Session T1A: Interactive Session: Preaching what you practice: Model-based reasoning in engineering

Chair: Wendy C. Newstetter, Georgia Institute of Technology
Time and place: Thursday, October 21, 8:00 a.m. - 10:00 a.m. *Chatham*

INTERACTIVE SESSION - PREACHING WHAT YOU PRACTICE: MODEL-BASED REASONING IN ENGINEERING

Wendy C. Newstetter, Georgia and Nancy J Nersessian, Georgia Tech

One of the defining characteristics of engineering is the use of models in problem solving. Graphic models or cartoon-like depictions of an identified body of interest, are used to design, to simulate, to test hypotheses and to make predictions. While students are repeatedly exposed to free body diagrams, circuit schematics and other forms of pictorial modeling in their textbooks and lectures, faculty repeatedly complain that students overlook the models and just seek an equation that they think fits the problem situation a situation characterized as plugging and chugging . This indicates that students do not fully understand the function these models serve as visual representations of mathematical models and provisional hypotheses of the problem space. The goal of this interactive workshop is to give engineering educators better tools to scaffold this process.

Session T1B: Interactive Session: Introduction to Concept-based Instruction

Chair: John Mitchell, University of Wisconsin
Time and place: Thursday, October 21, 8:00 a.m. - 10:00 a.m. *Savannah*

INTERACTIVE SESSION: INTRODUCTION TO CONCEPT-BASED INSTRUCTION

John Mitchell, University and Jay Martin, University of Wisconsin

The session focuses on the role of concepts in student learning. Most engineering courses are oriented more toward helping students develop problem-solving skills than on understanding the underlying concepts. A lack of conceptual understanding hinders the student s ability to solve new problems. Concept-based instruction acknowledges that understanding concepts are the key to understanding a subject and extending knowledge to new problems and areas. In this session participants will work in groups to develop a methodology for identifying the concepts in their field that students have difficulty with, formulating concept questions that test knowledge of the concept, and implementing concept-based instruction in the classroom. The goal of the session is to help instructors develop a holistic understanding on the relation between concept instruction and student learning.

Session T1C: Distance Learning: Methods and Technologies 1

Chair: Jonathan P. Mathews, The Pennsylvania State University
Time and place: Thursday, October 21, 8:00 a.m. - 10:00 a.m. *Waterfront North*

A HYBRID APPROACH TO DISTANCE EDUCATION TECHNOLOGY: TAILOR MADE FOR THE UNITED STATES FIRE SERVICE

David L. Murphy, University of North Carolina at Charlotte and Lorraine M. Stanton, University of North Carolina at Charlotte

Due to increasing demands, professional requirements, emergent technologies, and new threats to public safety, fire service professionals have an ever increasing need for access to higher education. In addressing that need, the University of North Carolina at Charlotte has initiated distance education classes as a part of the Fire and Safety Engineering Technology Program. Distance education enables the fire science degree-seeking student to access upper level college fire classes in the fire station or in the comfort of their own home. This paper describes the need for such a program, the strategies and technologies involved at UNC Charlotte, and the favorable outcomes that have resulted from the institution of this program.

USING PEER EVALUATIONS AND TEAMS IN ONLINE CLASSES

Joy L. Colwell, Purdue University Calumet and Carl F. Jenks, Purdue University Calumet

Students should have the ability to work together in teams, plan effective strategies for identifying appropriate issues within specific problem situations, research the answers to the associated technical questions presented by those situations, and develop the ability to review and comment on the solutions of others working on the same types of problems. Structur-

ing online classes to address these issues effectively can be challenging for the instructor. This paper will discuss the use of peer evaluations and teams in online classes. The paper involves two upper-level undergraduate courses, using a combination of teams and peer evaluations. The paper discusses the pros and cons of administering a team-based case-study course via the Internet. The innovative aspect of this case study method is the unique use of teams to analyze and critique other team members before the instructor ever participates. The paper also discusses the pros and cons of peer evaluations online.

WORK IN PROGRESS - INTEGRATION OF NEW TOOLS AND TECHNOLOGIES IN ELECTRONICS TEACHING

Manuel A. Castro, UNED, Gabriel Díaz, UNED, Catalina Martínez Mediano, UNED and Eugenio López Aldea, UNED

Nowadays the methods to learn Electronics are changing, improving and adapting to new tools and possibilities that offer us new technologies like Internet. Simulation in electronics improves the activities in design of electronic circuits. Students can learn and design their own circuits. They can carry out, check, analyze and make their practices of the course in Electronics applying several simulators with computer. Languages like VHDL present us a new form of designing and simulating Digital Electronics like a description language. New forms of adapting distance education like multimedia courses in Internet, new educational platforms like IPSS_EE (Internet-based Performance System Support with Educational Elements) are configuring new methods of learning based in task instead of classic study s methods. The DIEEC (Electrical and Computer Engineering Department) and MIDE (Methods of Investigation and Diagnosis in the Education) of UNED (Spanish University for Distance Education) in Spain are working to adapt all new methods and possibilities of electronics in learning and to evaluate the quality of the new methods.

WORK IN PROGRESS - INTEGRATING TECHNOLOGY FOR E-DIAGNOSIS OF AUTOMATED MANUFACTURING SYSTEM

Sheng-Jen Hsieh, Texas

Manufacturing automation and control technologies are critical for engineering education and essential to our national economic competitiveness. However, education in these subjects is often hindered by high student-to-faculty ratios, limited access to labs, and limited/outdated equipment to support lab assignments. Information technology can not only alleviate equipment access problems, but also make a variety of innovative and effective instructional approaches and technologies available to educators. This paper describes an ongoing effort to establish the feasibility of remote monitoring, operation, and diagnosis of an existing automated assembly system, to identify the issues involved in doing so, and to extend the system so that it can be used for tele-training. This will allow us to make manufacturing automation and control education available to anyone, anytime, anywhere. This paper focuses on the retrofitting of existing automated system, and integrating technologies include LabView software, a field-point communication module, a web based simulation model, and a Webcam.

WORK IN PROGRESS - DISTANCE LEARNING: THE PATH TO LIFELONG EDUCATION

Larry G. Richards, University of Virginia and Robert J. Ribando, University of Virginia

At the University of Virginia, the School of Engineering and Applied Science established a formal distance-learning program in 1983. Both of us have been teaching in this program for nearly 20 years. Between us we have taught five distinct types of courses, most through multiple iterations. In this paper, we describe our uses of information technology to enhance the learning environment for our students (including solids modeling, finite element analysis, computational fluid dynamics, and statistics and data visualization. We then reflect on the Distance Learning experience from both the professor s and student perspectives.

WORK IN PROGRESS AN INTEGRATED PROGRAMMING ENVIRONMENT SUITABLE FOR DISTANCE LEARNING

Colin B. Price, University College Worcester

Autonomous Robots are used as a vehicle to learn programming in C and Java, to design neural network controllers, to experiment with Finite State Machines and to explore operating system concepts. Our environment is deployed as (i) physical robots (ii) multi-robot simulation written as a Java application (iii) distributed multi-robot simulation using client-server architecture running on the Web. This paper details the design rationale, implementation, deployment and reports evaluation of the work to date. The software is freely available from the author at c.price@worc.ac.uk.

Session T1D: Topics in Electrical Engineering 1

Chair: Marion Hagler, Mississippi State University

Time and place: Thursday, October 21, 8:00 a.m. - 10:00 a.m. *Waterfront South*

WORK IN PROGRESS: A TIMS BASED LABORATORY FOR UNDERGRADUATE PROBABILITY AND RANDOM PROCESSES

Lance C. Pérez, University, Jerald L. Varner, University of Nebraska, Lincoln and Michael F. Anderson, Clarke College

Laboratory experiments for a junior level electrical engineering course in probability and random processes are described. The laboratory platform is centered on the Telecommunications Instructional Modeling Systems (TIMS). All of the laboratory protocols are available for download from the first author s website.

WORK IN PROGRESS - APPLIED PROCESS CONTROL SYSTEMS DESIGN: HANDS-ON LABORATORY EXPERIENCES FOR MULTIPLE DISCIPLINES AND ACADEMIC LEVELS

Jeffrey R. Mountain, The University of Texas at Tyler

Hands-on, design oriented experiences have been shown to increase the retention of undergraduate engineering students. Creatively engaging students throughout their engineering curriculum, and providing increased exposure to hands-on content with realistic connections to future careers is one method that may be used to increase graduation rates. While each discipline may find focused, relevant topics, relatively few demonstrate multidisciplinary appeal. Fewer still supply the variable levels of difficulty needed for cross curriculum integration. At the University of Texas at Tyler, under a grant from the National Science Foundation, process control systems design is being used to provide a common themed, hands-on experience at each academic level. Although applied to a mechanical engineering program, process controls is applicable to a variety of engineering disciplines including agricultural, chemical, electrical and petroleum engineering. This paper briefly describes the Process Control Breadboard system, the proof of concept basis for the hands-on design activities. Integrated into the design process is computer-aided solid modeling for system visualization and a web-based product catalog to assist with component selection. The curriculum integration plan and an outline for the future direction of the three-year project are presented.

