TEACHING AND HANDS-ON EXPERIMENTING EMBEDDED SYSTEMS FOR UNDERGRADUATES

Nicusor Birsan and Shekhar Sharad

A new approach is proposing for introducing embedded systems at undergraduate level: reading - experimenting - thinking - more reading. In our approach we respond to the "what" and "why" questions in a Just-in-Time Teaching (JiTT) manner, and show "how" things have to be done in practice by hands-on experimentation. This way, the students are involved in solving simple assignments shortly before lecture class. Responses to thought-provoking questions are used to organize the presentations regarding embedded systems and applications theory around student understanding. The ARM microcontroller based hands-on experiments enhance this understanding by making use of the LabVIEW Embedded Module for ARM Microcontrollers, a new tool from the evolving National Instruments’ Graphical System Design Platform. Involving a closer instructor-student relationship, with feedbacks in both directions, we are expecting that the approach will create a more stimulating environment for solving real-world problems - the main skill needed to be mastered by future engineers lasting their entire career.

SCAFFOLDING M-LEARNING APPROACH OF AUTOMOTIVE PRACTICE COURSES IN SENIOR VOCATIONAL HIGH SCHOOL

Hsiu-Yi Lin, Chun-Yu Chen and Wen-Chin Chen

In accordance with government policy, certain changes from new learning technologies would promote the economy and continuous progress. The technological and vocational engineering education must be modified and adjusted over time, especially the innovative learning activities design. Students who take automotive practice courses in vocational high school must apply principles about the automobile and use them practically. However, most of the students still cannot solve difficult problems and suffer frustration. Hence, this research uses the core
phases of scaffolding theory and knowledge management to build a mobile-learning model, applied in automotive practices courses. Students can learn and practice the automobile components and manipulations according to the scaffolding knowledge structure, accompanying with mobile instruments such as laptop and PDA. This paper expects students to study independently and handle any situation they encounter about the automotive service and repair.

**TEACHING EMBEDDED SYSTEMS WITH ACTIVE LEARNING: THE SMEAGOL APPROACH**
Elena Meshkova, Janne Riihijärvi and Petri Mähönen

We describe a novel laboratory and project course called SMEAGOL (Small, Embedded, Advanced and Generic Objects Laboratory) that we have developed at the RWTH Aachen University in Germany for 3rd and 4th year students. The aim of the course is to teach students not only programming and hardware design, but also basic teamwork and project management skills in the field of wireless sensor networks (WSNs) through active learning using mini- or full-blown project. The laboratory is split into two phases. First, in a more passive part students are introduced to the field of WSNs and familiarized with basic skills through carefully designed exercises. The second part requires independent work in a team. In this part limited design, research and organizational efforts are required from the students in order to complete a larger project. The content of the projects is not pre-fixed, and the students are strongly encouraged to innovate and develop their own ideas under the guidance and supervision of teaching assistants. As a consequence students typically become very motivated to finish the project and go into the trouble of doing substantial amount of extra work at home.

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Session F1J: Special Session  Does Size Matter? Small Programs Contribute as Many Graduates to the Engineering Workforce as Large Programs Do

Chair: Julie Ellis, University of Southern Maine

**SPECIAL SESSION  DOES SIZE MATTER? SMALL PROGRAMS CONTRIBUTE AS MANY GRADUATES TO THE ENGINEERING WORKFORCE AS LARGE PROGRAMS DO**

Julie Ellis

This special session focuses on the characteristics of small engineering schools: schools with fewer than 75 engineering faculty members. Based on the 2004 ASEE database, approximately 200 schools are in this category, about 60% of universities and colleges with engineering programs. Collectively these programs produced the same number of engineering graduates (14,000 or 25% of the total) as the 20 largest schools. Considering the collective impact of these programs, and their potential flexibility and nimbleness in implementing change, innovations at small engineering schools could have significant impact in transforming engineering education. Small schools must participate broadly in changing engineering education if all graduates are to be more like the Engineer of 2020. Small engineering schools need to collaborate in identifying their strengths and in overcoming impediments to change. This special session invites participants from small schools to share data, practices, and problems to increase awareness of the capabilities and challenges for innovative engineering education at smaller engineering schools.

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Session F2A: Active Learning 2

Chair: Eric Pappas, James Madison University

**AN INTERACTIVE TEACHING APPROACH BASED ON STUDENT-TEAMS**

Julio Gonzalez

This paper discusses the advantageous instructional experience of adding the student-team feature to the classical interactive teaching approach. The classical approach consists of three phases: 1) Presentation of an interesting engineering problem by the instructor, 2) Solution of the problem by students, resulting in the generation of a theoretical expectation usually represented graphically in the form of a sketch, and 3) Computer simulation of the problem with the aim of verifying the theoretical expectation. The approach presents a potential problem: students with less power of abstraction often get frustrated when they cannot generate a theoretical expectation, so they tend to skip phase 2), in an attempt to use computer simulation as a substitute for thinking. If the instructor allows this to happen, interactive teaching fails. To solve the above problem, I incorporated student-teams into the
interactive learning process. In each team, a student with strong power of abstraction operates as the leader. She or he leads the discussion to generate a theoretical expectation. The paper presents useful implementation details of this new instructional experience, as well as a measurement of the resulting learning improvement.

**INTERACTIVE LEARNING MODULES FOR INNOVATIVE PEDAGOGY IN CIRCUITS AND ELECTRONICS**

Jean-Claude Thomassian and Anoop Desai

Students, mainly non-electrical engineering majors, struggle in understanding the Principles of Electrical Engineering course. Some student struggle is probably due to 1) non-electrical engineering majors consider this course to be non essential, since it is not related to their majors, 2) have difficulty to picture how electric circuits work, and 3) lack of background in electrical engineering. To overcome these struggles, interactive learning modules are created. The revised studio format encourages students to learn by doing, not just listening, and to improve student understanding of difficult concepts. Initial experiences by both faculty and students have been positive.

**EFFECTS OF TYPES OF ACTIVE LEARNING ACTIVITY ON TWO JUNIOR-LEVEL COMPUTER ENGINEERING COURSES**

Saurabh Bagchi, Mark C. Johnson and Somali Chaterji

In several computer engineering and computer science courses, it has been observed that active learning activities (ALAs) aid the students in better understanding of the technical material. In this paper, we explore the influence of the type of the ALA and the academic quality of the student on the effectiveness of the technique. We perform the study in two junior level courses a course on discrete mathematics as applied to computer engineering topics and an ASIC (Application-Specific Integrated Circuit) design course. The first course has no laboratory component and teaches several abstract mathematical concepts. The latter course deals with the design of digital circuits using the VHDL hardware description language and has a laboratory component. We conduct ALAs of three kinds solving problems in-class with active participation of the students; homework problems which are worked on collaboratively by the students and with solutions provided later; and, practice examinations handed out before the actual examination which the students are encouraged to solve in groups. The effect on the students is measured through examination questions. Looking at the aggregate class performance, the ALAs through in-class questions and homeworks do not appear to have a significant effect, while the practice examination questions do. However, on segmenting the data, we observe that the A students benefited from the in-class ALAs while both A and B students benefited from the practice examinations. The worst performing students did not benefit significantly from any of the ALAs. This study leads us to investigate further the possibility of tailoring the ALA to the different learning styles and academic calibers of the students.

**CONTEXTUALIZATION OF PROGRAMMING LEARNING: A VIRTUAL ENVIRONMENT STUDY**

Micaela Esteves, Benjamim Fonseca, Leonel Morgado and Paulo Martins

In this paper, it is presented a study concerning about the use of the three-dimensional virtual world Second Life (SL) to visualize and contextualize the learning of computer programming. SL allows students to use avatars to create 3D objects and program their behaviours, process data, and interact with external servers, using Linden Scripting Language (LSL), a language with C-like syntax and a state machine. Scripts can execute concurrently, and several students can simultaneously work over the same object and/or script. Through action research, we explore and analyse the potential of SL for teaching-learning introductory computer programming in computer science undergraduate courses. We believe this virtual environment has potential to help students, since it presents an immediately visual feedback of the program execution.

**WORK IN PROGRESS - IMPACT OF GRAPHICAL PROGRAMMING ENVIRONMENTS ON LEARNING AND UNDERSTANDING PROGRAMMING CONCEPTS**

Gregory Bucks and William C. Oakes

There is widespread evidence to show that many first year engineering students have either a strong dislike for programming or an inability to write effective programs. This poses a problem, since many departments require their students to take some form of introductory programming as part of their first year in engineering. One possible reason why many engineering students have such difficulty with programming and the related concepts is that many engineers tend to fall heavily on the visual learner side of the Felder-Silverman Learning Styles Model. Since traditional, text-based programming languages, and the predominantly text-based way in which they are taught, do
not align with the learning styles of these students, their ability to understand and implement the necessary concepts in an actual program may be drastically reduced. This paper discusses a work in progress investigating the use of graphical programming languages as a means for introducing programming concepts and catering to the visual learning style of most engineering students.

Session F2B: Assessment 2

Chair: Carlos Vaz de Carvalho, ISEP
Time and place: Friday, October 24, 10:00 am. - 11:30 am.

EASSESSMENT OF OPEN QUESTIONS: AN EDUCATOR’S PERSPECTIVE
Victor Gonzalez-Barbone and Martín Llamas-Nistal

The use of language in free text answers provides an excellent means for assessment, but it is hard work to mark this type of material. The automatic assessment of open questions can be applied successfully to carefully written literal text explicit and literal text implicit questions, both categories very frequent in Engineering. Existing automatic marking systems exhibit results comparable to manual marking, but most of them fall short of educators’ expectations. Teachers like to keep control of marking, judge by themselves unusual answers, correct their own model answer on the fly. Hence, Computer Assisted Assessment (CAA) is preferred to fully automatic assessment. The inherent ambiguity of natural language and the difficulties of knowledge representation add to the constraints imposed by teachers’ requirements. However, there is still space for a system which is both useful and practicable. This paper reviews the types of questions apt for automatic marking and their usefulness in Engineering, examines some representative existing automatic marking systems, states requirements of teachers, reviews state of the art possibilities and puts forward some ideas for the design of a computer assisted open question marking system based on a controlled language for answer writing and knowledge representation comparison for assessment.

WORK IN PROGRESS - IMPROVING INTERRATER AGREEMENT USED TO MEASURE LEARNING OUTCOMES
Heleng Shi, Daniel M. Ferguson, Jonathan Beagley and Margaret H. Huyck

The Inter-professional Project Program (IPRO) at IIT hosts a one-day evaluation event (IPRO Day) every semester, during which 70-120 judges (~50% new each semester) judge 35-45 teams averaging 12 students each. The judges, in groups of three to five, rate ten criteria per team on a 1-5 scale for either group oral presentations or exhibits. While the statistics of measuring interrater agreement are well documented it is not completely clear from previous research how best to improve such agreement except for assertions that rater training is beneficial. Over the past two years, we have instituted several interventions to improve inter-rater agreement on IPRO Day: using experienced judges to coordinate each judging group, rewriting judging forms to match the learning objectives, developing rubrics to guide judging, and conducting orientation sessions with the judges. This study evaluates the effectiveness of these interventions by comparing judging group agreement results from semesters prior to the change with the semesters following the change. These results having broad applicability to all judging review panels.

AN EXPLORATORY FACTOR ANALYSIS OF THE PITTSBURGH FRESHMAN ENGINEERING ATTITUDES SURVEY
Jonathan Hilpert, Glenda Stump, Jenefer Husman and Wonsik Kim

The Pittsburgh Freshman Engineering Attitudes Survey (PFEAS) has become an important tool in engineering education for measuring students’ attitudes about engineering and their confidence in their abilities to achieve in the engineering classroom. Although different versions of the scale have been developed for students at different points in their educational careers, 28 of the items are equable across the various forms of the survey. The authors administered these items to a large sample (N = 372) of engineering majors at a large public university in the southwest. Item and factor analysis of the items revealed problems with the structural validity of the scale, and items and factors were removed based on theoretical and empirical justification. The remaining items produced a structurally valid three factor solution. The authors found these factors were significantly correlated with student study strategies.
DESIGN AND DATA ANALYSIS OF EXERCISES WITH HINTS
Pedro J. Muñoz Merino, Carlos Delgado Kloos, Mario Muñoz-Organero and Jesús Fernández Naranjo

The provision of hints during exercise sessions has a positive impact in the learning outcome. Based on it, we defined a specification for the provision of hints in problem based learning and we created a hint player as an extension to the XTutor Intelligent Tutoring System. We have introduced this tool in two university courses (Communication Software and Information Servers). This work shows a specific methodology of how to apply our approach in the classroom for both courses, in an easy way for teachers, from the design to the subsequent data analysis of exercises with hints. Regarding the design of exercises with hints we show how to create them directly in XML based on our specification, and we also present a new authoring tool which we have created that is easy to use by teachers without high technological knowledge. With respect to the subsequent data analysis, we explain an initial evaluation model of the concepts explained, the students' level and the exercises based on the information of the hint system. In addition, some correlation results regarding the use of the system and the students' grades is presented.

ANALYZING LARGE FREE-RESPONSE QUALITATIVE DATA SETS - A NOVEL QUANTITATIVE-QUALITATIVE HYBRID APPROACH
Jennifer Light and Ken Yaushara

Qualitative analysis tends to be unwieldy for large data sets yet is an indispensable tool for understanding how and why phenomena occur. Consequently, the goal of this study was to develop a method that is credible yet economical for large, specific, qualitative data sets. The strength of our hybrid, qualitative-quantitative method comes from using automated text analysis techniques to focus resource-intensive coding efforts on a small, carefully selected subset of data. This paper details the hybrid method as applied to a previously analyzed set of free-response data and argues for the method's validity by comparing results from the hybrid analysis with the previous traditional qualitatively analyzed method. With this data set, the hybrid method yielded comparable results with substantially less manual coding and in less than a third of the time required for the original analysis method. This hybrid analysis provides a more economical alternative for a coarse-cut qualitative analysis and observation of long-term trends, providing insight to practitioners, assessors, and researchers ranging from individual course evaluations to large-scale studies. Short, focused, open-ended survey questions are good candidates for this type of analysis.

Session F2C: Reading, Writing, and Communication Skills Development
Chair: Carolyn Pe Rosiene, University of Hartford
Time and place: Friday, October 24, 10:00 am. - 11:30 am. Broadway 2

"ACTIVE LISTENING" IN WRITTEN ONLINE COMMUNICATION - A CASE STUDY IN A COURSE ON "SOFT SKILLS FOR COMPUTER SCIENTISTS"
Christine Bauer and Kathrin Figl

"Active listening" is a well-known ingredient in contexts that involve gathering information and solving problems. Demanding both verbal and nonverbal skills, this way of communication improves mutual understanding by using techniques like paraphrasing. The benefits are manifold and crucial for computer scientists. For instance, it avoids misunderstandings, as people verify they do really understand. Our study investigates active listening in an online educational setting using written communication, which is a novel asset. We explore whether active listening is effective in written online communication and examine this medium’s capacity to fully exploit this concept’s benefits. The study was conducted in a technology-enhanced course on "Soft Skills for Computer Scientists". Interestingly, analysis reveals that active listening techniques do have positive effects on communication in the analyzed setting of online communication. Furthermore, it appears that instant messaging tools facilitate to let the other completely verbalize his or her thought before responding.

WORK IN PROGRESS - MEASURING READING COMPREHENSION IN TECHNICAL COURSES
Ananda Gunawardena

Reading is critical to any course. However, many courses in higher education (especially technical courses) do not emphasize reading as a significant part of the course. Despite recommendations from instructors with suggested sections to read before and after lecture, most students do not like to read or are less motivated to read material from textbooks. In this paper, we discuss a novel system that was developed and deployed to assist instructors...
automatically measure reading activities and to assess student degree of reading comprehension compared to that of an expert(s). The system consists of Adaptive Book, an interactive software tool that allows students to annotate and label the text, and an online markup analysis tool that uses a heuristic rule based algorithm to compare student markups to that of an expert reader. The system has shown some early promising results in Computer Science pilots and may serve as a tool that can be deployed across many technical courses to encourage and assess reading.

HELPING STUDENTS (AND ULTIMATELY FACULTY) WRITE AN EFFECTIVE RECOMMENDATION LETTER

Mary R. Anderson-Rowland and Julie E. Sharp

Both undergraduate and graduate students need recommendation letters to help them reach various educational and career objectives. Professors sometimes have difficulty getting sufficient information from students to make each letter unique and persuasive. Students often have trouble writing specific details to substantiate their claims. Without this information, writing a recommendation letter can place unnecessary time demands on the professor. This pilot project is designed to help students provide sufficient specifics for an excellent letter of recommendation and to improve writing skills. The authors have devised a checklist to help students write a recommendation letter. The checklist can also serve as a useful career planning tool, establishing a framework on which to build and a guideline for analyzing the gap between school and work. The authors also suggest a handout to generate the first draft. Using the checklist can empower any student to develop an effective letter of recommendation.

WORK IN PROGRESS - PEER REVIEW FROM A STUDENT PERSPECTIVE

Teresa Larkin and Dan Budny

Writing can be a unique way for students to learn topics in physics and engineering. A unique writing activity for students in a second-level physics course at American University and a freshman engineering course at the University of Pittsburgh involves having students prepare a formal research paper for presentation at a student conference. The activity began with submission of an abstract followed by the preparation of a draft paper which went through a formal peer review process. Following the peer review, students prepared a final paper which was then presented at a formal conference held at the end of the semester. In this paper we look at the peer review process and its value as a learning tool in physics and engineering. The current paper will focus specifically on students perception of the peer review process. To this end, a discussion of survey data collected from both past and present students will be shared.

INNOVATION IN LINKING AND THINKING: CRITICAL THINKING AND WRITING SKILLS OF FIRST-YEAR ENGINEERING STUDENTS IN A LEARNING COMMUNITY

Rebecca L. Damron and Karen A. High

For the engineering educator, implementing and integrating professional, institutional, and pedagogical goals into a course is complex and becomes more so when working with first-year students. These students are not always comfortable with problem-posing situations, and as tasks increase in complexity, so does the difficulty in thinking and writing. The question then arises as to how to help students become more comfortable with problem-posing as they write and think in a new academic community. This paper reports on a study integrating learning communities with problem-posing by using a model of critical thinking to structure writing assignments that require students to report about in-class, team-based activities applied to engineering concepts. The effectiveness of this approach was measured by assessing writing and critical thinking skills and surveying engineering and writing attitudes. Students in three sections of an Introduction to Engineering course were paired in two sections of English composition, and one section was not paired. The study also included several students in a female only composition class (total n=68). Results of the study show that mean scores of paired students were generally higher in both writing and critical thinking and significantly higher on one subscore of critical thinking. Paired course students also showed significant positive changes in viewing themselves as writers.
INTRODUCING DATA MINING TECHNIQUES AND SOFTWARE ENGINEERING TO HIGH SCHOOL SCIENCE STUDENTS
Bartley D. Richardson, Karen C. Davis and Michelle Daniel Beach

This paper describes the activities of a Computer Science doctoral student and a Secondary Education masters student in the design, development, and implementation of a lesson for a high school science class. The graduate students, called Fellows, worked in secondary classrooms in the Cincinnati Public School District as a part of Project STEP at the University of Cincinnati, which is funded by the National Science Foundation GK-12 Program. The Fellows formed partnerships with secondary math and science teachers to generate new lessons, activities, and resources to enhance the STEM skills of high school students. Additionally, the Fellows used their engineering expertise to bring authentic, inquiry-based learning experiences into the classroom and introduced engineering concepts to underserved student populations. This paper highlights a lesson that integrates data mining and software engineering into a physical science lesson that focuses on the periodic table. Included in the paper are techniques used by the Fellows, reactions and feedback from the students, and observations and reflections by the Fellows regarding aspects of the activity that had the most impact on student learning.

WORK IN PROGRESS - MATH INFUSION IN A MIDDLE SCHOOL ENGINEERING/TECHNOLOGY CLASS
David Burghardt and Michael Hacker

Engineering design projects can provide a rich opportunity to enhance middle school student knowledge in core disciplinary subject areas, such as mathematics and science and forms an important aspect of the NSF-supported Mathematics, Science, Technology Education Partnership (MSTP) project [1]. A key goal of the project has been to develop a model for infusing mathematics into science and technology at the middle school level. The informed design process was created as part of a NSF materials development program and formed the engineering design framework for this study. Structured mathematics activities (knowledge and skill builders - KSBs) were developed that linked to the design challenge. As a result of these hands-on activities, students apply the mathematical reasoning developed in order to solve an engineering problem; the design of a bedroom. A pilot research study, involved implementation of a math-infused bedroom design lesson. A paired t-test indicated the difference was statistically significant t (128) = 2.828, p<.005, providing evidence that students were showing gains on their math content knowledge.

A NOVEL PARTNERSHIP OF A SCHOOL AND A UNIVERSITY: USING THE WORK OF UNIVERSITY STUDENTS TO ENHANCE SCIENCE TEACHING AND TO FOSTER INTEREST TO TECHNOLOGY IN K-12 SCHOOLS
Petri Mähön, Elena Meshkova and Janne Riihijärvi

We report on a novel partnership program with elementary schools aiming to enhance science teaching using wireless sensor network (WSN) technologies while at the same time enriching the university students' curriculum in Electrical Engineering. The program is designed to provide simulated real-life experience on WSN product design. In collaboration with school teachers we have decided to apply WSNs, tiny measurement devices connected wirelessly to Internet, to create new kinds of demonstration and laboratory equipment to make the teaching more interesting. The design work is primarily done by third and fourth year university students as part of their project and laboratory course work. One of the key paradigms in this project is to work, in part, with customer-supplier model. The schools with their teachers and pupils are customers, and the university students produce sort of products for them with the agreed specifications and time-lines. The additional aim of the program is to make pupils interested in engineering education, and also to provide them a glimpse of new kinds of embedded and wireless communications technologies. We report here the early experiences and encouraging results from this program that is trying to combine K-12 science outreach program with the university curriculum development.
WORK IN PROGRESS - ATTRACTING K-12 STUDENTS TO STUDY COMPUTING
Bruce R. Maxim and Bruce S. Elenbogen

There is general agreement that the need for computing professionals in the near term will continue to increase, while enrollment in computer science degree programs is decreasing. We hope to meet this need by attracting pre-college students to study computer science and information technology at the collegiate level through participation in summer camps and weekend events focused on different aspects of computing technology. The authors offered three game development camps and several one-day events (computing workshops and competitions). Participants were self selected pre-college students who experienced many aspects of the software development life cycle and used software tools to create original multimedia products. Participants completed an established attitude scale before and after the events to assess the impact of the project activities on multiple components of their attitudes and their future plans to take information technology courses. Initial data analysis indicates significant positive attitude changes toward the study of computing and technology.

UNIVERSITY OF MAINE GK-12 SENSORS! PROGRAM BENEFITS A LOCAL COMMUNITY
Stacy Doore, Margaret Chernosky, Eeva Hedefine, Jim Smith, Joseph Arsenault, Stephen Godsoe, Constance Holden and John Vetelino

Since 2003, University of Maine (UM) GK-12 Sensors! Fellows and Bangor High School (BHS) teachers and students have been addressing community issues for various agencies and organizations in the City of Bangor, Maine. Through GK-12 involvement, a community need was identified by teachers, students and emergency service agencies for comprehensive maps of city resources and hazardous material sites to be used in emergency and disaster response planning. GK-12 Sensors! participants in partnership with Bangor Police and Fire Departments, Bangor Emergency Response Unit and Bangor International Airport, built a geographic information system (GIS) for emergency service providers and produced planning maps. These maps contained locations of all emergency shelters, hospitals, police and fire stations, as well as all known hazardous materials sites within city limits. Other identified community-needs projects included spatial analysis of the incidence of OUI arrests. These activities led to the development of a GIS course at BHS in 2006, one of only a few GIS courses in the U.S. aimed specifically at high school students. Since that time, GK-12 Fellows have assisted students and teachers in other projects based on identified community needs such as spatial analysis of the incidence of teen driving accidents in Bangor and detection of spatial patterns of burglaries for the Bangor Police Department. Currently, students are involved in projects to document burial patterns of a 19th century Irish cemetery using Ground Penetrating Radar and creating walking tour maps of historic ethnic neighborhoods for the Bangor Museum and Center for History and the Bangor Daily News. These highly visible partnerships and resultant products, which raise community and parental awareness of GK-12 Sensors! activities at BHS, may serve to increase interest and support of STEM career pursuits for students.

Session F2E: Degree Programs and Curricula 2
Chair: I. K. Dabipi, University of Maryland Eastern Shore
Time and place: Friday, October 24, 10:00 am. - 11:30 am. Broadway 4

INDUSTRY ORIENTED TEACHING AND LEARNING STRATEGIES APPLIED TO THE COURSE WITHIN TRADITIONAL ENGINEERING TECHNOLOGY UNDERGRADUATE PROGRAM
Tom Ziming Qi

With traditional technical teaching methodologies in educational environments, the conventional pathway is to build the foundation learning through subject based teaching of maths, physics and science independently. Subjects based on the relative topics required for the discipline usually follow on from this. The problem with this traditional methodology of learning is that there is no close relationship with industry requirements. Students may well graduate with no industrial oriented learning experience prior to their first job. Previous researches by author and his colleague were to explore a new teaching methodology — an industry oriented the teaching and learning in an undergraduate degree in New Zealand. All foundation skills can be achieved within technical courses studies and the students are well prepared to develop further knowledge and skills required for their industry project required in their final year through cooperative education with industry. This paper is to introduce the Industry Oriented Teaching and Learning methodology into a traditional engineering technology undergraduate degree. As an example, a course with this new
methodology had been designed and delivered in a joint program within Shanghai Normal University (China) and Dayton University (USA) since 2006.

WORK IN PROGRESS - A CASE STUDY OF TRANSFORMATION IN HIGHER EDUCATION
Young B. Moon and Alfonso Duran

Universities in Spain have launched one of the most ambitious and significant changes in their history through the adoption of the so-called Bologna Process. The European Higher Education Area (EHEA) to be established by this effort aims at promoting mobility and internationally comparable degree programs within European Union (EU). This paper presents an implementation experience at Carlos III University, with a focus on their Engineering School. The objectives of this study are two-fold: (i) to share the implementation experience so that other Spanish universities may be able to adopt any success factors from the case study, and (ii) to inform other higher educational institutes around the world about significant changes taking place in their counterparts in Spain. In addition, a data collection system is being developed so that the effectiveness of the new system can objectively be measured and analyzed. Experiences with EC2000 changes initiated by Accreditation Board for Engineering and Technology (ABET) in USA will also be compared with the Spanish experience.

PROJECT BASED LEARNING AS A CATALYST FOR ACADEMIC EVOLUTION AND AS AN INCUBATOR FOR ACADEMIC INNOVATION
Daniel Walsh, Robert Crockett and Zahed Sheikholeslami

As engineering education at the undergraduate level continues to evolve, the support structure required for educational approaches such as Project-Based Learning (PBL) is expanding to include not only the Department, College, and University levels, but also significant commitments from industrial partners. While the benefits of project based learning approaches are clear, there are a number of challenges in establishing and maintaining the deep level of institutional and industrial interaction required to create a successful program. This paper discusses several approaches adopted by the Project Based Learning Institute (PBLI) in developing project-centered relationships with external organizations. PBLI serves as an academic incubator that has been used to overcome institutional inertia by creating a structure that lies outside existing well-established territories. It discusses the self-supporting nature of the approach, which allows resource issues which typically shackle initiatives to be obviated. It describes how the program has developed into a catalyst for industry participation that benefits both students and corporate sponsors. It describes the how the juxtaposition of high-potential faculty, coupled with incentives for multi-disciplinary faculty collaboration, enriches the educational experience for students. The outcome is underpinned by vehicles that couple industry interests to university resources. This system, which hinges on an effective mechanism to uncover and respond to industry needs, creates an environment capable of educating an engineering graduate who is steeped in multidisciplinarity, who is exceptionally team-oriented and who is more able to function in today's complex environment.

SIX SIGMA QUALITY IMPROVEMENT METHODS FOR CREATING AND REVISING COMPUTER SCIENCE DEGREE PROGRAMS AND CURRICULA
Jaruek Chookittikul and Wajee Chookittikul

The first Bachelor of Science in computer science program was offered by our department 25 years ago. Today, as a School of Information Technology, we offer six computer science undergraduate degree programs, two graduate degree programs, and one doctoral degree program. In this paper, we report how our existing undergraduate degree programs have been revised using the Six Sigma DMAIC methodology to guarantee the continuous quality improvement of the programs and the quality of the graduates. We report on how two new unique undergraduate degree programs (B.Sc. in Computer and Cyber Security and B.Sc. in Office Computer Technology) were created by applying the DFSS Six Sigma concept. This not only guarantees the quality of the program and our graduates, but also ensures that we can meet the future demands of employers. We also report DFSS results on our two unique graduate programs: the M.Sc. in Computer Education Technology, a multi-disciplinary program combining computing, learning psychology, education, computer business, and ethics, and the M.Sc. in Information Technology Strategy which has derived from a combination of information technology, management, ethics, and strategies. Our doctoral program called Quality Information Technology, opened in 2005, is also briefly reported as our newest curriculum resulting from our Six Sigma-based research and development project.
A NEW INTERLEAVED BACHELOR OF ELECTRICAL ENGINEERING PROGRAM
Neil Cox and Glenn Pellegrin

This paper describes a new four-year Bachelor of Electrical Engineering program being introduced in British Columbia (BC), Canada at the BC Institute of Technology (BCIT). The program addresses the need in industry for engineering graduates that have a solid practical focus as well as the expected theoretical depth and topical breadth of knowledge. The program works in tandem with a nationally accredited two-year Diploma of Electrical and Computer Engineering Technology. The program structure allows both the existing Diploma program and the Degree program to be optimized based on their respective priorities and market needs, i.e., there is no need to impose major changes on the Diploma program in order to accommodate the Degree program. The result is a pair of programs that allow students to graduate with either a diploma or a degree, and also to return after receiving their diploma to complete their degree later. This structure provides, in effect, a two-stage entrance evaluation process which allows the program to draw from a broader pool of prospective engineers, thereby providing a path to the profession to people that may otherwise have missed the opportunity. The program’s curriculum uses a contextual or spiral approach, where applications are introduced prior to theory, and then revisited once the theory is developed. While the program described here is designed to help address the shortage of electrical engineers in Canada, similar conditions prevail in the United States and elsewhere, and similar programs may be useful in addressing these shortages.

Session F2F: Distance Learning 3
Chair: Ismail Fidan, Tennessee Tech University
Time and place: Friday, October 24, 10:00 am. - 11:30 am. Travers

PROVIDING INSTRUCTIONAL LAYERS OF ABSTRACTION IN AUTHORING TOOLS FOR ENGINEERING EDUCATION CONTENT
Miguel Rodríguez-Artacho and Javier Velasco García

In the context of the authoring process of educational material in e-learning, the notion of learning specification has been considered the fundamental step for the development of an e-learning industry, based on reusability and interoperability of interchangeable components. However, when considering authoring based on instructional and pedagogical aspects, it is necessary to avoid being driven by LT specifications, and better rely on an abstract reference model based on instructional semantics. This paper proposes this instructional layer stack to provide independence from content specification in the authoring process and develop an authoring tool based on it with exporting capabilities to IMS specifications.

WORK IN PROGRESS - INITIATIVE FOR THE USE OF LEARNING OBJECTS IN THE ELECTRONICS LABS PRACTICE
Francisco García-Sevilla, Pedro Carrion, Miguel Latorre, Eugenio Lopez, Elio Sancristobal, Gabriel Diaz, Catalina Martinez-Mediano, Juan Peire and Manuel Castro

In this paper we describe how to use a learning object repository in order to store large multimedia files that can be queried by students while they are at home preparing their digital electronic circuits and later at laboratory when they must mount and check them. The system is currently being tested under the pilot project carried out in Electronics Engineering courses. These courses are conducted in the Polytechnic High School at University of Castilla-La Mancha (Spain) with students that attend Digital Electronics subject classes taken during the fourth semester of Bachelor’s degree.

USING DATA MINING TO DISCOVER THE CORRELATION BETWEEN WEB LEARNING PORTFOLIOS AND ACHIEVEMENTS
Chien-Ming Chen, Cheng-Hao Ma, Bin-Shyan Jong, Yen-Teh Hsia and Tsong-Wuu Lin

Internet learning is different from traditional classroom teaching. This is because there is no actual contact between teachers and students; therefore, it is difficult for teachers to keep track of students’ learning conditions. By analyzing the learning portfolios of students studying through online learning, teachers can observe their learning activities. This study conducted a cluster analysis on each attribute of students’ learning portfolios. By observing the activities of individuals in each cluster and investigating their activities at every stage, the behavioral styles were determined and the appropriate warning messages were sent to students in certain clusters. The learning portfolio
analysis system proposed in this study provides statistical and data mining techniques, focusing on students assignment grades, test results, and records of online learning portfolios, for explorative analysis. It also provides a remedial mechanism for teachers to send out adaptive warning messages according to students learning portfolios. The evaluation in this study demonstrates that the sent warning messages can affect students learning behaviors and achievements.

**CONCEPTUAL GRAPH BASED LEARNING MATERIAL PRODUCING STRATEGY FOR COOPERATIVE LEARNING**

Te-Yi Chan, Rou-Mei Wang, Bin-Shyan Jong, Yen-Teh Hsia and Tsong-Wuu Lin

In this study, the teacher decided on the structure of the conceptual graph before the course began. The architecture of the conceptual graph followed the course plan. The diagnosed conceptual graphs of cooperative learning group members in each learning phase were used to produce learning materials for group discussion. Since the learning materials were produced from group members analyzed conceptual graphs (knowledge structure), each group received the most appropriate learning materials, and thus, were able to increase their learning efficiency. This study performed a four month evaluation from October 2007 to January 2008 to prove the effects of the proposed learning material production strategy on the curriculum of system programming an important part of computer engineering. The evaluation results indicate that the proposed strategy can help group learners to learn more efficiently.

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**Session F2G: Panel Session - Preparing the Engineers of 2020 - Emerging Evidence from Six Exemplary Colleges and Universities**

Chair: Patrick T. Terenzini, The Pennsylvania State University

*Time and place: Friday, October 24, 10:00 am. - 11:30 am.*

**PANEL SESSION - PREPARING THE ENGINEERS OF 2020 - EMERGING EVIDENCE FROM SIX EXEMPLARY COLLEGES AND UNIVERSITIES**

Patrick T. Terenzini, Lisa R. Lattuca, Gul E. O. Kremer, Carolyn Plumb and Lois C. Trautvetter

This session will present preliminary findings from Prototyping the Engineer of 2020: A 360-degree Study of Effective Education (P360), funded by the National Science Foundation. The study is designed to provide empirically based guidance for engineering programs seeking to recruit and retain diverse students and to prepare all new engineers for work in a changing global economy. Researchers identified six institutions that are, in different ways, already producing engineers with some of the attributes of the Engineer of 2020: Arizona State University, Harvey Mudd College, Howard University, MIT, the University of Michigan, and Virginia Tech. Brief presentations will identify educational and institutional practices and policies that appear to be especially effective in producing engineers with superior design, interdisciplinary, and contextual knowledge and skills. Presenters will also discuss linkages between effective curricula, instruction, and student experiences (inside and outside the classroom) and supportive institutional cultures, practices, and policies.