WORK IN PROGRESS - TESTING & LEARNING THE FUNDAMENTALS OF DC CIRCUIT ANALYSIS

Jean-Pierre R. Bayard, Cal., Linda Martin, Lecturer and Suresh Krishna, Student Assistant

A database platform accessible on the internet is used to provide the engineering community testing and learning opportunities in DC nodal and mesh analyses. The testing modules are complete problems asking learners to calculate node voltages and mesh currents for a variety of circuits. The learning portion is provided through a series of interactive help topics, some of which are specific to the module at hand, others are expository in nature, covering broader circuit concepts. While students can test their knowledge and skill levels in DC circuit analysis at http://gaia.ecs.csus.edu/~jpforms/NSF/, instructors can monitor (with administrative privileges) their students' performances, as well as compare those to performances from students enrolled at other universities. Assessment results will be provided from a small pilot group of students enrolled during the fall 2003 semester. These will include performance data, as well as contextual examples aimed at evaluating the effectiveness of this work.

GRAPHICAL DESIGN OF FREQUENCY SAMPLING FILTERS FOR USE IN A SIGNALS AND SYSTEMS LABORATORY

Andreas Spanias, Arizona State University, Constantinos Panayiotou, Arizona State University and Venkatraman Atti, Arizona State University

In this paper, we present educational filter design tools used in the signals and systems course. A graphical-user-interface (GUI) for filter design using the frequency-sampling method has been developed and embedded as a module in the Java-DSP (J-DSP) editor. Three realizations are presented: the non-recursive, non-recursive using least-squares, and recursive. The paper describes several laboratory exercises that involve interactive filter design using the Freq. Samp block. The performance of the frequency sampling method is compared against the performance of the Kaiser and Parks-McClellan algorithms. The exercises have been used at Arizona State University in the signals and systems course. Pre- and post-assessment quizzes have been assigned and results have been compiled to evaluate the learning attributed specifically to the J-DSP software and exercises.

WORK IN PROGRESS - MASTERY OF DIGITAL LOGIC SKILLS THROUGH PRACTICE USING JAVA APPLETS

Phillip A. Mlsna, Northern Arizona University

Our electrical and computer engineering students at Northern Arizona University often have difficulty successfully applying their digital logic skills to subsequent courses. Colleagues at other universities have expressed similar experiences. To provide more extensive practice and immediate student feedback, we have been developing a set of Java applets to address key digital logic skills. Two such applets have been introduced in our logic course to date. The first targets Karnaugh maps and their use in minimizing Boolean equations. The second centers on the expression of timing diagrams derived from propagation delays and logic circuit topology. Preliminary results obtained during fall semester 2003 have shown encouraging signs of improved mastery of the targeted skills. These applets will be deployed in fall 2004 on a larger scale, including at least one partner university, for a more complete assessment of effectiveness.

WORK IN PROGRESS OPERATIONAL NOTATION OF FRACTIONS FOR SIGNAL PROCESSING

Masachika Miyata, Kanazawa

This paper describes nontraditional notation which seems to be helpful to learn about a kind of signal processing. Suppose the operator which extracts the fractional part of a real number. Then a remainder k mod n is expressed using this operator which relates remainders to real numbers, and hence it becomes easy to explain the properties of residue classes, especially when several moduli must be considered simultaneously. Since a residue class of polynomials has similar properties, analogous calculation is available as shown in examples for a cyclic code encoder and a perfectly linear phase recursive filter.

Session T1E: Learning Models (with Computers)

Chair: John Chen, Rowan University

Time and place: Thursday, October 21, 8:00 a.m. - 10:00 a.m. *Sloane*

COLLABORATIVE LEARNING TECHNIQUES AND THEIR EXTENSIONS TO VIRTUAL CLASSROOMS

Paul S. Steif, Carnegie Mellon University and Anna Dollár, Miami University

A wide variety of classroom techniques are being advocated to increase learning: active learning, collaboration, integration of assessment and feedback, and the use of concrete physical manipulatives. Through the construction of Learning Modules, the authors have transformed these techniques into practical classroom tools. Learning Modules often include relevant physical examples (classroom desktop experiments or demonstrations or schematics), PowerPoint Presentations and, often, Concept Questions. Students study the physical artifacts, with the instructor guiding the class through the PowerPoint Presentations so as to deliberately focus student attention on relevant aspects of these artifacts. There is clearly an increased interest in devising effective learning environments when students are distributed geographically. This paper addresses some of the challenges and opportunities for the extending our in-class collaborative learning techniques. While there are technical challenges to realizing this vision, there are also opportunities to develop environments which are, in some respects, superior to the in-class environment.

CURRICULUM DECELERATION AND ON-LINE LEARNING COMMUNITIES FOR WORKING STUDENTS

Musoke H. Sendaula, Temple University and Saroj K. Biswas, Temple University

Online Interactive Learning Communities and a decelerated five-year engineering program, are proposed as possible strategies for increasing the number of undergraduate students obtaining degrees in science, technology, engineering, and mathematics fields. These strategies are aimed at minimizing the differences in the learning environment and the support systems at residential campuses and those at urban commuter schools. The learning communities provide on-line mentoring and tutorial support to all the community members. Initial focus is to establish on-line interactive learning communities for all incoming students led by the student engineering professional societies. Five-year decelerated curricula for both electrical engineering and computer engineering programs have been developed, which are currently being used to advise students. Preliminary results from the on-line learning communities for incoming students are very encouraging.

EVOLUTION OF AN E-LEARNING ENVIRONMENT BASED ON DESKTOP COMPUTER TO UBIQUITOUS COMPUTING: GUI DESIGN ISSUES

Ana Isabel Molina Díaz, Universidad de Castilla-La Mancha, Miguel Ángel Redondo Duque, Universidad de Castilla-La Mancha and Manuel Ortega Cantero, Universidad de Castilla-La Mancha

Using the new wireless technologies, mobile devices with small displays (handhelds, Personal Digital Assistants, mobile phones) are present in many environments. We are interested in the effective use of such mobile computing devices for supporting collaborative learning. We want to show its application in a study case: the teaching of Domotics. To reach this goal, we analyze the tasks which are susceptible of improvement through mobile computing. We will take as starting point a collaborative e-learning environment of domotical design, based on the desktop metaphor, called Domosim-TPC. We pretend to adapt this tool to the characteristics of mobile devices. This evolution is based in a task-based analysis. In this paper we describe some learned lessons in the semi-automatic generation of users interfaces for a PDA-type devices. This generation process is carried out starting from the user interface for desktop devices.

NEW TECHNOLOGY AND THE NEED TO CHANGE THE FOCUS IN ENGINEERING EDUCATION

Kip P. Nygren, U.S. Military Academy

The history of engineering is a history of the development of tools to enhance and expand the engineer's effectiveness in creating solutions to societal problems. Most of the tools have been focused on improving the engineer's ability to calculate, or to analyze mathematical models of the physical system or process under design. Since 1965, I have seen a revolution in the ability of engineers and students to perform the calculate step of the design or problem solving process. Students bring everyday to the classroom laptop computers more powerful than engineers could yet imagine 40 years ago. While this enormous power to calculate has changed how engineers think, it has not significantly changed the manner in which undergraduate engineering is taught. Engineering educators need to reconsider what is taught and how students learn in light of revolutionary and continuously changing tools for the design of new technology.

FORMATIVE ASSESSMENT OF A COMPUTER-AIDED ANALYSIS CENTER: PLAN DEVELOPMENT AND PRELIMINARY RESULTS

Joan Burtner, Mercer University, Renee Rogge, Mercer University and Loren Sumner, Mercer University

Mercer University School of Engineering received a grant to establish a computer-aided analysis center to enhance the undergraduate experience. Through learning modules selectively embedded into engineering courses, students are introduced to advanced computational techniques and analysis skills while they are learning engineering fundamentals. Establishing a routine use of the Center and assessing its success and impact constitutes a three-year project beginning Fall 2003. There are several critical objectives associated with this project including a) the improvement of pedagogy and student learning, b) the enhancement of engineering analysis skills and abilities, c) the quantification of faculty workload, and d) the motivation of student efforts. Assessment plans consist of a project-level and learning module-level investigation. This paper discusses the project-level assessment plan, assessment instruments, and the preliminary results of one-semester of implementation. The assessment instruments of the current phase include student and faculty surveys, and Center-usage monitoring.