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**Session F2H: Improving Access and Retention in Engineering Programs**

Chair: Jack G. Mottley, University of Rochester

*Time and place: Friday, October 24, 10:00 am. - 11:30 am.*

**WORK IN PROGRESS - IMPLEMENTING A FRESHMAN MENTOR PROGRAM**

Matthew Shuman, Jace Albert Akerlund, Donald Heer and Terri Fiez

Creating positive learning communities that engage incoming engineering students with varying degrees of engineering experience poses a challenge to universities with high numbers of enrolled students. Many schools have a general university-wide orientation program for every student. Other universities address only a distinct subset of students in their mentorship programs. Neither solution provides individual technical mentorship to the entire incoming class. In September 2006 a solution was started at OSU which was to implement a mentor program for the entire freshman class. Evaluation tools for the freshman mentor program consist of student retention rate records, a freshman mentor database, and a survey to track growth in our mentoring effectiveness within the student body.

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Future goals of the program will include: increasing student involvement with academic clubs, implementing novel structures to increase retention.

**MASTERING CIRCUIT ANALYSIS: AN INNOVATIVE APPROACH TO A FOUNDATIONAL SEQUENCE**  
William J. Leonard, C. V. Hollot and William J. Gerace

The Department of Electrical and Computer Engineering at the University of Massachusetts Amherst has dramatically changed how Circuit Analysis is learned. Combining a traditional lecture/recitation format with secure, online tests, we have raised our expectations for students and improved student performance, while increasing the fraction of students who succeed, especially underrepresented minorities and women. We call the instructional approach Mastery, because students continue to work on a topic until they earn a perfect score on the corresponding test. Further, it shows great promise for transforming undergraduate education, especially those courses that provide foundational skills and prepare students for future learning. The approach could have a positive impact on the retention rates of all students and even greater impact on those for underrepresented groups. In this paper, we describe the Mastery approach and its implementation over the past two years. We also show the current state of passing and completion rates as compared to those rates before Mastery was introduced. Finally, we discuss a range of issues, including the appropriateness of the Mastery approach for other courses.

**WORK IN PROGRESS - STUDENTS' PERCEPTIONS AND INTERACTIONS WITH VIRTUAL DISSECTION**  
Katie Grantham Lough, Deborah Moore-Russo and Kemper Lewis

This paper will report on the preliminary findings from two universities who, as a part of a NSF-funded nine university collaborative, have implemented virtual dissections through the use of design repositories. Data for the work-in-progress paper was collected via instructor interviews, focus group interviews and student surveys from over 200 students enrolled in sophomore engineering courses at two universities. In the courses students were part of product design teams that took a product, disassembled it, investigated various design and manufacturing issues associated with the products, and then reassembled the product—standard reverse engineering learning activities. However, each project was centered around a national product dissection project and utilized state-of-the-art digital design and dissection tools. Groups used product repositories to upload/download digital models of their products and components, along with communication modules. Training for the use of the design repository was provided in class. While this paper will supply information on how other instructors can access some of these cyber-tools and how these tools greatly reduce the cost of product dissection, the main focus of this work-in-progress paper will be to report on how students have interacted with the virtual dissection materials. Among the findings to be reported will be the students' perceptions as to the advantages and disadvantages of virtual, as opposed to real-life, dissections and collaborations. The work-in-progress paper will also report on both instructors' and students' suggestions on how cyber-tools and related technologies can support the reverse engineering process and enhance its impact in product design.

**WORK IN PROGRESS - USING A MOBILE ROBOTS LABORATORY TO TEACH ADVANCED COMPUTING CONCEPTS**  
Zack Butler, Minseok Kwon and Rajendra K. Raj

It is widely believed that one reason that the current generation of college students are not majoring in computing because such majors are viewed as uninteresting and not relevant. This WIP paper describes a curricular proof-of-concept project that attempts to integrate diverse computing concepts to increase and retain student interest in computing. We are developing a flexible mobile robots laboratory, not to teach introductory computing concepts but instead to teach intermediate and advanced computing topics such as networking, database management and distributed security. The essence of our approach is twofold: to provide exciting and physically-grounded projects in required intermediate-level courses, and to integrate the teaching of advanced computing topics into single courses, for example, networking with database management, and not merely defer such topics to capstone courses or projects. Such an approach is likely to pique and retain the interest of computing students. We briefly describe our curricular approach and its current status in this paper.
APPROACHING INCLUSIVE UNIVERSAL ACCESS ON THE COMPUTER SCIENCE CURRICULUM LEVEL
Sonja Kabicher, Michael Derntl and Renate Motschnig

In previous work, we extended the concept of Universal Access in the context of technology-enhanced learning in engineering education by including essential non-technological aspects resulting in a concept we call Inclusive Universal Access (IA). IA denotes a paradigm that is aimed at fully involving students in learning and assessment, at addressing them on all levels of learning including intellect, skills, and personality, and at employing universally accessible tools to support educational activities. In this paper, we present the Active Curriculum for Computer Science project to illustrate the systematic inclusion of multiple dimensions of IA on a curriculum level, in particular the consideration of all levels of learning, learner-centered learning goals, inclusion of stakeholders and students in curriculum development, assessment, e-learning and specifying various kinds of dependencies among courses and modules within the curriculum. Through this work we aim to make the curriculum more learner-centered, or in other words, one that dynamically meets current challenges of industry, science and society.

Session F2J: Special Session - Linking Research Findings on Engineering Student Learning and Engineering Teaching: Implications for Engineering Education

Chair: Cynthia Atman, University of Washington
Time and place: Friday, October 24, 10:00 am. - 11:30 am.

SPECIAL SESSION - LINKING RESEARCH FINDINGS ON ENGINEERING STUDENT LEARNING AND ENGINEERING TEACHING: IMPLICATIONS FOR ENGINEERING EDUCATION
Cynthia Atman, Lorraine Fleming, Deborah Kilgore, Ron Miller, Sheri Sheppard, Karl Smith, Reed Stevens, Ruth Streveler and Jennifer Turns

The goal of this special interactive session is to engage attendees in (1) knitting the results of two linked studies (of engineering undergraduates and engineering faculty) into the larger body of engineering education scholarship and (2) developing ways of thinking about these findings that can be used to inform engineering education program planning and classroom practice. The findings are from an extensive set of data collected over multiple years by the Academic Pathways Study (APS) and Studies of Engineering Educator Decisions (SEED), both of which are part of the NSF-funded Center for the Advancement of Engineering Education (CAEE). These data sets present a unique opportunity to examine the intersections between research on engineering learning from the student perspective and research on engineering teaching from the faculty perspective.

Session F3A: Industry Partnerships in Education

Chair: Alfonso Durán Heras, Universidad Carlos III de Madrid
Time and place: Friday, October 24, 1:30 pm. - 3:00 pm.

COOPERATIVE EDUCATION: AN EXPLORATORY STUDY OF ITS IMPACT ON COMPUTING STUDENTS AND PARTICIPATING EMPLOYERS
Paul Golding, Sophia McNamarah, Heather White and Stanford Graham

The University of Technology, (UTech) Jamaica recently implemented an exploratory cooperative education program in its computing curricula where students work part-time for five days per week and attend classes fulltime in the evenings. This paper uses a case study methodology based on semi-structured interviews with both students and employees to determine the impact of this cooperative education model. This paper explores factors found in the literature that internship has an impact on, including GPA, time management, team work, problem solving and communication skills. From the company's perspective factors examined were, students overall attitude, skills level and the impact of the program. The preliminary results are encouraging with students indicating considerable improvement in time management. Initial findings also suggest that the participants grades were not negatively impacted by their involvement in the program. The responses from the employers have all been positive. The findings will help to determine what model the School implements and may provide a framework for other universities to adopt.
WORK IN PROGRESS   THE GREAT RACE INNOVATION CHASE
Jeffrey Blessing

As one of the fourteen member universities of the Kern Entrepreneurship Education Network (KEEN), Milwaukee School of Engineering (MSOE) is striving to make our engineering and technology undergraduates more innovative, entrepreneurial and action-oriented. To accomplish these added goals, we have created new courses in entrepreneurship and innovation. But how do we address the problem of encouraging students to add these courses to their already ambitious engineering studies? We decided to create a high-profile, showcase event that makes the learning fun. The Great Race Innovation Chase is a one-day event that requires students to think and act in creative, innovative and entrepreneurial ways; to work in teams to complete tasks, accumulate points, satisfy judges and compete for cash prizes. Along the way, the value of multi-talented, interdisciplinary teams will become apparent to both students and their faculty mentors as they work together to solve real-world problems posed by nationally recognized companies, with brand-name products, under unbelievably tight time constraints.

PARTNERING WITH INDUSTRY VIA YOUR ADVISORY BOARD
Daniel Davis

Many schools and programs have advisory boards that function as little more than a fundraising pool or an audience for the reading of the annual report. Ideally, an advisory board should team with the school to drive the strategic direction while providing advice on various important issues. Having the right group of people on the board is a key factor in determining how effective it will be. But, who are the right people? And, how should they be organized? According to many academic leaders, the board should be made up of a small, select group of people with a variety of experiences. This variety of people and experience makes the meetings much more productive and the board much more effective. Finding and attracting the right outside advisors is not as easy as it seems. Regardless of who is on your board, it is important that they can be relied upon for good advice and direction.

REAL-WORLD INDUSTRY COLLABORATION WITHIN A MECHATRONICS CLASS
Vidya Nandikolla, Susan Shadle, Patricia Pyke, John Gardner, Robert Grover and Suhas Pharkute

This paper describes the implementation and assessment of an innovative senior/graduate level mechatronics (robotics) module that integrated structured and unstructured learning experiences, in collaboration with an industry partner. With real-world constraints and expectations, students designed and delivered a product as the final project. In fall 2007, the corporate partner provided state-of-the-art, programmable robotic kits with a user-friendly programming environment. The assigned project was to design a biomedical robot to work in a hospital intensive care unit (ICU) to perform tasks such as transporting supplies or delivering paperwork. Students with diverse skills and majors were grouped in ten teams, two to three students each. Student learning activities included designing a robot from a box of FisherTechnik materials, without the aid of instruction manuals; writing program code using the PCS environment; and integrating hardware and software. After four weeks of building, training, and testing, each team s robot was unique. In the final competition, each robot was assigned to a particular room in the ICU to perform a specific task. Overall, the results indicated that the students gained hands-on experience with the state-of-art technology and effectively applied the conceptual course content to a real application.

WORK IN PROGRESS - TEACHING ENGINEERING ETHICS TO PROFESSIONAL ENGINEERS IN PUERTO RICO
William J. Frey and Efrain O’Neill-Carrillo

A productive dialogue has arisen between engineering ethicists teaching at the University of Puerto Rico at Mayagüez and the Puerto Rico State Society of Professional Engineers and Land Surveyors (CIAPR). This Work In Process will discuss three themes arising out of this dialogue by summarizing engineering ethics in Puerto Rico, outlining a workshop developed to respond to CIAPR continuing education requirements, and detailing the ethical challenges facing engineers in Puerto Rico. Teaching engineering ethics to practicing engineers raises pedagogical challenges that elicit creative responses. This essay will provide readers with insights into teaching engineering ethics.
WORK IN PROGRESS - THE USE OF TEMPLATES TO SUPPORT LEARNING DESIGN
Isabel Azevedo, Eurico Carrapatoso and Carlos Vaz de Carvalho

This paper discusses the use of IMS Learning Design based templates to illustrate how to utilize a learning object, providing one or more scenarios that incorporate the learning object, giving a pragmatic characterization of it. The adopted notation for the templates is quite similar to the IMS Learning Design Extensible Markup Language binding, also incorporating abstract elements of the specification, like title, learning objectives and roles, for example. The generation of the pre-defined templates has been following the 8 Learning Events Model.

A COMPONENT-BASED VISUAL SIMULATOR FOR MIPS32 PROCESSORS
Hessam Sarjoughian, Yu Chen and Kevin Burger

Processor implementation and performance analysis are fundamental in computer architecture education. A processor can be described at different abstraction levels: a black box with inputs and outputs, the composition of RT (Register-Transfer) level components, the composition of gate level components, etc. Performance of a processor is impacted by factors such as clock cycle, programs, and components’ propagation delays. With the traditional text-based educational material, teaching and learning of the processor implementation is difficult. Processor simulation offers an effective way for education through dynamic visualization and flexible experimentation. This paper presents a MIPS32 Processor Simulator that models the single-cycle, multi-cycle, and pipeline processors described in the classic textbook, "Computer Organization and Design: The Hardware/Software Interface" written by Patterson and Hennessy. The Simulator is developed in DEVSJAVA simulator, a realization of the Discrete Event System Specification with support for modeling parallel, hierarchical, and component-based systems. This simulator provides animation at RT-level during instruction execution, collects performance data (including cycle count, execution time, and instruction count), allows viewing components at desired abstraction levels, and is platform independent. The simulator can also be easily extended/reused to develop other processor types. Existing MIPS processor simulators do not provide sufficient support for the above mentioned features.

TOWARDS THE REUSE OF PRACTICAL AND COLLABORATIVE LEARNING EXPERIENCES
Manuel Caeiro-Rodriguez, Jorge Fontenla-Gonzalez, Martín Llamas-Nistal and Luis Anido-Rifón

In this paper we introduce a proposal to support the reuse of educational resources involved in practical and collaborative learning experiences, intended to complement existing reuse initiatives for LMS resources. These initiatives are mainly focused in media contents, while our proposal is devoted to the tools that can be used in practical educational scenarios (e.g., simulators, remote labs, communication tools) and, more important, to the ways such tools are intended to be used. A main point of the proposal is to enable the use of different tools. In relation to the intended use, three main issues are described: authorizations, awareness and interaction. The proposal is part of a more comprehensible development based in the language PoEML. This language extends the IMS Learning Design capabilities to support practical scenarios through a generalized solution and following an approach based on the separation of concerns.

AN OVERVIEW OF THE STEAMiE EDUCATIONAL GAME ENGINE
Scott Nykl, Chad Mourning, Mitchell Lietich, David Chelberg, Teresa Franklin and Chang Liu

Today, there exists a significant disparity in the degree of technological development between commercial and educational games. The STEAMiE Educational Engine is a cutting-edge system used to create advanced, realistic, immersive learning environments. These environments have been shown to influence comprehension and retention of hard-to-teach science concepts. This paper will present an overview of the features of our STEAMiE Educational Engine and how to use it to create games/simulations capable of enhancing a user’s learning experience. The STEAMiE Educational Engine contains a rich feature set allowing for development of powerful modules within a short period of time. From a development point of view, the STEAMiE Educational Engine’s object oriented design is modular and can be easily extended to support new functionality in a timely manner. This significantly shortens
development time and abstracts complexities from the developer allowing for clean and efficient implementations of games and simulations.

Session F3C: Engineering Education Topics 2
Chair: Antonio Perez Yuste, Technical University of Madrid
Time and place: Friday, October 24, 1:30 pm. - 3:00 pm. Broadway 2

WORK IN PROGRESS - HOW DO WE TEACH AND MEASURE SYSTEMS THINKING?
Linda Vanasupa, Erika Rogers and Katherine C. Chen

Since the 1990’s blue-ribbon commissions on engineering education have called for educators to graduate engineers who are capable of systems thinking. However, there is sparse information on how to cultivate this type of cognitive development. How do we develop and measure systems thinking? In this paper, we present the first of a series of methods that we are piloting to initiate the systems thinking process. This exercise, developed by Checkland and Scholes and called "Rich Pictures," requires the participant to express a reality in terms of images and connections between these images. We utilized the Rich Pictures exercise in combination with an appreciative inquiry strategy in pursuit of an initial research hypothesis regarding the impact of project-based learning on female students. We only partially answered our initial question, but the exercise unexpected yielded enthusiastic participation by the students and a rich set of data regarding unanticipated factors that influenced students’ learning. The value of the activity is that it initiates the process of thinking non-linearly, an important first step in students’ cognitive development for systems thinking.

DEVELOPING TEAM SKILLS USING A PROGRAM-EMBEDDED TEAM ASSESSMENT PROCESS
Leah M. Akins and Daniel C. Barbuto

Although industry and academia alike place high value on teamwork, how do we actually develop and assess those skills in our students and ourselves? How do we evaluate whether our efforts have had a measurable impact on the students so that we can adjust our approach for maximum benefit? In October 2004, the authors presented initial work on a program-embedded process designed to help students (1) learn critical teambuilding skills, (2) identify their strengths and weaknesses when working in teams, and (3) improve their team skills. The process involves data collection, exit interviews, and student feedback in five program-specific courses taken over three semesters and with two different faculty. Data has been collected on 100 students to provide evidence of student development in the three areas indicated. Although data analysis did not always indicate student development, the exit interviews conducted at the end of the three semester sequence of courses consistently revealed improved skill. This paper summarizes the program-embedded process and provides results based on data collected from Spring 2003 through Spring 2007.

WORK IN PROGRESS - CLINIC TO CLASSROOM - A NEW PARADIGM FOR BIOMEDICAL ENGINEERING EDUCATION
Eric H. Ledet and Richard L. Uhl

In traditional undergraduate curricula, biomedical engineers are trained in the fundamentals of engineering and the basic sciences to solve problems and develop new technology. In traditional programs, biomedical engineers have limited exposure to the day to day challenges of practicing medical professionals. To enhance the traditional curriculum, we have introduced Clinical Orthopaedics and Contemporary Research as a one semester biomedical engineering course. Eight practicing surgeons teamed up with engineering faculty to offer a unique educational experience for biomedical engineers. Eight topics related to the nation’s highest priorities for musculoskeletal disease (as identified by the NIH) were studied in modules. In each module, the students first learned relevant anatomy and pathophysiology through interactive lecture materials, contemporary literature, and web-based learning tools. Following background lectures, one of eight surgeons discussed with the students during lecture time the clinical perspective of the problem and presented clinical case studies. Each module concluded with a live webcast of surgery during which time students were able to communicate with the surgeon and operating room staff in real time. From this unique experience, students are better able to effectively communicate with clinicians and are better prepared for work in the medical device industry or other fields related to clinical medicine.
WORK IN PROGRESS - ENGINEERING LEADERSHIP PROGRAM: TRACKING LEADERSHIP DEVELOPMENT OF STUDENTS USING PERSONALIZED PORTFOLIOS

Krishna S. Athreya, Michael Kalkhoff, Gregory McGrath, Adam Bragg, Amy Joines, Diane Rover and Steven Mickelson

The Engineering Leadership Program was started at Iowa State University in 2006 to inspire altruistic leadership in engineering students. The program uses a cohort model to promote leadership development of students who pursue co-curricular and innovative curricular opportunities throughout the undergraduate years, starting from the first year. A collaboratively crafted competency based leadership learning model is the framework for Engineering Leadership Program activities and assessment. Students within the program are using a locally designed electronic portfolio system to track their progression, using the leadership model competencies to guide their leadership development. The tracking of competency development for individual scholars through the personal portfolio system will be presented.

IMPLEMENTING PEER LED TEAM LEARNING IN FIRST-YEAR PROGRAMMING COURSES

Tristan T. Utschig and Monica Sweat

In the Peer Led Team Learning model (PLTL) many of the skills developed by students correlate well with desired learning outcomes in CSET programs. The authors report the results of a project to implement PLTL in introductory programming courses. An overview of the implementation model is provided, lessons learned are reported, and the assessment process and results are described. The research questions explored are: (1) What is the impact of the PLTL model on student skills and confidence regarding teamwork, leadership and communication? (2) How effective is PLTL in terms of building problem-solving skills in introductory programming? This project involved a pilot implementation followed by full implementation in the following year. Student peer leader surveys, along with a peer leader focus group, were used to analyze project impact and to plan for improvement in achieving the learning outcomes described above. Results indicate that students are satisfied with the peer led team learning model and that significant skill enhancement is occurring. In particular, a significant fraction of peer leaders in the second year of implementation came from those participating in the pilot.

Session F3D: Student Retention 2

Chair: Tershia Pinder-Grover, University of Michigan

Time and place: Friday, October 24, 1:30 pm - 3:00 pm

WORK IN PROGRESS - UTAH S ENGINEERING INITIATIVE

Amy Aldous Bergerson and Cynthia Furse

In response to a shortage of engineers in Utah an interdisciplinary team at the University of Utah developed an outreach program intended to increase the number of students recruited into the College of Engineering and who complete engineering degrees. An innovative mix of service learning, outreach, and peer mentoring comprises the program. Recruitment efforts include outreach, integration with teachers and public relations. In outreach, college students work with high school teachers and engineering faculty to prepare and present engineering-based teaching modules that meet requirements of the state core science curriculum. Education and public relations materials aimed at students, parents, teachers, and counselors also contribute to outreach. Retention efforts include academic advising, tutoring, peer mentoring, and service learning. Retention programs are based on college student retention research, and focus on engaging students both academically and socially. This paper reports on the first year of the initiative, including the creation of outreach teams and the development of high school teaching. We also discuss how participation in the outreach team impacted current students.

WORK IN PROGRESS - IMPLEMENTATION OF SECOND LIFE IN ELECTROMAGNETIC THEORY COURSE

Lauren D. Thomas and Patricia Mead

As an abstract course, students struggle with core concepts in electromagnetic theory which negatively impact their ability to meet the expected competencies of the course. An out of class activity using the Second Life platform developed by Linden Labs, will be used to (1) implement instructional methods designed to improve conceptual understanding of introductory principles in an electromagnetic theory course, (2) encourage knowledge transfer with
a problem solving experience, (3) explore ways to use the Second Life platform to encourage communication through engagement and interactivity amongst people in groups and (4) evaluate the Second Life virtual platform as an effective tool for instruction on introductory principles in an electromagnetism course. The Second Life platform was selected for its attractive animation that rivals video games that generation Y students use for recreation and for its ability to facilitate visualization of concepts in electromagnetism. Constructivist learning theory is applied in the design of the activities and is purposes so that the students will take more responsibility toward their own learning experience. Additionally, the activities are intended to assist students in more complex problems later in the course.

**WORK IN PROGRESS - IMPROVING SELF-EFFICACY WITH A FRESHMAN MENTOR PROGRAM**

Matthew Shuman, Donald Heer and Terri S. Fiez

Transitioning from high school to a university setting is difficult, and when combined with the academic stresses of an engineering program, low undergraduate retention rates are a common problem. A solution is to produce a curriculum that can instruct students about engineering basics while improving self-efficacy. Most current methods to increase self efficacy are mentorship programs, addressing different learning pedagogies, and creating separate learning communities. Execution of these methods is prohibitive when educating large numbers of students. Preliminary self efficacy survey results show an improvement in our students as a response to both our Freshman Mentor program and Platform for Learning, TekBots.

**LEARNING THE STRUCTURE OF RETENTION DATA USING BAYESIAN NETWORKS**

Amy McGovern, Christopher M. Utz, Susan E. Walden and Deborah A. Trytten

We introduce a novel approach to examining retention data by learning Bayesian Networks automatically from survey data administered to minority students in the College of Engineering at the University of Oklahoma. Bayesian networks provide a human readable model of correlations in large data sets, which enables researchers to improve their understanding of the data without preconceptions. We compare the results of our learned structures with human expectations and interpretation of the data as well as with cross-validation on the data. The average Area Under the Curve of the networks using cross-validation was 0.6. The domain experts believe the methodology of automatically learning such structures is promising and we are continuing to improve the structure learning process.

**WORK IN PROGRESS - REEXAMINING THE PROBLEM OF ENGINEERING PERSISTENCE FOR AFRICAN-AMERICAN FEMALE STUDENTS**

Sherri S. Frizell and Felecia M. Nave

This paper describes a mix-method study designed to examine the experiences and factors that influence African-American female students' decision to leave engineering degree programs for other academic majors. Using the Students Leaving Engineering Instrument developed by the Assessing Women in Engineering (AWE) project, data is being collected from female students who entered Prairie View A&M University, a historically black university, as freshman engineering, computer science or technology majors during the 2003, 2004, and 2005 academic years, but have subsequently switched to other degree programs. The factors being examined include initial commitment and preparation for studying engineering, confidence in completing an engineering degree program, course workload and institutional climate, relationships with faculty and peers, and financial concerns.
INTEGRATING A RESEARCH COMPONENT INTO A WEB DEVELOPMENT INTRODUCTORY COURSE
Amalia Rusu and Bridget Keyes

Exposing students to research topics enhances their learning experience. It is therefore desirable for instructors to include a research component into their courses. The courses most prone for incorporating research components are the upper level undergraduate and graduate courses. However, this becomes challenging in the case of introductory courses, where learning new programming skills is the focus. In this case, the research component needs to satisfy two key conditions: to be easy enough to implement, and to have a fast learning curve. In this paper we describe the introduction of a research component into an introductory web development course (upper undergraduate and lower graduate) for software engineering students. In this context we present a web security research application that is successful at keeping unwanted malicious attacks from happening on web services. It can be implemented using basic web development skills and fast to learn and rationale. Due to the interdisciplinary nature of the research problem, the students have been exposed to techniques and research topics in several other fields. The projects outcome including student experiences conducting user studies and human surveys are discussed in the paper.

VISUAL EMBEDDED SYSTEM PROGRAMMING HAS ARRIVED!
Alex Doboli, Simona Doboli and Edward H. Currie

Many ECE graduates have only limited experience with design and integration of mixed-signal, embedded systems. This is in part due to the multitude of topics that must be taught to students during a very limited period of time. Fortunately, recent advances in reconfigurable hardware/software platforms and Visual Programming tools have the potential to dramatically address this deficiency, and enable a paradigm shift in ECE undergraduate education towards complex systems and networks of systems. This paper presents new educational material based on Visual Programming and reconfigurable mixed-signal systems on a chip to teach mixed-domain co-design and integration, including analog, digital, and software. The paper presents a new introductory course for freshmen ECE students, which is currently being developed at Stony Brook University, and a senior design project that was successfully completed at Hofstra University.

WORK IN PROGRESS - INITIAL EVALUATION OF AN INTRODUCTORY COURSE IN PROGRAMMING THAT ASSISTS IN CAREER CHOICES
Eric Andrew Freudenthal, Mary Kay Roy, Alexandria Nicole Ogrey, Sherri Irene Terrell, Olga Kosheleva, Pilar Gonzalez and Ann Q. Gates

We present initial results from an effort to investigate the effectiveness of programming-centric computer literacy courses at the University of Texas at El Paso (UTEP). UTEP is an urban university serving a largely Hispanic student population principally drawn from the sister cities of El Paso, TX, USA, and Ciudad Juarez, Chihuahua, MX. This course is based on the creatively engaging Media Programming approach of Dr. Mark Guzdial of Georgia Tech. In this course, which was designed for Liberal Arts students, students are introduced to the Jython programming language. Class projects implement and extend algorithms that directly manipulate multimedia and expose students to digital representations of images and sounds in a sequence of aesthetically focused projects. We are investigating whether (1) there is value in modifying this curriculum to complement common occupational traits for student cohorts enrolled in engineering and computer-science programs and (2) such courses can assist students in career choices and improve long-term student success.

WORK IN PROGRESS - EMBEDDED SYSTEM-BASED INTRODUCTORY PROGRAMMING COURSE FOR COMPUTER AND ELECTRICAL ENGINEERING STUDENTS
Bryan J. Mealy

Introductory programming courses are unique in that they typically represent the student’s first technical experience in computer and electrical engineering curriculum. The presentation of these courses is important because the impressions students form from these courses stay with them throughout their college experience and beyond. This paper describes an embedded system-based introductory programming course designed specifically to support the specific needs of computer and electrical engineering students. This course replaces a similar course taught from primarily a computer science perspective by changing the course context to a hardware-based embedded environment. The embedded system environment fully supports the learning outcomes of the computer science-based programming course but also accustoms students to the nuances of embedded systems that would otherwise require introduction in later coursework. The hardware nature of this course provides students with an introduction to interfacing basic and common I/O devices typically available on microcontroller-based hardware platforms. The
presentation of this course also mitigates traditional cultural differences between computer science and engineering-based approaches to curriculum that can have a negative impact on students in their perspective majors.

Session F3F: Broadening the Engineering Community

Chair: AnnMarie Polsenberg Thomas, University of St Thomas

Time and place: Friday, October 24, 1:30 pm. - 3:00 pm.

THE RICHMOND AREA PROGRAM FOR MINORITIES IN ENGINEERING: SUMMER ENGINEERING INSTITUTE
Gymama E. Slaughter

The Richmond Area Program for Minorities in Engineering has been established as a pre-engineering K-12 education outreach program to achieve greater diversity in science and engineering. It provides an array of opportunities for middle and high school students to develop their communication and leadership skills, as well as build self-confidence. This is accomplished through two programs: the Summer Engineering Institute (SEI) and the Scholarship Program. The SEI consists of comprehensive hands-on activities, and mentoring of women and minority students in the quest to increase the presence, retention and the advancement of girls and minorities in engineering and science. In the following paper, the Richmond Area Program for Minorities in Engineering SEI attempts to diversify engineering education while assisting middle and high school students in becoming culturally knowledgeable in engineering and science.

WORK IN PROGRESS - THE PUBLIC IMAGE OF AN ENGINEER
Mani Mina, Iraj Omidvar, Ryan Michael Gerdes and Sasha Kemmet

Recent efforts aimed at improving technological literacy and attracting the younger generation to engineering careers by the National Association of Engineers, as well as IEEE, have provoked discussions about the public image of the engineer. These discussions usually focus on the image or stereotype of engineers in popular television shows or other media. One element that is missing from this discussion, however, is the historical context in which this image has developed. This paper presents a historical perspective which examines how engineers were viewed by past generations and how the current image of engineers from earlier periods shapes how individuals see the engineering profession today. We conclude that though the overall image of the engineer is not entirely negative, there is a lack of understanding of the contribution of engineers in the public’s perception. This paper also proposes an image of engineering that more fully represents the work and contributions of engineers.

THE STARS LEADERSHIP CORPS: CASE STUDIES IN BROADENING PARTICIPATION IN COMPUTING
Teresa Dahlberg, Tiffany Barnes, Audrey Rorrer, Cheryl Seals, Mia Lustria and Lois Hawkes

We have formed the STARS Alliance to address alarming declines in computing enrollments and the need to broaden participation in computing. Our innovative STARS Leadership Corps engages college students in a community dedicated to giving back, persevering, and striving for excellence. The successful Corps model incorporates best practices in recruiting and retention in computing, including student experiences in outreach, research, and service. We present case studies of three diverse implementations of the STARS Leadership Corps that demonstrate how the Corps can be tailored to individual institutions and student interests.

PSYCHOLOGICAL SENSE OF COMMUNITY & BELONGING IN ENGINEERING EDUCATION
Denise Wilson, David Spring and Lisa Hansen

Using previously validated measures, belonging and psychological sense of community are measured in a cross section of engineering communities including engineering classes at the sophomore and junior level at a major Research 1 University and various conference venues and research center retreats. Belonging and sense of community vary among the venues examined. As students become more invested in their community of practice (moving from undergraduate to graduate level), belongingness and psychological sense of community (PSC) increase. Differences in belonging and PSC also occur within different groups of graduate students but remain surprisingly consistent among undergraduates. Both of these affective/relational measures are important to academic outcomes and student experience as they mediate academic engagement and are mediated by extraversion, making it more difficult for the introvert-dominated engineering student population to attain strong connections to community.
WORK IN PROGRESS - THE ROLE OF ENGINEERING COLLEGES IN PROVIDING TECHNOLOGICAL LITERACY
Mani Mina

This paper addresses some of the most important questions regarding the role of engineering colleges in providing technological literacy programs throughout national-level colleges and universities. While addressing the issues of technological literacy is of utmost importance at the national level and has been encouraged by influential groups such as the National Association of Engineers (NAE), the National Science Foundation (NSF), and other national agencies, the process of how to achieve it is still under debate. Engineering colleges seem to be natural places for leading these activities. However, engineering faculty in general are not generally used to teaching non-engineering students. This paper addresses challenges and discusses how to make such programs effective by involving other faculty from non-engineering disciplines.

Session F3G: Panel Session - Improving Learning and Retention in Introductory Statics

Chair: Christine Valle, Georgia Institute of Technology
Time and place: Friday, October 24, 1:30 pm - 3:00 pm. Alabama

PANEL SESSION - IMPROVING LEARNING AND RETENTION IN INTRODUCTORY STATICS
Christine Valle, Wendy C. Newstetter, Edward E. Anderson, Thomas A. Litzinger and Sheri D. Sheppard

Statics is the first engineering class mechanics-based majors encounter. It tends to operate as a weeder course, due to most students' difficulties in learning the engineering approach to problem solving, which is characterized by model-based reasoning. Difficulty in model-building can cause a lack of confidence and a diminished sense of self-efficacy that is particularly problematic when amplified by gender and underrepresented minority (URM) issues. Many valuable attempts have been made in the past at developing new tools to help students learn modeling, and develop engineering intuition. The goal of this panel is a two-pronged discussion: on the one end, present and discuss the most pertinent and intractable challenges associated with Statics learning that students encounter; on the other, present and discuss various interventions, technological or otherwise, that the panelists have attempted and/or developed to remedy the situation. Ideally the panel outcome will be to define pathways for developing and disseminating cognitively-based interventions that better supports learning and retention of all engineering students.

Session F3H: Software Engineering

Chair: James A. Roberts, University of Kansas
Time and place: Friday, October 24, 1:30 pm - 3:00 pm. Whitney

THE "SOFT" TOPICS IN SOFTWARE ENGINEERING EDUCATION
Mark A. Ardis, Stephen V. Chenoweth and Frank H. Young

Engineering educators struggle with soft topics, topics which include a social element. Soft engineering topics are distinct from the scientific and mathematical underpinnings of engineering. Students frequently complain when these topics are integrated into engineering curricula. Engineering educators also express concerns that they lack both preparation and ability to teach these topics. Software engineering educators have an even greater problem. More soft topics need to be included in a good software engineering program. Furthermore, software engineering instructors need to remain current with non-social best practices, which can leave little time to study techniques to incorporate soft topics into the curriculum. This paper is an attempt to alleviate the problem. We organize the soft topics necessary for a good software engineering program; present exercises to include them in software engineering courses so that students develop needed abilities and understand their importance; and describe effective ways to evaluate student performance.