LEARNING MOTIVATION EVALUATION FOR A COMPUTER-BASED INSTRUCTIONAL TUTORIAL USING ARCS MODEL OF MOTIVATIONAL DESIGN

David Wenhao Huang, Purdue University, Heidi Diefes-Dux, Purdue University, P.K. Imbrie, Purdue University, Brian Daku, University of Saskatchewan and James G. Kallimani, Purdue University

This pilot study demonstrates the feasibility of utilizing instructional theories, specifically on learning motivation, to evaluate a computer-based tutorial for the purpose of proposing effective instructional interventions. Keller's ARCS Model of Motivational Design provides the conceptual framework to address motivational issues while developing instruction. The ARCS Model has four dimensions: Attention, Relevance, Confidence, and Satisfaction. Keller's Instructional Material Motivation Survey measures student motivation along the ARCS dimensions and was modified for this study to evaluate students' motivation while using a computer-based tutorial. This study was conducted in an engineering problem-solving and computer tools course for first-year students. The studied computer-based instructional tutorial, M-Tutor, is designed for learning MATLAB syntactical structures. A pre-post evaluation research design was employed. A coding system was developed to categorize qualitative responses into corresponding instructional components. Qualitative and quantitative data were triangulated for instructional intervention development.

Session T1F: Educational Research 1

Chair: Julie Sharp, Vanderbilt University

Time and place: Thursday, October 21, 8:00 a.m. - 10:00 a.m. *Vernon*

WORK IN PROGRESS IMPROVING THE FRESHMAN ENGINEERING EXPERIENCE

Gary Stewardson, Utah State University, Christine Hailey, Utah State University, Paul Wheeler, Utah State University and Wynn Walker, Utah State University

In an effort to improve retention of engineering students, the College of Engineering at Utah State University piloted an effort to strengthen the freshman experience. Four different experiences were provided fall semester, 2003, and data was collected to determine which combination of experiences or factors were critical in retaining students. The first experience was a class targeted at Electrical and Computer Engineering (ECE) majors. This class required concurrent enrollment in Calculus I and focused on key concepts relevant to ECE majors. The next two experiences were offered in a second class to freshmen less certain of their major and requiring no mathematics prerequisite. This class was randomly divided into two laboratory groups the first representing teams working on paper designs and the second representing cooperative teams in a hands-on laboratory approach. The fourth experience was essentially no experience. Those majoring in mechanical engineering took the required math, science, and general education courses.

CRITICAL FACTORS FOR SUCCESS IN AN INTRODUCTORY ASTRONOMY CLASS

Stuart D. Kellogg, South Dakota School of Mines & Technology, Dan Durben, Black Hills State University and Shauna Ayers-Junek, South Dakota School of Mines & Technology

A number of researchers suggest that a student s learning preference curve can be an effective predictor of student success in a particular course. Others suggest that cognitive development, as measured by a student s development of learning and study strategies, may be more relevant. Still others suggest that preconceived notions of science and astronomy may be more useful yet. In this paper we explore the critical factors in each of these areas as they relate to student success in an introductory astronomy class. In this study, 65 students were given the Visual, Aural, Read/Write, and Kinesthetic learning style inventory (VARK), the Learning and Studies Strategies Inventory (LASSI), and the Astronomy Diagnostic Test (ADT). Results of these inventories along with gender, age, and previous academic performance were correlated with overall classroom performance. A step-wise regression analysis was then performed to determine the most critical factors that affect student performance in this area.

WORK IN PROGRESS - COGNITIVE, AFFECTIVE AND SOCIAL FACTORS CONTRIBUTING TO THE SUCCESS IN UNDERGRADUATE COMPUTER SCIENCE AND ENGINEERING EDUCATION

Karina Vashta Assiter, Wentworth Institute of Technology and Barbara A. Karanian, Wentworth

A three-year research project is proposed whose overall goal is to look at how cognitive, affective and social factors determine success for undergraduate students and how this varies across 1) major 2) year of study 3) campus culture (geographic location, size) 4) gender and 5) race. The proposed research will explore cognitive, affective and social factors that contribute to success in engineering education and computer science with one central question: How does the student s state of mind (mind-state) influence the physical process of learning which then can lead to academic success. Under investigation are the differences with mind-state in response to learning in engineering and computer science, and the relational images that explain the quality and quantity of how the student respondents constructed success. Defining and implementing research measures for mind-state is a central part of this project. Quantitative, qualitative, medical, and projective methods will include samples that reflect variations in mind states reported by male and female participants, in mixed-sex and same sex environments, by race, by discipline and by major.

A GLIMPSE OF HOW SENIOR ENGINEERING STUDENTS UNDERSTAND ENGINEERING AS A PROFESSION

Susan Codone, Mercer University, Laura Lackey, Mercer University School of Engineering and Helen Grady, Mercer University School of Engineering

Because senior engineering students have experienced a rigorous curriculum and lived in an academic engineering environment for at least four years, one can assume that they automatically associate engineering with a profession. Furthermore, it may be assumed that senior engineering students can distinguish between those occupations considered a profession and those considered a vocation or a trade. In 1998, Mercer University implemented a freshmen course titled EGR 108: Professional Practices to teach professional and ethical concepts and skills. Current seniors in Mercer s School of Engineering completed this course as part of their freshmen curriculum. To measure senior students understanding of pro-

fessions, Mercer Engineering and Technical Communication professors developed research questions and a survey regarding entering their understanding of professions and ability to distinguish professions from vocations and trade. The measurements taken by this study assume that senior students will identify engineering as a profession but may be less prepared to classify jobs across a broader spectrum as professions or trades. This paper reports the resulting data as a means of qualifying the senior engineering students understanding of professions and to demonstrate any differences in their perceptions of professions, vocations, and trades. Data will also be used to modify the EGR 108 Professional Practices course as needed.

DO STUDENTS BENEFIT? WRITING-TO-LEARN IN A DIGITAL DESIGN LABORATORY COURSE

Jill L. Auerbach, Georgia Institute of Technology, Christina M. Bourgeois, Georgia Institute of Technology and Thomas R. Collins, Georgia Institute of Technology

Communication instruction in engineering education has been formally integrated in numerous engineering programs, as industry and ABET increasingly require oral and written skills for engineering professionals. As engineering programs have adapted to these requirements, the need to understand the benefits of communication instruction to students while they are learning course content is paramount. This paper focuses on the discipline-specific method for teaching communication skills and addresses whether or not students learn the discipline-specific material more fully when they are required to write about that material. Data for this research comes from a sophomore-level communication- intensive digital design laboratory course. To assess retention, student answers to a specific final exam question are analyzed over three semesters. During these semesters, different writing assignments were associated with the tested subject matter. The results of this study speak directly to content-driven communication instruction and test performance.

DIFFERENCES AMONG EXPERTS, NOVICES AND TRAINEES WRITING A REPORT

Osvaldo Clúa, Universidad de Buenos Aires and María Feldgen, Universidad de Buenos Aires

Experts approach problems in a manner different from that of novices. We had the opportunity of comparing three groups of students with different levels of expertise in a classical information literacy assignment: writing a report on current research and findings on some computing related areas. Each group was at a different level of their experience building life. We asked our students to write a report on some cutting edge development related with computer technology. As we compared their work, we found that previous exposure of our novices group to writing abilities forced us to change a general assessment criterion by more specific ones.

Session T1G: Assessment -- Using Surveys and Portfolios

Chair: Ted Batchman, University of Nevada at Reno

Time and place: Thursday, October 21, 8:00 a.m. - 10:00 a.m. *Percival*

DEVELOPMENT, TESTING, AND APPLICATION OF A CHEMISTRY CONCEPT INVENTORY

Stephen Krause, Arizona State University, James Birk, Arizona State University, Richard Bauer, Arizona State University, Brooke Jenkins, Arizona State University and Michael J. Pavelich, Colorado School of Mines

A Chemistry Concept Inventory (CCI) has been created that provides linkages to misconceptions observed in chemistry and subsequent introductory materials engineering courses as revealed by a Materials Concept Inventory (MCI). The CCI topics included were bonding, intermolecular forces, electrochemistry, equilibrium, thermochemistry and acids and bases. Numerous students were interviewed in development of questions in order to ascertain that the questions and responses were interpreted as intended. Questioning students on topics of molecular shape gave helpful insight into how students solve problems. For example, a question might be written to test one aspect of the topic, but students might solve it differently. They might use different reasoning that would lead to a correct answer. The item is therefore testing something other than the intended topic. Interviews led to some unique findings in spatial understanding and misconceptions held by these students. Multiple rounds of testing were then used in ascertaining development of a valid Chemistry Concept Inventory.