AN EVALUATION OF TOOLS SUPPORTING ENHANCED STUDENT COLLABORATION
Joo Tan and Mark Jones

Team communication and project collaboration are critical for the success of today's software projects. In a one-semester upper-division Software Engineering course offered at our Kutztown University, student project teams worked independently on software systems for real business clients. Throughout the entire software development lifecycle, each team utilized a Google Groups account for project coordination and communication among its team members.
members. The use of Google groups as a forum for team collaboration is re-visited and student experiences with Google Groups are provided. Next, features that are desirable for collaboration are discussed. Then three web-based tools, Basecamp, Central Desktop, and Viewpath are investigated. We compare Google Groups to these collaboration tools with respect to features for collaboration and project management.

**EMBEDDING VIRTUAL AND REMOTE EXPERIMENTS INTO A COOPERATIVE KNOWLEDGE SPACE**

Sabina Jeschke, Thomas Richter and Uwe Sinha

Today, experimental environments and setups in natural sciences and engineering are neither available sufficiently, nor accessible enough to cover the broad demand. Yet, they form an essential part of the scientific methodology within the technological disciplines. Additionally, the ability to cooperate and work in teams when performing experiments is crucial. By integrating experimental setups into a virtual cooperative knowledge space, availability and accessibility can be enhanced for a wide range of people, working individually or in groups, making them independent of limitations in time, budget or access to classical laboratories. This article describes a SOAP-based architecture by which this objective can be achieved, and which is currently being implemented for CURE, a room-based cooperative knowledge space platform developed at FernUniversitaet Hagen.

**WORK IN PROGRESS - OBJECT ORIENTED METRICS AND PROGRAMMERS' MISCONCEPTIONS**

Osvaldo Clua and Maria Feldgen

As a final grading tool we ask our students to develop a project using Java. In the last courses we decided to make some industry standard measurements on the code. We found values in with open source internet available games, but unrelated to quality object oriented code. Post grading interviews were done to explore the values obtained by the metrics. In the interviews we found some documented misconceptions about Object Oriented Programming present in our students.

**MOVING TOWARD REALITY IN TEAM SELECTION FOR SOFTWARE ENGINEERING**

Rose F. Gamble and Melanie L. Smith

College students have been bombardeed with reality shows. Coupled with extensive video gaming, these weird tasks and challenges have become commonplace for vicarious thrill seekers. Place these same students in a software engineering class where pedagogical norms include process understanding, project design methods, and implementation guidelines, and the class trends toward low-energy and minimal student effort, even with the most state-of-the-art projects. Our approach is to re-energize students using a new mode of competition. The goal is to allow the students to compete for role, team, and project choice. The difficulty in the approach is shaping competitions within the confines of the CS curriculum while maintaining accreditation standards, appropriately grading reality challenges, and uniformly configuring teams without ousting anyone. We introduce the REALity Software Engineering Network (REASEN), a set of challenges designed around software engineering principles. We discuss how REASEN fits into a classroom setting and helps incite creativity, team bonding, and more appropriately disclose the skill set of individual students toward fairer and more satisfying team and project selection.

**Session F3J: Special Session - New Engineering Stories: How Feminist Thinking Can Impact Engineering Ethics and Practice**

Chair: Jessica Tucker, Stony Brook University

*Time and place: Friday, October 24, 1:30 pm. - 3:00 pm. Highrock*

**SPECIAL SESSION - NEW ENGINEERING STORIES: HOW FEMINIST THINKING CAN IMPACT ENGINEERING ETHICS AND PRACTICE**

Jessica Tucker, Alice Pawley, Donna Riley and George Catalano

The goal of this special session is to examine the way we as engineers frame stories about engineers and engineering, and to ask: do we need to embrace new stories? We will explore traditional stories about engineers and engineering ethics and ask, how might these stories, and the kind of engineering practice and education they inspire, change if framed from a feminist perspective? The outcomes of this session are to build a greater community interested in social engagement, engineering ethics, and feminist methodologies as they apply to engineering.
DEVELOPING AND ASSESSING CONCEPTUAL UNDERSTANDING IN MATERIALS ENGINEERING USING WRITTEN RESEARCH PAPERS AND ORAL POSTER PRESENTATIONS
Kathleen L. Kitto

Introduction to Materials Engineering at Western Washington University has been transformed from a traditional lecture course to a conceptual knowledge-centered course using several different teaching strategies. This paper focuses on the development and assessment of conceptual understanding using written research papers and oral poster presentations. Pre- and post-class concept questionnaires, paper and poster rubrics, and scores on traditional exam and design questions were used to evaluate improvements in conceptual knowledge. The pre-class questionnaires revealed several significant deficiencies. The questionnaires also revealed how robust student misperceptions can be and that it is important to build several appropriate scaffolds to new knowledge during the term so the students can reconstruct their conceptual understanding. Written research papers and oral poster presentations were also used to help the students articulate their own understanding of material properties. The process of explaining to themselves and to others develops and constructs conceptual knowledge. Forming questions for others in the language of materials engineering similarly advances scaffolding. The assessment benchmarks indicate enhanced development in some conceptual areas. However, only limited progress was made in other important areas. Faculty time needed to complete the necessary assessments is definitely a limiting factor. Future directions conclude the paper.

WORK IN PROGRESS - CS0 COURSE IMPLEMENTATION IN COMPUTER SCIENCE
Mohsen Beheshti, Richard A. Alo, John Fernandez, Ann Quinroz Gates, Desh Ranjan, Antonia Boadi, Karen Villaverde, Sarah Hug, Heather Thiry and Lecia Barker

The Computing Alliance of Hispanic Serving Institutions (http://cahsi.fiu.edu), a consortium of 7 institutions focused on the recruitment, retention, and advancement of Hispanics in computing, is implementing and promoting the development of recruitment mechanisms to attract other majors to the field of Computer Science. CS has lost roughly 50% of its majors in the last 5 years. The member institutions have introduced a 3-credit hour course called CS0 that is intended to motivate students, especially those who have a weak background in computing, to continue studies in computing and to prepare students for success in the first CS course. There are two models that are being implemented: one using Alice software and another using Python. CAHSI is creating a repository for support materials for dissemination of each of the implementations and collecting data to determine the success of the approaches. This paper discusses the structure, materials, and implementations, and presents preliminary results.

TOWARDS LEARNER-CENTERED LEARNING GOALS BASED ON THE PERSON-CENTERED APPROACH
Renate Motschnig-Pitrik, Michael Derntl, Kathrin Figl and Sonja Kabicher

While learning goals need to be predefined at the curriculum and course level, it is the concrete course offering, the instructor or facilitator, the student colleagues and learning designs that are decisive in determining whether learning goals can truly be called learner-centered. In this paper we identify features and preconditions of learner-centered learning goals, consider their context and focus on describing course-level scenarios that allow facilitators to include students in co-determining and following learning goals. Results are illustrated by student reactions and brief summaries of results and references to more detailed studies. The theoretical inspiration and interpersonal value system for learner-centeredness is borrowed from the Person-Centered Approach.

WORK IN PROGRESS - EFFECTIVE ENGAGEMENT OF MILLENNIAL STUDENTS USING WEB-BASED VOICE-OVER SLIDES AND SCREEN DEMOS TO AUGMENT TRADITIONAL CLASS DELIVERY
Jon Sticklen, Mark Urban-Lurain and Daina Briedis

An emerging literature focuses on differences in learning style between the so-called millennial generation and preceding generations of students. Concurrently, a number of intuitions have developed among engineering educators about millennial students, most with the common theme of lowered tolerance for lecture settings. Two current threads addressing the lower attention span problem are (a) approaches under the rubric active learning and (b) technology
developments such as web-enabled screen movies and pod-casts. The second thread is often aimed at a technology fix. Experience shows that any technology fix is of itself minimal value. We focus on possibilities for improved instructional design. Specifically, our research question is the following: What is the effect of augmenting course material with web-based, voice-over slide presentations punctuated with full screen demonstrations and interactive quizzes? We report on our first steps to develop voice-over slide presentations with embedded quiz questions and full motion screen demonstrations in a web-accessible environment. Initial results focus on student attitudes based on data collected in Summer and Fall terms, 2007. Future work will include quantitative evaluation of learning outcomes.

**WORK IN PROGRESS - HOW TO INTERPRET POLYLINES APPROXIMATING CURVES ON A SURFACE**

Takatomi Miyata and Masachika Miyata

Every wireframe model of a smooth surface is considered as a simple but very rough approximation. However it contains rich information. In this paper a piece of an approximated tangent plane, a tangent cell, is defined from a wireframe model in order to introduce students to an approximation of connection by making a tree of tangent cells. When this tree is put on a plane, parallel transport of a vector is equal to its parallel shift on the plane in usual meaning.

Session F4B: Gender & Minority Issues in CSET Education

Chair: Sherri S. Frizell, Prairie View A&M University

**INFLUENCES FOR SELECTING ENGINEERING: INSIGHTS ON ACCESS TO SOCIAL CAPITAL FROM TWO CASE STUDIES**

Julie Martin Trenor, Shirley L. Yu, Consuelo L. Waight and Katherine S. Zerda

This paper employs the theory of Social Capital to explore the educational experiences and academic career decisions of engineering undergraduates. Two case studies are presented from a larger mixed-methods project which investigated the experiences of ethnically and socio-economically diverse female engineering students at an urban research university. Participants completed an online survey, which included items about reasons for selecting engineering and information sources utilized in doing so. Additionally, semi-structured interviews explored participants’ perceived supports and barriers for college and career plans. Triangulation of survey and interview data yielded insights regarding the relations between social capital and students’ academic and career decision making processes. While both participants first became interested in engineering during middle school, their reasons for entering the field and access to information about engineering were very different. The social capital inequity apparent in these cases can be attributed in part to parental educational attainment and occupation.

**THE ASYNCHRONOUS LEARNING ENVIRONMENT (ALN) AS A GENDER-NEUTRAL COMMUNICATION ENVIRONMENT**

Maxine S. Cohen and Timothy J. Ellis

Women are under-represented in technology-intensive fields. Arguments abound on the question are there true gender differences. Some see the Internet as the great equalizer. Some studies have shown the gender gap to be narrowing in certain online activities. Distance education often uses discussion forum postings as one of the common learning activities. This research reports on a study with doctoral level students in both a technology intensive class and a more people-oriented class. The directionality of forum discussion postings were examined from both a within gender perspective and a cross gender perspective. The findings did show that the postings in this Asynchronous Learning Environment (ALN) were gender-neutral. In addition, two different configurations were examined: a free-form posting and a structured posting. These configurations were examined from a gender perspective and no difference was found. Lastly, the nature of the program of study was examined in regards to level of interactivity related to gender. Again, there were no significant differences found. This research did demonstrate that an ALN can be perceived as a gender-neutral environment.
WORK IN PROGRESS - GENDER PARITY SUCCESS IN THE CIVIL ENGINEERING DEPARTMENT AT KUWAIT UNIVERSITY
Rana Al-Fares and Lulwa A. Al-Abdulmuhsen

In recent years, studies have shown that the percentages of female undergraduates, faculty, and administrators has been increasing. However, many engineering fields continue to have low female percentages. In the College of Engineering at Kuwait University an observable exception exists. As of spring 2001, over 62 percent of the Civil Engineering undergraduates were females, while around six percent of the faculty were females. This high females percentage has been increasing, reaching a peak in the academic year 2004-2005. To investigate the local factors contributing to the Civil Engineering department gender parity, a pilot study was conducted. A survey was used on a random sample of 104 undergraduates. The study revealed many interesting outcomes, some of which were that 64.4 percent of the study sample thought that there was inequality in treatment between genders, of them 56.7 percent thought that males were treated better. The study also found that females perceive the Civil Engineering field as very interesting.

VALUING DIVERSITY: DEVELOPMENT OF A STUDENT SUPPORT FORUM FOR FEMALES
Sandra Cairncross, Karen Gordon, Debbie Ratcliffe, Jenny Tizard and Caroline Turnbull

Research into student retention and persistence emphasises the importance of social integration: students who form strong peer-group friendships are more likely to graduate. However this can be difficult when you are in a minority, for example a female student on a male-dominated programme. Less than 30% of students within the Faculty of Engineering, Computing and Creative Industries at Napier University, Edinburgh are female; in the Schools of Computing, Engineering and the Built Environment this drops to 15%. In order to provide a more supportive environment in which to encourage women to study and remain in computing, engineering and built environment, the Faculty set out to establish a student support forum for females. This paper describes the work undertaken by the project team of staff and students. Following initial research, two key strands were identified to support the development of a community for female students; an online presence through which students could communicate and access information, and face to face meetings where students could come together, meet females from industry, developing networking skills and discuss topic of common interest. Advice for others wishing to develop a similar resource will be given, along with recommendations for future enhancements.

GENDER AND RACE: STEREOTYPING, COPING SELF-EFFICACY AND COLLECTIVE SELF-ESTEEM IN THE CSET UNDERGRADUATE PIPELINE
Antonio M. Lopez, Kun Zhang and Frederick G. Lopez

Gender and race play significant roles in how people view and experience the world. In certain contexts both gender and race may activate doubts about one’s career-related performance- and coping-related capabilities. This paper presents findings on the effects of gender and race in the undergraduate pipeline of the computing disciplines (i.e., computer engineering, computer science, software engineering, information systems, and information technology) through the more proximal impacts of stereotyping, coping self-efficacy and collective self-esteem. Data were collected in Fall 2004 from 1,208 computing discipline and 581 non-computing discipline students attending forty-two colleges and universities across the United States. Twenty-one of these institutions were Historically Black Colleges and Universities and 21 were Predominantly White Institutions. Data were analyzed using statistical and data mining techniques to investigate the influence of stereotyping, coping self-efficacy and collective self-esteem in the computing disciplines.

Session F4C: Design Experiences 2
Chair: David Voltmer, Rose-Hulman Institute of Technology
Time and place: Friday, October 24, 3:30 pm. - 5:00 pm. Broadway 2

WORK IN PROGRESS - USING A COMPANY BASED MODEL TO ORGANIZE PROJECT TEAMS IN AN INTRODUCTORY DESIGN COURSE
Allen H. Hoffman and Jeffrey R. Court

The value of a team approach to design projects has been well established. Projects require teams to demonstrate a wide range of skills including group management, creativity, analysis, manufacturing, testing and communication.
Insuring that a team has a sufficient breadth of skills can be problematic. Establishing individual accountability within the project team can also be difficult. A new approach was recently implemented in sophomore/junior design course where teams were assembled based upon the role of company officers. Students interviewed for the positions of Chief Executive Officer, Chief Technical Officer, Chief Information Officer and Chief Manufacturing Officer. Three progress reports were submitted which contained reports from each of the officers. Three oral design reviews were conducted where the instructor and teaching assistant took on the role of venture capitalists (VCs) who were funding the company. Here each officer presented a status report and had the opportunity to ask for advice from the VCs. The company officer approach insured that each student actively participated and was accountable for their work throughout the project. Course evaluations strongly supported the use of this role playing format.

**GREEN HOUSE ON WATSON  CASE STUDY IN ENERGY PERFORMANCE AND COMMUNITY SERVICE**  
Shirley T. Fleischmann

In the spring of 2006 a GVSU engineering professor and her students designed an ICF (Insulated Concrete Forms) home that they built in partnership with a local not-for-profit housing agency and a local residential builder. More than 70 students worked on the house in the spring and summer of 2006. In the fall of that year a low income family moved in. The house was certified at the Silver level under the LEED-H Pilot Program in Grand Rapids Michigan and also certified under Energy Star as a 5 Star Plus home. A year and a half later we have a significant amount of data on the performance of this home including measured temperatures of the concrete core of the ICF walls. This paper will describe the design of the home and the resulting energy performance in a format suitable for use in a Thermodynamics or Heat Transfer class. This will be followed by lessons learned in the process of this very ambitious community service project.

**ROBOTICS COMPETITION: PROVIDING STRUCTURE, FLEXIBILITY, AND AN EXTENSIVE LEARNING EXPERIENCE**  
Joseph Grimes and John Seng

This paper presents the design and implementation of the annual robotics competition at Cal Poly State University, San Luis Obispo. Described are the infrastructure used to run the competition, the educational outcomes, and student responsibilities that make this competition an excellent opportunity for broad-based student educational growth. This annual robot competition provides a forum for students to receive educational credit while working on a multi-faceted project that provides an experience that is close to what they would encounter in their future professional career, and to compete for prizes. With faculty advisor supervision, the students have full responsibility for defining the competition rules, designing and constructing the competition course, developing partnerships with industry, and carrying out the competition. Each year the students define a new set of rules for the competition that results in the development of new robots. The key student learning possibilities that will be presented in the paper include: a) team-based learning; b) interdisciplinary experience that includes mechanical engineering and computer engineering; c) life-long learning skills; d) communication skills; e) leadership skills. Also this paper will address the key responsibilities of the faculty that are necessary for this student learning experience to be successful.

**DESIGN AND CONSTRUCTION OF A STEREOSCOPIC AERIAL IMAGING PLATFORM: A PROJECT-BASED PLATFORM FOR TEACHING FRESHMAN ENGINEERING STUDENTS**  

Structured project-based approach to teach engineering design is not new. However, the use of practical projects to institutionalize the teaching of freshman engineering design has been made a key component of interdisciplinary program approach whereby faculty from both programs in the Department of Engineering and Aviation Sciences compliment student learning through shared projects. While the Aviation Science faculty serves as clients, they generate plausible problems that can benefit the Aviation Science students in the program and these problems are then used as the basis for a structured engineering design approach for introducing engineering design fundamentals to the freshman engineering class The design and construction of a stereoscopic aerial imaging project was given to students in the freshman engineering class to articulate a proof-of-concept for a low-cost, light-weight, easily controllable stereoscopic aerial imaging platform. The stereoscopic 3 dimensional data could be applied to terrain and plant life mapping for use in agriculture, forestry, wetlands and coastal studies. Three project groups were formed with a choice of remote controlled aircraft provided by the client for the implementation of their design. This paper discusses the process, approach to introducing course content and objectives as a means of promoting communication skills, team work, critical thinking as well as research skills and the experience acquired by the students in the freshman engineering class.
AN INDUSTRY-ACADEMIA TEAM-TEACHING CASE STUDY FOR SOFTWARE ENGINEERING CAPSTONE COURSES
Amalia Rusu and Mike Swenson

Exposing software engineering students to newest industry practices and latest research and theories allows them to acquire and maintain the technical skills necessary to continually adjust to the rapid changes that occur in technology. Close interaction with industry members help the university and engineering programs identify real-world problems and their solutions and incorporate them into the curriculum. Software engineering capstone projects require the development of major software products and are usually either industry-generated or research-based. They are either assigned for the overall supervision of one instructor or each project is supervised by different instructors independently. In this paper, the authors present a case study in which the software engineering capstone projects have been team-coordinated by two instructors: one full-time faculty and one part-time faculty (full-time industry practitioner), thus combining two complementary sets of skills towards the mentoring of the software engineering students. Two capstone projects (one industry-generated and the other research-based) are also presented with the contribution of each instructor described.

Session F4D: Research, Technology and Resources for Global Engineering Education
Chair: Claudio da Rocha Brito, Council of Researches in Education and Sciences
Time and place: Friday, October 24, 3:30 pm. - 5:00 pm. Broadway 3

FUTURE OF DISTANCE EDUCATION THROUGH EHEA
Manuel Castro, Antonio Colmenar and Juan Peire

This article provides with updated information of the implementation of new Learning Technologies in the Engineering Education inside the new European Higher Education Area that is evolving to allow a new framework of University education inside Europe. The article shows the way developed from early distance institutions to on-line learning changing concepts from class and mail learning to blended learning and ubiquitous learning that are challenging our Learning Space with a new set of services that are improve learning capabilities. It has taken a step closer to this evolution personalized and closed the user, based on learning by services. The new learning concept (s-learning), which continues with the philosophy of re-usable educative objects to create encapsulated and re-usable educative services to be easily integrated in Learning Management Systems. In broad terms, this new e-learning philosophy is described through several examples of advanced services that can be integrated into a Learning Management System.

EVOLVING MODELS FOR GLOBAL MEDICAL TECHNOLOGY EDUCATION
Perry Sprawls

The application of advanced technology in the field of medicine, especially for imaging, is expanding rapidly in the developing countries of the world. The effective and safe use of this technology requires up-to-date knowledge of science and engineering characteristics at the local level. Projects providing open shared resources have been developed that utilize digital technology to create high-quality educational media and materials and make them available in the developing countries as free and open resources. The Physical Principles of Medical Imaging Online provided by the Sprawls Educational Foundation (SEF) at http://www.sprawls.org/resources, combines visuals for classroom discussions, self-study modules, online textbook, and a curriculum guide with outlines and learning objectives. It is designed to be incorporated into courses in local institutions and to be used by individual practicing professionals. The Virtual Library of the American Association of Physicists in Medicine (AAPM) is available to engineers and scientists in developing countries as an open resource through the web site http://www.aapm.org/international, providing over 100 courses on the latest applications of radiation oncology, medical imaging, and related topics. These two programs are examples of evolving models designed to enhance health care in the developing countries with effective and affordable learning opportunities.

ADVANCING GLOBAL CAPACITY FOR ENGINEERING EDUCATION RESEARCH: PRELIMINARY FINDINGS
Maura Borrego, Brent K. Jesiek and Kacey Beddoes

Advancing the Global Capacity for Engineering Education Research (AGCEER) is a joint initiative by the European Journal of Engineering Education (EJEE) and the Journal of Engineering Education (JEE). The purpose is
to significantly advance the global capacity for engineering education research. A series of moderated interactive sessions are being offered at international engineering education conferences between July 2007 and December 2008. In these sessions, participants discuss what constitutes engineering education research, who is and should be involved, and what infrastructure is required to sustain engineering education research. To date, AGCEER sessions have been held at regional engineering education conferences in Europe, Hong Kong, Australasia, and at the ASEE Global Colloquium in Turkey. Future sessions are planned for Europe, the United States, Russia, Brazil, South Africa, and India. Transcripts of completed sessions were analyzed using qualitative, open coding methods. Common themes across all these sessions were (a) the need for more rigorous engineering education research, (b) improving resources and recognition for engineering education researchers, and (c) getting research results into the hands of practitioners. Variations across countries and regions include who is engaged in engineering education research (e.g., faculty, administrators, policymakers), their levels of activity, and their interest and expertise in engineering education research. Our analysis includes some background on engineering education in each of these regions to help explain variations in the current state of research efforts.

**WORK IN PROGRESS - DEVELOPING JOINT DEGREES THROUGH E-LEARNING SYSTEMS**  
Sandra Aguirre, Juan Quemada and Joaquín Salvachúa

The development of Joint Degrees is an important mechanism for opening higher education systems nationwide, adapting them to the international standard, and promoting quality assessment to a broader environment. Since e-Learning systems covers a wide range of academic programs, and as joint degrees such as e-Learning are rapidly growing trends, finding a suitable solution that enables universities to design joint degrees through their own e-Learning systems becomes necessary. This paper introduces the design of a federated service-oriented architecture, which through collaboration agreements, will allow the development of new curricula and the participation in the unstoppable process of globalization.

**CREATING TRANSPARENCY FOR MUTUAL RECOGNITION IN TECHNICAL TEACHINGS THROUGH INTERNAL QUALITY ASSURANCE SYSTEMS**  
Edmundo Tovar and José Carrillo

The European Higher Education Area with its 40 states is an example of diversity of political systems, higher education systems, socio-cultural and educational traditions, languages, aspirations and expectations. In the light of this diversity and variety, technical universities set its face to develop their internal quality assurance systems according to the European standards and the guidelines, focusing more on what should be done than how they should be achieved, but also to different factors and sources. This paper defines and applies a process that, taking into account both standards and particular sources, obtains quality policies adequate to the technical teachings, including engineering accreditation, programs, funding programs or improvement plans. The presentation is showed with a practical case as part of the elaboration of the Quality Manual of a Spanish Engineering school.

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**Session F4E: Web-Based Learning**

Chair: Asad Azemi, The Pennsylvania State University

**CLASSIFICATION OF LEARNING PROFILE BASED ON CATEGORIES OF STUDENT PREFERENCES**  
Luciana A. M. Zaina and Graça Bressan

In an environment applied in engineering teaching, as in many knowledge areas, is very important to know and understand learner differences in a way to be able to adapt system's actions to student's best learning conditions and aptitudes. Working thus makes it possible to identify learning profiles within a group of students, allowing the system to supply learners with contents and tools more suited for them. The goal of this work is to present the architecture of a system that realizes an evaluation of learning profiles based on categories of student preferences. The categories are defined from Felder-Silverman Learning Style Model. The architecture enables the teacher to specify the observable characteristics he considers most suitable within the teaching scope in question, whose characteristics are related with categories of student preferences. Through the categories create a relationship between what is observed and the learning objects used to build automatically the learning scenarios according to the student learning profile.
THE EFFECTIVENESS OF COLLABORATIVE TECHNOLOGIES IN REMOTE LAB DELIVERY SYSTEMS
Joe E. Ashby

The remote lab is an innovative approach in engineering and technology education which allows learners to access traditional laboratory facilities through on-line connections which use Internet interfacing technology. While simulations are important instructional tools, they do not fully emulate the lab learning environment. The validity of the on-line lab approach was validated in 2002 when ABET published draft standards for on-line lab sessions. Collaboration, namely students working in teams on lab exercises, is a key ingredient in creating an effective lab experience. While work continues globally on development, a definitive approach does not yet exist for the design of virtual collaborative learning methodologies. Accordingly, the design of remote lab delivery systems that foster and support virtual or social presence is an important issue as this technology continues to advance. This paper reviews the pedagogical basis for presence and collaboration in the remote lab environment and presents summary data from research involving the usability and performance of commercially available web collaboration tools to deliver remote lab learning experiences. The remote lab involved in the study allows students to execute lab exercises on industrial automation equipment including educational robots, programmable logic controllers, and associated peripheral hardware and software.

WORK IN PROGRESS: IGRAPHS FOR CHARACTERIZATION OF ONLINE COMMUNITIES
Alvaro Figueira and Joanne Laranjeiro

The general available tools for analyzing interactions in online discussion forums appear to be insufficient to characterize groups of medium/large dimensions, as they are limited to provide general information of participation, access statistics and message posting. Our research contributes for analyzing and characterizing asynchronous online interactions applying the Social Network Analysis methodology, by providing e-learning platforms with an interactive graph the iGraph that illustrates, and analyses, students interactions. In a graphical interface embedded in an open source learning management system we combine real-time graphs and numerical indicator to provide the educator with a more thorough understanding of relations between course participants. Preliminary results indicate that the iGraph enables an insightful characterization of the interactions between actors and their participations in discussion forums.

FORMING COMMUNITIES IN WEB-BASED EDUCATIONAL SYSTEMS THROUGH USERS’ PREFERENCES AND INTEREST MEASURING
Reginaldo Aparecido Gotardo, Cesar Augusto Camillo Teixeira and Sergio Donizetti Zorzo

Service customizing in Web-based Educational Systems aims at directing content and teaching strategies towards students’ individual and group needs. This paper presents a virtual learning community forming approach, which helps knowledge exchange among its members. The approach here presented uses implicit and explicit information collection of users’ interests and preferences and relates the values in a correlation among the users. The correlation measuring ends up in groups with distinct characteristics. The proposal presented is validated by case study and it shows that from correlation values among the users in the interest and preference items, a group algorithm results in the formation of the intended groups. The results among interest and preference correlation were compared and assessed.

RESEARCH ON THE INFLUENCE OF COMPUTER NETWORK SUPPORTED COOPERATIVE LEARNING ON SENTENCE CONSTRUCTION SKILLS OF ELEMENTARY SCHOOL STUDENTS
Tzu-Hua Huang, Yuan-Chen Liu and Wei-Ti Hsiao

This study concentrates on the improvement of students’ sentence construction skills from using the sentence construction learning website, which is based on computer network, supported cooperative learning. Nonequivalent pretest-posttest control group design was adopted in this research. Different sentence construction learning methods served as independent variables, while discussions focused on their effects on dependent variables, such as use of words and punctuation, wrong words, predicates, and rhetoric ability. After both the experiment group and the control group took the sentence construction pretest, the teacher divided the students into heterogeneous groups according to results of the assessment, and the groups started a sentence solitaire activity. The result indicated that after using the website, students in the experimental group showed significant improvement in use of words punctuation, adjectives, adverbs, similes and metaphors.
CROSSING DISCIPLINARY BORDERS: A NEW APPROACH TO PREPARING STUDENTS FOR INTERDISCIPLINARY RESEARCH

Kathryne M. Drezek, Deborah Olsen and Maura Borrego

This paper presents a research-based developmental model to aid faculty in developing interdisciplinary graduate curricula. The model progresses from the recognition of disciplinary boundaries to the integration of multiple disciplinary approaches, and finally to a meta-cognitive stage in which graduate students were able to self-consciously reflect on the knowledge construction process within and outside of engineering. The model was developed using assessment data from student and faculty interviews, surveys and productivity reporting. Analysis was grounded in the qualitative methodologies of the social sciences. The setting is the EIGER program at Virginia Tech, which aims to reshape the graduate experience for engineers by complementing traditional discipline-based study with a program explicitly designed to foster in students the interdisciplinary and team-based knowledge and skills that are fundamental to successful collaboration. The findings of this study may have significant implications for efforts to reshaping and enhance graduate engineering curricula.

THE VIRGINIA PARTNERSHIP FOR NANOTECHNOLOGY EDUCATION AND WORKFORCE DEVELOPMENT

James F. Groves

The University of Virginia (UVA) has partnered with universities in Virginia for the sharing of graduate nanotechnology courses by distance learning technology. With the other schools, UVA has developed a four semester sequence of shared courses. The program provides students at the schools and at companies with access to a broader set of nanotechnology course offerings than previously available. The program shares several types of courses. Some courses were previously available only to students at one institution because the only faculty expert was resident there. Some courses were previously common at all institutions but consuming significant faculty resources, with faculty teaching just a few students at their institution. Now, new courses are being developed, team-taught courses are being offered, and fully on-line courses are becoming available. While opening educational opportunities, this program has challenged the participants. Faculty are being asked to alternate teaching assignments with colleagues at other institutions. Departments are being asked to accept instruction from faculty at neighboring institutions. On-campus students are being asked to take classes offered over the commodity internet. Working engineers are grappling with the challenge of taking graduate courses while working full time jobs. These challenges and some proposed solutions will be discussed.

WORK IN PROGRESS - MENTORING UNDERGRADUATE STUDENTS PREPARING FOR GRADUATE STUDY IN ENGINEERING-A CREATE CASE STUDY

Lane Thames and Randal Abler

This paper discusses the Collaborative Research Experiences in Advanced Technology and Engineering (CREATE) undergraduate research program and observations made during the first phase of this case study. CREATE is a program that targets undergraduate students from non-research based universities who are interested in pursuing graduate study in engineering. CREATE is a short-term project that takes place during the summer semester. Since it is a short-term project and the students have little experience with engineering research, the authors posit that a research environment that conforms to the student’s incoming skill-set is needed so that the time needed for the student to learn the experimental environment can be reduced. A solution to this need is the introduction of a rapid research and development environment using software plugin architectures.

THE GRADUATE TEACHING ACADEMY: IMPLEMENTING GRADUATE LEARNING COMMUNITIES

Kenneth E. Viall, Jiyeon Kim and Debra Fowler

The Graduate Teaching Academy at Texas A&M University has provided a graduate student learning community across all academic disciplines focused on preparing students for future faculty positions. PhD candidates in Science, Technology, Engineering, and Mathematics constitute the majority of program participants. Participation statistics
and surveys during the 2005, 2006, and 2007 academic years indicate that program participation has doubled and student retention has improved based on the establishment of learning community groups led by experienced graduate students in the early stages of each program cycle. Senior graduate students in the second level learning community plan, implement, and assess the overall program as an academic unit and participate in Center for Teaching Excellence programs, courses offered through the Center for the Integration of Research, Teaching, and Learning network, and teaching as research projects with faculty mentors.

**INTEGRATING GRADUATE AND UNDERGRADUATE EDUCATION WITH REAL WORLD PROJECTS**  
Bradley Perrin, Amy Thompson, Cyrus Agarabi and Valerie Maier-Speredelozzi

This paper discusses three case studies where graduate students worked alongside undergraduate students on projects suggested by local companies. In the first case, graduate students were assigned to work in teams with undergraduate students, and later continued the project to fulfill both company expectations and publication of a conference paper. In the second case, a graduate student who had previously completed a course continued working with the instructor on a thesis with an industry case study. The master’s student proposed the involvement of a new student team the next time the course was offered, and the team worked in a separate, but related area of the company. In the third case, a senior graduate student became the teaching assistant instructor for an undergraduate level course. A company project was used to fulfill graduate student independent study credits, as well as a team project for the undergraduate course. The educational advantages and benefits of these models for undergraduate students, graduate students, and faculty advisors will be discussed in this paper.

**Session F4G: Panel Session - Pen-based Computing in the Engineering and Science Classroom: Implementation Scenarios from Three Institutions**

Chair: Julia Williams, Rose-Hulman Institute of Technology  
_A time and place:_ Friday, October 24, 3:30 pm. - 5:00 pm. _Alabama_

**PANEL SESSION - PEN-BASED COMPUTING IN THE ENGINEERING AND SCIENCE CLASSROOM: IMPLEMENTATION SCENARIOS FROM THREE INSTITUTIONS**  
Archana Chidanandan, Patrick Ferro, Jeff Frolik, Maki Hirotani, Kathy Schmidt, Deborah Walter and Julia Williams

As digital ink technology continues to make an impact on the technical classroom, faculty members are exploring the different strategies for using this technology to improve student learning. The purpose of this panel is to demonstrate how faculty members are implementing this technology in engineering and science classrooms at three different institutions: Rose-Hulman Institute of Technology, University of Texas at Austin, and University of Vermont. The panel is designed to show both experienced pen computing users and those who are new to the field the different ways this versatile technology may be employed. In addition to the demonstrations, the presenters will discuss the pedagogical implications that result from the implementations. Faculty who are interested in both the pedagogy and assessment of pen-based computing in the classroom should find the session informative and useful.

**Session F4H: Assessing and Understanding Student Learning**

Chair: Debbie Chachra, Franklin W. Olin College of Engineering  
_A time and place:_ Friday, October 24, 3:30 pm. - 5:00 pm. _Whitney_

**WORK IN PROGRESS - PROGRAMMING MISUNDERSTANDINGS DISCOVERING PROCESS BASED ON INTELLIGENT DATA MINING TOOLS**  
Paola Britos, Elizabeth Jiménez Rey, Dario Rodriguez and Ramon Garcia-Martinez

We present research work in progress that focuses on data mining tools used for helping teachers to apply a three step knowledge discovering process to diagnose students’ misunderstandings (and their causes) related to their programming errors.
WORK IN PROGRESS - BENEFITS OF COOPERATIVE LEARNING IN A MULTIDISCIPLINARY COURSE
Carlos Álvarez, David López, Daniel Jiménez-González and Javier Alonso

The implementation of multidisciplinary courses presents both a challenging task and a powerful tool due to the students’ different knowledge areas’ contributions. In this paper we present the experience had during a technical course where students from different programs had to cooperate to develop both technical and professional skills. The basis of our proposal was to make students work in pairs formed by students from different programs. They had to use cooperative work and peer-to-peer learning that would allow them to cover the course’s technical and non-technical objectives. Our first results have shown that all students have achieved good learning results despite their different backgrounds.