AFFECTIVE FACTORS AND STUDENT ACHIEVEMENT: A QUANTITATIVE AND QUALITATIVE STUDY

Leo F. Denton, University of South Alabama and Dawn McKinney, University of South Alabama

The affective domain can be used to support the internalization of cognitive content and foster the development of curriculum and industry-related interests, attitudes, values, and practices. During a two-year period, using validated instruments, the authors measured student interest, value, effort, perceived competence, lack of pressure, student-peer belonging, and student-faculty belonging. Initial findings included a positive correlation between each affective factor and course grade, a significant decrease in the levels of affective factors over the course term, and a lessening of those decreases with

the use of specific affective objectives and instructional strategies. The current study built upon these initial results by incorporating new quantitative and qualitative data for each affective factor. The paper reports on the results of these analyses and offers practical suggestions and instructional guidelines based upon the findings. These findings appear to be broadly applicable throughout our curriculum and could extend to other science, mathematics, engineering, and technology disciplines.

GRADE-POINT AVERAGE, CHANGES OF MAJOR, AND MAJORS SELECTED BY STUDENTS LEAVING ENGINEERING

Matthew W. Ohland, Clemson University, Guili Zhang, University of Florida, Brian Thorndyke, Stanford University and Timothy J. Anderson, University of Florida

Graduation success, grade-point average, and destination major of ten cohorts of students matriculating and subsequently leaving undergraduate engineering programs at nine southeastern universities are studied from 1987-2002. Grade point averages are frozen at the time students leave engineering to investigate the role of grades in their decision to leave engineering and their choice of a destination major. This study adds to evidence indicating that poor performance is not the primary reason students leave engineering. Students leaving with low grades most likely select business, students with high grades more likely choose natural science majors and, interestingly, 10 to 20% at all performance levels choose education or a social science. The study also found that 10 to 15% of the students leaving engineering at all performance levels changed majors at least a second time before graduating, suggesting that changing majors is, for some, a journey of exploration rather than a matter of settling for one s second choice.

STUDENT ATTITUDES SURVEYED IN AN INTRODUCTORY ENVIRONMENTAL RESOURCES ENGINEERING COURSE

Doreen M. Espinoza, Michigan State University, Jeffrey W. White, Humboldt State University, Elizabeth A. Eschenbach, Humboldt State University and Eileen M. Cashman, Humboldt State University

An undergraduate engineering survey course has been redesigned to improve Environmental Resources Engineering and Environmental Sciences student retention and recruitment. A student survey, containing Likert scale and open-response questions, was developed to measure attitudes and beliefs about the course, major, profession, and abilities. We report results from post-course and paired pre- and post-course surveys. Multivariate analysis of variance on Likert scale items and qualitative analysis of open-response questions were conducted. Results indicate that the course positively impacted students technical and math skills, and confidence in writing and critiquing skills. Program year appears to impact student s perceptions. First year students, more than non-first year students, indicated greater interest in major s topics beyond coursework, and the course positively impacted their decision to choose their major. By semesters end, students had an increased perception that professionals in their field are innovative and respected. This paper discusses the design of the study and results gathered to date. This work is supported by a NSF CCLI Adaptation Grant.

WORK IN PROGRESS - GENERAL ENGINEERING PROGRAM ASSESSMENT - WHERE DO WE STAND?

Abulkhair Masoom, University and Fahmida Masoom, University of Wisconsin-Platteville

Identifying and adopting suitable assessment methods are the beginning steps in planning for an accreditation process of a program. For a non-degree-granting department such as the General Engineering Department at the University of Wisconsin-Platteville, where do we begin? It is not a degree-granting department; rather it feeds students into the pipeline of the majors after they have completed the basic and core engineering science courses. Assessment requires and reflects a long-term commitment to the program and its constituencies, viz., the students, alumni and industry partners. Like most engineering programs, we have had a long history of self-assessment and improvement. However, we have had little documentation of processes already in place. This paper is a discussion of possible assessment measures for departments such as ours and also raises questions about what more could be done.

WORK IN PROGRESS: USING E-PORTFOLIOS TO ASSESS COMMUNICATION SKILLS

Marie C. Paretti, Virginia Tech

With communication skills crucial to workplace success and communication-in-the-disciplines programs gaining popularity, educators need effective mechanisms to assess student learning in this area. Traditional product-based assessments in individual courses reflect students mastery of assignments, but provide no means to evaluate their understanding of how to develop documents based on situational constraints or to track student progress and curricular effectiveness across a multi-year program. Portfolio assessments offer one solution, and the advent of web-based e-portfolio systems provide added gains. This project explores the potential of e- portfolios in assessing both student and programmatic success. Pre-

liminary results of a pilot project suggest that while the interface, which is still in development, has some usability issues, the e-portfolio system, with appropriate pedagogical support, is a feasible alternative to paper portfolios.

Session T1H: Computer and Web-Based Software 1

Chair: Claudio da Rocha Brito, COPEC - Council of Researches in Education and Sciences
Time and place: Thursday, October 21, 8:00 a.m. - 10:00 a.m. *Verelst*

AUTOMATING INSTRUCTIONAL DESIGN WITH ECAD
Timothy J. Ellis, Nova Southeastern University, William Hafner, Nova Southeastern University and Frank Mitropoulos, Nova Southeastern University

Colleges and universities are increasingly offering at least part and, in many instances their entire curriculum via online learning modalities. Despite this trend, there is inadequate support for the professors responsible for restructuring the courses they have refined over a career in the classroom for delivery via the Web. Teachers who are expert in their subject area and masters of their craft when in a classroom find themselves in the uncomfortable position of having to relearn how to teach in a new environment with little or no support. The process of planning and developing a course for delivery in an online environment is, in many significant aspects, analogous to the processes required to develop a software system. Both situations require the developer to manage resources through a series of steps with the goal of designing a product that effectively utilizes the computer to solve a problem. The procedures and tools used in software engineering to manage software system development, therefore, offer promise for developing online courses. Computer Aided Software Engineering (CASE) tools are of special interest by virtue of the support afforded the development process through computerization. This paper offers an architectural overview of a knowledge-based, course engineering system: eCAD (electronic Course Analysis & Design). The requirements for the system, the manner in which those criteria were developed and validated, and system design will be detailed. A working prototype will also be presented.

USING COMPUTERS TO DELIVER A MATHEMATICS COURSE, TO INCREASE RECRUITMENT AND RETENTION RATE OF NON-TRADITIONAL STUDENTS AND REDUCE STAFF WORKLOAD
Maggie Pollock, University of Glasgow

This is a longitudinal case-study (over 12 years) which discusses the conversion of a basic mathematics course for technology students to Computer Aided Learning and Computer Aided Assessment. This was easier than expected because suitable off-the-shelf software was available. The change also enabled the maths admissions requirement to be relaxed, thus increasing access to the degree programme for non-traditional students. A scheme of work has been developed to cover all required mathematical concepts and computers are used to deliver the curriculum and assess students knowledge and understanding. Staff workload is reduced as they no longer lecture or assess but act as tutors working alongside students individually. Students like this method of learning as they study at their own pace and attempt tests when they feel ready. Retention rates for class sizes of 50+ are similar to those of using small group didactic teaching.

AN UNDERGRADUATE COURSE - INTERNET-BASED INSTRUMENTATION AND CONTROL
Hanqi Zhuang, Florida Atlantic University and Sal Morgera, Florida Atlantic University

In this paper, the objective, strategy and implementation details of a new undergraduate course, Internet-based Instrumentation and Control, are presented. The course has a companion laboratory that is supported by the National Science Foundation. It is offered to senior-level undergraduate engineering students who are interested in sensing, instrumentation, control and web programming and want to learn more about the integration of these technologies for solving real-world engineering problems. It will also be offered to gifted high school seniors as a vehicle to attract them to engineering disciplines. Preliminary assessment of the first offering of the course is encouraging and has shown that the course has achieved success in helping students to understand concepts and master basic technologies for developing Internet-based automatic systems.

SUPPORTING CONSTRUCTIVIST LEARNING IN A MULTIMEDIA PRESENTATION SYSTEM
Dula Kumela, UMass Amherst, Kenneth Watts, UMASS Amherst and W. Richards Adrion, University of Massachusetts Amherst

The Research in Presentation Production for Learning Electronically (RIPPLES) group in the Department of Computer Science at UMASS Amherst have developed a course delivery system named Multimedia Asynchronous Networked Individualized Courseware (MANIC). MANIC uses the approach of record and playback . While record and playback technologies can be very effective in supporting a constructivist mode of instructional delivery, the technology is not inherently

constructivist. In support of a more constructivist mode of instruction, we have implemented advanced indexing and search features in MANIC that makes use of ranking and relevance, and a query expansion technique to generate queries and conduct search over the World Wide Web (WWW) using Google. In this paper we describe initial experiments conducted, and our plans for additional assessment and enhancement of the search mechanism.

WORK IN PROGRESS USING INTERNET APPLICATIONS TO CONTROL REMOTE DEVICES FOR AN INSTRUMENTATION LABORATORY

Carmen Ciubotariu, University of Calgary, Alberta, Canada

Undergraduate Engineering students have undertaken a research project on the creation and the development of an internet based real-time access to laboratory devices. SelfLab@Home is a novel tele-education project of the Department of Electrical and Computer Engineering of the University of Calgary. Its original objective was to become a self-paced remotely accessed training for the use of four basic laboratory devices: oscilloscope, waveform generator, DMM (digital multimeter) and a power supply. The high-level design components include a Client Interface, a Client/Server Interface, a main Server, a Server/Hardware Interface, the Agilent Oscilloscope, and a Video Streaming Scheme. The implementation of this project required the following components: Client Web Browser Interface, Web Server, Application Server, Hardware Dynamic Link Library (DLL), Video Streaming Scheme. A joint team of high school students enrolled in the Research Enrichment program and fourth year students have built this remotely accessed instrumentation laboratory to give all undergraduate students a chance to learn how to operate the equipment from outside the lab while working at their own pace.

A COMPUTER-BASED PROBLEM-SOLVING COURSEWARE FOR REINFORCED CONCRETE DESIGN

Nirmal K. Das, Georgia Southern University

Typically code-based structural design uses trial-and-error procedure that often requires several iterations, involving tedious, repetitive calculations. Also, only a limited number of examples can be presented in the classroom due to time constraint. To circumvent the situation, a logical option is to capitalize on the computer s abilities to compute, display graphics, and interface with the user. Some asynchronous web-based course materials are available in the civil engineering technology area, but to the author knowledge, very few exist in structural design. The purpose of this paper is to present a computer-based problem-solving courseware that has been developed to complement traditional lecture-format delivery of the reinforced concrete design course in order to enhance student learning. The courseware consists of interactive, web-based modules. Commercial symbolic-manipulation software (e.g., Mathcad) is utilized for the calculations performed in different modules. Besides allowing for faster solution of a problem, the tool is useful for experimentation with parameter changes as well as graphical visualization.

Session T2A: Interactive Session: Synergy: Can University and College Students Share a Learning Experience?

Chair: Peter Spasov, Fleming College

Time and place: Thursday, October 21, 10:30 a.m. - Noon *Chatham*

INTERACTIVE SESSION - SYNERGY: CAN UNIVERSITY AND COLLEGE STUDENTS SHARE A LEARNING EXPERIENCE?

Barrie Jackson, Queen's University, Peter Spasov, Sir Sandford Fleming College, Dale Dilamarter, Queen's University, Rose Manser, Sir Sandford Fleming College and Annette Bergeron, Queen's University

In industrial practice, engineers and engineering technologists often collaborate on solving problems. Yet, this collaboration rarely occurs in an educational setting. Queen s University and Fleming College have programs where students work in teams to solve real-world problem for clients. During the 2002-03 academic year, a project team consisting of engineering students from Queen s University and engineering technology students from Fleming College worked together to solve an industrial problem for a fee-paying client. Using the experience of this case study and that of participants, this interactive session develops a framework of the possibilities, pitfalls and prospects of implementing shared University and College student learning experiences. The participants will discuss and explore how to choose appropriate consulting projects, how to establish expectations which encourage synergy, how diverse students can work together to achieve learning outcomes appropriate to their professions or disciplines, how to manage crises, inter-personal relationships, and satisfy administrative needs.

Session T2B: Panel: Learning Science and Technology R&D

Chair: Kay Howell, Federation of American Scientists
Time and place: Thursday, October 21, 10:30 a.m. - Noon *Savannah*

PANEL - LEARNING SCIENCE AND TECHNOLOGY R&D: A ROADMAP TO THE FUTURE OF LEARNING
Kay Howell, Federation of American Scientists, Jan Cannon-Bowers, University of Central Florida, Albert Corbett, Carnegie Mellon University, Max Louwerse, University of Memphis and Alfred Moye, Hewlett Packard (retired)

This panel will discuss the Learning Science and Technology R&D Roadmap developed by the Learning Federation, a partnership among industry, academia, and private foundations to stimulate research and development in learning science and technology. The Roadmap outlines a detailed research plan for developing next-generation learning environments focused on post-secondary science, math, engineering, and technology education. Developed over a three-year period with advice provided by over seventy experts from educational institutions, government, and industry, the roadmap identifies key research priorities, along with metrics and milestones for each research focus area. The panel, comprised of researchers who participated in the development of the Roadmap, will summarize the key research challenges, R&D chronology, and five and ten-year goals identified in the Roadmap. The panelists will encourage comment from the audience regarding the research priorities identified in the Roadmap and effective management strategies for building multi-disciplinary teams to undertake the research.

Session T2C: Distance Learning: Methods and Technologies 2

Chair: Mark A. Ardis, Rose-Hulman Institute of Technology
Time and place: Thursday, October 21, 10:30 a.m. - Noon *Waterfront North*

WEB BASED CURRICULUM AS A PEDAGOGIC TOOL FOR E-LEARNING, IN NETWORK SECURITY
Suranjith Ariyapperuma, Anglia Polytechnic University and Kaniz Minhas, Anglia Polytechnic University

This research investigates the suitability of a web based pedagogic tool, for delivering network security courses in an educational framework. Our research is based on the Cisco Network Academy Program, a comprehensive web-based interactive curriculum, for computer networking. We consider the curriculum usage, and views expressed by lecturers and students, to assess whether this method could be usefully incorporated to include specific sections of Information Security subject domain. Curriculum usage data was collected, by analysing log files of the web server, which hosts the pedagogic documents. An on-line survey was administered, within the Network Academy community, in Europe Middle East and Africa. Results are extrapolated, to assess the suitability of the proposed deployment of network security curriculum. The deviation from current e-learning paradigms is addressed, in relation to the use of new technology such as Internet Protocol TV (IPTV) multicasting for distance learning, targeted at combining the social context of learning to content delivery.

BUILDING THE SCAFFOLD FOR EVALUATING THREADED DISCUSSION FORUM ACTIVITY: DESCRIBING AND CATEGORIZING CONTRIBUTIONS
Laurie P. Dringus, Nova Southeastern University and Timothy J. Ellis, Nova Southeastern University

As asynchronous learning networks mature, a demand has been placed on incorporating presence and interaction in the online learning experience. The threaded discussion forum is a promising asynchronous tool for promoting the desired student and faculty interaction essential to fostering a collaborative community of learners. Although the threaded discussion forum is widely used to support a variety of course requirements, the instructor is faced with the difficulty of interpreting and evaluating the learning and quality of participation reflected in the student contributions. A considerable discussion in the literature is ongoing on the theoretical foundation for discourse analysis of discussion forum activity. There have also been a number of attempts to develop rubrics for evaluating that activity. Unfortunately, many of the rubrics have little or no grounding in discourse analysis theory, and those that are conceptually sound are either too cumbersome for a professor to use or have not been tested for reliability and validity. The presentation will describe SCAFFOLD Scale for Forums/Online Discussion Assessment. The authors will describe the SCAFFOLD instrument as a tool for categorizing and describing contributions. The process for establishing reliability and validity will be detailed.

DISTANCE LEARNING DESIGNING NEW RELATIONS IN ENGINEERING EDUCATION

Claudio da Rocha Brito, COPEC - Council of Researches in Education and Sciences and Melany M. Ciampi, COPEC - Council of Reseaches in Education and Sciencesr

The goal of this paper is to show a project developed for a School of Engineering in Brazil that is a Telecommunication Engineering Program, which contains in its curricula a flexible period that is a time the student can attend in the several areas of human knowledge, in one of the other Schools. A distance education course is included among their choices and the experience has showed that this kind of education is one step further in engineering education. Distance education is not new in Brazil once it is one of the pioneers of this kind of education in the world. It has a history that dates back the 40 s with the University of Air ; a radio program was developed by the Ministry of Education of Brazil to bring education to the remote areas of the Country. Followed by the "Telecurso 1 Grau" and "Telecurso 2 Grau" in the 60 s.