SCALING UP: TAKING THE ACADEMIC PATHWAYS OF PEOPLE LEARNING ENGINEERING SURVEY (APPLES) NATIONAL
Krista M. Donaldson, Helen L. Chen, George Toye, Mia Clark and Sheri D. Sheppard

The Academic Pathways of People Learning Engineering Survey (APPLES) was deployed for a second time in Spring 2008 to undergraduate engineering students at 21 American universities. The goal of APPLES was to corroborate and extend findings from the Academic Pathways Study and the first deployment of APPLES (Spring 2007) on factors that correlate with persistence in engineering on a national scale. This set of deployments, which surveyed over 4,500 students, was among the largest and broadest cross-sectional surveys focusing on undergraduate engineering ever undertaken. Because there was no readily-available list of undergraduate students attending American institutions studying and intending to study engineering, we sampled by institution using institutional characteristics such as Carnegie 2000 classification. In seeking participation by a broad range of institutions, we recognized the need to vary the target student strata for recruitment by institution. In this process paper, we present an overview of our institutional sampling, discuss our student sampling and recruitment, and report response results. We extend our lessons learned from deploying the online survey at four institutions to 21 institutions, including coordination with local campus coordinators, IRB requirements, subject recruitment and deployment to build on the model for conducting survey design and research for engineering education researchers.

ASSESSING STUDENT LEARNING IN TECHNOLOGY ENTREPRENEURSHIP
Angela M. Shartrand, Phil Weilerstein, Mary Besterfield-Sacre and Barbara M. Olds

Driven by changes in the global economy, entrepreneurship has grown rapidly as a curricular focus at many engineering schools in the U.S. Nonetheless, defining appropriate content and assessing how these educational experiences impact student learning has not yet been accomplished. To address this need, we have developed two tools to assess the educational outcomes of entrepreneurship courses and programs among engineering students. The first tool, the NCIIA Entrepreneurship Inventory, measures students’ self-reported familiarity with technology entrepreneurship terms and concepts, has been piloted at eight schools, and shows high reliability. The second tool is a rubric that provides a framework for analyzing higher-level entrepreneurial thinking in more advanced undergraduate and graduate students. The rubric was derived empirically from student responses to two brief technology start-up cases, and was piloted at four NCIIA member schools. Discussion will focus on the results and implications for future development of assessment tools in technology entrepreneurship.

COMPARING THE EFFECTIVENESS OF EVALUATING PRACTICAL CAPABILITIES THROUGH HANDS-ON ON-LINE EXERCISES VERSUS CONVENTIONAL METHODS
Isabel García, Alfonso Duran and Manuel Castro

Two interrelated methodological transformations involved in the current transition of European universities towards the European Higher Education Area (EHEA) are the role of applied capabilities and the evaluation process. In this context this paper presents the results of a structured comparison, throughout a five course period, of the impact of alternative evaluation methods in courses aimed at the development of applied engineering capabilities. The comparison perspective is twofold: how accurately does the evaluation method measure the competence level attained by the students, and how does it affect their active learning. The experiment was conducted in a simulation course from the Industrial Engineering curriculum and the aim was the evaluation of the capability of using a simulation software. Evaluation was traditionally based on a written final exam and two other evaluation methods were then introduced: Computer exam and team project assignment. The assessment of the evaluation methods was carried out by both faculty members and students (through anonymous surveys). Results suggest that both group
assignments and computer exam perform far better, in this environment, than written exams. The comparison between group assignments and computer exam is less straightforward, being dependant on which criterion is being appraised.

**Session F4J: Special Session - Increasing Awareness of Issues of Poverty, Environmental Degradation and War within the Engineering Classroom: A Course Modules Approach**

Chair: George D. Catalano, State University of New York at Binghamton

*Time and place: Friday, October 24, 3:30 pm - 5:00 pm.*

*SPECIAL SESSION - INCREASING AWARENESS OF ISSUES OF POVERTY, ENVIRONMENTAL DEGRADATION AND WAR WITHIN THE ENGINEERING CLASSROOM: A COURSE MODULES APPROACH*

George D. Catalano, Caroline Baillie, Dean Nieusma, Margaret Bailey, Donna Riley, Katy Haralampides, Chris Byrne and Michelle Bothwell

The goals of the proposed special session are the following: (1) Describe ongoing efforts at various institutions which attempt to integrate the issues of poverty, environmental degradation and war into existing engineering courses; (2) Describe process(es) used in developing course modules; (3) Provide an interactive, experiential process whereby the session participants will begin to develop their own course modules for use in their respective courses; (4) Further develop a community interested in increasing awareness of issues of poverty, environmental degradation and war within engineering education and the engineering profession; and (5) Explore options for establishing closer ties between the course modules and real-world community agencies/organizations.
META-ANALYSIS OF EFFECTIVENESS OF TECHNOLOGY USE IN UNDERGRADUATE ENGINEERING EDUCATION

Georgette M. Michko

The purpose of this study is to synthesize recent quantitative research on the effects of teaching and learning with technology on student outcomes in undergraduate engineering education. An extensive search of 26 engineering education journals and 10 electronic databases included a review of 21,353 articles and yielded 45 studies that met all the search criteria. Representing over 11,700 students, these studies reported 123 outcomes for which effect sizes were calculated. Although empirical evidence in the engineering education literature is very limited as indicated by the small number of studies qualifying for this meta-analysis, the combined effect size indicates that technology has a moderate, positive impact on cognitive student outcomes. The combined weighted effect size across all outcomes is 0.433 with a standard error of 0.067 and a 95% confidence interval from 0.302 to 0.564. No characteristics of the technology, methodology or instruction were found to have a significant impact on the overall effect size, although this may be partially due to a lack of sufficient detail in the primary study reports. This study represents a significant contribution to engineering education by synthesizing quantitative reports on the effect of educational technology on student outcomes.

LESSONS LEARNED FROM THE FIRST-TIME USE OF TABLET PCS IN THE CLASSROOM

Micah Stickel and Sean V. Hum

The tablet PC (TPC) is quickly becoming a widely used tool for engineering education. However, as with any new education initiative, care must be taken to introduce this properly. This paper will present the lessons learned from the experiences of two first-time TPC users in the Electrical and Computer Engineering Department at the University of Toronto. The courses were a second-year differential equations & algebra course, and a third-year electromagnetic waves course. To evaluate the effectiveness of the TPCs the same survey was given to both classes, with a total of 129 responses. Generally, these students strongly supported the use of the TPC, however, as this paper will show, caution must be exercised when incorporating the TPC into the classroom. This is evident by considering how the popularity of the TPC as a learning tool is correlated with the types of learners present in the class. In most of the literature dealing with TPCs, no such correlation is presented, but as the results of this survey show, it is an important relationship to consider. In this paper we will summarize our approach for using the TPC, present the results of the survey, and discuss some lessons learned.

A STUDY OF STUDENT ATTITUDE TOWARDS MEDIA BASED INSTRUCTION IN INTRODUCTORY ENGINEERING COURSES

Jean-Claude Thomassian, Anoop Desai and Patrick Kinnicutt

In this paper, Media Based Instruction technique is used to enhance student understanding of engineering fundamentals. It also seeks to examine the effects of technology based instruction in order to complement conventional instruction. This progress as well as lessons learned in the first two semesters of Media Based Instruction in introductory engineering courses namely Circuits, Electronics, and C++ for digital computation is evaluated and some statistics are offered. Pilot study: A concluding section assesses the advantages of complementing conventional instruction with Media Based Instruction.

A STUDY ON THE INFLUENCE OF ONLINE OFFICE INSTRUCTIONS ON MOTIVATION AND EFFECTS OF INFORMATION LEARNING IN ELEMENTARY SCHOOL STUDENTS

Tzu-Hua Huang, Yuan-Chen Liu, Chir-Neng Hung, Chih-Chang Chang and Wan-Ting Yen

In recent years, computer courses in Taiwan’s elementary schools are limited to learning Microsoft Office on a single machine. Therefore, the main purpose of this study is to identify the influence of Online Office Instructions on motivation and effects of information learning in elementary school students. This study also discusses differences in motivation and effects of information learning for students with different interpersonal relationships and the
feasibility of applying Online Office Instruction in elementary school computer courses. Quasi-experimental research was adopted in this research. Four classes were chosen from the fifth grade. Two were assigned as the experiment group, learning Microsoft Office online. The other two classes served as control groups and learned Microsoft Office on a single machine. The experiment lasted for six weeks and the content of the instruction were Basic concepts of Excel and Beautifying your class schedule. The research tools include Online Office software, Learning motivation scale, Office learning evaluation sheet, and interpersonal interaction scale sheet of web/real life behaviors. The participants took the interpersonal interaction scale sheet of web/real life behaviors first, followed by Learning motivation scale, Office learning evaluation sheet as pretests. After the experiment, the subject participants took Learning Motivation scale and Office learning evaluation sheet as posttests. The results above were analyzed by using independent-samples T-test and two-way ANOVA. The results indicate that: 1. Online Office Instructions significantly improved learning motivation and learning effects of elementary school students. 2. Noticeable differences were observed in learning motivation and learning effects among students with different interpersonal relationships that received different Instruction courses. 3. Online Office learning courses proved to be feasible for elementary school computer courses.

USE OF EAC IN LEARNING DIGITAL SYSTEMS

Marta Prim, Joan Oliver and Vicenç Soler

In electronic circuit subjects it is very important that students practice their exercise with analysis and synthesis of circuits in order to acquire knowledge, skill and competences. Usually, students are poorly motivated and thus problems classes get reduced to the professor giving the solution to the set problems. Students' only mission is then to copy the information from the blackboard without having to study, develop or think about the problem. In this paper, we present the use of an interactive docent tool, Educlick, which has been adapted to these problems classes [1-3]. Educlick is based on the use of electronic answer remote controls (clickers). The classes are wholly directed. The experience is done in the subject of Digital Systems of Computer Science at the Universitat Autònoma of Barcelona. The objective is to increment students' participation in class and thus improve their learning of the design of combinational and sequential digital systems.

Session S1B: Laboratory Experiences 3

Chair: Victor P. Nelson, Auburn University

Time and place: Saturday, October 25, 8:00 am. - 9:30 am. Broadway 1

WORK IN PROGRESS - BALANCING PRESCRIBED AND PROJECT-BASED EXPERIENCES IN MICROFABRICATION LABORATORIES

Chang-Soo Kim and Steve E Watkins

Student education for microfabrication processes needs to integrate theoretical understanding with process understanding. Instructional challenges exist in designing effective laboratory experiences. The pedagogical issues include linking theoretical lecture concepts to cost-effective laboratories, tailoring the relative time between lectures and laboratories, and balancing the laboratory assignments between prescribed and project-based experiences. We describe the progressive implementations of microfabrication laboratory experiences in graduate courses. The first offering has no laboratory activity. The prescribed laboratory and project-based laboratory components were gradually incorporated. All laboratory experiences were team-based and utilized cost-effective facilities. The assessments indicate that students prefer significant laboratory experience and that learning of selected lecture concepts is enhanced through an interactive environment. Furthermore, observations are made concerning the effective balance of lecture and laboratories and of prescribed and project-based experiences.

A LABORATORY PLATFORM FOR TEACHING COMPUTER VISION CONTROL OF ROBOTIC SYSTEMS

Lelio R. Soares Jr. and Victor H. Casanova Alcalde

Nowadays, due to the involved complex issues, teaching robotics is demanding new methodologies. One of the complex issues regarding robotics is the use of computer vision for a proper robot guiding control. At the University of Brasilia an educational robotic workstation around a Rhino XR4 robot was built. Students can perform experiences on kinematics, trajectory generation and motion control. A new controller was further designed to introduce motion control by visual servoing. These new laboratory experiments allow implementation of various vision-based control schemes: position-based (3D), image-based (2D) and hybrid (21/2D). For visual servoing simulation experiments a
robot wire-frame modeling scheme simulation RobSim was developed within the Matlab environment. The simulation environment is flexible regarding parameter adjustments for robot, camera, targets and workspace. As the simulation experiment becomes satisfactory, the experiment can then be performed with the robotic workstation. Primitive functions built on Matlab allow modeling and simulating a large class of manipulators.

**TOWARDS CONSTRUCTIVIST LABORATORY EDUCATION: CASE STUDY FOR PROCESS CONTROL LABORATORY**  
Mahmoud Abdulwahed and Zoltan K. Nagy

Laboratory education is an integrated part of engineering and science degrees. Many research papers refer to poor constructivist learning during the laboratory sessions, indicating the need for reforming the laboratory education in a way that facilitates constructivist learning as well as conceptual understanding. In this paper we present a model of conducting laboratories, based on the well known Kolb’s experiential learning cycle, implemented with recent available technologies, and applied to an undergraduate process control lab. There are four main stages in Kolb’s model, namely: concrete experience, reflective observation, abstract conceptualization, and active experimentation. To implement these stages, the hands-on lab is conducted in conjunction with supplemental activities such as experiments performed in the classroom remotely through the internet, using virtual lab and preparation sessions, and conducting pre and post lab tests. The paper presents how the supplemental activities are mapped with Kolb’s cycle to promote the constructivist laboratory education. The quantitative analysis showed reasonable enhancement of learning outcomes of the experimental groups compared with the control group. The paper presents a novel model of conducting experiential education based on well known pedagogical approach facilitated with recent information and communication technology (ICT) developments.

**TELELAB - REMOTE AUTOMATIONS LAB IN REAL TIME**  
Manuel E. Macias and Israel Méndez

Automation is rapidly evolving, having a profound impact in the way we do work. Such development and the rapid integration of automation systems into most of the engineering processes call for constant, efficient training into automation and control systems. However, this kind of equipment is very expensive, constantly limiting both universities and private companies to have training facilities that are not widely available or, definitely, to not being able to have these facilities at all. The present paper establishes a scheduling/connection scheme for real remote automation laboratories based in common automation protocols for connection, image acquisition systems, and their publication for remote access in real time, interconnecting all the elements by a server, reducing the needed space for traditional automation laboratories, the staff needed to operate it, and the overall cost of equipment required, as well as allowing the lab practices to be customizable.

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**Session S1C: Promoting Effective Learning Communities**

Chair: Maggie Pollock, University of Glasgow  
*Time and place: Saturday, October 25, 8:00 am. - 9:30 am. Broadway 2*

**WHAT STUDENTS KNOW ABOUT STATICS: SPECIFIC DIFFICULTIES COMMON AMONG STUDENTS ENTERING STATICS**  
Jeffrey L. Newcomer and Paul S. Steif

To gain insight into the specific difficulties exhibited by students as they enter Statics, we analyzed students explanations to concept questions students completed as Warm Up exercises at the beginning of Statics. Students completed four questions as part of three Warm Up exercises on free body diagrams, equilibrium, and equivalence. Students did exhibit some common specific difficulties, and those difficulties are influenced by context. For free body diagrams the most common specific difficulty is the inclusion of an internal force, especially for problems involving ropes. For equilibrium problems students are likely to not consistently apply both force and moment equilibrium. Finally, for equivalence problems students are most likely to try to maintain a specific point of rotation for the body.
CLASSROOM DEMONSTRATIONS WITH MULTIPLE MODES: VIRTUAL + REALITY = ENHANCED LEARNING

Luciana R. Barroso, Jim Morgan and Nancy Simpson

Demonstrations can be very effective at engaging students, generating interest in a topic, and enhancing student learning. Demonstrations can occur at three different stages of a course topic: as an introduction, as a wrap-up and an aid used throughout the class discussion of a topic. A key component to an effective demonstration is active student engagement throughout the entire process. This means students are involved in discussing the purpose of the demo; predicting what will happen during the demo; discussing who developed theories to help us understand what happens during the demo; and comparing observations to predictions, as opposed to simply passively watching a demonstration. This paper presents a model for infusing demonstrations into an engineering science class and the use of this model during a semester. Demonstrations in this class incorporate both software simulation and physical models of dynamic systems. While physical models provide a concrete example, computer simulations allow the exploration of ‘what-if’ scenarios and greater meta-cognitive activities. Assessment includes components from both faculty and students.

WORK IN PROGRESS - A STUDY OF THE EFFECT OF INSTRUCTIONAL MEDIA IN AN UNDERGRADE ELECTRICAL CIRCUITS COURSE

Xiaoyan Mu, Deborah Walter and Carlotta Berry

Studies have demonstrated that instructional media play an important role in instructors teaching and students learning. The purpose of this study is to assess the students preferences for different instructional media and the impact of different instructional media on the students’ learning and course-related behavior in an undergraduate electrical circuits course. The instructional media under study are: Computer-based PowerPoint presentation, whiteboard only, combination of PowerPoint and whiteboard and combination of printed handouts and whiteboard. In this study, nine sections of Introduction to Electrical Circuits sections were taught by 6 instructors using different instructional media. All the instructors used a common syllabus, labs, homework, and tests. Two midterm exams and one final exam were used to assess the learning effectiveness of different instructional media. At the end of the quarter, a questionnaire was collected from participating students to measure their preference for the instructional media. To understand the course related behavior, each of the instructors were asked to assess their students’ behavior in terms of attendance, amount of classroom interaction, percent of homework completion and web logins.

PROMOTING SOCIAL NETWORKS AMONG COMPUTER SCIENCE STUDENTS

Kathrin Figl, Sonja Kabicher and Katharina Toifl

The main scientific aim of this study was to investigate how Computer Science students regarded their social networks among study colleagues. The study was conducted at the Research Lab for Educational Technologies (University of Vienna) in order to find connecting factors for improving students’ networks by means of curricular design as well as in single courses. Social Networks drawings and accompanying detailed descriptions provided by students were analyzed according to network analysis measures and set into relation with qualitative content analyses. Additionally qualitative interviews on how course instructors can foster social networks among students were conducted. Empirical results show that university courses provide good opportunities to build networks among students. As expected, students are more likely to experience a supporting network if they have more contacts as well as stronger ties to those colleagues. Furthermore, our results clearly indicate that virtual communication via e-mail or chat plays a significant role in maintaining contacts among study colleagues. Finally, there is reflected the influence of students’ habits to communicate via new media upon their social networks as well as upon the didactical concept of university courses.

EXPERIENCES IN SIMULATION-BASED EDUCATION IN ENGINEERING PROCESSES

Hugh McManus and Eric Rebentisch

The Lean Advancement (formerly Lean Aerospace) Initiative at MIT has applied lean business processes to the Aerospace Industry. The material has proven difficult to teach to engineers, as it is empirical and based on processes founded on human interactions, not scientific and based on mathematical and physical laws. Simulation-based education has proven highly effective in getting past this barrier. Design of a number of pedagogical simulations, and experience with both professional and student audiences are discussed. Data is available to evaluate both a manufacturing simulation and a full simulation of an aerospace enterprise and its supply and engineering chains.
which capture enterprise interactions. Good data on student satisfaction and perceived outcomes, and lower-quality data on some directly-measured outcomes, support the idea that simulation-based education is highly effective in this challenging situation.

Session S1D: First Year Courses 3
Chair: Jenni Light, Lewis-Clark State College
Time and place: Saturday, October 25, 8:00 am. - 9:30 am.

**WORK IN PROGRESS - A FRESHMAN ENGINEERING COURSE DESIGNED TO CONVEY THE ESSENCE OF THE ENGINEERING PROGRAM AT JAMES MADISON UNIVERSITY**

Robert Prins, Olga Pierrakos, Eric Pappas and Ronald Kander

James Madison University has established a School of Engineering commencing in fall 2008. Students will earn Bachelor of Science degrees in Engineering. The curriculum features a broad base of humanities coursework to accompany the traditional math, science, and engineering courses. The curriculum also features integrated business courses, a six semester sequence of Engineering Design courses, and a sustainability focus. The engineering program is designed to meet ABET criteria and prepare students for the Fundamentals of Engineering Exam. The introductory course is designed to be representative of the program content, teaching techniques, assessment techniques, and culture. As such the introductory course will contain material related to social context as well as engineering practice. This paper discusses the content and culture aspects of the introductory course.

**INTEGRATING SOLID MODELING AND COMPUTER PROGRAMMING THROUGH A FRESHMAN DESIGN EXPERIENCE**

Norma Veurink and Jim E. Hertel

Although courses in solid modeling and computer programming are required in many engineering curriculums, students typically study these topics in separate courses. At Michigan Technological University, both of these topics are taught in the same course to meet the first-year engineering program objective of developing proficiency in the use of computers in solving engineering problems. Another objective of the program is for students to understand the design process through a practical, hands-on design experience. Michigan Tech uses these objectives to engage second semester freshmen in engineering design in a unique way. Students are challenged to create an innovative design concept, produce CAD solid models and assemblies to convey their concept, and develop a mathematical model in Matlab to predict the performance of their design. This paper will discuss the design projects used in this first year course to innovatively integrate solid modeling and computer programming throughout the freshman design experience.

**WORK IN PROGRESS - FIRST YEAR ENGINEERING STUDENT RESPONSES ON EXIT SURVEYS AS INDICATORS OF PROGRAM EFFECTIVENESS**

Jim F. Chamberlain, Lisa Benson and Elizabeth Crockett

Improving student retention rates in first year engineering courses is of critical importance, especially considering the one-way migration pattern out of engineering. Our program retains approximately 70% of new students in engineering disciplines. Students who choose to leave engineering by the end of their first year at our institution voluntarily complete a survey with questions regarding their certainty upon entry, motivating factors to enter and to leave engineering, and what appeals to them about their new majors. We have analyzed nearly 400 surveys over a five-year period to examine correlations between reasons for leaving and how students come to that decision, with changes in program resources, specifically refining career information, personality profile assessment, and mastery assessment. Open-ended survey responses were categorized based on concerns about the profession, the curriculum, self-awareness and institutional (or programmatic) issues. Using career theory as a framework, the survey responses were evaluated in light of programmatic changes that have been implemented.

**FIRST YEAR ENGINEERING: EXPLORING ENGINEERING THROUGH THE ENGINEERING DESIGN LOOP**

Douglas Troy, D. Steven Keller, James Kiper and Lei Kerr

Over the past few years, the School of Engineering and Applied Science (SEAS) at Miami University has moved toward the principle of a common first year curriculum for all of our nine majors. A significant component of this
common first year is a one hour course entitled Computing, Engineering, and Society that all engineering and computing students take in the first semester of their freshman year. Herein, we describe a recent revision to this course that allows our students to experience the entire design loop that is fundamental to engineering design. The specific project that we used was the design and construction of a HO-scale model train layout. The key to success, we believe, was not the particular project but the fact that it was sufficiently complex that it required a team of students to work for several weeks using each step of the engineering design loop.

CREATE LEARNING COMMUNITIES TO ENHANCE SUCCESS FOR STUDENTS WITH DIVERSE ACADEMIC PREPARATION BACKGROUND

Edmund Tsang and Cynthia Halderson

Learning communities have been demonstrated to improve student success, particularly for first-time, first-year students making the transition from high school to college. At Western Michigan University (WMU) College of Engineering and Applied Sciences (CEAS), the challenge to creating learning communities is the diverse academic preparation background of the first-time, first-year students, as indicated in the first-semester mathematics placement. Another challenge to creating learning communities is the lack of a common first-year engineering curriculum or core for the 15 undergraduate engineering and applied sciences programs. In addition to student learning communities, the WMU-CEAS program to improve student success and retention includes a faculty learning community and revision of several first-year science, technology, engineering, and mathematics (STEM) courses. In this paper, the details of the process for creating learning communities for students with diverse academic backgrounds will be presented, and the improvement in first-year STEM courses will be described. Preliminary results indicate CEAS students placed in learning communities have a higher successful course completion rate (grade=/>C) of first-year STEM courses than the comparison group of non-learning community students, and the second-year and third-year retention rates to CEAS have improved by about 10% above the historic retention rates of the college.

Session S1E: Degree Programs and Curricula 3

Chair: Maura Borrego, Virginia Polytechnic Institute and State University

Time and place: Saturday, October 25, 8:00 am. - 9:30 am. Broadway 4

WORK IN PROGRESS - AN INNOVATIVE SUSTAINABLE ENERGY ENGINEERING GRADUATE CURRICULUM

Pritpal Singh, Rominder Suri, Alfonso Ortega and Bill Lorenz

Sustainable energy engineering is an important emerging area. A survey of sustainable energy engineering curricula shows a number of programs in Europe and Australia, but very few in the United States. We have started to offer a new Sustainable Energy Certificate program in the College of Engineering at Villanova University and are in the process of developing this into a full Master’s degree program. The certificate program is open to all engineering graduate students and comprises four courses, one offered by each of the departments in the College of Engineering.

WORK IN PROGRESS - AN INTERDISCIPLINARY INITIATIVE IN BIOENGINEERING EDUCATION

Maneesha R. Aluru and Diane T. Rover

The College of Engineering at Iowa State University is initiating a new minor program of study in bioengineering for undergraduate engineering majors. This minor program will introduce students to bioengineering and its applications to agriculture and health sciences, which are of high interest to both students and employers. Students who complete the bioengineering minor will be well-positioned to address engineering needs in the bioeconomy, specifically in the areas of bioinformatics and systems biology, biomechanics, biomaterials, bio micro systems, biobased products and bioprocessing. Core courses are designed to facilitate a holistic understanding of the field rather than compartmentalized introduction to various subfields. Several of the courses will be team taught by groups of two faculty with complementary expertise to bring broad and integrative learning experiences. This interdisciplinary effort will also involve undergraduate research and project experiences that provide opportunities for students to work as part of interdisciplinary teams and broaden their educational and career opportunities. The program will be offered starting Fall 2008.
INTERDISCIPLINARY ENGINEERING: ENABLING STUDENT DREAMS, BROADENING PARTICIPATION IN ENGINEERING, AND INCREASING STUDENT RETENTION
Katie Grantham Lough, Robert B. Stone and Bonnie Bachman

This paper presents the status of the Interdisciplinary Engineering (IDE) degree program at Missouri University of Science and Technology (Missouri S&T), formerly the University of Missouri-Rolla (UMR). The IDE degree was founded in 2005 at UMR to meet the emerging need to provide considerable flexibility to students allowing them to construct programs of study in areas of interest while maintaining a solid and rigorous foundation in mechanics, thermal science, electrical networks and/or systems. Students are able to pursue studying the latest technological fields through a collection of tracks enabled by the flexibility of the curriculum. This modern degree program houses energetic motivated students interested in a variety of disciplines from product design and amusement park fundamentals to industrial automation and control. The first students graduated the IDE program in December 2007. This facilitated the evaluation of IDE’s current status, preparation of its future plans, and sharing these findings with other universities interested in increasing student retention and broadening their demographic of engineering students. This paper presents statistics detailing the students involved in the IDE program, their educational interests inside the program (i.e. track selection), IDE’s budding reputation with potential students as well as its recognition in corporate America and its plans to broaden the popularity of the program. Lessons learned from the curriculum development and implementation will be discussed.

WORK IN PROGRESS - COMPUTING AND UNDERGRADUATE ENGINEERING: A COLLABORATIVE PROCESS TO ALIGN COMPUTING EDUCATION WITH ENGINEERING WORKFORCE NEEDS (CPACE)
Claudia Vergara, Mark Urban-Lurain, Daina Briedis, Neeraj Buch, Jeannine LaPrad, Louise Paquette, Jon Sticklen and Thomas F. Wolff

This NSF-funded community-building (CB) project brings together Michigan State University (MSU), Lansing Community College (LCC), and the Corporation for a Skilled Workforce (CSW) to design and implement a process to create a collaboratively-defined undergraduate computing education within the engineering and technology fields in alignment with the computational problem-solving abilities needed to transform mid Michigan’s economy and workforce. In this WIP we outline the process we are developing to ensure that a wide variety of stakeholders, business, community leaders and post secondary educators collaborate to identify workforce computational skills, define how these skills can be integrated across a curriculum, and develop revised curricula that integrate computational problem-solving across engineering departmental courses. By documenting, evaluating and making the process explicit, this process can serve as a model for national efforts to revitalize undergraduate computing education in engineering, and should be extensible to other computing education reform efforts.

WHAT IS ELECTRICAL ENGINEERING TODAY AND WHAT IS IT LIKELY TO BECOME?
James Roberts, Ken Demarest and Glenn Prescott

This paper takes an introspective look at electrical engineering as it exists today and poses several questions about the future of EE. While traditional EE departments have been adding computer engineering and/or science degrees and expanding their titles to include the word computer, not all students want to do computing beyond what is essential to their specialty. So what is EE, as distinct from computer engineering, and what is its future? We address this question by examining it from the perspective of university EE programs and the needs of industry and society. As a result of our investigation, we also develop a definitional set of broad areas and specialties that define EE, both now and in the future. We conclude with a recommendation to give EE more curb appeal for prospective students. The perception of service to society is important in attracting students. EE has historically been critically important to society. If whatever form EE takes in the future continues to be of critical importance, we need to be able to convey this to prospective students and attract them to the field.
WORK IN PROGRESS - EXPOSING THE COOL STUFF IN C.S.
Michael Leverington, Jennifer Mahon and Yaakov Varol

We report on the goals, activities, and some early results related to a new course that has been implemented in our Computer Science and Engineering (CSE) department. The course is developed to expose students to curricular and career related options available in our department, and to provide them with hands-on experiences in a broad variety of Computer Science areas. To this end, we have provided Computer Science experiences such as problem solving, group and team work, and multiple interactions with the hardware and software components of computers and other technologies. In addition, we have had Professors bring their leading-edge research to the class to show incoming students the exciting activities they could pursue as juniors and seniors, and in their future careers. The course also accepts non-CS students who are exposed to this same "Cool Stuff" with the result that some of them decide to change their major, while all of them come away with a better understanding of what Computer Science really is. Finally, virtually every class activity incorporates some cognitive or metacognitive component that supports student thinking with the intention that they have exercised their higher-level thinking skills by the time they step up to future coursework.

A PROJECT-BASED APPROACH TO TEACHING INTRODUCTORY CIRCUIT ANALYSIS
Andrew Sterian, Bogdan Adamczyk and M.M. Aziz Rahman

We present a project-based approach to teaching an introductory circuit analysis course. Traditional introductory courses emphasize analysis techniques at the expense of instilling an intuitive understanding of the problem and the underlying engineering principles. We propose that an introductory circuit analysis course should teach the inter-relationships of current, voltage, power, resistance, inductance, and capacitance both mathematically and intuitively, since much of practical circuit design is notar and cannot be reduced to circuit analysis problems. The fundamentals of circuit analysis remain important for working with arized models of devices and for developing closed-form solutions that develop intuitive understanding of simple circuits. We describe a revision to our Circuit Analysis I course that balances both the theoretical and intuitive aspects of circuit analysis. We have also introduced a hands-on design project to engage the students in the material and to unify the laboratory exercises. The course project also introduces students to the excitement and breadth of the field of electronics, including a basic understanding of practical devices such as diodes, transistors, oscillators, and amplifiers. We present evidence that this project-based approach has benefits that include increased student interest in electronics and improved student preparation for subsequent courses.

WORK IN PROGRESS - MOVING AWAY FROM AN INTRODUCTORY PROGRAMMING SEQUENCE
Gregory W. Hislop

This WIP describes an effort to create a better starting course sequence for computing degrees. This effort, the EntryPoint project, focuses primarily on the first two years of the undergraduate program. As such, a key aspect of the effort relates to the traditional introductory programming sequence, and an attempt to move beyond that approach. A three dimensional model, CAP (content, application, and process), is used to organize the discussion of introductory courses.

A QUANTITATIVE STUDY OF GUI VERSUS TEXT-BASED OBJECT-ORIENTED INSTRUCTION
Per Andersen and Susan Mengel

Introductory object-oriented programming is considered difficult to teach and a number of different methodologies have been proposed to address this difficulty. One method, which is reported in this paper, involves the use of graphical user interfaces (GUI's). The research question developed for this study is as follows: Does any statistical difference exist in test scores between a control group using text-based object-oriented programming (OOP) and a test group using GUI-based OOP? To answer this research question, quantitative data was collected through the use of common questions on the final CS2 exam for both groups. Data was collected over a period of 3 class offerings for five multiple-choice questions and one question requiring programming. No statistical difference
between the groups was found for either the 5 multiple-choice questions or the open programming question. An analysis of the final CS2 course letter grade showed no significant difference between the test and control groups. Further, students who participated in the first year of the study were tracked through Data Structures, the course which follows CS2 in the curriculum sequence. A statistical analysis of the final letter grade for found no significant statistical difference between control and test groups.

**WORK IN PROGRESS YEAR 2 RESULTS FROM A BALANCED, FRESHMAN-FIRST COMPUTER ENGINEERING CURRICULUM**

Russ Meier, Steven L. Barnicki, William Barnekow and Eric Durant

The Milwaukee School of Engineering replaced a traditional computer engineering curriculum that located the majority of the core computer engineering topics in the final two years of study with a new freshman-first curriculum in academic year 2006-2007. The new curriculum was designed around the 2004 guideline report of the IEEE/ACM Joint Taskforce on Computer Engineering Curricula but took a more aggressive approach by distributing the computer engineering topics throughout all four years of study. The result is a balanced, freshman-first curriculum that presents software, hardware, math, science, and humanities side-by-side for most of the twelve undergraduate quarters. The goals of the curriculum was to improve retention, reduce prerequisite material time gaps, and respond to the industrial advisory committee request for improved soft skills. All three of these goals have been met: first-to-second year retention has improved, large gaps in hardware coverage have disappeared, and a course on teamwork and leadership has been taught for the first time.

**Session SIG: Panel Session - Lean in Engineering Education**

Chair: Jacqueline Candido, Massachusetts Institute of Technology

**Time and place:** Saturday, October 25, 8:00 am. - 9:30 am. 

**PANEL SESSION - LEAN IN ENGINEERING EDUCATION**

Magdy Attia, Phillip Farrington, Alberto Hernandez, Annalisa Weigel and Jacqueline Candido

The concept of using lean six sigma principles to help create more efficient processes is now being applied in engineering. The panel will discuss how lean six sigma thinking is being integrated into educational programs in different disciplines: industrial & systems engineering, and aerospace engineering. Lean techniques are already being applied in corporate engineering and product development projects. This is important because efficient engineering processes are key to ensuring customer value and enterprise success. Furthermore, today’s engineers work on multifunctional teams and need to understand modern process improvement methods to be effective team members. By integrating lean concepts into engineering education curriculum, graduates will be able to approach projects already thinking lean. They will have the potential to implement lean practices upon entering the workforce. Panelists will discuss how engineering programs at colleges and universities are incorporating lean ideas into their curriculum, and why this is important for the future.