LEARNING PORTFOLIO ANALYSIS AND MINING IN SCORM COMPLIANT ENVIRONMENT

Wei Wang, National Chiao Tung University, Jui-Feng Weng, National Chiao Tung University, Jun-Ming Su, National Chiao Tung University and Shian-Shyong Tseng, National Chiao Tung University, Taiwan,ROC

With vigorous development of the Internet, e-learning system has become more and more popular. Sharable Content Object Reference Model (SCORM) 1.3 provides the Sequencing and Navigation to define the course sequencing behavior, control the sequencing, select and deliver of course, and organize the content into a hierarchical structure, namely Activity Tree. Therefore, how to provide customized course according to individual learning characteristics and capability, and how to create, represent and maintain the activity tree with appropriate associated sequencing definition for different learners become two important issues. However, it is almost impossible to design personalized learning activities trees for each learner manually. The information of learning behavior, called learning portfolio, can help teacher understand the reason why a learner got high or low grade. Thus, in this paper, we propose a Learning Portfolio Mining (LPM) Approach including four phase: 1. User Model Definition Phase: define the learner profile based upon pedagogical theory. 2. Learning Pattern Extraction Phase: apply sequential pattern mining technique to extract the maximal frequent learning patterns from the learning sequence, transform original learning sequence into a bit vector, and then use distance based clustering approach to group learners with good learning performance into several clusters. 3. Decision Tree Construction Phase: use two third of the learner profiles with corresponding cluster labels as training data to create a decision tree, and the remaining are the testing data. 4. Activity Tree Generation Phase: use each created cluster including several learning patterns as sequencing rules to generate personalized activity tree with associated sequencing rules of SN. Finally, for evaluating our proposed approach of learning portfolio analysis, several experiments have been done and the results show that generated personalized activity trees with sequencing rules are workable for learners.

WORK IN PROGRESS - THE STUDY OF WEB-BASED ADAPTIVE FEEDBACK BASED ON THE ANALYSIS OF INDIVIDUAL DIFFERENCES

Hyunjong Choe, Korea National University of Education, Youngkwon Bae, Korea National University of Education, Taeyoung Kim, Korea National University of Education and Taewuk Lee, Korea National University of Education

To demonstrate the feasibility of Web-based adaptive feedback, our study exploits the individual differences as a solution. However, the implicit characteristics of individual make hard to derive an explicit model. In many countries, primary, secondary and high school students undergo a standardized personality and aptitude test. This test guarantees reliability and validity, and the result of it shows various aspects of personal characters and aptitudes. Thus, we think that the results of the standardized test can be used to differentiate individuals in the class. From the standardized test results, seven general cognitive and aptitude factors are selected, and then, we relate those factors to feedback types. Also we design a Web-based performance assessment system to evaluate our proposed method. We are going to apply this system to the students in a secondary school for evaluating our proposed adaptive feedback model in a Web-based environment.

Session T2D: K - 12: Teaching Teachers and Using Student Mentors

Chair: Susan Lord, University of San Diego

Time and place: Thursday, October 21, 10:30 a.m. - Noon *Waterfront South*

WORK IN PROGRESS: RESEARCH EXPERIENCE FOR TEACHERS (RET) PROGRAM IN THE COLLEGE OF ENGINEERING (COE) AT THE UNIVERSITY OF SOUTH FLORIDA (USF)

Carlos A. Smith, University of South Florida, Louis Martin-Vega, University of South Florida, Edwin Steiner, University of South Florida, Nancy Johnson Marsh, Scholl District of Hillsborough County and Melinda Hess, University of South Florida

The USF College of Engineering (CoE) is fully committed to working together with school districts, community colleges, and the USF College of Education toward the improvement of education from the K-12 level to the community college level. One of the cornerstones for successful integration of engineering into the K-12 environment is the development of relevant and sustainable partnerships between engineering faculty, and teachers/faculty in the K-12/community college environment. Toward this end, CoE instituted the Research Experiences for Teachers (RET) program two years ago in order to help math and science teachers from both middle and high schools learn about engineering research at the university level and how to better pass this knowledge on to their students, instilling an interest, and thus a desire to potentially pursue higher education in science, math, and engineering related fields. The objectives of the program include: (i) exposing teachers to engineering research in which science and math backgrounds are used; (ii) revealing the necessary integration of science and math disciplines when conducting engineering research; (iii) providing teachers with real life examples in which science and math are used in this way; (iv) enhancing teacher self esteem and confidence in science as a discipline. This program makes the K-12 teachers and community college faculty full partners in engineering research. The experience provides these individuals with enhanced teaching skills/methods, the ability to motivate students in science and math disciplines, and a higher level of credibility and knowledge to apply when advising/guiding students toward engineering disciplines.

CHALLENGES IN ENHANCING SCIENCE EDUCATION IN ELEMENTARY CLASSROOMS THROUGH UNIVERSITY-SCHOOL DISTRICT PARTNERSHIPS

Rajesh Ganesan, University of South Florida, Tapas K. Das, University of South Florida, Cheriese Edwards, University of South Florida and O. Geoffery Okogbaa, University of South Florida

Science and Math performance of America s children has shown a decline in recent years. A study among K-5 teachers in the Hillsborough County, Florida (location of the project) showed that 64% the teachers did not feel prepared in science content and 49% did not feel prepared in mathematics. This paper discusses some of the major challenges of a partnership between the University of South Florida and the school district of the Hillsborough County of Florida that was undertaken with the help of a National Science Foundation Grant to improve science education in elementary classes. This project focuses on K-5 classes and is poised to infuse advanced knowledge in sciences and engineering in the curriculum within the framework of State science education standards.

LESSONS LEARNED FROM A PROJECT FOR K-12 ENGAGING UNIVERSITY STUDENTS AS INSTRUCTORS

Valentin Razmov, University of Washington, Karalee Woody, University of Washington and Louis Fox, University of Washington

The boundaries between K-12 and higher-education institutions are blurring as high school students increasingly take active roles in local university projects, and college students reach out to engage K-12 students in their educational pursuits from research to college and career planning. This partnership provides continuity of education, making learning the constant and time the variable. The Digital Learning Commons is a program whose mission is to improve access to educational opportunities and learning resources for students and teachers. In its pilot year, the program employed 24 university students as instructors who would visit 17 schools throughout Washington State, and train students and teachers on the use of online tools to improve student learning. This paper provides an experience report from two perspectives a program administrator s and a student-instructor s. We share our goals and expectations, and discuss the planning and evaluation processes, focusing on the lessons learned. Finally, we provide a glimpse into the challenges ahead.

WORK IN PROGRESS ENGINEERING AMBASSADORS IN THE CLASSROOM: EXPERIENCES AT SOMERS HIGH SCHOOL

Louise Audette, Somers High School and Robert F. Vieth, University of Connecticut

The University of Connecticut School of Engineering, in partnership with the Neag School of Education and selected local school districts has received a grant under the NSF GK-12 fellowship program to develop and implement an innovative, comprehensive, affordable, and accessible program to integrate engineering into the secondary school curriculum. This program, called the Galileo Project seeks to: I) Make college engineering programs accessible to the widest possible range of students, particularly those from underrepresented groups, II) Instill a strong sense of commitment to and appreci-

ation for education among participating Graduate Fellows, and III) Expose teachers to the tremendous challenges, rewards and opportunities that are implicit in engineering education and practice.

JAVA ENGAGEMENT FOR TEACHER TRAINING: AN EXPERIENCE REPORT

Raja Sooriamurthi, Indiana University, Suzanne Menzel, Indiana University, Arijit Sengupta, Indiana University, Katie Moor, Indiana University, Sid Stamm, Indiana University and Katy Borner, Indiana University

Starting with the 2003 academic year, the advanced placement (AP) exams in computer science conducted by the college board moved from a C++ to a Java based curriculum. In order to assist high school computer science teachers with the transition from C++ to Java, the ACM together with the college board conceived of Java Engagement for Teacher Training (JETT) workshops. In the Fall of 2003, Indiana University organized such a workshop. The outreach workshop was held over two days and was attended by 35 high school computer science teachers from Indiana and several nearby states. The workshop was conducted as an inter-disciplinary effort with faculty and support from Computer Science, Information Systems, Informatics, and the School of Library and Information Science. Sessions spanned the gamut of foundational concepts of object-oriented programming in Java to network games. A theme of the workshop was to address the problem of the ever-shrinking pipeline of women in the IT field. With this in mind, we also conducted a separate session titled ``Where have all the women gone?" Judging by participant feedback, the workshop was a resounding success. This paper describes our experience in organizing the JETT workshop, the lessons learned, and outlines our plans for the future to build upon this K-16 relationship-building exercise.