**Session S1H: CS Courses and Labs 4**

Chair: Chris Fernandes, Union College

**Time and place:** Saturday, October 25, 8:00 am. - 9:30 am. 

**WORK IN PROGRESS - BUILDING A LEARNING COMMUNITY USING COMPUTER GAMING**

Kent White, Windy Rachal and Roberta Munive

Many universities are interested in integrating interdisciplinary programs. Perhaps a first step is to implement interdisciplinary learning communities into existing curricula. Learning Communities can provide senior level students with pre-professional experience through interdisciplinary projects. Furthermore, seniors are more engaged in their disciplines and capable of the critical thinking required. Several senior classes are currently participating in building a multi-user networking game. Gaming is an ideal theme because it is fun, cross disciplinary and has real-world application. All of the major games currently released are the product of large, multi-disciplinary teams. Nicholls anticipates that replicating that team in a university setting will motivate students and increase learning. Students and faculty will decide the nature of the game, the goals for the class, and boundaries of the assignment. This paper describes current work and plans, so that future educators can replicate and improve upon these processes.
WORK IN PROGRESS - STUDENT-DRIVEN EXTENDED MINI-CASES FOR EE SERVICE COURSES
James R. Rowland

Modern electrical engineering services courses for the other engineering majors have expanded beyond simply providing coverage of basic electrical topics to prepare students for the FE exam. These junior and senior students soon afterwards will also be applying electrical concepts for instrumentation and measurement within their other engineering courses. In Fall 07, 65 civil and architectural students in an EE service course identified the need for mini-cases in the areas of resistance strain gauges, transducers involving capacitors, power systems, and amplifiers. In Spring 08, 125 mechanical and aerospace engineering students in another EE service course focused on force measurements using Wheatstone bridges, digital position encoders, EPROM-based lookup tables, and electronic controllers. A block of material on electrical circuits is common between the two courses. Student-driven mini-cases are being prepared during the summer for class testing during Fall 08, and others will be developed in the fall for Spring 09. Preliminary mini-case details on distinct materials covered in the separate service courses will also be available at FIE 08.

INTEGRATED TEACHING OF PROGRAMMING FOUNDATIONS AND SOFTWARE TESTING
Ellen F. Barbosa, Marco Aurélio Graciotto Silva, Camila Kozlowski Della Corte and José Carlos Maldonado

The importance of software testing is widely recognized, but usually only a small portion of the Computer Science (CS) curriculum is allocated for teaching it. Some experiences have suggested that the teaching of software testing should begin as early as possible so an adequate culture of testing could be created. One way to achieve this is addressing testing practices in conjunction with programming concepts in introductory CS courses. In this paper we explore such idea, working on the integration between the teaching of software testing along with the teaching of programming foundations. We discuss the development of an educational module, and its related learning materials, for integrating such knowledge domains. Besides that, we propose PROGTEST - a Web-based environment for the submission and automatic evaluation of practical programming assignments based on testing activities, aiming at providing an adequate feedback to evaluate the learners' performance concerning programming and testing.

TASK-LIST MANAGER - A CS2 LAB ON ADVANCED GRAPHICAL USER INTERFACE AND DATA STRUCTURES
Joshua Guyette and Wing H. Huen

A lab assignment for CS2 students, first time in a team environment, to design and implement a Task-List Manager with advanced Graphical User Interface in two one-hour labs has been well received. Students had studied list and binary search tree implementations and Java I/O but with minimal knowledge of Graphical User Interface. A student acted as the system architect providing Unified Modeling Language diagrams for design. The Task-List Manager consists of a split-pane on the left side containing a tree (for task-list creation and selection), the right side containing another split-pane with a table (containing the tasks in the selected task-list) in the top side, and a text pane in the bottom for detailed notes of the selected task. Students were required to look up the Java documentation for appropriate classes. The tree may contain folders with nested folders and task-lists with layout adjustable with drag-and-drop. A right click on any folder or task-list produces a popup menu with editing options. Based on student feedback, the success stems from creating a practical product and learning through independently investigating the Java documentation for data structure and graphical user interface classes and hands-on software development in a team environment.

DIGITAL DESIGN AND PROGRAMMABLE LOGIC BOARDS: DO STUDENTS ACTUALLY LEARN MORE?
Thomas Weng, Yi Zhu and Chung-Kuan Cheng

Digital design classes are increasingly using programmable logic devices (PLD) to augment the educational experience. Previous works discuss the advantages of using PLDs, such as Complex Programmable Logic Devices (CPLDs) and Field Programmable Gate Arrays (FPGA), in digital logic design education and highlight the instructor’s experience of integrating these teaching methods in the classroom. This paper instead focuses on the students’ experience to determine the overall effectiveness of using PLD boards. By using statistics from a comprehensive survey that targets student feedback and opinion, and by comparing our class’s final exam scores with a previous class that did not use PLDs, we are able to informatively assess the benefits of using PLDs for digital design education.
Session S1J: Special Session – Prepare Locally to Engineer Globally: Embedding a Global Citizenship Foundation into Engineering Curricula

Chair: Jennifer Karlin, South Dakota School of Mines and Technology

Time and place: Saturday, October 25, 8:00 am. - 9:30 am.

SPECIAL SESSION – PREPARE LOCALLY TO ENGINEER GLOBALLY: EMBEDDING A GLOBAL CITIZENSHIP FOUNDATION INTO ENGINEERING CURRICULA
Jennifer Karlin, Stuart Kellogg and Carter Kerk

Design projects that require engineering students to travel to other countries and semesters abroad have the potential to be very powerful learning experiences for those students. Unfortunately, cost and other constraints keep many students from taking advantage of such experiences and not all of those students who do travel reap the hoped-for gains. The goal of this special session is to discuss the importance of domestic preparation for global citizenry and consider options that are available to engineering departments to not only satisfy the ABET global and societal impact requirement but truly prepare students to be global citizens. This issue is particularly vital for those students who will not have a travel abroad opportunity as part of their curriculum. Aimed at faculty, department chairs, and student support personnel, this special session will address pedagogical options that can be embedded into the curriculum for human dignity, expanding mental models, and achieving complex thinking.

Session S2A: Remote, Virtual and Freshman Laboratories

Chair: Pritpal Singh, Villanova University

Time and place: Saturday, October 25, 10:00 am. - 11:30 am.

DEPLOYING INTERACTIVE REMOTE LABS USING THE ILAB SHARED ARCHITECTURE
James L. Hardison, Kimberly DeLong, Philip H. Bailey and V. Judson Harward

The MIT iLab Project has developed a distributed service infrastructure and software toolkit to support a scalable community of online laboratory experiments. The iLab Shared Architecture provides a framework for the development and deployment of remote laboratories using a three-tiered model based on web services consisting of lab clients, service broker middleware, and lab servers. This simplifies the development of remote labs by providing reusable components for common lab administration functions. The initial focus of the iLab Project was on batched labs, which require no interactive control. Following the project’s success in supporting these labs, it has expanded its efforts to include those requiring interactive control. Interactive labs require that the user have active control of lab instruments during the course of an experiment and can generate a large amount of data. In order to accommodate these requirements, the iLab Shared Architecture has been extended with a highly configurable lab resource scheduling service, a robust data storage system and support for high bandwidth communication between the lab client and server. By integrating these services into the iLab Shared Architecture, a more diverse set of educationally valuable labs can now be easily deployed online and shared around the world.

INTEGRATION OF VIRTUALIZATION TECHNOLOGY INTO NETWORK SECURITY LABORATORY
Peng Li and Tijjani Mohammed

Distance education has witnessed a tremendous growth in the past decade. Advances in Internet technologies have made it possible to deliver not only lectures, but also hands-on labs remotely. Virtualization technology enables multiple virtual machines and their applications to run simultaneously on a single physical computer. This eliminates the need to have multiple physical machines host diverse operating systems typically deployed in remote network security labs. In preparation for a course on intrusion detection systems (IDS), the instructor creates pre-configured virtual machines and network trace files for students’ use. These virtual machines are then installed by the students on their personal computers at home and used to conduct lab exercises. The virtual lab approach is different from the centralized remote laboratory because students run the lab on their own computers and do not depend on the remote servers. Additionally, the virtual environments allow rapid changes to be made to the lab exercises or environments thus allowing instruction with up-to-date technologies. Furthermore, the burden of maintaining centralized physical labs has been lifted from the institution’s shoulders. Our approach to decentralized virtual lab-based distance education has been well received by our students.
LASITO: A LATHE SIMULATED VIRTUAL LABORATORY
Julieta Noguez and Gilberto Huesca

Engineering students need to practice and carry out experiments in laboratories to complement their learning process. However, instructors and equipment are not always available. Additionally, there may be risk and trouble using some equipment that may hurt students or damage the equipment. A generic architecture based on probabilistic relational models to combine virtual laboratories with intelligent tutoring systems had been developed, and applied in some domains. Based on this generic architecture, a lathe simulated virtual laboratory has been developed, giving the students knowledge and skills to use safely a lathe. An initial evaluation with technician high school students has been concluded. The results show that: (i) the students feel that interaction with the virtual laboratory increase their skills and learning, (ii) students increase their awareness of security rules when they used a real lathe, and (iii) the effort to develop the software is considerably reduced using the generic architecture.

MICROFABRICATION OF A RESISTANCE TEMPERATURE DETECTOR BY FRESHMAN ENGINEERING STUDENTS
Hisham E. Hegab and David E. Hall

A hands-on microfabrication project was developed and implemented for Louisiana Tech’s integrated freshman engineering curriculum. The project involved the design and fabrication of a simple nickel resistance temperature detector. The project is part of a series of hands-on projects being developed for the freshman engineering curriculum as part of a Living with the Lab concept that utilizes a microcontroller-based robotics kit to increase experiential learning. The project was initially piloted in two sections of a freshman engineering course and was extended to seven sections in the current academic year. The project included the direct application of fundamental engineering topics as well as applied technical skills and additionally provided an opportunity to introduce students to some common microfabrication techniques. The sensors were fabricated using optical lithography and etching of a nickel coated microscope slide. Students interfaced the sensors with microcontrollers and calibrated the sensors. The project provided an opportunity for freshman students to gain first-hand experience in the design, fabrication and calibration of a temperature sensor as well as motivated the need for engineering tools such as spreadsheets and CAD packages. The paper presents assessment results for the project’s impact on student knowledge and interest in micro and nanotechnology.

NETLAB: A FRAMEWORK FOR REMOTE ENGINEERING AND SCIENCE EXPERIMENTS
Itana Stiubiener, Wilson Vicente Ruggiero, Regina Melo Silveira, Cintia Borges Margi, Christiane Meller Baptista, Gustavo Vieira and Fabio Luiz Esperati Pagoti

This paper presents results from the construction of the NetLab framework, which provides remote network experiments. NetLab facilities were improved to provide not only network experiments but also any scientific experiment, since hardware and software resources reutilization is a critical aspect in any experimental area. The framework development considers experiments might be offered through high-speed networks, since some experiments will always transmit images, videos and any kind of "heavy" media. These considerations made us realize how important a network measurement experiment dealing with network quality parameters is. NetLab is being developed using JAVA technology and will be totally integrated to Tidia-Ae Platform (powered by SAKAI). It will offer all remote experiments from the undergraduate Networks class at the Computer Engineering course at Polytechnic School of Universidade of Sao Paulo virtually to regular students and students of other correlated courses.

Session S2B: Assessment 3
Chair: Mauricio Dziedzic, Universidade Positivo
Time and place: Saturday, October 25, 10:00 am - 11:30 am. Broadway 1

CREATING A CULTURE OF ASSESSMENT WITHIN AN ENGINEERING ACADEMIC DEPARTMENT
Maura Borrego

EC2000 changes to ABET accreditation have emphasized outcomes-based assessment in engineering courses and curricula. All faculty in an engineering department have some responsibility for assessment, but few have the time, training or resources to do it as well as we’d like. In this paper, we review the literature on developing a culture of assessment, including characteristics of well-known assessment cultures (e.g., at Alverno and Rose-Hulman). Then,
we describe a procedure that departments without a longstanding culture of assessment can use to address local concerns and promote faculty buy-in for new policies. Specifically, we present systematic analysis of faculty interviews using qualitative research data analysis coding procedures. All instructors were asked about assessment priorities and current efforts to collect and pool assessment data. Assessment priorities within the department were identified from this input, and recommendations were made for developing data collection and archiving procedures, updating department policies, and distributing assessment responsibilities across department instructors, administrators and appropriate committees. This paper presents the procedure for gathering input from instructors as a transferable model to other departments and institutions while providing a concrete example of outcomes to expect from it.

**ENGAGING STUDENTS VIA STUDENT-UNIQUE WEEKLY ASSESSED TUTORIAL SHEETS: A FOUR YEAR REVIEW**

Mark Russell

Following unacceptable examination performance in a core engineering module, (Fluid Mechanics and Thermodynamics), an alternative and innovative approach to assessment was developed. The new approach centered on the use of student unique Weekly Assessed Tutorial Sheets (WATS). The emphasis on assessment arises because of i) the overwhelming evidence that assessment plays a significant part in student learning - good assessment guides the students' effort towards the intended learning outcomes and helps distribute their effort across both the curriculum topics and the semester, and ii) the previous assessment programme did little to promote learning nor support teaching. This paper outlines the new development and presents findings from its use across four years. Since its implementation all performance indicators have improved. Students are now more actively engaged with the module, teachers are now provided with information on the students' current (mis)-conceptions and examination scores have improved. Feedback from the students on the various features of the assessment programme is encouraging as is their feedback relating their perception of the assessment programme to scaffold their learning. Many students, however, still note the importance of grades, however, in driving their effort.

**WORK IN PROGRESS - ASSESSMENT OF MEA PROBLEM SOLVING PROCESSES USED BY ENGINEERING STUDENTS**

Renee Clark, Mary Besterfield-Sacre, Larry J. Shuman and Tuba Pinar Yildirim

We are developing model eliciting activities (MEAs) for use in undergraduate engineering education to enhance problem solving ability as well as to provide a means for assessment. The MEA construct, originally developed by math educators, involves a student team developing an analytical model to solve a real-world, open-ended engineering problem and providing formal documentation of the solution procedure for reusability. As we extend these to juniors and seniors, we are evolving both the process and the constructs. In order to study the relationship of MEAs to the problem solving process, we are assessing this process using handheld electronic devices (PDAs) and work measurement software, which capture the predefined steps taken by the students. We have completed a pilot study using PDAs, which showed this approach to be feasible. The design of the pilot study, lessons learned, data obtained, and outcomes requiring additional investigation will be discussed. Much of the data showed a progression through multiple steps of the problem solving process in sequential order.

**WORK IN PROGRESS - ACTIVITIES THAT CAPSTONE TEAMS USE TO CREATE INNOVATIVE DESIGN IN BIOENGINEERING**

Mary Besterfield-Sacre, Renee M. Clark and Larry J. Shuman

Engineering design is a social and a cognitive process: an opportunity resolved through a question-driven, divergent progression that builds upon knowledge about clients and users, needs and specifications, technology and market assessments, and other constraints. In order to educate engineers with the ability to be innovative designers we need to better understand the complicated processes engineering students utilize when developing innovative designs. In this research we are evaluating how engineering students navigate the process of design from initial conception to product and determine the extent that resultant innovative designs traverse the entire process. To do this we are employing on-line reflective journals via an exhaustive list of design process elements that span the five primary stages typically found in product development. Specifically, we are studying nine (four person teams) biomedical engineering design capstone projects at the University of Pittsburgh; hence we are able to study student design processes in action. Qualitative pattern analysis is being conducted on the reflective journals coupled with the quantitative analyses of the periodic questionnaires. In this work-in-progress, we investigate the differences in the student groups with regards to their first term progress and the various strategies/activities they employed.
WORK IN PROGRESS ASSESSING THE UN-ASSESSABLE
William C. Lasher, Oladipo Onipede and Russell L. Warley

ABET requires direct assessment of student outcomes. For some outcomes this can be relatively simple; for others it can be a significant challenge. The authors have been developing and implementing direct assessment instruments for several of the un-assessable outcomes. This includes outcomes related to life-long learning, adapting to a continuously changing work environment, and teaming. The instruments address various competencies related to each outcome at different levels according to Bloom’s taxonomy, and include instruments from non-engineering courses. Preliminary results show that the instruments produce assessment results that are consistent with ad-hoc faculty observation and appear to be reliable indicators of achievement of the outcomes.

Session S2C: Undergraduate Research Experiences
Chair: Tulio Sulbaran, The University of Southern Mississippi
Time and place: Saturday, October 25, 10:00 am - 11:30 am. Broadway 2

ACOUSTIC IMAGING OF SOUND SOURCES - A JUNIOR YEAR STUDENT RESEARCH PROJECT
Guenter Bischof

In this paper the development of an acoustic camera within the scope of an undergraduate research project is presented, with a particular consideration of the project’s embedding into the curriculum. At the start of the project sixteen microphones and a data acquisition device with the capability of sampling all channels simultaneously were available. In order to build an acoustic camera out of it, the students had to develop both the hardware for a microphone array and the software for the generation of an acoustic image. The physical principle that was made use of is the phase information present in the signals picked up by spatially separated microphones. For the computation of the acoustic image two different algorithms were employed. Delay-and-sum beamforming was used for the determination of the sound intensity as a function of the direction of arrival. And multiple signal classification was implemented in order to enhance the microphone array’s spatial resolution. For a flexible mounting of the microphones a portable tripod was designed, thus enabling a variety of microphone arrangements. The functionality of the acoustic camera is demonstrated by a spatially resolved noise measurement of a combustion engine in its engine compartment.

RFID-BASED NETWORK FOR PERSONNEL AND MISSION-CRITICAL ASSET TRACKING IN A DISASTER CITY
Ben Zoghi and J. Robert McKee

The purpose of this paper is to describe a successful undergraduate research project and lessons learned. The project scope is to design, implement and test a proof of concept for personnel and mission-critical asset tracking at the Texas A&M Disaster City® site utilizing RFID system. On a larger scale solution, this system can be used for underground mine safety and communications, subterranean building safety and communications, indoor/Outdoor Personnel tracking, indoor/Outdoor Moveable asset tracking, environmental test and measurement, and continuous data logging, trending and homeland security concerns. Our approach is to start with a proof-of-concept scalable system architecture that could be used for a full-scale system. This is an excellent example of how multiple industry partners can impact undergraduate education on a real-world project while seeking new applications for their products and solutions.

WORK IN PROGRESS - B A STAR - A LAUNCH PAD FOR ACTIVE LEARNING
Derrick Booth and Lucy Casale

Since 2004 community college students in the Basic and Advanced Science and Technology Academies of Research (B A STAR) have made significant educational contributions to their communities. The program, funded by the National Science Foundation, seeks to increase the technical talent pool by providing students the opportunity to develop critical skills in leadership, teamwork, academics and technology. This goal is accomplished by developing students historically under-represented and currently performing below their capability in the technical fields. The Program consists of four components: the Leadership Development Conference, the Basic Science and Technology Academies of Research (B STAR), the Advanced Science and Technology Academies of Research (A STAR), and the Science and Engineering Research Symposium. These four components provide venues that progress students through increasingly complex and focused academic and research opportunities. The Leadership
Development conference is the foundation upon which the program is based. The B STAR focuses on academic and technical development while the A STAR provides an opportunity to gain internship experience. The Science Symposium brings it all together as a venue for showcasing the work of students and exposing them to a greater scientific community.

**WORK IN PROGRESS  THE EYES HAVE IT: THE USE OF AFFECTIVE IMAGERY TO CAPTURE PERCEPTIONS**
Tracy L Lewis, Nicolas Dishon and Matthew Firtion

This work in progress introduces an innovative database tool that develops valid, reliable and interesting surveys for the visualizers generation. Undergraduate researchers use affective imagery survey techniques to create a pilot study database and tool to assess the perceptions of the IT discipline.

**DEMONSTRATING SUSTAINABLE SUCCESS: USING ETHNOGRAPHIC INTERVIEWS TO DOCUMENT THE IMPACT OF THE AFFINITY RESEARCH GROUP MODEL**
Kerrie Kephart and Elsa Q. Villa

The Affinity Research Group (ARG) is a model of undergraduate research that extends the undergraduate research experience to a broad range of students by providing opportunities to learn and integrate the knowledge and skills that are required for research with those required for cooperative work. ARG creates an integrated research environment in which a collective of diverse students and faculty contribute to the research effort. The framework and pedagogy enable faculty to create and sustain a cooperative environment that explicitly develops skills needed for success in research, academe, and the workforce. This paper describes a qualitative design used to investigate ARG. The objectives of the effort were to gather alumni descriptions and to gauge the long-term effects of their experiences in the research group. The study shows that former ARG members readily describe specific aspects of the ARG model, such as paper and presentation critiques, through which they developed technical and social skills that they continue to use in the workplace and that they believe have contributed significantly to their professional mobility and success. To ground the findings, the paper relates components of the ARG model to sociocultural learning theory.

**Session S2D: Engaging GK-12 Students in STEM**

Chair: Cecelia M. Wigal, University of Tennessee at Chattanooga
Time and place: Saturday, October 25, 10:00 am. - 11:30 am. Broadway 3

**WORK IN PROGRESS - A STUDY ON THE EFFECTIVENESS OF AN INNOVATIVE RESEARCH PROGRAM FOR URBAN HIGH SCHOOL STUDENTS**
LaRuth C. McAfee

To increase minority high school students’ interest in STEM, an innovative outreach program has been developed in the Center for Layered Polymeric Systems. The Polymer Envoys Program features a two-year research internship where local students are matched with graduate student mentors, and participate in STEM research beginning the Fall of their junior year and concluding the Spring of their senior year. A study is being used to determine the effectiveness of this program. Issues considered include initial selection of schools and student participants, experiences of program participants, related academic choices made during high school, and post-program choices made regarding college and major. Questionnaires and informal observations indicate that this program has had very positive results in its implementation to date. While many students initially indicated minimal experience with research and technical communication, within one year all made significant improvements. This change was self-reported on surveys, and observed in students’ oral and written communication assignments. Additionally, positive changes were observed in students’ academic and career aspirations through experiences in the program.

**WORK IN PROGRESS - INSTRUMENTATION ON A TRUSS ADAPTED FOR PRE-COLLEGE OUTREACH**
Amy Perrey, Steve E. Watkins, Ralph E. Flori and Theresa M. Swift

Engineering content is a valuable addition to pre-college instruction in science, technology, engineering, and mathematics (STEM) since it applies scientific concepts, illustrates scientific relevance and technology, and provides measurement opportunities. Also, complex systems and interactions can be shown. This work describes outreach resources using a seven-member instrumented truss apparatus. This aluminum bench-top model is scaled to support
up to fifty pounds. Electrical resistance gauges are installed on several members for strain measurement. The resource set includes the truss apparatus, instrumentation, a PowerPoint presentation, and a background document. The pre-college objective is a set of demonstration resources for middle or high school classrooms. Effective outreach design is modeled by tailoring to accommodate curriculum standards, level-appropriate concept terms, and grade continuity. The resources were developed by students in an interdisciplinary college class on sensors and structures. The development activities involved testing the models and measurements and refining the construction. Selected resources were implemented and evaluated in a local middle school classroom. The interdisciplinary content includes structural, force analysis, sensing, and measurement components.

WORK IN PROGRESS - SUNRISE: SCHOOLS, UNIVERSITY N (AND) RESOURCES IN THE SCIENCES AND ENGINEERING-A NSF/GMU GK-12 FELLOWS PROJECT

Rajesh Ganesan, Donna Sterling and Philip Henning

This WIP documents the development, implementation efforts, and preliminary results of SUNRISE a unique graduate Fellowship program at George Mason University (GMU) that targets graduate students working in the grade 4-6 school environment. SUNRISE is a new GK-12 project aimed at partnering STEM (Science, Technology, Engineering, and Mathematics) students and graduate students (Fellows) with elementary and middle school teachers from three different school divisions in Northern Virginia. The expected outcomes and an evaluation plan are also presented. Sponsored by the National Science Foundation (NSF), the project serves as one source of evidence that demonstrates the importance and the process of building partnerships among university s engineering and education departments, and the K-12 education system.

WORK IN PROGRESS - ADOPT A SCHOOL - THE FOUNDATION OF A LONG-TERM OUTREACH EFFORT

Chad Mano and Vicki Allan

A glaring problem in undergraduate computer science programs is the lack of females and members of certain ethnic minority groups. This problem is compounded by the fact that many faculty members and departments are unable to devote much time or financial resources towards outreach efforts. This paper presents a model for a long-term outreach effort that is enabled by adopting a local K-8 School. This model enables a department to participate in effective outreach activities with a minimal time commitment. Additionally, this model provides tremendous educational and financial benefits to the partner school with little, if any, financial obligation on the part of the sponsoring department. While the scope of this project is relatively small compared to many outreach efforts, it is appropriate for departments that lack the time or financial means to launch a large-scale program.

WORK IN PROGRESS - A STEM EDUCATIONAL OUTREACH DAY FOR YOUNG FEMALES

Victoria Weston, Aubrey Bonhivert, Allison Elia, Heileen Hsu-Kim and Gary Ybarra

The existing gender disparities in the sciences, especially in the field of engineering, underscore the need for outreach programs to engage young women in such areas. Many programs exist for high school students, but girls may be turned away from engineering at an earlier age. FEMMES (Females Excelling More in Math, Engineering, and Science) is an annual free, one-day event, which provides an exciting, hands-on experience for 4th-6th grade girls from Durham, North Carolina, to encourage them to further explore their potential in these fields. Over 150 participants come to Duke to attend interactive activities designed and led by female faculty. To assess the program's effectiveness, surveys were completed by participants before and after the event. Each participant assessed her own interest, knowledge, and confidence in math, science, and engineering on a scale of 1 to 10. With respect to engineering, the mean post-event values were significantly higher than pre-event values in all three categories (p < .001). The increase value (± 95% confidence interval) for each category was the following: interest 1.32 (± 0.57); knowledge 1.94 (± 0.58); confidence 1.66 (± 0.63). The increases for engineering were also notably larger than the math and science values, indicating that this type of event especially influences attitudes toward engineering.
MANAGEMENT EDUCATION FOR THE 21ST CENTURY ENGINEERING MANAGER: AN AUSTRALIAN PERSPECTIVE
Steven Goh, Warren Coaker and Frank Bullen

Engineering Managers in the 21st Century will be operating in a very different environment compared to 2008. The major change is that it will be a more globalized world. The professional and educational requirements of senior engineering managers will need to noticeably evolve to meet these changes. Thus, there are implications for relevant education providers such as engineering faculties. This paper provides results of a 2007 investigation into the perspectives of CEOs on career progression of engineers from new graduates to CEOs in Australia, and determining the skills and qualities engineers need as CEOs of large companies. The paper also investigates the implication of predicted changes in operating environments in the year 2020 via an environmental scan, and recommends strategies for career development for the potential senior engineering managers of the 21st century. This paper also proposes potential implications for educators. Some unique findings are that it will be desirable to have an ability to deal with the increasingly globalized nature of engineering projects and an ability to lead multi-disciplinary multi-cultural teams but to also possess deep technical knowledge, as opposed to a generalist background.

BOUNDARY SPANNING KNOWLEDGE BROKER: AN EMERGING ROLE IN GLOBAL ENGINEERING FIRMS
Aditya Johri

With the emergence of globalization, engineering firms as well as engineers that work in those firms are faced with new opportunities and challenges. Recent globalization has led to new work roles for engineers. Whether formally or informally, an increasing number of engineers are now playing the role of boundary spanners and are brokering knowledge across geographic boundaries. In this paper I present a case study to identify the requirements and characteristics of this role. The data for this paper comes from two sources: selected interviews with software engineers and an ethnographic study of a global engineering R&D firm. The informants represent the U.S., Japan, and India. The findings show that agency of workers in the midlevel of the organizational hierarchy drives successful global practices. Moreover, given the dynamic nature of work in the present knowledge economy, the requirements of this role keep changing. In addition to skills such as working across time zones, using technology effectively, and developing interpersonal networks, there are additional tacit aspects of this role that can be learned only through participation. I present and analytical model and discuss the relevance of these findings for preparing engineers for the global workforce.

WORK IN PROGRESS   DEVELOPING MULTI-COUNTRY, MULTI-TEAM, MULTI-TERM PROJECTS FOR A LARGE, INTRODUCTORY ENGINEERING-DESIGN COURSE
Jason M. Daida and Erik Hildinger

This paper describes our efforts at the University of Michigan in addressing globalization in project-centered engineering design courses at the first-year level. The additional challenges that come from doing engineering design over multiple countries tend to be social. We have subsequently engineered social network motifs that allow a class to adapt to such projects and their associated clients/stakeholders. Emphasis has been on the transmission of artifacts from one team to the next, one term to the next, one country to the next that afford the creation of realizable designs that work for the people / culture for which such designs are intended. From Spring 2006 to Fall 2007, approximately 630 students in the United States and China have participated in this course. Data suggests that this network-based, artifact-centric method can have a positive impact on a student s learning about globalization and engineering.

EMBEDDING A CORE COMPETENCE CURRICULUM IN COMPUTING ENGINEERING
Mónica Edwards, Edmundo Tovar and Óliver Soto

This paper describes the processes that have started to reform the curriculum and learning landscape at Computer Engineering School of the Universidad Politécnica de Madrid (Spain) within the European Higher Education Area framework. In this context, competences and learning outcomes are emerging as a new teaching/learning paradigm,
where approaches centered on the learner are increasingly important. In first place, it describes the process followed for the identification of its own core generic competences map explaining its connections between learning outcomes, levels, descriptors, credits, methodology, learning activities and assessment. Finally, it reports some of the results obtained in the implementation of this core competence curriculum realized in a pilot experience the first and second semester, analyzing the degree of institutional impact of the actions undertaken and perspectives for the future.

**DEVELOPING STUDENTS UNDERSTANDING OF GLOBAL ISSUES THROUGH LEAN MANUFACTURING**

Frank Peters, Leslie Potter and K. Jo Min

While traditional international exchange programs provide valuable experience for engineering students, they are neither within reach nor practical for all students. An innovative course was developed and executed Spring 2007 to provide engineering students with an intense international experience. This course is aimed at strengthening ABET outcome item (h) [the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context]. Additionally, the course provides students the opportunity to practice contemporary, industry-relevant skills by exploring lean manufacturing, including tools, philosophies, and current literature. In the first offering of the course, fifteen students participated on kaizen teams at companies in the United Kingdom and the United States. Survey results of student participants indicate that the experience increased students understanding of global issues and lean manufacturing. Feedback from industrial partners also showed that this was an effective exercise for developing students understanding of these issues. This paper describes the creation of this course, including the assessment data that provided the impetus for its inception. Course content, structure, and activities are detailed. Survey results are examined. Long term impact expectations and assessment plans are described.

**Session S2F: Distance Learning 4**

Chair: Xiaoyan Mu, Rose-Hulman Institute of Technology

**VIRTUAL LABORATORY ONTOLOGY FOR ENGINEERING EDUCATION**

Josep Prieto-Blázquez, Ivan García-Torà, Jordi Herrera-Joancomartí and Anna Guerrero-Roldán

Virtual Laboratories are an indispensable space for developing practical activities in a Virtual Environment. In the field of Computer and Software Engineering different types of practical activities have to be performed in order to obtain basic competences which are impossible to achieve by other means. This paper specifies an ontology for a general virtual laboratory. The proposed ontology provides a mechanism to select the best resources needed in a Virtual Laboratory once a specific practical activity has been defined and the main competences that students have to achieve in the learning process have been fixed. Furthermore, the proposed ontology can be used to develop an automatic and wizard tool that creates a Moodle Classroom using the practical activity specification and the related competences.

**A REMOTE LABORATORY FOR MICROELECTRONICS FABRICATION**

Aaron Mohtar, Zorica Nedic and Jan Machotka

During the last decade there has been a move towards using remote laboratories in engineering education. These labs allow students to control either electrical or mechanical systems remotely via the internet. At the University of South Australia (UniSA), we have been developing a remote lab that will allow users to visually inspect and test microelectronic circuits under a microscope. In this paper, we describe the architecture of the laboratory and discuss the obstacles that are faced in designing and building a remote laboratory that deals with the accurate manipulation of micro-probes for testing microelectronic circuits. Challenges include mechanical construction of probes, motor control for accurate positioning of probes and the development of a realistic graphical user interface (GUI) which will give students an environment that closely resembles that of a real lab. This laboratory is the extension of the existing, fully functional UniSA remote lab, NetLab, which has already been successfully used in teaching students on-campus as well as off-shore.
AN ENGINEERING EDUCATIONAL APPLICATION DEVELOPED FOR THE BRAZILIAN DIGITAL TV SYSTEM

Lady Daiana Pinto, José Pinheiro Queiroz-Neto and Vicente Ferreira Lucena Jr.

Recent studies pointed out that Brazil has a deficiency of about 40,000 engineers. It is well known the continental dimension of this country turning any nationwide educational policy difficult to be implemented satisfactorily. Indeed, in order to be successful it is necessary to create a program able to cover the whole country and with good acceptance of the population. Television is the most popular source of entertainment and information of the Brazilian population being present in approximately 90% of the homes. Nowadays, the Brazilian TV system is moving from analog to digital. That means that will be possible to offer personal interactive services such as home banking, games and most importantly, educational programs. That is the main objective of this work: to investigate and present the necessary elements for developing interactive educational systems for Digital TV (DTV). The paper starts with a study of the technologies involved in the development of such systems, as well as an analysis of the necessary elements for the proper use of DTV educational applications and the importance of this new media in teaching engineering. A basic application is presented in order to validate the involved theory. Furthermore, as a concluding experience, an interactive game developed for teaching computing engineering principles is presented. Finally, the results obtained when the educational application was used in a class of high school teenagers are presented.

WEB-BASED STATICS COURSE: PATTERNS IN USE AND THE RELATION TO LEARNING GAINS

Anna Dollar and Paul S. Steif

Computer-based learning materials eventually forming an entire online course in Statics are presented. The course developed as part of the Carnegie Mellon Open Learning Initiative (OLI) and available to individual learners and institutions, draws upon the authors ongoing work to reorganize Statics instruction to better address the conceptual challenges students face. The course is divided into approximately twenty modules, with approximately 60% completed as of fall 2007 (the completion is scheduled for summer 2008). Each module is based on a set of carefully articulated learning objectives and contains expository text and various interactive exercises and simulations. Assessment is tightly integrated within each module, with students confronting frequently interspersed formative and summative assessments, that offer hints and feedback. This paper reports on the effectiveness of these on-line materials as they have been integrated into a Statics class. Paper and pencil pre- and post-tests have been administered which capture essential conceptual knowledge and skills presented in the modules. By analyzing log files maintained by the system, patterns of students usage of the on-line materials can be traced. This usage is compared with progress as measured by the pre-post tests.