Session T2E: Issues in Entreprenuership & Professionalism

Chair: Mary Besterfield-Sacre, University of Pittsburgh

Time and place: Thursday, October 21, 10:30 a.m. - Noon *Sloane*

INSTITUTIONALIZING THE ASSESSMENT OF ENGINEERING ENTREPRENEURSHIP

John C. Wise, The Pennsylvania State University and Sarah E. Rzasa, Penn State

Several years ago, Penn State received a grant from General Electric to establish a minor in Engineering Entrepreneurship at the College of Engineering. Along with the grant came a requirement for extensive assessment and evaluation of the program. Now that the grant period has expired, there is a desire to continue the assessment process that was created. Unfortunately, with the expiration of the grant came the loss of funds dedicated to the assessment of the entrepreneurship program. Institutionalization is seldom a concern when a program assessment is contemplated, designed, or executed. A well-planned process, however, can become a continuing source of quality data for many years with little or no additional cost to the user. This paper reports on the efforts taken to continue the assessment of the entrepreneurship minor without the funds that were previously available. This requires the development of a leaner design. The use of online forms, automation, and existing college-level databases is discussed.

A MULTIDISCIPLINARY BUSINESS AND ENGINEERING COURSE IN PRODUCT DEVELOPMENT AND ENTREPRENEURSHIP

Ralph M. Ford, Penn State Erie, The Behrend College, Jana G. Goodrich, Penn State Erie, The Behrend College and Robert S. Weissbach, Penn State Erie, The Behrend College

This paper describes the design and development of a multidisciplinary course that pairs business and engineering students on teams for the objective of developing a new small product. The course is team-taught by faculty from business, engineering, and engineering technology. The student teams are required to develop a product concept, an engineering design, and a business plan. The major deliverables for the course include: an intellectual property search, a project proposal, a market analysis, a product requirement specification, an engineering design, a financial plan, and a marketing plan. The course culminates with a business plan deliverable that integrates all of these elements.

WORK IN PROGRESS: ETHICS AND THE DEVELOPMENT OF PROFESSIONAL IDENTITIES OF ENGINEERING STUDENTS

Michael C. Loui, University of Illinois at Urbana-Champaign

How do undergraduate students in engineering conceive of themselves as professionals? How does a course on engineering ethics affect the development of a student s professional identity and potential for moral courage? In this project, students responded to questions about the characteristics and responsibilities of professional engineers. They identified people and experiences that shaped their understandings of these characteristics and responsibilities. They reflected on their own development of these characteristics and preparation for these responsibilities.

ADDRESSING PROFESSIONAL ISSUES THROUGH AN EXPERIMENTAL CAPSTONE DESIGN EXPERIENCE
George D. Catalano, SUNY Binghamton, Robert S. Sterlacci, SUNY Binghamton and Karen Catalano, SUNY Binghamton

A senior level capstone design experience has been developed and offered with a particular emphasis on many of the professional issues raised in Accreditation Board for Engineering and Technology (ABET) Engineering Criterion IV. The course has sought to develop student awareness of the ethical foundation of the engineering profession, the global and societal framework within which engineers practice, and the environmental impact of engineering. The capstone design course also focused upon improving the technical communications skills of the graduating senior class with both extensive instruction in writing and multiple workshops dealing with the art of making an effective oral presentation. The effectiveness of the design course was assessed using Kirkpatrick s model for evaluating training programs.

TEACHING ENTREPRENEURIAL LEADERSHIP: A PROJECT-BASED APPROACH
Gül E. Okudan, Penn State and Sarah E. Rzasa, Penn State

This paper first discusses the evolution of the Entrepreneurial Leadership course (ENGR 310), which is one of the four core courses at The Pennsylvania State University (Penn State), and provides a description of the current project-based teaching practice. The current practice has been developed after a comprehensive review of similar courses and entrepreneurship education literature. This paper discusses the new curriculum of the course, and relevant innovative changes. The results of an assessment plan conducted to measure student satisfaction and perceptions of the course are included along with a summary of the experience gained while teaching the improved version of the course. In addition to the assessment results, there are two other results that attest to the success of the course: (1) All teams completing the build and sell project made profits. One team in fact made about $700 in profit. Considering the time they were allotted to work on the project, $700 is a great accomplishment. (2) Most students taking the class, who are not graduating, decided to enroll in the minor. This paper aims to share implementation of these changes as an avenue for entrepreneurship educators to learn from others experiences.

Session T2F: Active & Cooperative Learning 1

Chair: Robin Adams, University of Washington
Time and place: Thursday, October 21, 10:30 a.m. - Noon *Vernon*

USING THE EXPERIENTIAL LEARNING MODEL TO TRANSFORM AN ENGINEERING THERMODYNAMICS COURSE
Margaret Bailey, Rochester Institute of Technology and John Chambers, Rochester Institute of Technology

Rochester Institute of Technology (RIT) has long been committed to experiential learning within its undergraduate engineering programs. With one of the oldest cooperative education programs in the country, RIT firmly believes in learning through doing. This paper describes how an experiential learning model is also incorporated within the classroom in order to improve student learning within a Thermodynamics course. The experiential learning model can be applied while designing a course to ensure that planned activities give full value to each stage of the process. The methodology is based on an existing educational model which includes four basic stages; active experiences, reflective observations, abstract conceptualization, and active experimentation. Traditionally, a course in thermodynamics is taught in a lecture style which addresses the conceptual phase of the experiential learning model. In this paper, discussions and specific details are presented on how an experiential learning model is used in order to transform an existing thermodynamics course. Preliminary assessment results based on course-end student feedback are included which indicate a high level of perceived learning in the course.

AGENTIVE LEARNING IN ENGINEERING RESEARCH LABS
Wendy C. Newstetter, Georgia Tech, Elke Kurz-Milcke, Georgia Institute of Technology and Nancy J. Nersessian, Georgia Institute of Technology

Over the last two years, we have been conducting NSF-funded research on learning in two biomedical engineering research laboratories. Our goal is to understand the mechanisms that support student learning in such innovation communities. We have identified five characteristics of what we call "agentive" learning environments, which seem to account for the rapid membership and robust learning we have chronicled. In using this term, we refer to students both as agents of their own learning but also as assigning agency to the devices and technologies they encounter in the laboratories. In this paper, we present the five principles of an agentive learning environment with examples of how it unfolds day to day life in

the labs. Finally we discuss the implications of these principles and our findings for the development of classrooms as sites of learning which better replicate the agentive learning found in the laboratories.

REAL-WORLD PROBLEMS IN THE CLASSROOM: VITAL IN ENGINEERING EDUCATION

Glennelle Halpin, Auburn University, Gerald Halpin, Auburn University, P. K. Raju, Auburn University, Chetan S. Sankar, Auburn University and Lara Belliston, Auburn University

Innovative approaches to engineering education are required in order to improve student learning and to graduate students capable of meeting the challenges of the future. One such approach has been implemented at Auburn University, and the students have been tracked longitudinally to study the impact of this innovative instruction wherein theory and practice were brought together. Multimedia case studies were developed and used as a primary instructional mode in experimental classes over a 2-year period. Students in the experimental classes were matched with a comparison group randomly selected from the engineering student population but stratified by high school grades, ACT/SAT, and engineering major. The longitudinal evaluation revealed significant differences in college grade point averages among the groups with the experimental mechanical engineering majors tending to have the best grades. Even more supportive of the experimental program was that a significantly greater proportion of the participants was admitted to study in a professional engineering program from pre-engineering than was found with the comparison participants. These results suggest that the experimental instructional approach employed for the engineering students in this study is indeed an innovation that leads to improved student learning and advancement in engineering.

ACTIVE LEARNING COURSES ON THE CUTTING EDGE OF TECHNOLOGY

Marlin H. Mickle, University of Pittsburgh, Larry Shuman, University of Pittsburgh and Michael Spring, University of Pittsburgh

This paper discusses providing an active and cooperative learning experience in a cutting edge area where textbooks either are not yet available or if available, the coverage is insufficient. Specifically, the course described is in wireless computer networks; students from several disciplines must deal with a wide spectrum of device types as they also learn how technological advances have affected past and current directions in products and services. The active learning approach motivates students to ask questions immediately or prior to the next class in order to clarify gaps in understanding. The active learning concept is based on vocabulary increasing rhetoric ; i.e., "you really do not own a word unless you can use it correctly in a meaningful sentence or context." Here, the premise is that you do not really learn the material until you can explain it to yourself through text that will be critically read thus also benefiting technical writing and teamwork skills. The course has now run successfully for two years.