DISTRIBUTED DIGITAL CONTENT ACCESS IN A VIRTUAL COMMUNITY BASED E-LEARNING PLATFORM

Rafael Pastor, Salvador Ros, Roberto Hernández, Timothy Read and Manuel Castro

Eight years on from the start of the development of the aLF (active Learning Framework) platform, by the Innova group (in the UNED, Spain), we have approximately 100,000 users grouped in more than 500 virtual learning communities. The development of an integrated space of communities and courses has provided a unified model adapted to the new European Higher Education Area (EHEA). In the first part of the paper the fundamentals of aLF are discussed, and the service model provided based on the concept of virtual community. Following the description of aLF, how the official digital repository (based on an application of Fedora) has been integrated into aLF to allow professors and students to search for (and retrieve) digital content (audio and video generated from more than 30 years of UNED activity and references from papers) is described. The paper will discuss the application developed together with the advantages of using it: recorded classes reused in the courses, access to institutional library material in a distance education model and a simple way of consulting related content to help students in their learning activities.
IMPORTANT STUDENT MISCONCEPTIONS IN MECHANICS AND THERMAL SCIENCE: IDENTIFICATION USING MODEL-ELICITING ACTIVITIES
Brian P. Self, Ronald L. Miller, Andrew Kean, Tamara J. Moore, Teresa Ogletree and Frank Schreiber

As any engineering faculty member teaching undergraduates knows, students possess a wide variety of misconceptions about fundamental engineering concepts. In the thermal sciences, there are numerous misconceptions about heat, energy, and temperature; mechanics students hold misconceptions about inertia, angular velocity, and energy. This is complicated by the fact that we possess many years of everyday experiences with energy flows, forces, and kinematics. Due to previous experiences, it is often difficult to repair these misconceptions - simple classroom lecturing often fails to instill correct conceptual knowledge. In order to provide real-world context, we are developing Model-Eliciting Activities (MEAs) to help repair misconceptions in dynamics and the thermal sciences. An MEA is a client-driven problem that requires student teams to develop an engineering model or procedure. This approach creates an environment where students value abilities beyond using the traditional prescribed equations and models. During this process, we hypothesize that rich discussion and model re-formulation will help students recognize and repair misconceptions, and that the real world context will help them remember these critical concepts.

WORK-IN-PROGRESS: EMBEDDING ENTREPRENEURSHIP IN THE COMPUTING CURRICULA
Kevin Gary, Anshuman Razdan, Harry Koehnemann, Adrian Sannier and Albert Kagan

Two projects at Arizona State University at the Polytechnic campus blend a range of student engagement activities to promote entrepreneurship. The first, from .EDU to .COM, engages students with industry entrepreneurs through on-campus events (colloquia and a Polytechnic showcase event), student engagement projects with SMEs, and internships. The second, Agile Methods for Entrepreneurship proposes curricular modifications, cohort programs with the Polytechnic’s business school, lab-oriented practice with ASU’s University Technology Office, and an off-campus 2-day workshop with students and real-world entrepreneurs, among other activities. Besides being housed in the same academic unit, these projects also share a common, differentiating approach. First, both emphasize a learn by doing approach consistent with the Polytechnic mission. Second, both engage students in entrepreneurship through a variety of activities. We believe the latter point is especially important; in our view entrepreneurship is often promoted through a single highly visible activity. Our approach embeds entrepreneurship across the spectrum of student engagement. This reflects our belief that students must engage repeatedly with entrepreneurs to understand and adopt this cultural norm. In this paper we describe our entrepreneurial engagement activities and discuss preliminary results from the first year of our experience.

EXPERIENCES OF ENGINEERING STUDENTS IN POST-KATRINA SERVICE LEARNING PROGRAMS
Denise Wilson

This paper discusses two case studies of engineering student experiences in a 10-week fully integrated academic/service learning program on the Gulf Coast of Mississippi in the Hurricane Katrina Recovery effort. The program delivered in the Winter of 2007 combines a service learning component oriented to hands-on reconstruction of a Gulf Coast community and a formal academic curriculum that emphasizes a bird’s eye understanding of the Hurricane Katrina Story, from a perspective of the technology that helps and hinders natural disaster recovery. The pilot program was a full load (12 quarter credits) program that placed 12 students from a major Northwest university on the Gulf Coast for an entire term. The case studies of two engineering students presented herein demonstrate a level of advanced performance (as compared to campus-based learning) that has been often suggested but rarely documented in the literature. Improvements in affective measures (such as belonging) and academic outcomes (such as demonstrated understanding of broader impacts in persuasive writing) are significant for both students, despite the significant differences between them.
WORK IN PROGRESS - SOCIALLY CONSCIOUS INNOVATION CLASS
John Farris and Paul Lane

The authors are developing a course on socially conscience innovation. The purpose of the course is to teach students to identify and evaluate opportunities for new and innovative products. The course will be divided into five modules. Each module will begin with the students selecting an academic article read and summarize for the class. The first module will cover foundation topics. The following three modules are focused on an individual area for innovation. For the first offering the areas of concentration are active aging in modern society, the office environment and innovation at the bottom of the economic pyramid. For each area of concentration an academic subject expert will present on a topic on a topic relevant to the area of concentration. Next the class will go visit sites to explore the area of concentration and talk with people who live and or work with the issues involved. After collecting information the students will use a variety of methods to ideate solutions to the problems they discovered. In the last module the students will evaluate the product opportunities they have identified.

WORK IN PROGRESS - BEHAVIORAL ASPECTS OF STUDENT ENGINEERING DESIGN EXPERIENCES
Barbara A. Karanian, Loutfallah Georges Chedid, Micah Lande and Gloria Monaghan

Problem- and Project-Based Learning courses have come to be popular as underlying pedagogies for Engineering Design classes. Though shown to increase student learning and engagement such active learning approaches also sometimes fall short of addressing student and faculty uneasiness with novel and seemingly unorthodox course designs. Through a planned 2-year qualitative comparison evaluation of two capstone engineering design courses at two different universities, the difficulties and successes of both students and faculty engaged in such courses will be described and characterized on a social plane. Qualitative and projective methods will be utilized to report project development across three dimensions: 1) assignment milestones of design iterations, 2) student and team reflections, and 3) instructor team reports on progress. It is planned that from these affective and social observations, interventions can be constructed and organized into a workshop format for students participating in these Problem- and Project-based Learning Engineering Design courses.

Session S2H: CS Courses and Labs 5
Chair: John Spinelli, Union College
Time and place: Saturday, October 25, 10:00 am. - 11:30 am. Whitney

WORK IN PROGRESS - INTEGRATING MULTIPLE COMPUTER SCIENCE DISCIPLINES VIA A TECHNICAL GAME DEVELOPMENT COURSE
James Dean Mathias

This paper describes a new course in development that utilizes technical game development as the unifying subject. This matches a goal of our Computer Science program to provide opportunities for students to utilize multiple CS topics in a single course. Doing so results in those subjects being reinforced and expanded by repeating them in a new context, it also provides new challenges and learning opportunities when several topics are integrated in a single project. The course requires all work is done in teams of three to five, with each project following standard software development practice, and incorporating multiple technical components, such as concurrency, Artificial Intelligence, and etc. The course requires students to peer review, which helps train them to critically review other’s work; they are also required to give an oral presentation of their final project.

WORK IN PROGRESS - COMBINED INTRODUCTION OF C AND ASSEMBLY WITH A FOCUS ON REDUCTION OF HIGH-LEVEL LANGUAGE CONSTRUCTS
Eric A. Freudenthal, Brian Alan Carter, Frederick F. Kautz IV and Alexandria Nicole Ogrey

This paper describes the reform of a sophomore-level course in computer organization for the Computer Science BS curriculum at the University of Texas at El Paso, an urban minority-serving institution, where Java and integrated IDEs have been adopted as the only language and development environments used in the first three semesters of study. This effort was motivated by faculty observations and industry feedback indicating that upper-division students and graduates were failing to achieve mastery of non-garbage-collected, strictly imperative languages, such as C. The similarity of C variable semantics to the underlying machine model enables simultaneous mastery of both C and assembly-language programming and exposes implementation details that are difficult to teach independently,
such as subroutine linkage and management of stack frame. An online lab manual has been developed for this course that is freely available for extension or use by other institutions. In this paper, we report on pedagogical techniques for facilitating student understanding of the relationships between high-level language constructs, such as algebraic expression syntax, block-structured control-flow structures, and composite data types, and their implementations in machine code.

**COMPUTER SUPPORTED CO-OPERATIVE SYSTEMS TO SUPPORT THE PROBLEM SOLVING - A CASE STUDY OF LEARNING COMPUTER PROGRAMMING**

Crediné Silva de Menezes, Orivaldo de Lira Tavares, Rosane Aragón De Nevado and Davidson Cury

Nowadays it is widely accepted that the teaching of computer science and engineering reaches better results when it focuses on problem solving. However, the adoption of this pedagogical approach is often hampered by the limitations of the learning environment in a typical classroom. In this work, we present a pedagogic proposal supported by a digital environment to power and to facilitate the cooperative authoring.

**ENHANCING STUDENT LEARNING WITH HANDS-ON RTOS DEVELOPMENT IN REAL-TIME SYSTEMS COURSE**

Sudha Anil Gathala, Ramon Mercado, Manimaran Govindarasu and Diane T. Rover

Traditionally, real-time systems are built for a very small set of mission-critical applications like space crafts, avionics and other distributed control systems. The various steps in building such systems include, characterizing the workload, designing scheduling algorithms and performing schedulability analysis. Conventional teaching methodologies for real-time systems have primarily focused on these topics and the choice is completely justified for the targeted traditional real-time systems. However with the evolution of small scale real-time embedded systems like cell phones, PDAs, sensor motes and other portable control systems primarily driven by a Real-Time Operating System (RTOS), the conventional teaching methods fall short in several ways. This is because, building such real-time embedded systems poses certain different design and implementation challenges branching out of the severe resource constraints that these devices should operate under. In order to keep pace with these changing trends, we have enhanced our real-time systems course in two different ways. First, we have included the relevant topics like compiler-level and operating systems-level energy aware real-time scheduling algorithms and further developed corresponding assignments and projects to reinforce student learning in these topics. We present some of these details here. Secondly, we have developed a series of laboratory experiments based on commercial RTOSs which give students a rich hands-on experience in building real-time embedded systems. We have tried two different RTOSs namely, RT-Linux and VxWorks in two consecutive years. In this paper, we present the similarities and differences between two the RTOS platforms and their impact on student learning.

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**Session S2J: Special Session - Engineering for a Sustainable World: How Do We Incorporate Sustainability in Undergraduate Engineering Education?**

Chair: Robert Prins, James Madison University

*Time and place: Saturday, October 25, 10:00 am. - 11:30 am.*

**SPECIAL SESSION - ENGINEERING FOR A SUSTAINABLE WORLD: HOW DO WE INCORPORATE SUSTAINABILITY IN UNDERGRADUATE ENGINEERING EDUCATION?**

Robert Prins, Ronald Kander, Towana Moore, Eric Pappas and Olga Pierrakos

Sustainability principles in engineering are currently taught and promoted through graduate programs and professional engineering societies. It is appropriate that sustainability principles are also addressed in undergraduate engineering education. Retooling an existing undergraduate engineering curriculum to include comprehensive coverage of sustainability may be outside of the expertise or purview of an individual educator. However, sustainability principles can still be introduced to different degrees and at different class levels within an existing curriculum. This Special Session seeks to facilitate discussion of how to best incorporate sustainability in undergraduate engineering education and also seeks to build a cohort of engineering educators that join James Madison University in a desire to bring sustainability education into the engineering classroom.
A CASE-BASED PEER-TO-PEER FRAMEWORK FOR MANAGING STUDENT MODELS IN INTELLIGENT TUTORING SYSTEMS
Juan Carlos Burguillo-Rial, Carolina Gonzalez Serrano, Martin Llamas-Nistal and Fernando Mikic

Intelligent Tutoring Systems (ITSs) aim at providing personalized and adaptive tutoring to students by the incorporation of a student modeling component. In the near future, a very interesting scenario will appear when multiple tutoring systems exchange information in order to learn from its own experiences and improve their student modeling components. In order to get closer to such scenario, in this paper we present a case-based peer-to-peer multi-agent system for collaborative management of student models in ITSs. The goal of the system is twofold: first, to initialize the student model when a new student logs on the tutor system and second, to update the student model depending on the student’s interaction with the system and exchanging this information with its peers. The quality of the system is evaluated in terms of its ability for searching similar cases (accuracy) tested under three different strategies. Our results show that increasing the system complexity (number of nodes and/or number of students) and using a committee strategy, the performance of the global system is improved by reducing network traffic, and preserving the quality of the solutions for the new students (cases).

T-BOT AND Q-BOT: A COUPLE OF AIML-BASED BOTS FOR TUTORING COURSES AND EVALUATING STUDENTS
Fernando A. Mikic, Juan C. Burguillo, Daniel A. Rodríguez, Eduardo Rodríguez and Martín Llamas-Nistal

Intelligent Tutoring Systems are computer programs that aim at providing personalized instruction to students. In recent years, conversational robots, usually known as chatterbots, become very popular in the Internet, and ALICE (Artificial Linguistic Internet Computer Entity) is probably the most popular one. ALICE brain is written in AIML (Artificial Intelligence Markup Language), an open XML language. We consider the combination of both approaches, i.e., the use of AIML-based bots for tutoring purposes in open e-Learning platforms like Claroline or Moodle. With that aim in mind, we have developed two different bots for helping the students during the learning process and for supporting the teaching activities of the professor. One of them is a tutor bot (T-Bot), and is able to analyse the requests made by the learners in written natural language and to provide adequate and domain specific answers orienting the student to the right course contents. The other one is an evaluation bot (Q-Bot), and is oriented to track and supervise the student progress by means of personalized questionnaires. Both bots have been already developed and integrated as user-friendly modules in Claroline and Moodle.

WORK IN PROGRESS COLLABORATIVE LEARNING FOR PACKAGING DESIGN USING KM AND VR
Ratchadawan Nimnual and Surachai Suksakulchai

The purposes of this research were to develop online collaborative learning with the application of Knowledge Management and Virtual Reality technology for the course in Packaging Design in order to find solutions to the issues of insufficient time spent for instruction in classroom, resulting in lack of proper practice, and paper waste for the design, resulting in high cost. The sampling group for this study was composed of 30 third year undergraduate students studying at the Department of Printing and Packaging Technology, Faculty of Industrial Education and Technology, King Mongkut’s University of Technology Thonburi. The students were divided into groups of 2-3 persons. Each member in the same group, when logged in, would enter their own working space and could see their pieces of work, which they were doing, at the same time in 3 dimension format. Each member in the same group could help one another to design the assigned packaging. They could control their packaging design by using mouse and keyboard. They could also discuss via chatting system or microphone. Their records for activity participation would be made automatically, for example, their date and time of logging in, and transcripts of their conversation. The test at the moment reveals that learners who participated in online collaborative learning showed more interest and enthusiasm in learning. Moreover, learners had more time to practice outside classroom and reduced a large waste of paper.
WORK IN PROGRESS - THE ONLINE-MULTIMEDIA INSTRUCTION OF PLASTIC PACKAGING TECHNOLOGY
Khanchai Tunlasakun and Ratchadawan Nimnual

In recent years, online learning systems have become a popular learning environment. For learners, online learning knows no time zones, and location and distance are not an issue. In online learning, students can access the online materials at anytime, while synchronous online learning allows for real time interaction between students and the instructor. Learners can use the Internet to access up-to-date and relevant learning materials, and can communicate with experts in the field in which they are studying. Situated learning is facilitated, since learners can complete online courses while working on the job or in their own space, and can contextualize the learning. [1] In this paper we created The Online-Multimedia instruction of Plastic Packaging Technology. The purposes of this study are included; to create the online multimedia, to evaluate the quality of the online multimedia, and to find the satisfaction to the online multimedia utilization. The quality of this multimedia package content was verified and evaluated by three specialists. The quality score was 4.62 averagely, which means the quality is in excellent level. After the multimedia was created completely, it was evaluated by three website specialists. The result shows the score of website is 4.10 averagely which also means good level. The satisfaction to the multimedia is evaluated by 60 students from Printing and Packaging Technology department. The satisfaction score is 4.56 which mean excellent level. The above mentioned average score indicated that this multimedia package can be applied for education and general public relation about plastic packaging technology.

MSYS: AN ACTIVITIES TRACKING TOOL FOR E-LEARNING SYSTEMS
Christiane Meiler Baptista, Regina Melo Silva e and Wilson Vicente Ruggiero

E-learning content creation is not an easy task, but its evaluation is even more complex. In order to evaluate if the content is adequate to the students needs, it would be helpful to know how the student assimilated the learning content, how he/she reacted to it and the period of time spent on the learning object. Besides, considering the different cognitive features of learning and the possibility of adjusting the didactic content, it could help teacher s evaluation in an available online course. This work describes a monitoring system (Msys) able to track the level of utilization of student s activities, and presents summarized and comparative results to the teacher and to the student. This paper describes how the Msys tool was created using current standards on digital content construction, defining functional requirements of interface to its development, presenting a proof-of concept and how it could be integrate to online learning systems, providing benefits to the teacher s evaluation.

Session S3B: Computer and Web Based Software 3
Chair: Cherrice Traver, Union College
Time and place: Saturday, October 25, 1:30 pm. - 3:00 pm. Broadway 1

WORK IN PROGRESS - BRINGING SOCRATES INTO COMPUTER-ASSISTED INSTRUCTION
Stephen Zahorian, Radim Belohlavek, Scott Craver, Roy T.R. McGrann and Lei Yu

SOCRATES (Student Oriented Creative Resource for the Assessment and Teaching of Engineering Skills) will be an automated computer-based system for simulating the Socratic Method of learning in the subject area of Probability and Statistics. The goal is for the student to be an active partner in the learning process using directed self-reflections. In SOCRATES, a knowledge space is created from data gathered from expert practitioners and students. An automatic question poser is then used to lead students through the knowledge space by presenting them with additional questions. We describe several methods for gathering data from domain experts (instructors and students). This dataset is then analyzed to produce a basis set of generic questions and actions that appear commonly within the tree structure of instructor responses. These various sources of data are combined and analyzed to identify prerequisite relationships and dependencies between the topics. We also show how the collected data can be used to guide an automated question poser. Student interactions with the system can be monitored to develop a model of how students learn.

AUTOMATIC GENERATION OF TECHNICAL-STYLE NOTES FROM LIVE LECTURE
Adrian Rusu, Gary Dainton, Kevin Dahm and James Metting

With student persistence and retention being a cascading issue within higher education (particularly in Computer Science and Engineering), developing processes and tools to help students overcome the challenges of systemized
learning becomes an academic necessity. The authors contend that if an information translation apparatus was in existence that could generate individual learning data formats, students will have another tool to understand and apply information that was delivered in a fashion un-natural to their personal learning processes. Survey data has revealed that in many situations students spend mental effort trying to record, via note-taking, exactly the words being used by the instructor instead of the synergy and application of the content. Voice recognition software (voice-to-text) is the vehicle by which data is digitally recorded for format manipulation between a marriage of human learning and technology. The research-tested Interactive Learning Model© is the foundation of the learning systems component of this project and an innovative algorithmic development was utilized to manifest specific data formats consistent with technical learning processes.

**WORK IN PROGRESS IMPROVING FEEDBACK USING AN AUTOMATIC ASSESSMENT TOOL**
Daniel Jimenez-Gonzalez, Carlos Álvarez, David Lopez, Joan-Manuel Parcerisa, Javier Alonso, Christian Perez, Ruben Tous, Pere Barlet, Montse Fernandez and Jordi Tubella

Students of Computer Science freshman year usually develop assembler programs to learn processor architecture. Homework exercises are done on paper, while those in lab sessions are solved with the aid of programming tools. Students perceive theory and lab as different subjects, so they don’t use lab tools to test their theory solved problems. Moreover, during lab sessions, students often tend to ask for the teacher’s guide and advice instead of using the debugging tools because these are new and unfriendly for them, and do not offer a quick and clear feedback. In this paper we present an automatic and friendly assessment tool, SISA-EMU, with a novel feature: exercise driven feedback with teacher’s expertise. It provides correctness information and clues to help the students solve their most common mistakes for each individual problem (and not typical generic debug information) without the physical support of a teacher. SISA-EMU is currently in pre-deploy phase via a Moodle learning platform and we will have first evaluation results by the end of the current term.

**GAME BASED SPELLING LEARNING**
Raquel M. Crespo García, Carlos Delgado Kloos and Manuel Castro Gil

Game-based learning aims at getting people to learn about a certain subject or to acquire certain skills by means of playing. Educational games must fulfill both recreational and didactic goals in order to succeed. This paper introduces a Pac-Man like educational game, designed to learn orthography and foreign language vocabulary. A brief description of the game is provided, together with the results of experimental evaluation. Experimental data include subjective opinions about entertainment and learning potential credited by the students and objective measures of learning improvements. Reported results demonstrate that the developed game successfully fulfills the entertainment requirements, while achieving a significant learning effectiveness.

**Session S3C: Design Experiences 3**
Chair: Julie A. Reyer, Bradley University
*Time and place: Saturday, October 25, 1:30 pm. - 3:00 pm. Broadway 2*

**A BIOSIGNAL ACQUISITION AND CONDITIONING BOARD AS A CROSS-COURSE SENIOR DESIGN PROJECT**
Steve Warren and James DeVault

In a single-semester course that incorporates both lecture and design, time constraints make it difficult to provide students with a substantive design experience that addresses multiple system elements. This paper presents a design experience that addressed numerous facets of a biomedical signal acquisition system by merging design credits for two undergraduate, senior-level courses: EECE 773 Bioinstrumentation Design Laboratory and EECE 628 Electronic Instrumentation. The innovative effort joined the sensor circuitry and signal display elements of a bioinstrumentation course with the data acquisition and serial communication topics often taught in electronic instrumentation courses. The overall goals of this project were to (a) create a substantial, design-driven learning experience for electrical engineering seniors and (b) increase student interest by attaching a biomedical context to an instrumentation project that would otherwise be generic. These goals were supported by 11 learning objectives that address clinical context, project planning, project roles, signal conditioning, signal management, printed circuit board development, biomedical data display, and written communication. In the initial project offering, 18 students were divided into three teams, each of which designed and built a system to acquire, process, and display data from
multiple biomedical sensors, where the signal conditioning functionality for each sensor was remotely programmable. Each acquisition board communicated with a custom LabVIEW interface via a Universal Serial Bus link. Development foci for each team changed over time as technical choices led to unexpected design complexities. Assessment of the experience was provided via a post-project survey that addressed the 11 learning objectives, learning in 16 technical areas, interpersonal team dynamics, and project administration. Survey results mirrored informal student comments: while this effort required a substantial time commitment relative to a typical course project, the learning and satisfaction derived were worth the investment.

**REFLECTING ON RUNNING LARGE SCALE STUDENT COLLABORATION PROJECTS**

Mattias Wiggberg and Mats Daniels

Large scale student collaboration projects are commonly used in Computer Science education programs. These endeavors are complex and there are many aspects to consider when using such a learning environment. We propose a model based on four key features for reflecting on how to set up and analyze such projects. The proposal is based on insights from two empirically grounded phenomenographic studies on large scale student collaboration projects at Uppsala University, Sweden. The studies were focused on decision-making and experience of competence, e.g. how the perceived level of competence and the decision-making process among students influence the projects. The overall aim with using the framework is to address issues related to the learning outcomes of such project courses, and thus be useful for both education researchers and teachers.

**WORK IN PROGRESS - ENHANCING STUDENT-LEARNING THROUGH STATE-OF-THE-ART SYSTEMS LEVEL DESIGN AND IMPLEMENTATION**

Albert A. Liddicoat, Jianbiao Pan, James G. Harris, Dominic J. Dal Bello and Lynne A. Slivovsky

The curriculum for undergraduate engineering programs is often partitioned into several courses that are taught in isolation followed by a single culminating senior design or capstone project experience. In the senior design class students begin to synthesize the knowledge and skills that they acquired through the engineering curriculum. This paper presents lower and upper division course and curricular changes made to accommodate learning objectives that better prepare students for project-based learning. These learning experiences and skills include: systems level design, experience with state-of-the-art Computer Aided Design (CAD) tools, printed circuit board (PCB) design, design for manufacturability, electronics assembly, project management, engineering ethics, and communication skills. Three upper division project based learning courses have been developed and are being offered this year. In addition, the development of laboratory tutorials and learning modules for the lower division engineering curriculum will introduce all engineering majors to current electronic manufacturing technology, and allow them to design electronic systems using PCBs. The courses and tutorial learning modules are currently being classroom tested and assessed.

**WORK IN PROGRESS - TRANSFORMING SENIOR DESIGN**

Regina Hannemann

In 2004 the Electrical Engineering BS program at the University of Kentucky went through its latest ABET Accreditation Process. As a result, we began to change the Senior Design course. In the past, individual students or teams of students would find an advisor and a project and would work without interaction between any of the teams to design their prototypes. Today students are required to register for one common class. All students hand in the same number of reports and prepare presentations. The students are required to form a team of three or four. Projects might be proposed by a faculty member, local industry or might be an original student idea. The teams prepare a proposal and present the basic approach for their project design within the first three weeks of the semester. Randomly chosen industrial advisors review the proposals and comments are provided to the students. At midterm, they prepare and present a status report, which is also reviewed by the advisory board. During ECE Senior Design Day, a full day event, the teams present posters and demonstrate prototypes to faculty, students, and outside visitors. This paper describes changes implemented in senior design to incorporate ABET criteria.

**WORK IN PROGRESS - FROM FIRST-YEAR PROJECTS TO SENIOR CAPSTONE DESIGN WHAT SKILLS ARE REALLY GAINED?**

Daria Kotys-Schwartz, Daniel Knight and Gary Pawlas

Innovative curriculum reforms have been instituted at several universities and colleges with the intention of developing the technical competence and professional skills of engineering students. First-Year, or Freshman Design
courses have been integrated into undergraduate engineering curricula across the country. Many of these courses provide students with hands-on engineering opportunities early in the curriculum. Senior Capstone courses are ubiquitous in engineering programs, incorporating technical knowledge and real-world problem solving. However, it is unclear what professional and technical engineering skills are gained between freshman and senior year design courses. This research project investigates the longitudinal technical and professional skill development of mechanical engineering students at the University of Colorado at Boulder. An overview of First-Year Engineering Projects and the Senior Capstone Design project coursework detailed. The assessment tools and schedule are presented, and the initial findings are discussed. Additionally, a summary is addressed discussing how the evaluation results, which may affect skills development, will be integrated into the next course offering of Senior Capstone Design.

Session S3D: K 12 Initiatives 2
Chair: Trevor S. Harding, California Polytechnic State University
Time and place: Saturday, October 25, 1:30 pm - 3:00 pm. Broadway 3

RECRUITMENT AND RETENTION OF FEMALES IN THE STEM DISCIPLINES: THE ANNUAL GIRL SCOUT DAY CAMP AT BAYLOR UNIVERSITY
Cynthia C. Fry, Jessica Davis and Yasaman Shirazi-Fard

What would the demographics of typical Science, Technology, Engineering, and Mathematics (STEM) programs in the United States look like if the ratio of females going into those fields approached the ratio of females showing an aptitude and an affinity for STEM fields prior to puberty? The School of Engineering and Computer Science (ECS) at Baylor University, in conjunction with the student sections of the Society of Women Engineers (SWE) and the American Society of Mechanical Engineers (ASME), has designed an annual Girl Scout Day Camp for Brownies (ages six, seven, and eight) and Junior (ages nine, ten, and eleven) Girl Scouts. This paper will review the current research on the retention of females, especially in the elementary ages, in the STEM areas; document the design and development of the annual Girl Scout Day Camp, including the multi-year rotation of badges and activities offered; as well as the feedback from the local and area Girl Scout Councils, Troop Leaders, and parents. In future years we hope to be able to determine whether involvement in this type of activity has any significant effect on the recruitment of females as they approach high school and college, or the retention of current ECS females.

WORK IN PROGRESS - IMPROVING K-12 STUDENTS PROBLEM-SOLVING SKILLS VIA INNOVATIVE TEACHER TRAINING
Maureen P. Hall and Jan Bergandy

Building on the findings of our recent SoTL research project which investigated teachers’ attitudes towards technology in a graduate-level educational research and technology course, this work in progress is a creative pilot program comprised of innovative teacher training modules designed to improve instruction at the K-12 level. Unified Modeling Language (UML) represents the vehicle through which we propose to improve students’ problem-solving and critical thinking skills. This project focuses on improving students’ analytical and problem-solving skills by working with in-service teachers who are graduate students in education courses.

THE EFFECTIVENESS OF VISUAL PROGRAMMING FOR MODEL BUILDING IN MIDDLE SCHOOL
Terence C. Ahern

The National Center of Educational Statistics (NCES) documents a troubling downward trend starting in the eighth grade in conceptual reasoning, scientific investigation, and practical reasoning. The data indicate no improvement in the eighth grade scores and by the time these students reach the 12th grade the data show a downward turn. The downward trend implicates the type of curriculum being taught in the middle school. Middle school students learn how to use reasoning in the abstract, not in the context of real-world problems. Modeling and simulation software is a possible way out of this dilemma by learning about potential implications of today’s actions on tomorrow’s outcomes. However, programming can present a huge obstacle for middle school teachers who want to integrate model building into their curriculum. To overcome this hurdle we introduced StarLogo, which uses an interface that simplifies programming making it accessible even for novices. StarLogo makes building programs as easy as dragging color-coded puzzle-piece like statements together. The paper reports on a usability study that investigated the effectiveness of the visual programming language of StarLogo from two perspectives. Did the visual interface make programming useful for middle school teachers and effective as a teaching platform?
NASA ENRICHED COLLABORATIVE STEM K-12 TEACHER PROFESSIONAL DEVELOPMENT INSTITUTES WITHIN THE CALIFORNIA STATE UNIVERSITY SYSTEM
Silvia Liddicoat

The State of California must remain a leader in Science, Technology, Engineering, and Mathematics education to maintain its competitive edge and economic vitality. The California State University system recognizes the urgency to increase the STEM talent pool for California. A research review on teacher quality and student achievement from the Center for Public Education (November 2005) indicates that more than two decades of research findings are unequivocal about the connection between teacher quality and student learning. This paper presents and analyzes three NASA Enriched Collaborative STEM K-12 Teacher Professional Development Institutes held in 2007: California Polytechnic State University, San Luis Obispo; California State, Fresno; and California State, Bakersfield. The three institutes implemented unique practices based on trial and error, past experiences, and institutional learning. This paper highlights the critical elements, extracts the best practices from the three institutes and proposes an implementation model as a framework for other campuses and institutes.

TRASH CAN ROBOT: HIGH SCHOOL ROBOTICS INITIATIVE
Elizabeth Fudge, Gregg Fox, Justin Maham and Elester Williams

This paper, written by students on the Rockwall High School (Texas) Robotics Team, describes how we developed a remote-controlled, talking trash can robot for greater public exposure for our team and for greater practical experience in robotic construction and design. We were motivated by the FIRST (For Inspiration and Recognition of Science and Technology) emphasis on fostering enthusiasm in the technological field on a competitive level. We used this framework in a non-competition setting to design, build, and test our trash can robot. After the construction and trouble-shooting were completed, we demonstrated the trash can robot to our community, stimulating local interest in FIRST and robotics in general. We learned important real-world engineering concepts from this project and inspired fellow students with an enthusiasm for computer science, engineering, and technology.

WORK IN PROGRESS A FRAMEWORK FOR DEVELOPING COURSES ON TECHNOLOGY AND ENGINEERING FOR ALL STUDENTS
John Krupczak, Timothy Simpson, Vince Bertsch, Kate Disney and Elsa Garmire

All Americans need to better understand the wide variety of technology used everyday. The need for technological understanding has never been greater at both an individual and national level. Creating a population with a more empowered relationship with technology will require a significant and widespread initiative in undergraduate education. Standard course models and materials that are easily adoptable in diverse and varied institutional environments will facilitate this effort. A framework to evaluate technology literacy courses was proposed as part of a recent NSF/NAE Workshop. This work attempts to forge links between recently established definitions of technological literacy, course structures and student learning at the undergraduate level, and the needs of faculty in proposing and developing new technology literacy courses. The framework also provides a benchmark to institutions for evaluating and establishing new technology courses. This was accomplished through a review and survey of the 22 existing successful courses on technology recently developed and being taught. The proposed framework intends to from the facilitating infrastructure for an online repository of course materials to help expand and enrich the growing community devoted to a broader understanding of technology by all Americans.

DEVELOPING A BODY OF KNOWLEDGE FOR ENVIRONMENTAL ENGINEERING
James Kilduff

An environmental engineering (EnvE) body of knowledge (BOK) is currently under development by a Working Group composed of academics, consultants, local and national government employees, and representatives of NCEES and ABET. The EnvE BOK is being developed in close consultation with these and other stakeholders. Our approach to developing the EnvE BOK is guided by expectations of educators and other stakeholders. Our goals are to make the BOK adaptable, in recognition of the fact that environmental engineering is rapidly evolving, and that the BOK should facilitate future needs. The BOK emphasizes the application of fundamental math and science
knowledge domains to solving environmental engineering problems. The need for in-depth competence is recognized, but the BOK also needs to be sufficiently flexible to promote innovation. The EnvE BOK focuses on core competencies and knowledge domains integral to the understanding and practice of environmental engineering. It defines the BOK needed to enter the practice of environmental engineering at the professional level in the 21st century. This paper is an interim report on EnvE BOK development with a focus on the outcomes, knowledge domains, and levels of achievement to provide a basis for further input into the EnvE BOK development process.

**WORKSHOP SYNOPSIS: FRONTIERS OF ENVIRONMENTAL ENGINEERING EDUCATION**

James Kilduff

A workshop on environmental engineering education, sponsored by the National Science Foundation (NSF), the Association of Environmental Engineering and Science Professors (AEESP) and the American Academy of Environmental Engineering (AAEE), was held on the Arizona State University campus in Tempe, AZ, January 8-10, 2007. Approximately 60 attendees represented a broad cross-section of environmental engineering education and practice, including faculty and stakeholders from industry, government, and professional organizations. A major objective of the workshop was to explore emerging frontiers, innovations, developments, and needs in Environmental Engineering curriculum and education. Such developments and needs were assessed in the context of how environmental engineering has evolved as a field. Breakout sessions identified trends and needs in environmental curricula and plenary speakers discussed future needs in engineering education, and trends in environmental engineering education. These included sustainability and how systems engineering applies to environmental issues. Different environmental curriculum structures were discussed in the context of a study supported by the Council of Environmental Deans and Directors (CEDD).

**WORK IN PROGRESS - ASSESSING THE ENGINEERING CURRICULUM THROUGH BLOOM’S TAXONOMY**

Alan Cheville, Aman Yadav, Dipendra Subedi and Mary Lundeberg

This research project examines using a taxonomy-based survey to permit engineering programs to self-assess whether students are given a broad spectrum of learning opportunities. An engineering taxonomy, designed to be compact and simple, identifies seven key engineering skills; one conceptual, one factual, and five process oriented skills based on the engineering design cycle. Four levels of mastery are defined, compared to the six originally defined by Bloom. The taxonomy survey has been piloted in an electrical engineering program at a land-grant research university. This paper discusses the validation process and initial results.

**INTEGRATING MOBILE DEVICES INTO THE COMPUTER SCIENCE CURRICULUM**

Qusay H. Mahmoud

Mobile devices such as cellular phones and smart personal digital assistants out-ship personal computers (PCs) 20 to 1, and for many students the mobile device is becoming the computer. Such devices are becoming more powerful than the PCs of twenty years ago and they represent a useful tool for conveying important computer science concepts. This calls for innovations in the computer science curriculum, not only in some specific courses but across the curriculum to create a motivating framework for computer science students. After all, students expect faculty to integrate leading edge technology in the classroom. Here we present our approach for integrating mobile devices into the Computer Science curriculum, supported by an example of our experience in integrating BlackBerry devices into two programming courses, a distributed systems course, and senior capstone projects. Some of the courses are lab-intensive where students experiment with the devices, and develop and deploy applications for them. Teaching computer science and programming in the context of mobile applications provides a motivating framework for students and inspires them to excel due to the practical experience they gain allowing them to develop applications for their own mobile devices.
RESEARCHING THE DEVELOPMENT OF TEAM COMPETENCIES IN COMPUTER SCIENCE COURSES
Kathrin Figl and Renate Motschnig

The capability to effectively work in teams has been a key competence for computer scientists for a long time. Gradually, more attention is paid to developing this generic competence as part of academic curricula. At the University of Vienna, we have conducted and researched a number of different courses that were aimed at developing students' team competencies along with subject specific and/or other generic competencies. The major scientific goal of the accompanying studies was to investigate the influence of person-centered technology-enhanced courses on the development of team knowledge, skills and attitudes. In these courses, emphasis was put on team projects with authentic tasks selected by students, and on providing a cooperative atmosphere. Students' perceptions on these issues were collected in online questionnaires and analyzed using qualitative and quantitative methods. Results indicate that courses had significant effects on the development of team competencies, whereby effects on knowledge and skills were stronger than on attitudes. Courses including reflection were perceived as having stronger impact on team competencies in general than other courses. As expected, sub-skills that were promoted by specific interventions in a course were also perceived as those being most significantly improved as a result of that course.

WORK IN PROGRESS - THE FIVE PARAGRAPH ESSAY IN JUNIOR/SENIOR ELECTRICAL ENGINEERING COURSES
Ladimer S. Nagurney and Hisham Alnajjar

To strengthen the writing of Junior and Senior Electrical and Computer Engineering students, we are adding several writing assignments based upon the Five Paragraph Essay format to our Junior and Senior courses. The five paragraph essay format, almost universally taught in middle and high schools, requires the student to clearly and concisely analyze and communicate a single idea, beginning with a single paragraph that states the overall point, three supporting paragraphs, and a concluding paragraph. During the Spring 2008 semester, these essays will be used in Electromagnetic Field Theory, Engineering Practice, and Capstone Design Project courses. In each course, the students will be asked to describe concept or argue why a specific design choice must be made without presenting just a mathematical calculation. The paper will include a discussion of the format, and graphic organizers used to help students write the essays, as well as the rubric used for grading the essay. Since a sizable fraction of our students are non-native speakers of English our evaluation on their performance will be compared to the performance of students writing these essays in English as a Second Language courses as reported in Education Literature.

PARTICIPATING IN AN INTERNATIONAL ROBOT CONTEST AS A WAY TO DEVELOP PROFESSIONAL SKILLS IN ENGINEERING STUDENTS
Julio Pastor Mendoza, Irene González García and Francisco Javier Rodríguez Sánchez

The article analyses the design of robots that were developed by engineering students for a robot contest with the aim of strengthening a set of basic skills that would be useful for the future professional lives of the participants. To this end, the results of a survey given to the participants of the international competition Eurobot 2007 are presented. Participants were asked their opinions on why they participated in the competition, what they gained in their personal and professional lives for having participated as well as positive and negative aspects of the experience.

SIMULATED CONFERENCE SUBMISSIONS: A TECHNIQUE TO IMPROVE STUDENT ATTITUDES ABOUT WRITING
Aaron G. Cass and Chris S. T. Fernandes

While many models have been suggested for improving the writing skills of students in technical fields, we contend that improving attitudes about writing is equally important. We present an approach that seeks to improve both skills and attitudes through the use of Simulated Conference submissions. In this model, students are asked to write and present as if they are submitting to a technical research conference, complete with a review panel. By giving students this audience, we aim to focus their efforts on communication, rather than simply completing assignment requirements. In this paper, we present our results after having implemented this approach twice. The
results show that student skills and appreciation of those skills both improve. In particular, student appreciation of the value of a literature review increases over the course of a term.

**WORK IN PROGRESS - ENHANCING ETHICAL AWARENESS WITHIN UNDERGRADUATE MULTIDISCIPLINARY TEAMS BY PREPARING CODES OF ETHICS**

Margaret H. Huyck, Daniel M. Ferguson, June Ferrill, Lisa Getzler-Linn and Mary Raber

IIT, Lehigh, Michigan Tech, and Rice universities are piloting a strategy based on the book by Jones & Ferrill, The Seven Layers of Integrity (2006), to teach ethical awareness to engineers and scientists. Students at the four universities are expected to prepare a Code of Ethics for their own project or course problem context. These codes are evaluated and each Code of Ethics must have an over-arching principle as well as seven canons describing the standards of conduct to which the individual or professional working in the problem context shall be held. Each canon must be supported by descriptions of ethical pressures and risks. Each of these requirements is scored and the scores from these code evaluations constitute evidence of the extent to which teams understand the principles of ethics and can translate that understanding into a code of ethics.

**Session S3G: Engineering Education Innovations to Enhance Learning**

Chair: William Hornfeck, Lafayette College

**WORK IN PROGRESS - THE REDESIGN OF A FLUID MECHANICS LAB**

Dan Budny and Dave Torick

Most fluid labs were built back in the 1960 - 1970 time frames and consisted of large facilities that included flumes, wind tunnels, pump stations, wet wells, etc. Today these labs are out dated and the need for lab space is forcing the closing of large scale labs. This same basic problem exists within the Engineering School at the University of Pittsburgh, thus over the past two years we have begun the task of removing all the old equipment and replacing it with small bench top scale experiments. This paper will describe the concepts behind the design of the new experiments and the learning improvements discovered as a result of moving from a few large experiments to a large number of small scale experiments.

**DROWNING IN METHOD, THIRSTY FOR VALUES: A CALL FOR CULTURAL INQUIRY**

Jonathan Stolk, Mark Somerville and Debbie Chachra

A decade or more has passed since publication of most calls for reform in engineering education. In the ensuing time, there has been significant work on the design, implementation, and transferability of appropriate methods and techniques accompanied by, in most cases, little discussion of the values and beliefs of the people involved. But many theories of change rely on a fundamental shift in human beliefs and values, and purport that institutionalization of methods is impossible without this shift. Given this, now may be a reasonable time to re-visit the questions: What are the values of people involved in engineering education, and are our educational reform efforts considering these values throughout the curriculum design process? In this paper, we examine several models for engineering educational reform, with a particular focus on the role of individual values in determining responses to change. We highlight the importance of developing understandings of individual perspectives and social context. We contrast a user-oriented approach to curriculum design with common scenarios of curriculum design practice, and we argue that, in many cases, successes in curricular change can be traced to employment of user-centered approaches.

**LIVING WITH THE LAB - A FRESHMAN CURRICULUM TO BOOST HANDS-ON LEARNING, STUDENT CONFIDENCE AND INNOVATION**

David Hall, Hisham Hegab and James Nelson

A new freshman engineering curriculum has been implemented at Louisiana Tech University to boost hands-on learning, student confidence and innovation. The new curriculum, called Living WITH the Lab, increases experiential learning by moving the ownership and maintenance of laboratory equipment from the university to the students. Each student purchases a robotics kit with a programmable controller, sensors, servos, and software along with a toolkit to provide the basis for a mobile laboratory and design platform. A basic tenet of the curriculum is that student-owned labs motivate student learning and broaden the spectrum of projects and design topics that can be addressed, thus facilitating innovation. The curriculum has been piloted for the past five years, and we are currently
TEACHING PROBABILITY AND STATISTICS IN A FIRST-YEAR ENGINEERING COURSE

Eric C. Johnson, Barbara Engerer, Kenneth Leitch and Douglas Tougaw

Teaching probability and statistics to undergraduate engineering students is a challenge because of the theoretical nature of the topic. There are many advantages to introducing this topic to first-year students. Students who have seen and worked with topics in probability and statistics are more likely to understand these principles when they are used in later courses, and they more clearly understand the relationship of statistics to their disciplinary coursework. In this paper we describe how probability and statistics can be introduced within a first-semester engineering course. A modular approach was used, which included a lecture with a number of active learning exercises, a homework assignment, and a hands-on experiment to help them better understand the theoretical background. Assessment results illustrate that after the module, the students believed they could meet all of the module's learning objectives and that each of the learning opportunities contributed to their achievement of the objectives.

Making Mathematics Meaningful

Virginia Eaton and Natalie Campbell

The Making Mathematics Meaningful (3M) project was designed to prepare 50 elementary school teachers to be better qualified to teach their students about measurement. The project was a partnership among the University of Louisiana at Monroe, the Louisiana Department of Education, and a number of school systems in Northeast Louisiana. The project emphasized practical applications of mathematics in the real world, grade-appropriate hands-on activities, and mathematics literacy activities. The project consisted of a three-week Summer Institute and five follow-up Saturdays during the Academic Year. Projects such as this are necessary if students are going to be properly prepared to pursue careers in engineering, mathematics, science, and technology.

BUILDING SOFTWARE ENGINEERING TEAMS THAT WORK: THE IMPACT OF DOMINANCE ON GROUP CONFLICT AND PERFORMANCE OUTCOMES

Tracy L. Lewis and Wanda J. Smith

This project is designed to build on theories of team composition and proposes an innovative way of assigning students to teams. Currently, professors are using a variety of team assignment techniques to form software engineering teams. This research believes that a contributing factor to the undesired outcomes (i.e., low performing teams and high levels of conflict) of software engineering teams is that the teams were not formed using relevant and salient criteria. To address the relevance issue, we test the impact of problem solving preferences (a sub-set of the MBTI scale) on group conflict and performance. We then test the extent to which the numerical dominance (i.e., salience) of problem solving styles influences conflict and performance. It was found that dominance of problem solving styles is related to negative team outcomes. We conclude by discussing ways in which instructors and team members may minimize negative team outcomes when there is no choice other than forming a team with one dominant problem solving preference.

WORK IN PROGRESS - CHALLENGES TO EDUCATING STUDENTS WITHIN THE COMMUNITY OF OPEN SOURCE SOFTWARE FOR HUMANITY

Heidi J. C. Ellis, Ralph A. Morelli and Gregory W Hislop

This WIP describes the challenges faced by the SoftHum (Student Participation in the Community of Open Source Software for Humanity) project in incorporating undergraduates in Humanitarian Free and Open Source Software (H-FOSS) projects. The goal of SoftHum is to develop course-level support for the use of H-FOSS as a foundation for software engineering education. Such support will take the form of course materials and a process to support student success in a community-based software experience using H-FOSS, and the documentation of a
classroom environment that supports student open source experience. We present a brief overview of the project, discuss the challenges we face in involving students in H-FOSS projects, and present our current progress.

**SPANNING THE GAP BETWEEN SOFTWARE ENGINEERING INSTRUCTOR AND STUDENT**

Andrew J. Budd and Heidi J.C. Ellis

Many computing degrees have a project-based software engineering course where teams of students complete a project under the guidance of the instructor and possibly one or more teaching assistants (TAs). However many instructors are unsure as to how well course objectives for these project-based courses are being met and more importantly, how best to structure the experience to optimize student learning. This paper presents the contrasting views of the instructor and a TA on the learning that occurred in an undergraduate software engineering project course. The undergraduate TA for the course is uniquely qualified to support the course, having had several years of real-world software development experience. This experience allows him to straddle the gap between the typical undergraduate student perspective and the requirements of real-world software development.

**WORK IN PROGRESS - SVAEC, AN ADAPTIVE ENVIRONMENT FOR CREATING AND EXPLORING KNOWLEDGE STRUCTURES**

Fernando Sanchez-Zamora and Martin Llamas-Nistal

We present SVAEC, a visual adaptive environment to assist students, professors and researchers in their knowledge representation and visualization tasks for improving engineering education. The system provides a web 2.0 rich environment and it encourages the user to interact with already represented knowledge and to include new one. For this purpose it combines an adaptive visualization of the knowledge structure with new features as the nested visualization view and the text parsing tool. The adaptive process of the knowledge structures representation utilizes the user and knowledge profile, including mouse movements and keyboard inputs as a source for extracting user information. At present, a web mining component is being developed for extracting knowledge from educational web resources.

**LEARNING SOFTWARE ENGINEERING PRINCIPLES USING OPEN SOURCE SOFTWARE**

Jagadeesh Nandigam, Venkat N. Gudivada and Abdelwahab Hamou-Lhadj

Traditional lectures espousing software engineering principles hardly engage students’ attention due to the fact that students often view software engineering principles as mere academic concepts without a clear understanding of how they can be used in practice. Some of the issues that contribute to this perception include lack of experience in writing and understanding large programs, and lack of opportunities for inspecting and maintaining code written by others. To address these issues, we have worked on a project whose overarching goal is to teach students a subset of basic software engineering principles using source code exploration as the primary mechanism. We attempted to espouse the following software engineering principles and concepts: role of coding conventions and coding style, programming by intention to develop readable and maintainable code, assessing code quality using software metrics, refactoring, and reverse engineering to recover design elements. Student teams have examined the following open source Java code bases: ImageJ, Apache Derby, Apache Lucene, Hibernate, and JUnit. We have used Eclipse IDE and relevant plug-ins in this project.
engagement in lectures. The technology further supported awareness and feedback within lectures and allowed co-construction of shared representations among faculty and students leading to a feedback based learning environment. We argue that there is some evidence that pen-based computing can transform large lecture classes to make them more inclusive and participatory. This technology driven innovation can help us in developing effective formative assessment strategies to redesign learning environment, particularly in large classrooms, to support the conceptual understanding of students. We analyzed and present both qualitative and quantitative assessment data collected from freshman engineering students through in-class and end of semester course exit survey (N~500).

**EFFECTIVE USE OF TABLET PCS FOR ENGINEERING MATHEMATICS EDUCATION**

Micah Stickel

Recently, there has been a growing interest in the use of tablet PCs (TPCs) as a means for improving engineering education, primarily in technical courses such as basic physics. However, there has been little discussion on how to apply this technology to engineering mathematics courses. The purpose of this paper is to present an approach for teaching mathematics to engineering students with the TPC. The approach was implemented in a second-year differential equations and algebra course within the Electrical and Computer Engineering Department at the University of Toronto. The effectiveness of the approach was tested qualitatively through a survey of 89 students, and quantitatively through a comparison between the three lecture cohorts of the course, since two of the cohorts were taught with a traditional blackboard technique. The survey results were quite positive, yet the more interesting results are found from the grade comparisons. These results indicate that the TPC-based instruction had the greatest impact on the students in the bottom half of the class. In this paper, the approach will be discussed and survey and grade comparison results will be presented.

**WORK IN PROGRESS - SAGES: PODCAST, WIKIS AND EMERGING TECHNOLOGIES IN THE ENGINEERING CLASSROOM**

Li (Emily) Liu, Marie-Pierre Huguet and Thomas Haley

Technology in education is seen as a powerful educational instrument and its integration, as a significant force driving change. An increasing number of research is linking technology-enriched learning environments to improved higher-order thinking skill and showing that, by using technology as an educational tool, students are better prepared for real work skills and future success in this new technological society. In this report, we propose to address some of these issues by sharing our work in progress: the integration of podcasts, wikis, and emerging technologies in engineering instruction. We will first outline our selection of the various tools as well as the process we followed to select the technologies. We will then describe the SAGES project itself, using examples and best practices from its various stages. This will enable the participants to get a holistic understanding of how they too can effectively integrate established or emerging technologies in their own engineering classroom.

**EFFECTS OF TABLET COMPUTERS AND COLLABORATIVE CLASSROOM SOFTWARE ON STUDENT ENGAGEMENT AND LEARNING**

Andy Hurford and Eric Hamilton

This research centers on an intervention designed to elevate the depth of learner engagement in mathematics classrooms in order to enhance students' mathematical growth. The design blends tablet personal computers with collaborative workspaces and reports on the implementation of personal digital assistants for carrying out an experience sampling research method designed to measure student engagement. We report recent research developments in which engagement sampling is carried out electronically, employing an experience sampling research method first developed in the late 1970s. In our study, engagement sampling is carried out electronically in calculus classrooms that covered subject matter prerequisite for most engineering coursework. Results show statistically significant increases in learner engagement related to the implementation of tablet computer technologies and collaborative software and these quantitative results are supported by classroom observations, interviews, and an on-line student survey. The paper closes with observations on how to increase student engagement and promote learning in science, technology, engineering, and mathematics classrooms.
WORK IN PROGRESS - JAVA SIMULATIONS OF DSP ALGORITHMS FOR ION-CHANNEL SENSORS
Andreas Spanias, Peter Knee, Homin Kwon, Karthikeyan Natesan, Jayaraman Jayaraman and Photini Spanias

The use of ion channels as sensing elements for chemical and biological agents is a rapidly developing area. Ion channels are proteins that mediate the flow of ions and molecules across membranes such as cell walls. At Arizona State University researchers have devised a silicon ion-channel sensor. Experiments have been conducted to characterize this sensor and examine its utility in various applications. This paper presents Java functions developed to demonstrate ion channel signals and their analysis using DSP functions in class. The Java functions were developed in the J-DSP visual programming environment. Students can experiment with ion-channel signals, extract features, and differentiate signals representing the presence of different analytes.

Session S4A: Learning Models and Teaching Tools
Chair: Michael A. Collura, University of New Haven
Time and place: Saturday, October 25, 3:30 pm. - 5:30 pm.

WORK IN PROGRESS - IMPACT OF RESEARCH TECHNOLOGIES ON SERVICE LEARNING
Saurabh Bagchi, Carla Zoltowski and William C Oakes

While the effect of service learning in technology-based curriculum has been documented, it is as yet unknown what benefits or challenges are felt by the students when the technologies being applied in their service learning course lie in the research domain. We investigate these questions through a study carried out in the context of a service learning program called EPICS, in which teams of undergraduates develop real systems to address engineering and computing-based needs for a local community partner. Through a questionnaire, we study the students' perception of the availability of resources and skills for their project, and their perception of the value add of the project to their curriculum. The experimental group consists of teams that use cutting-edge research technologies in their projects. The control group consists of teams that develop prototypes using mature technologies. The study uncovered that neither group of students felt hampered by a lack of resources or skills. However, the control group felt greater ease in dealing with the community partner. It is hoped that this effort will serve to increase the viability of integrating research and service learning activities.

WORK IN PROGRESS - IMPLICATIONS OF THE MASTERY APPROACH FOR RATES OF LEARNING AND ASSESSMENT
William J. Leonard, William J. Gerace and C. V. Hollot

The Mastery approach has been used successfully to improve both performance and success of students learning Circuit Analysis, a foundational, one-year sequence for Electrical and Computer Systems Engineering majors. Students work toward mastering secure, online modules, which can be retaken when a student fails to earn a perfect score. Preliminary results indicate that the total number of modules mastered by the class doubles every two to four weeks during the first semester, suggesting that learning is also nonlinear. Results also show that different students follow very different trajectories toward mastery. In this paper, we report on these findings and others, and discuss the implications for assessments in foundational courses.

WORK IN PROGRESS - CAN THE TABLET PC PROVIDE NEW OPPORTUNITIES TO LEARN?
Deborah Olsen, Kimberly Filer, Joseph G. Tront and Glenda Scales

With the advent of the information age, engineering educators have struggled to change pedagogical practice to prepare students for the pace and complexity of the world ahead. Constructivist instructional methods are particularly promising because they explicitly promote active evaluation of information and higher-order thinking, and encourage faculty to act as a facilitator of student learning. The Tablet PC is a potentially valuable tool in this instructional environment because of its wide-ranging functionality. In the present study, we examine the unfolding effects of a large-scale Tablet-based deployment at a R1 College of Engineering We employ pre and post measures to evaluate students: (1) attitudes toward technology, (2) technology use, and (3) metacognitive strategies and motivation. Initial results also show some significant cognitive effects in courses using the Tablet. With course implementations underway that make fuller use of Tablet capacities we anticipate more positive learning outcomes.
WORK IN PROGRESS - THE FUNDAMENTAL RESEARCH OF CYBERWORLDS: POTENTIALS OF OPEN-SOURCE-STYLE-EDUCATION FOR SOCIAL REVOLUTION
Masaya Osaki

We explore the potentials of "open-source-style-education" from the viewpoint of an axiomatic approach of cyberworlds adopting an approach to study a basic 4 step reasoning: axiom, theorem, implementation and proof. The first step is defining the axioms of world; "in the evolutionary power, borrowing and utilizing functions exceed owned functions." The second step is "theorem" as the prediction derived from the axiom; "to enjoy sharing unlimited resources make the world stable by its cooperation processes." The third step is the "implementation" as "open-source-style-education" for producing global commons and wealth. The fourth step is the "proof" of the potentials of "open-source-style-education" from the point of view of network science and open society Sir Karl Raimund Popper argued. Open Source has hitherto been discussed mainly in relation to software development, politics, economics, and sociology, however it can and should also be investigated from educational aspects as a means for changing our society according to the advance of science that could invent the weapon even the individual can slaughter the all mankind instantaneously in the near future. In this paper we argued the potential powers of "open-source-style-education" to change our society. In using conceptual education-models we propose here an open source learning models on the basis of legitimate peripheral participation and scale free network as a potential contribution to the improvement and evolution of our society.

KNOWLEDGE MAPS AND THEIR APPLICATION TO STUDENT AND FACULTY ASSESSMENT
Ricky Castles, Vinod K. Lohani and Pushkin Kachroo

This paper discusses the development of Knowledge Maps for enhancing engineering learning. These maps are somewhat similar to concept maps, which have been widely used and developed in various areas of study. Knowledge Maps, however, extend concept maps in that they not only illustrate the underlying concepts of a discipline, but they actually embed the knowledge in each of those concepts through various multimedia attachments. Knowledge maps also allow reverse mapping so that students can be assessed based upon how many concepts they know and whether they have understood the proper relationships between the concepts. A reverse map can be used to evaluate students and act as a record of student learning. Aggregate course maps may be used to gain an average understanding of the gains of entire classes of students and may be used to evaluate faculty effectiveness and provide valuable insight into the gains and weaknesses of students matriculating from one course to the next. The work contained herein presents the strategies implemented to allow for the design of custom knowledge maps. Reverse mapping techniques are discussed to indicate the method for evaluation of students.

WORK IN PROGRESS - PROCESS EDUCATION: GROWING PERFORMANCE ACROSS DOMAINS
Daniel Mitchell Litynski and Daniel Kenneth Apple

Learning is a fundamental human activity that occurs throughout life. Growth is inherent in each and every individual; with it comes more empowerment. Education and educational systems are constructed to support learning and growth. Process EducationTM is a performance-based philosophy of education which integrates many different educational theories, processes, and tools in emphasizing the continuous development of learning skills through the use of assessment principles in order to produce learner self-development. Process Education principles enhance and accelerate the learning and growth processes. The innovative philosophy and practice of Process Education have demonstrated significant success in the educational domain and in other professional and personal domains. We are investigating the depth and breadth of achievement of Process Educational philosophy and practice across multiple domains and will analyze future directions.
WORK IN PROGRESS - WEB-BASED IMPLEMENTATION OF CAPSTONE ENGINEERING DESIGN ASSESSMENTS
Denny Davis, Howard Davis, Steven Beyerlein, Phillip Thompson, Olakunle Harrison and Michael Trevisan

Assessment of student performance in capstone engineering design is vital to student learning and to program accreditation and improvement. Performances important to capstone design courses include students' growth in personal capacity for design, development of teamwork, development of design processes, and delivery of solution assets. The Transferable Integrated Design Engineering Education (TIDEE) consortium is creating and testing a capstone design assessment system to measure these student performances and provide rapid personalized feedback. Broad adoption of this assessment system requires ease of use by both students and instructors. This paper describes design features of a web-based implementation of the TIDEE capstone design assessment system.

INTEGRATING SERVICE LEARNING INTO PROGRAMMATIC ASSESSMENT
Kenneth R. Price

The process of receiving and using feedback from teachers and peer editing groups in the writing classroom, while valuable, is not sufficient in the discipline of technical communication. Technical communication relies heavily on experiential learning, which is typically gained through internships and coops. Similarly, in courses with a service-learning component or activities, students are able to interact with real-world audiences, getting feedback on their work from audiences beyond the classroom. There has been little integration of service learning into technical communication courses serving a student population comprised of engineering students. In courses with this type of curricular structure, students have the opportunity to learn and apply writing, editing, and collaboration strategies specific to the field of engineering in nonacademic situations. This paper outlines the justification and methodology for using community engagement and service learning assignments in technical writing courses that primarily serve students in engineering programs. It outlines the benefits to the students and community organizations; details how I, while at the University of Alaska Anchorage, used service learning as a means of programmatic assessment in my technical communication courses; and concludes with the methods of assessment used to evaluate the effectiveness of this type of course.

ANALYZING THE TRANSITION OF LEARNERS' MOTIVATION TO LEARN PROGRAMMING
Hidekuni Tsukamoto, Hideo Nagumo, Yasuhiro Takemura and Kenichi Matsumoto

In this research, a model of motivation design called ARCS was used to analyze the transition of learners' motivation to learn programming. The students were in an art and design course, and a programming environment specialized for design/art called Processing was used to teach introductory programming to the students. The questionnaire based on the ARCS model was conducted three times: early, middle, and late in the course. From the analysis of the questionnaire, it has been found that the change of the motivation from early to middle in the course was more remarkable than the change from middle to late in the course. Therefore, it was important to raise and maintain the motivation of the learners in the early stage of the course. It has also been found that the correlation between the factors in the ARCS model increased as the learning progressed. Therefore, the instructors should prepare their teaching materials in such a way that the four factors in the ARCS model are balanced.

WORK IN PROGRESS - A CASE STUDY OF PERCEPTION AND LEARNING BARRIERS OF STUDENTS IN NON-MAJOR ENGINEERING COURSES
Qaiser Malik, Punya Mishra and Michael Shanblatt

This paper presents the preliminary outcome of an ongoing study conducted on engineering students in a non-major course in electrical engineering. The goal of this study is to better understand the reasons for lower levels of performance in non-major engineering courses. We accomplish this by assessing student perceptions and attitudes towards learning, and measuring their understanding of core concepts related to a specific topic. Analyses of data collected to-date points towards some inherent flaws in common teaching methodology. We anticipate that this study
will lead to a restructuring of these service courses to make them more relevant and conceptually grounded. Additionally, the development of reliable subject specific instruments as used in this study could be the basis for a broader framework which could be used for other engineering courses.

**OUTCOMES OF THE UNIVERSITY OF WISCONSIN-MADISON S CAMPUS-BASED SESSIONS OF LEADERSHAPE®**

*Julie Zogg and Mark Mastalski*

To determine the outcomes, based on participant responses, of the University of Wisconsin-Madison’s campus-based LeaderShape® sessions, a comprehensive assessment and evaluation was conducted. The participants in this assessment study were LeaderShape alumni who participated in the 13 sessions hosted by the University of Wisconsin-Madison between 1997 and 2006. Using qualitative data analysis techniques, seven outcomes of the campus-based sessions of LeaderShape at the University of Wisconsin-Madison were extracted from participant responses. Those seven outcomes include: (a) changed goals and aspirations; (b) self discovery; (c) application of knowledge; (d) actions planned and taken; (e) changed concept of leadership; (f) increased understanding of values and convictions; and (g) celebration of diversity. Several suboutcomes emerged within each of the seven outcomes. Conclusions were reached and implications for future campus-based sessions of LeaderShape at the University of Wisconsin-Madison are discussed.

**PRELIMINARY RESULTS ON THE IMPLEMENTATION OF OUTCOME-BASED EDUCATION ON THE NON-EXAMINABLE COMPUTER ENGINEERING MODULES**

*Wahidah Mansor, Hadzli Hashim, Syahrul Afzal Che Abdullah, Mohd Uzir Kamaluddin, Mohd Fuad Abdul Latip, Ahmad Ihsan Mohd Yassin, Titik Khawa Abdul Rahman, Zuhaina Zakaria and Mahanijah Md Kamal*

The implementation of Outcome Based Education (OBE) on non-examinable courses such as case study or mini project, has eliminated the conventional ways of assessment at the Faculty of Electrical Engineering, Universiti Teknologi MARA. In order to facilitate the assessment process, an evaluation system has been developed to assist the lecturer. This dynamic system consists of several evaluation criteria for the students’ raw marks. The outputs are in terms of indicator plots representing the course and programme outcomes achievement scores. Hence, a continual quality improvement procedure can be carried out and implemented at the end of the process cycle. The usage of this system for students’ project work in the last academic term at this faculty has clearly shown some necessary actions needed to be taken in order to improve the performance outcomes.

**Session S4C: Ethics**

Chair: Margaret Huyck, Illinois Institute of Technology

*Time and place: Saturday, October 25, 3:30 pm. - 5:30 pm. Broadway 2*

**WORK IN PROGRESS BUILDING THE SURVEY OF ENGINEERING ETHICAL DEVELOPMENT (SEED) INSTRUMENT**

*Janel Sutkus, Donald Carpenter, Cynthia Finelli and Trevor Harding*

When developing surveys, researchers can readily identify the concepts they intend to study, but how do they create individual survey items that will most accurately measure those concepts? Here we describe the first year of a four-year NSF project in which the E3 Team (Exploring Ethical Decision Making in Engineering) prepared to develop a national survey of the curricular and co-curricular activities, events, and experiences affecting the ethical development of engineering undergraduates. As this survey is likely to be the most comprehensive assessment of ethical development both in content and scope ever administered to engineering undergraduates, it is critical the development process includes rigorous and thorough educational research methods. By using such methods, we greatly increase the probability our survey instrument will appropriately measure the determinants of ethical behavior in engineering undergraduates.

**SYSTEMATIC APPROACH TO ETHICAL DECISION MAKING USING MATRICES**

*George Wise, William Keat, Robert Balmer and Philip Kosky*

With origins in the decision matrices used to choose between competing alternative designs, the Ethical Decision Matrix is a practical way to ensure that a student will use a systematic approach in engineering ethical situations and
at least reflect on a broad range of considerations. Alternative ethical solutions are evaluated using a subset of the professional canon of ethics from the National Society of Professional Engineers. The columns of the decision matrix correspond to the alternative ethical solutions; the rows correspond to the canons. The students fill in the matrix blanks with a yes, no or maybe (with perhaps a few words of explanation) to indicate if the solution is consistent with a particular canon. A process for introducing this method to students is described and illustrated for the case of an engineer who feels design changes may have compromised the safety of a bridge.

**SOCIAL, ETHICAL AND GLOBAL ISSUES IN ENGINEERING**

Efrain O’Neill-Carrillo, William Frey, Luis Jimenez, Miguel Rodriguez and David Negron

The College of Engineering of the University of Puerto Rico-Mayaguez (UPRM) adopted an ethics across the curriculum (EAC) strategy in 2005. EAC is based on the combination of faculty development workshops, a standalone course in ethics, and ethics learning modules integrated at various levels of the engineering curriculum. In 2006 the EAC strategy was expanded to include social and global issues in engineering. A Coordinator for Social, Ethical and Global Issues (SEGI) in Engineering was appointed in the College of Engineering to coordinate and support activities related to these areas at all engineering departments. Such a position is valuable in demonstrating the commitment to educating integral engineers that are both technically capable and socially responsible. This SEGI work presents a more integrated curriculum to students through activities that link liberal arts courses and topics to engineering. The position also serves as a liaison with other Colleges in these matters, and supports the achievement of eight of the learning outcomes from ABET’s criterion 3. This paper describes the various activities of the coordination of the SEGI work, and its relationship to the general education component of engineering curricula.

**WORK IN PROGRESS - DEVELOPMENT AND ASSESSMENT OF AN INTRODUCTORY RESEARCH ETHICS MODULE**

Efrain O’Neill-Carrillo, Jorge J. Ferrer, William Frey, Erika Jaramillo and Luis Jimenez

An interdisciplinary team planned, implemented and assessed a new framework for integrating Research Ethics into the science and engineering graduate curriculum at the University of Puerto Rico-Mayaguez (UPRM) as part of an NSF project. This paper presents the cornerstone of this new Research Ethics framework, a Graduate Awareness Workshop (GAW) aimed at new graduate students at UPRM. The main objective of the GAW is that students develop a basic understanding of Research Ethics that allows them to participate in ensuing activities that deepen their knowledge of Research Ethics. Preliminary assessment results are presented in the paper. These results are encouraging, favoring the use of the GAW since the workshop increased student understanding of the basic issues related to graduate Research Ethics.

**WORK IN PROGRESS - ETHICAL MODEL ELICITING ACTIVITIES (E-MEA) EXTENDING THE CONSTRUCT**

Larry J. Shuman, Renee M. Clark, Mary Besterfield-Sacre and Tuba Pinar Yildirim

Mastery of the professional skills is needed if our graduates will continue to excel in the increasingly global engineering environment. To date, much of the research associated with studying ethical decision making in organizations has focused on business and individual decisions with little empirical research focused on team-based ethical decision making specific to engineering. As part of a Phase III CCLI project, we are developing E-MEAs, which are open-ended, realistic problems that challenge student teams to recognize and resolve potential ethical dilemmas embedded within a larger engineering problem requiring skills integration. By extending the MEA construct to ethical situations we are able to better identify and understand the various strategies teams use to resolve complex ethical dilemmas. We are both adapting existing cases and creating our own scenarios that bring out differing perspectives, in order to provide a rich body of work that will enable the analysis of students’ ethical decision making processes in the context of engineering problem solving. To capture needed process data, we are adapting MEA reflection tools and utilizing PDA devices and team Wikis. Further, to assess performance outcomes, we are utilizing two rubrics, one of which (P-MEAR) was developed previously to assess the ethical dimension of student projects. Data collected will be analyzed using cluster and statistical methodologies to classify students according to performance and strategies employed.
WORK IN PROGRESS  INTRODUCING GRADUATE STUDENTS TO ETHICAL DELIBERATION AND CASE ANALYSIS IN RESEARCH ETHICS
Didier M. Valdés, Erika C. Jaramillo and Jorge J. Ferrer

This paper describes a work in progress focused on graduate education activities that will immerse graduate students in Research Ethics. The project aims to develop ethical awareness and basic skills in moral deliberation. Because these workshops will verify common concerns in Research Ethics, it is expected that they will also produce results valuable to other institutions. The ethical deliberation workshop is the second in a series of four workshops introducing the students to the basic issues in Research Ethics. The moral deliberation workshop will be followed by a Case Analysis Workshop which includes the analysis of famous cases of Research Ethics misconduct as well as hypothetical cases that are likely to be encountered in the student's career. The hypothetical cases include situations related to fabrication, falsification and plagiarism.

Session S4D: Faculty Development
Chair: John C. Bennett, University of Connecticut
Time and place: Saturday, October 25, 3:30 pm. - 5:30 pm. Broadway 3

CLASSROOM ARTIFACTS: TOOLS TO ASSESS THE USE OF ACTIVE, INNOVATIVE, AND ENGAGING PEDAGOGIES AMONG ENGINEERING FACULTY
Michael R. Tomlinson and Norman L. Fortenberry

This paper examines artifacts of the classroom as a method of assessing whether or not engineering faculty are using best-practice teaching methods in class. Past research has achieved success in using artifacts to give similar results as direct observation. Artifacts assessment alone or in combination with surveys would be more accurate and less biased than surveys alone. Success of past portfolio assessment and the rise of college e-portfolio use among faculty make it highly likely that e-portfolios could provide the artifact information necessary for large scale assessment. Additionally, e-portfolios could enhance learning and teaching thereby increasing the willingness of faculty and students to participate nationally.

ACCEPTANCE OF TABLET PC TECHNOLOGY BY ENGINEERING FACULTY
Roxanne Toto, Kyu Yon Lim, Hien Nguyen, Sarah Zappe and Tom Litzinger

This paper considers the results of a two-year project in which Tablet PCs were given to engineering faculty at the Pennsylvania State University. During Phase 1, 34 faculty members received a Tablet PC for use in the classroom. Due to the success of this implementation and demand by other faculty, the project was expanded in the following year to include an additional 30 faculty members in the College of Engineering. During both phases of the project, the participants were asked to complete various assessment tools including scales measuring teaching efficacy, computer skills efficacy, and technology acceptance. A sample of the faculty members participated in interviews intended to gather additional information on their perceptions of the Tablet PC and its benefit in the classroom environment. This paper provides results of the project assessment and its relation to the literature on the diffusion of innovation and the Technology Acceptance Model. Implications of the assessment will be discussed that may be helpful to those who are interested in implementing a similar program for engineering faculty.

FACULTY DEVELOPMENT STRATEGIES FOR OVERCOMING THE "CURSE OF KNOWLEDGE"
Jeff Froyd and Jean Layne

Research shows that novices and experts organize knowledge very differently. Experts may make huge leaps up an educational ladder of inference and often forget how to explain the reasoning process through which they arrived at their complex, deep understandings. Shortcuts become invisible. In an educational setting, this phenomenon is called the curse of knowledge. It describes how being an expert in something may make it more difficult to infer what a novice requires in order to develop a deep, working knowledge of engineering and scientific content. In the paper, the authors explore potential faculty development strategies to increase awareness of the curse of knowledge and offer approaches through which faculty can use their expertise for effective teaching. Several approaches are offered: (i) principles to make messages sticky, (ii) developing more reflective approaches to understanding learning and teaching, (iii) encouraging construction of teaching portfolios, and (iv) ascertaining knowledge that students have at the beginning and throughout a course.
**OPPORTUNITIES AND CHALLENGES IN PROFESSIONAL EDUCATION-RELATED FACULTY DEVELOPMENT IN THE US**

Tristan T. Utschig and Dirk Schaefer

The authors outline important opportunities and challenges relating to formal education-related faculty development on a large scale. Questions explored are: What major opportunities exist regarding moving towards educational professional qualification for US Higher Education institutions, their faculty and students, industry, and society as a whole? How can resources be synergistically integrated to support such an effort? What are the major challenges or barriers present that must be overcome in order to create such a system? In response to these questions, a concept map is presented to explore how faculty educational development could support and greatly enhance an entire system revolving around faculty development in teaching and learning. Utilizing and reflecting upon the literature, major issues considered that relate to the questions above include various roles in the higher education engineering community; relationships between educational research, student learning outcomes, and engineering faculty; resources supporting engineering education, and the implication of different faculty reward structures. Analysis indicates that pieces already in place offer great potential to create the Engineering Education of 2020 for The Engineer of 2020 if key barriers are addressed.

**WORK IN PROGRESS - INTEGRATING MOBILE TABLET-PC TECHNOLOGY AND CLASSROOM MANAGEMENT SOFTWARE IN UNDERGRADUATE ELECTRONIC ENGINEERING TECHNOLOGY COURSES**

Kuldeep S. Rawat, George B. Riddick and Lakiesha J. Moore

The preliminary results of integrating mobile Tablet-PC technology and supporting Classroom Management Software (CMS) in undergraduate Electronic Engineering Technology courses is discussed in this WIP paper. The use of NetSupport School CMS in conjunction with a Tablet-PC, improves course delivery by centrally instructing students on their Tablet-PCs, broadcast the dynamic screen contents along with digital ink annotations in real-time, maintain student attention by monitoring student activities and web usage, and save time by quickly polling the class and showing responses instantly. The students can share their class work instantly with other students or the instructor. The instantaneous sharing of work in real-time improves collaboration between students and faculty and adds new dimensions to the learning environment in the classroom. The initial results show a significant improvement in students class performance and learning experience. The technology integration, redesigned course, pedagogical approach, student experiences, and results are discussed in this WIP paper.

**WORK IN PROGRESS - ENHANCEMENT OF PROBLEM SOLVING TECHNIQUES WITH TABLET PC-BASED LEARNING TECHNOLOGIES**

Kenneth Stanton

EC2000 criteria raised the bar for educating engineers in the traditional 4-year degree program, requiring more student learning outcomes and teaching in more innovative ways. A challenge of teaching more in the undergraduate program is that it's hard to do so in the time available. After recognizing a deficiency in problem-solving skills, an initiative was developed which will use classroom technologies to improve the skills yet have minimal time requirements. The initiative will enhance small, currently-existing workshops for the first-semester engineering course, which are taught by GTAs. DyKnow's interactive software used on tablet PCs will enhance problem-solving techniques as suggested in literature. Integration of these technologies and techniques will be implemented in spring of 2008 when there are fewer students, assessed via quantitative and qualitative methods, and finally revised before the next large student cohort arrives in fall of 2008. This paper will highlight the problem-solving techniques being enhanced, the technologies used and their implementation, assessment of the initiative, application of relevant literature, and future work.
BRAZILIAN ENGINEERING EXCHANGE PROGRAM
C. Raubenheimer and Robert E. Young

This paper presents the external, summative evaluation findings of the International Teams in Engineering Industrial Projects: A Cooperative Manufacturing and Production Engineering Program, funded by the Fund for Improving Postsecondary Education (FIPSE): Special Focus Projects from 1 September 2002 to 31 August 2007. The project was a collaborative between two US universities in North Carolina and two universities in Brazil, and involved student exchanges to the respective countries, where students studied engineering coursework. During the evaluation, relevant documents were analyzed, interviews were held with the project PIs, and those students who had participated in the exchange visits to Brazil were surveyed. Evaluation findings are presented in relationship to the project objectives and other unanticipated outcomes. Overall, the exchange program was successful in achieving its objectives.

INTERNATIONALIZING THE CURRICULUM: DEVELOPING TRAVEL COURSES FOR GLOBAL AWARENESS
Daniel Farkas and Narayan Murthy

In most colleges and universities, study abroad focuses on students and curriculum in business, foreign language studies and the natural sciences. In today’s global economy, it is necessary for engineering and technology students to also have significant international experiences. In addition to exposing students to the broad issues of globalization, study abroad is both a career hedge against outsourcing and a response to internatio-nalization requirements of accrediting bodies such as ABET. This paper will discuss the issues involved in de-veloping and offering international experience courses; determining curricula and content; developing the com-puting and technology components of the courses; and developing the field experience including the logistics of travel. The paper will describe two courses: an under-graduate course on Computer and Network Security with travel to London and Paris and a graduate course on offshore outsourcing with travel to India.

DEVELOPMENT OF A REQUIRED INTERNATIONAL EXPERIENCE FOR UNDERGRADUATE ENGINEERING STUDENTS
Lester A. Gerhardt and Richard N. Smith

The School of Engineering at Rensselaer has recently announced the REACH Program (Rensselaer Engineering Education Across Cultural Horizons) as a component of our undergraduate engineering degree that we envision will become a requirement for every student. The major feature of this experience will be a bi-lateral semester abroad with partner international universities, whereby students will spend a full semester studying abroad as a part of their educational program, and students from the partner university will likewise spend a semester at Rensselaer. The Program will begin in 2009 with approximately 25% of the then junior class growing to virtually 100% by 2015. The critical issues in developing and scaling up to such a large program of exchange will be discussed, along with the alternative international experiences that are also under development. We envision that this program will radically alter the culture of our undergraduate programs and our campus environment and will establish Rensselaer as unique among major engineering universities in terms of commitment to providing such an expansive global perspective for all of our students.

GLOBALIZATION OF THE UNION COLLEGE ENGINEERING PROGRAMS
Thomas K. Jewell and John M. Spinelli

Seventy percent or more of Union College engineering students have some type of international experience requiring travel to, and immersion in, a foreign culture before they graduate. Our goal has been, and continues to be, to have 100% of eligible students participate in an international experience. In the Class of 2007, 23% went on a non-engineering term abroad, 34% participated in an engineering exchange, and 13% went on a three-week mini-term program. An additional 18% met their international experience requirements by taking modern language courses. Previous classes have had up to 88% of the graduates participating in some type of program that required
international travel. These numbers are among the highest percentages of any engineering programs in the country. This paper will provide details on how the Union College engineering programs maintain such a high rate of sending students abroad, to include a historical perspective on how international programs were developed and implemented, administrative and faculty support for international programs, advising, efforts to develop more programs specifically aimed at engineering students, and lessons learned and pitfalls to avoid.

**WORK IN PROGRESS - AGENT BASED SOCIAL SIMULATIONS BY CROSS-CULTURAL STUDENT TEAMS**

Alfonso Duran, Rahul De, Isabel García, Esmeralda Giraldo and Manuel Castro

Intelligent software agents are particularly well suited for the simulation of complex collective behavior and interaction. Agent Based Social Simulation (ABSS) is currently being used within a multi-year, multi-university research project to develop a flexible benchmarking platform on which to test customer-facing algorithms. Along the process, the educational potential of the approach has become apparent. Given the user friendliness of the existing open source development environments, carefully designed assignments for the development of specific chunks can be carried out in a timeframe compatible with normal graduate coursework. However, operating within the framework of a project encompassing institutions in such different cultural environments as India and Europe enables taking advantage of the broader perspective it provides to design collective, interacting assignments, in which each student’s ABSS interacts with the others in a meaningful way. This project is modeled upon prior rewarding experiences by the research team in cross-cultural student teams in other environments. It involves combining students attending courses in each partner university in integrated assignments, interacting over the internet. This cross-cultural educational experience could be fine-tuned to focus on various potential development opportunities, ranging from the technological to the capability development. The fact that what they are simulating are social systems, which students from different cultures are likely to model very differently, will further raise their awareness of diversity and develop their skills to harness its positive potential.

**EXPOSING UNDERGRADUATE ENGINEERING AND COMPUTER SCIENCE STUDENTS TO THE ASIAN BUSINESS CULTURE IN A PROJECT-BASED ABROAD PROGRAM: AN ASSESSMENT OF PROGRAM CHALLENGES**

Cynthia C. Fry and Gregory W. Leman

Conducting an international summer program is difficult enough, but combine that with a project-based program that combines undergraduate and graduate technology and business majors from the United States, Europe, and China; working on real project for real companies and providing meaningful results in six short weeks; and you have a uniquely challenging program. The I5 program (Immersion Into International Interdisciplinary Innovation) is a program about technology innovation that itself had to be innovative to meet the growing ABET requirements for meaningful global experience for engineering and computer science majors. It also had to provide the learning experiences that would apply directly to the various engineering, computer science, and business fields to make it worthwhile and desirable for the students. While the coursework and various project plans were demanding, one of the real challenges came in the recognition and accommodation of the cultural differences and the language barriers within the teams, as well as those between the teams and their program sponsors. This paper will document the challenges faced in the deployment of this new study abroad program. It will also include an summary of the student evaluations, especially the impact of the program on the American, the European, and the Chinese students in terms of how they now approach their perspective of the world, different cultures, their chosen discipline, and their outlook on the future.
significantly more than male students. In order to find out whether this difference was simply an artifact of the negative wording of the statements or whether female students assess software tutors more positively than male students, we conducted a follow-up study using a feedback form that contained an even number of positively- and negatively-worded Likert-scale statements. We found that female students agreed with positively-worded statements and disagreed with negatively-worded statements significantly more than male students. We conclude that female students assess our software tutors more positively than male students and this is not an artifact of the (positive versus negative) wording of the feedback statements.

IMPACT OF THE POSSE PROGRAM ON THE ACADEMIC INTEGRATION OF MINORITY ENGINEERING STUDENTS
Sharon A. Jones and Martha Were

Lafayette College participates in the POSSE Program which has its own recruitment and retention strategies. We explore if these differences affect behavior, and subsequent commitment to engineering. While our small samples preclude general conclusions, the insights provide the foundation for more in-depth studies of similar programs within a similar campus context. Guided by Tinto’s theory of student retention, we surveyed group behavior in terms of academic and social integration. Our results show that POSSE students state a high commitment to engineering, and an ability to navigate the academic integration process. Minority students who are not part of the POSSE Program state a similar commitment to engineering, however they report less success navigating the academic integration process.

WORK IN PROGRESS - AN ONLINE SUPPORT SYSTEM FOR WOMEN IN COMPUTER SCIENCE
Sriram Mohan and Archana Chidanandan

In this work, we propose the creation of an online social network with the following objectives: (a) provide a platform for our female students to interact with our alumnae, (b) provide a platform for high school students in the Indiana neighborhood to interact with our female students and alumnae. This social network will facilitate a support system for our current students, our alumnae, and young women who are interested in pursuing careers in Computer Science. In the long term, we anticipate that the interactions made possible by the social network will be extended to encompass other educational institutions.

BROADENING PARTICIPATION IN COMPUTING: K12-COMMUNITY-COLLEGE-UNIVERSITY-GRADUATE PATHWAYS
W. Richards Adrion, Sharon Biskup, Deborah Boisvert, Lori Clarke, Jane Fountain, Priscilla Grocer, Sue Mackler, Alan R. Peterfreund, Kenneth A. Rath, Adrienne Smith, Dianne D. Snyder and Alana Wiens

The Commonwealth Alliance for Information Technology Education (CAITE) is designing and carrying out comprehensive programs that address under-representation in information technology (IT). CAITE focuses on women and minorities in groups that are underrepresented in most aspects of the Massachusetts innovation economy economically, academically, and socially disadvantaged residents and supports multiple points of entry into a broad spectrum of IT educational programs that provide multiple opportunities for learning and careers. Community colleges are the linchpin of the CAITE approach and strategy because of the central role they play in reaching out to underserved populations and in serving as a gateway to careers and further higher education. CAITE focuses on high-school-to-community-college-to-university-to-graduate school pathways, but also reaches out into middle schools and to adult populations. We report on our progress in the three CAITE regions (Boston, southeastern Massachusetts, and western Massachusetts). We describe the challenges of carrying out a multiple region, nine-institution project, our outcomes, and the assessment data collected on the CAITE programs.

WORK IN PROGRESS - EFFECT OF CLIMATE AND PEDAGOGY ON PERSISTENCE OF WOMEN IN ENGINEERING PROGRAMS
Susan M. Lord, Catherine E. Brawner, Michelle M. Camacho, Richard A. Layton, Russell A. Long, Matthew W. Ohland and Mara H. Wasburn

Our goal is to determine how climate and pedagogy affect the persistence of women in undergraduate engineering programs via a longitudinal, multi-institutional, and multivariate study. We focus on the nine institutions of the Southeastern University and College Coalition for Engineering Education from 1987 to 2004. The study uses three related data sources: the Multiple-Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD), two climate surveys, and three teaching practices surveys. We will conduct new analyses on these
existing data as well as new studies focusing on research questions relating climate, pedagogy, and persistence. This triangulated and longitudinal approach provides a powerful historical context to help explain changes and successes in persistence that will reach multiple stakeholders, scaffolding earlier qualitative studies with quantitative results that can inform policymakers. Here, we introduce our study and present initial results related to our first research question.

WORK IN PROGRESS - A STUDY OF HOW REAL-WORLD ENGINEERING EXPERIENCE CAN AFFECT WOMEN S ACADEMIC CAREER
Deborah Walter, Xiaoyan Mu and Carlotta Berry

Growing evidence has suggested that industry-sponsored project experience, where the student is paid, can provide students with a real-world perspective that enhances the student's academic experience. This experience is particularly valuable for female students because women may have less real-world exposure to applications in their chosen career path compared to their male counterparts. Sometimes internship experiences can be a negative experience for female students. Our working hypothesis is that internship experiences have the potential to affect female students more than male students, both positively and negatively. The focus of this paper is to determine if there are significant gender differences resulting from students' internship experience on academic performance and attitudes about their future career choice.

Session S4G: Engineering Education Topics 4
Chair: Edmund Tsang, Western Michigan University
Time and place: Saturday, October 25, 3:30 pm. - 5:30 pm. Alabama

OUTCOMES-BASED ASSESSMENT IN ENGINEERING EDUCATION: A CRITIQUE OF ITS FOUNDATIONS AND PRACTICE
Donald C. Woolston

In the ten or so years since ABET EC2000 and the new way of thinking about accreditation were announced, engineering educators internationally have labored dutifully with the difficult, time-consuming and perplexing demands of outcome-based assessment. Without question, ABET EC2000 has captured the attention of engineering administrators and faculty, but it has also dramatically increased the effort required to sustain accreditation in engineering. This essay critically examines key assumptions behind the outcomes-based assessment (OBA) philosophy on which ABET EC2000 is based, and proposes that perhaps as much as engineering education practices, assessment practices should be the subject of assessment and evaluation.

ASSESSMENT METHODS FOR THE UPCOMING ABET ACCREDITATION CRITERIA FOR COMPUTER SCIENCE PROGRAMS
Charles R. Lang and Hakan Gurocak

The accreditation criteria and assessment expectations for computer science programs are undergoing rapid changes as ABET seeks to normalize the criteria between its EAC and CAC commissions. This paper presents the curricular structure and assessment methods of a new computer science program and describes how it has met ABET/CAC's current criteria. The program adopted a set of outcomes for computer science that are aligned closely with those associated with engineering programs. Faculty connected their courses to the program outcomes with specific course outcomes, which are assessed quantitatively by multiple measurement methods. The end result is a program assessment procedure that fulfills the intent of ABET/CAC's criteria, provides the program with useful and actionable feedback, and does so without imposing an undue burden on faculty. The outcomes originally chosen for this program are a close fit with the program outcomes listed in ABET's recently published 2008-2009 Criteria for Accrediting Computing Programs New Criteria, thus the structure presented in this paper may be applicable to programs undergoing a transition to these new criteria.

WORK IN PROGRESS - LIFELONG LEARNING AND INFORMATION RETRIEVAL PRACTICES IN MATERIALS SCIENCE AND ENGINEERING
Marie C. Paretti and Michael Asaro

This paper describes an exploratory case-study of information retrieval practices in one specific discipline, materials science and engineering. In particular, we examine how do the information retrieval practices of practicing
professionals compare to those of undergraduate seniors? The preliminary findings provide provisional insights into the concrete retrieval skills students have and need, and suggest teaching practices (particularly in design courses) faculty can employ to help students build such skills.

EDUCATIONAL CHARACTERISTICS OF ADULT STUDENTS IN PORTUGUESE TECHNOLOGICAL SCHOOLS

Ana Maria Ramalho Correia, Dulce Magalhães de Sá, Ana Cristina Costa and Anabela Sarmento

Despite a massive expansion of education in Portugal, since the 1970s, educational attainment of the adult population in the country remains low. The numbers of working-age people in some form of continuing education are among the lowest, according to the OECD and EU-27 statistics. Technological Schools (TS), initially created in the 1990s, under the umbrella of the Ministry of Economy in partnership with industry and industrial associations, aimed to prepare qualified staff for industries and services in the country, particularly in the engineering sector, through the provision of post secondary non-university programmes of studies, the CET (Technological Specialization Courses). Successful CET students are awarded a DET (Diploma of Technological Specialization), which corresponds to Vocational Qualification level IV of the EU, according to the latest alteration (2005) of the Education Systems Act (introduced in 1986). In this, CETs are also clearly defined as one of the routes for access to Higher Education (HE), in Portugal. The PRILHE (Promoting Reflective and Independent Learning in Higher Education) multinational project, funded by the European Socrates Grundtvig Programme, aimed to identify the learning processes which enable adult students in higher education to become autonomous reflective learners and search best practices to support these learning processes. During this research, both quantitative and qualitative methods were used to determine how students organise their studies and develop their learning skills. The Portuguese partner in the project consortium used a two case studies approach, one with students of Higher Education Institutions and other with students of TS. This paper only applies to students of TS, as these have a predominant bias towards engineering. Results show that student motivation and professional teaching support contribute equally to the development of an autonomous and reflective approach to learning in adult students; this is essential for success in a knowledge economy, where lifelong learning is the key to continuous employment.

AN INTELLIGENT AND CONTEXTUAL INFORMATION RETRIEVAL ENVIRONMENT FOR LIFELONG LEARNING

Luis Carlos Costa Fonseca, Crediné Menezes, Rosa Maria Vicari and Jônatas Barbosa Soares

The current understanding of Lifelong Learning (LLL) does not refer simply to recurrent or adult education but encompasses all learning endeavors over the lifespan. The Internet, a large information database, readily available, may be used to support LLL. It is difficult to find the exact/correct information that one wants. Most of the search mechanisms on the WEB deal with isolated solicitations for information; being that the results for one determined request are identical, independent of the user or specific context of the user. It is possible improve the results using context information. The Learning Projects (LP) is a methodology based on the intentional and natural human activity of constructing projects. These LPs will give indications of the specific user’s information necessities, providing the context of this information. Our system can assist the process of constructing LPs into Virtual Learning Environments by recommending documents. The IR model is a basic component because documents will be retrieved, classified based on the user’s context, downloaded from the Internet and recommended to the user by artificial agents. The system builds domains ontology of the project using the user’s interactions with LPs and concept maps as a strategy to build context.

THE DISCOURSE OF ENGAGEMENT: AN APPROACH TO ANALYZING CONCEPTUAL UNDERSTANDING IN AN INQUIRY-BASED LEARNING ENVIRONMENT

Kerrie Kephart

Engineering educators are increasingly being encouraged to adopt instructional methods that engage students in authentic activities to foster inquiry and deeper conceptual understanding. However, a significant challenge facing professors who would like to incorporate such methods into their teaching is a lack of understanding of its basic principles, mechanisms, and features. This paper reports results of an innovative means of investigating promising approaches to inquiry-based teaching/learning in undergraduate engineering courses at an urban research university on the U.S.-Mexico border. The research design incorporates analysis of natural language data from classroom interaction to shed light on teaching and learning practices that show promise for fostering enduring conceptual understanding. Highlighted are the classroom practices of one professor who designed and implemented a problem-based case in an undergraduate industrial engineering course, which the researcher video-taped and transcribed.
Linguistic analysis of this transcript provided descriptions of instructional practices that encourage learners engagement with key concepts. Implications of the analytical approach are drawn for the investigation of conceptual understanding and the design and refinement of inquiry-oriented classroom practices.

Session S4H: Engineering, Engineering Education and Philosophy

Chair: John Heywood, Trinity College

Time and place: Saturday, October 25, 3:30 pm. - 5:30 pm.

SCREENING CURRICULUM AIMS AND OBJECTIVES USING THE PHILOSOPHY OF EDUCATION

John Heywood

A special session at the 2007 Frontiers in Education Conference was devoted to the question Can philosophy of engineering education improve the practice of engineering? In supporting a positive answer to this question it is argued that philosophy can contribute to better educational decision making, as for example in the screening of aims and of objectives. If that is the case then every engineering educator should have a defensible philosophy of education. The intention of this paper is to argue the case for screening using the example of the constructivist-realist debate that has pre-occupied teaching in science during the last twenty-five years. It is argued that at the epistemological level the stance taken by the educator has implications for the teaching of ethics. At the pedagogical level the differences are minimal although constructivism has caused consideration of negotiated curricular that has consequences for the design of project work. Realists have pointed out that in certain circumstances rote learning is likely to be necessary. Both theories support the contention that too much is covered in the curriculum. Brief mention is made of constructive alternativism. It is concluded that the learning procedures used will depend on the objectives to be obtained. It is argued that this discussion supports the contention that the screening of aims using the philosophy of education is a valuable exercise.

PHILOSOPHY AND ENGINEERING EDUCATION. A REVIEW OF CERTAIN DEVELOPMENTS IN THE FIELD

John Heywood

In 2005 a review of engineering publications in the area of philosophy and engineering showed that the majority were concerned with role and teaching of ethics. There were some in which the term philosophy was used to explain the rationale behind programmes. One or two discussed the relevance of philosophy to engineering education and Koen had just published his major discourse on method. Since then there has been a major thrust to develop a philosophy of engineering that is distinct from a philosophy of science. This movement has had support from the lead professional bodies in a number of countries (eg China, The Netherlands, the UK and the US) It has inspired seminars and a major international meeting in the Netherlands. The purpose of this paper is to review some of the 100 small and large published contributions during the last three years. No attempt is made to review all of them. The purpose is to give the flavour of the debate. It is clear that the mingling of engineering and philosophy raises profound issues and creates challenges that obligate a response from the engineering community. Many of the publications have something to say about either the curriculum or instruction but they do not draw on the philosophy of education. There is a need for the two philosophies to come together to create a more informed critique of engineering education.

THE PSYCHOLOGY OF ‘OUGHT’

Trevor S. Harding

As educators, we would like to believe that we can influence the ethical growth of our students. If we are to do this, it seems worthwhile to first understand what ethical decision-making is and how it happens. For millennia, ethical decision-making has fallen within the domain of philosophy. However, recent evidence suggests that the average person does not consider ethical dilemmas in the abstract. Instead, ethical decision-making appears to be a complex dance between an individual’s rational calculus of the ethical dilemma and their emotional response to the context of the dilemma. I will present an argument that in the trenches of daily life, psychology has a better grasp on the workings of ethical decision-making, while philosophy helps to provide direction. I will also present a number of historical and current psychological theories about ethical decision-making, from behaviorist to post-modern feminist. Throughout this discussion I will build on a psychological framework for ethical decision-making and moral development, and present implications for engineering education.
PHILOSOPHY MATTERS IN ENGINEERING STUDIES
William Grimson, Murphy Mike, Steen Hylgaard Christensen and Erik Erno-Kjolhede

This article explores the rationale for including in an integrated five-years Masters Engineering programme liberal arts subjects, in particular Philosophy and the History of Science and Technology. We argue that the tools of philosophy should be used to provide additional insight into how engineering was and is ‘performed’. We first review the challenge, next we present some results of an empirical case study carried out at AU-IBT in Denmark. The purpose of the case study was to examine a sample of engineering teachers’ attitudes towards the relevance and scope of liberal arts subjects for engineering students. Finally we conclude with a proposal for the inclusion of Philosophy and History of Engineering, Science and Technology in an engineering programme and how this might be done.

WHAT DO WE KNOW? HOW DO WE KNOW IT? AN IDIOSYNCRATIC READERS GUIDE TO PHILOSOPHIES OF ENGINEERING EDUCATION
Karl A. Smith and Russell F. Korte

Conversations at the 2002 ASEE Conference in Montreal prompted Karl to write an Academic Bookshelf column on educational philosophy for the July 2003 issue of the Journal of Engineering Education. The column and set of recommended books have been read or browsed by many. Five years have passed and there are many new developments in the area, including conversations on the philosophy of engineering education. The purpose of this paper is to update an annotated reading list for those interested in engaging in the conversation about philosophy of education. John Heywood and Roy McGrann, co-designers and implementers of the 2007 and 2008 special sessions Can philosophy of engineering education improve the practice of engineering education? have crafted fascinating position pieces [1,2] and in this brief readers guide we will try to provide complementary ideas based on selected recommended readings. Specifically we attempt to address ontology and epistemology, as well as the relationship between theory and practice.

PHILOSOPHY OF TECHNOLOGY IN ENGINEERING EDUCATION
Roy T.R. McGrann

In reflecting on the philosophy of engineering education as a distinct field, questions from other fields of philosophy are encountered. Among these, in addition to philosophy of education, are: ethics, epistemology, ontology, philosophy of science, and philosophy of technology. Within the philosophy of technology, a discussion of philosophy of engineering has been pursued in recent years. In this paper, the areas described and questions raised by philosophy of technology, specifically philosophy of engineering will be briefly presented. The importance of philosophy of technology for the philosophy of engineering education will be developed. In Teaching About Technology (2005), Marc J. de Vries identified four reasons for engineering educators to become acquainted with philosophy of technology. The reasons are: (1) philosophy of technology can yield insights into curriculum development, (2) it can provide a conceptual basis for understanding technology, (3) it helps position the teaching of engineering among other subjects, and (4) it is helpful in identifying the research agenda in engineering education. Included in this paper will be a discussion of the literature in the discipline of philosophy of technology.

Session S4J: Computer and Web Based Software 4

Chair: Arnold Pears, Uppsala Universitet
Time and place: Saturday, October 25, 3:30 pm. - 5:30 pm.

WORK IN PROGRESS - SOFTWARE ENGINEERING CAPSTONE PROJECT WITH RATIONAL UNIFIED PROCESS® (RUP)
Jan Bergandy

Any credible software engineering program must thrive to connect college education with the realities of commercial software development. In most cases, the study of software processes takes place in the lecture halls but it is not practiced in student projects. Students graduate into the commercial world driven by software and business processes without any hands-on experience and thus without an in-depth understanding of the significance of a process to the industrial setting. In order to close this gap, we have chosen to use a commercial grade process framework: Rational Unified Process® (RUP) for the backbone of our newly introduced software engineering capstone project. The capstone project is required for all students and offered through the senior year of our ABET-
accredited BS in Computer Science program. In our opinion, this will prepare students better for the competitive job market.

WORK IN PROGRESS - NEW DATA STRUCTURE IN SCORM 2004 SEQUENCING & NAVIGATION
Eduard Céspedes-Borràs, Lluís Vicent and Marc Segarra

SCORM is one of the most important specifications in e-learning. Its content aggregation model and run-time environment has been implemented in a large number of learning management systems (LMS). SCORM 2004 has defined a Sequencing specification which facilitates the instructional design of a subject. Faculty can define what contents should be studied and what questions should have been answered correctly before the study of a new content. But this sequencing specification presents some limitations, as the processing speed, which could be slow if the number of students is large, and the reading of the results, which is difficult if the teacher has not any SCORM knowledge. In this paper, a new opensource tool, with a new organization of the data which minimizes the calls between modules is presented, increasing the processing speed. In addition, the results reports are shown in an easy way, in order any teacher can use them without any previous knowledge. These improvements do not affect the compatibility with SCORM 2004 content packages build over other systems.

WORK IN PROGRESS - HOW BUILDING INFORMATIONAL MODELING MAY UNIFY IT IN THE CIVIL ENGINEERING CURRICULUM
Michael J. Casey

IT in the civil engineering curriculum is often fragmented into courses that emphasize either design tools (e.g., CAD), or packages for analysis, planning and modeling. Graduating students often report a lack of coherence in the IT tools used in their courses and a distinctive gap in their junior years where technology skills are under-used or forgotten. Building Information Modeling (BIM) may offer the opportunity to unify disparate technologies to provide a coherent IT skill set for civil engineering students to address the range of problems in the infrastructure and facilities life cycle. BIM is a framework that combines visualization and parametric modeling in a way that allows students to simultaneously consider the interdependent processes of planning, analysis, design and construction. This research will evaluate the feasibility of embedding BIM in the civil engineering curriculum with the goal of defining and promoting an extensible skill set that is reinforced through a comprehensive transportation design problem.

A SIMPLE BUT REALISTIC ASSEMBLY LANGUAGE FOR A COURSE IN COMPUTER ORGANIZATION
Eric Larson and Moon Ok Kim

Computer science curriculums, constantly evolving to include new material and methodologies, have reduced the amount of time spent on low-level computer hardware and organization. Our institution recently combined a course on computer organization and a course on assembly language programming into one course covering both topics. The choice of assembly language is a critical decision that contributes to the success of the course. ANNA (A New Noncomplex Architecture) is a new 16-bit instruction set architecture that is similar to MIPS but has fewer instructions. The instruction set, while small, is sufficient in illustrating how high-level languages are translated into assembly, how to design a CPU datapath, and how to implement pipelining. Real-world assembly languages such as IA-32 or MIPS have many subtleties that complicate the learning experience for students and consume valuable class time. This paper describes the ANNA assembly language and the assembler and simulator tools that can be used in the classroom. In addition, the paper describes how ANNA can be used effectively in a combined course on assembly language programming and computer organization. ANNA was used in three courses with very positive results based on our observations and feedback from students.

TRANSFORMATION OF A COLLABORATIVE VIRTUAL REALITY ENVIRONMENT FOR CONSTRUCTION SCHEDULING TO HELP INDIVIDUAL WITH MENTAL HEALTH ISSUES
Andrew Strelzoff and Tulio Sulbaran

The development of educational materials tends to be costly and time consuming, especially when using innovative technology such as Collaborative Virtual Reality Environments. The overall goal of this project was to develop a Collaborative Virtual Reality Environment for Construction Scheduling that could be transformed with minor modifications to be used in other areas such as to help individuals with mental health issues. The technology used to develop the environment was Second Life. Second Life is an Internet-based virtual world. A downloadable
client program enables its users, to interact with each other. In the case of this project, a group of students were asked to schedule a construction project and a group of volunteers were asked to play simple games that are expected to help individuals with mental health issues. While the two areas are not directly related, it is worth noting that the main modifications necessary to migrate from one area to the other were: (1) to establish the sequencing of the new process, and (2) to create new 3D models for the process. The results from the implementation of this project could serve as a steppingstone in the race towards innovation in engineering education.

WORK IN PROGRESS - NOVELTY IN A NUMERICAL METHODS COURSE
Julie A. Reyer

This paper discusses the development, implementation and preliminary assessment of a new course that integrates an Introduction to Programming course with a Numerical Methods course using discipline specific examples. In the drive to decrease the time to degrees in engineering programs across the country, many are seeking ways to combine subject material in course without losing the resulting technical abilities of the students. This paper describes one such effort regarding a new course Computational Techniques in Mechanical Engineering at Bradley University. The paper examines the course content and specific methods to combine the two subject areas. The location of the course in an engineering curriculum is considered. Preliminary comparison of the students abilities in both subject matters is presented, based on exam question responses in the separate courses versus those in the combined course.