THE LEADERSHIP ACADEMY AT UNC CHARLOTTE

Stephen C. Myers, The University of North Carolina at Charlotte

In addition to the academic preparation engineering students receive in the classroom, today s graduates also need to be prepared to enter the workforce with the ability to confidently interact in a corporate setting, as well as have an awareness of their own personal strengths and weaknesses. Technically competent graduates who also possess these soft skills are much more attractive candidates for potential employers. To address this need, the Lee College of Engineering at the University of North Carolina at Charlotte has developed the Leadership Academy, a unique program providing the opportunity for students to develop their leadership potential. The Leadership Academy teaches engineering students to deal with realistic challenges they will face in the business world, explore their own personal development process, and practice their leadership skills in a controlled setting. This extra-curricular program is conducted through evening and weekend retreats and is facilitated by a range of engineering faculty, alumni, and corporate partners over a two year time span. This paper describes the purpose of the Leadership Academy, engaging structure of the active learning environment, partnerships with industry, and specific areas of focus within the program components.

Session T2G: Capstone Design: Incorporating Real World Requirements & Experiences

Chair: David Voltmer, Rose-Hulman Institute of Technology

Time and place: Thursday, October 21, 10:30 a.m. - Noon *Percival*

CREATING CORPORATE WORLD EXPERIENCE IN CAPSTONE COURSES

Russel Bruhn, University of Arkansas at Little Rock and Judy Camp, University of Arkansas at Little Rock and Acxiom Lab for Applied Research

Many engineering capstone courses require senior design projects involving teamwork. The curricula at the University of Arkansas at Little Rock Donaghey CyberCollege engages local industries in providing meaningful design projects for student teams in real world settings. Both St. Vincent Health System and Heifer International sponsored capstone design teams in yearlong projects. These projects resulted in the students gaining professional skills, the industries gaining products that saved money and won awards, and the CyberCollege faculty gaining understanding and experience for developing its engineering curricula. Engineering educators who want to provide real-world experience to graduating seniors may benefit from learning how we obtained corporate sponsors for the projects, created student-consulting teams, and developed a capstone course incorporating system design theory. They may also gain insight from discussions about our methods for student evaluations and about the lessons we learned from our experimental capstone course.

IMPORTANCE OF TEACHING THE HISTORY OF TECHNOLOGY

Sridhar Condoor, Saint Louis University

In most engineering courses, students learn concepts, methods and tools. The education community seldom focused its attention on teaching the historical aspects of engineering and technology. As a result, students know very little about famous engineers, case histories, evolution of engineering science and technology, and influence of engineering activity on the society. The reading of engineering case histories emphasize the role of human error/failure in engineering design, the practice of engineering as an art form, and the difference between engineering and scientific activities. Due to the synergy between the product evolution and the product design, case histories can improve student learning in the capstone design courses. The paper presents a unique teaching approach, which backs away from the engineering achievements to the products and people behind the achievements, and then to the thought processes involved in the product design. This teaching approach exposes students to a few key engineering concepts and ties them with case histories. The paper illustrates the teaching paradigm using the case history of typewriters.

WORK IN PROGRESS: USING PROJECT DOCUMENTATION TO TEACH CREATIVE DESIGN

Marie C. Paretti, Virginia Tech

Project documentation can play an integral role in design by helping the students plan, theorize, analyze, and interpret their work; the need to communicate about their work pushes students to fully formulate project plans, understand the theories behind their work, and analyze their results more completely than they might otherwise. This project evaluates strategies for more fully integrating communication and design through studies in two senior-level design courses. Preliminary results show that while students can effectively use of writing and speaking assignments to further their projects, they need appropriate scaffolding to facilitate that process.

WORK IN PROGRESS: IMPROVING THE SENIOR CAPSTONE DESIGN EXPERIENCE THROUGH SHARED PERSPECTIVES AND BEST PRACTICES

Betsy M. Aller, Western Michigan University, Andrew A. Kline, Western Michigan University and Edmund Tsang, Western Michigan University

A recent effort to share expertise and best practices in teaching senior capstone design has led to a consortium of engineering faculty involved with the senior capstone experience. This group seeks to better understand the possible approaches to teaching design, while drawing on each others knowledge in specific skill areas. Common goals are to move toward multi-disciplinary design project opportunities and to reduce redundancy of teaching common topics. Toward that end, lectures on a variety of professional engineering topics are being developed and will be shared across the College of Engineering, beginning fall 2004. Because the capstone design sequence is increasingly the site of ABET accreditation documentation, an additional focus of this group is to support and enhance assessment activities in capstone design by sharing assessment / evaluation rubrics and best practices.

THE IMPACT OF VERTICAL INTEGRATION OF DESIGN TEAMS ON THE CHEMICAL ENGINEERING PROGRAM

Sandra Spickard-Prettyman, University of Akron, Helen Qammar, University of Akron, Francis Broadway, University of Akron, H Micheal Cheung, University of Akron and Edward Evans, University of Akron

For the last five years, the Department of Chemical Engineering at The University of Akron has implemented a Vertically Integrated Team Design Project (VITDP) involving our department s entire undergraduate student population. Teams, consisting of freshman through seniors, work together with an industrial or faculty mentor to solve an open-ended

design problem over a five-seven week period during the Fall semester. Each project is designed to require positive interdependency between the team members, thus creating an instructional framework where students learn through teaming rather than group work. All freshmen learn what chemical engineering is about, sophomores enhance their learning in process economics, juniors and seniors improve their proficiency with process simulation, and seniors make major improvements in their ability to lead or guide other people. When the design project introduces a concept or topic that has not been fully integrated into the curriculum, all students, including those who prefer to work alone, effectively increase their knowledge of that topic. The vertically integrated team structure provides a way to learn information in context, which has a particularly strong effect on women in the program. Overall, the VITDP has a positive impact on the chemical engineering program.

Session T2H: Computer Science Education 1

Chair: Francesco Colace, Università degli Studi di Salerno
Time and place: Thursday, October 21, 10:30 a.m. - Noon *Verelst*

WORK IN PROGRESS - TEACHING NUMERICAL COMPUTING WITH MATLAB
Cleve Moler, The

Numerical Computing with MATLAB is a new textbook for an introductory course in numerical methods, MATLAB, and technical computing.

WORK IN PROGRESS: PROGRAMMING KNOWLEDGE DOES IT AFFECT SUCCESS IN THE COURSE INTRODUCTION TO COMPUTER SCIENCE USING JAVA
Jeffrey S. Rosenschein, The Hebrew University of Jerusalem, Tamar Vilner, The Open University of Israel and Ela Zur, The Open University of Israel

AAt the Hebrew University of Jerusalem, the course "Introduction to Computer Science" (CS1) is taught using the programming language Java. In Israeli secondary schools, Computer Science is not a required subject, but those who do study it learn a procedural programming language at an advanced level. Some students who study Computer Science at the university level have thus previously been exposed to the field. Our research examined whether prior knowledge of programming languages contributed to the success of students in their first university programming course. The research included an examination of the correlation between prior knowledge and their success in the course. We queried students both about their familiarity with various programming languages, as well as about a variety of programming concepts. A partial analysis of the results shows that there is a positive correlation between having previously learned procedural languages (such as Pascal and C) and success in the course.

NEW CHALLENGES IN TEACHING INTRODUCTORY PROGRAMMING COURSES: A CASE STUDY
Isabel Huet, University of Aveiro, Osvaldo Rocha Pacheco, University of Aveiro, José Tavares, University of Aveiro and George R. S. Weir, University of Strathclyde

The Department of Educational Sciences and the Department of Electronic & Telecommunications at the University of Aveiro (Portugal) have been working together with the Department of Computer & Information Sciences at the University of Strathclyde (UK), with the aim of improving the teaching quality of introductory programming courses and, indirectly, the academic success of their students. Over the past two years, data has been collected through interviews and questionnaires, to better understand the organization of the different courses and approaches to teaching. The present paper discusses how the organization of introductory programming courses in each institution reflects the teaching philosophy of the members of staff and also how course organization and teaching strategy relate to the students attitudes to learning and their motivation for course involvement.

INCORPORATING HCI INTO THE UNDERGRADUATE CURRICULUM: BLOOM S TAXONOMY MEETS THE CC 01 CURRICULAR GUIDELINES
Bill Manaris, College of Charleston and Renée McCauley, College of Charleston

This paper presents an outline for an upper-level Human-Computer Interaction (HCI) course. This work is being carried out in the context of an NSF-sponsored effort by 26 CS educators to incorporate HCI into the undergraduate CS curriculum. This paper presents an overview of existing approaches for incorporating HCI in the undergraduate curriculum, including several standard textbooks. It briefly discusses the perceived gap between the interests of the HCI community and the needs of CS educators. It then proceeds to address this issue by presenting one possible implementation of the CC 01 HCI curricular guidelines. This implementation includes a semester-long course outline, project ideas and consider-

ations, and, most importantly, measurable course objectives based on Bloom s taxonomy. Finally, it includes pointers for additional, forthcoming implementations of the CC 01 HCI curricular guidelines.

INCREASING THE PROBABILITY OF SUCCESS IN THE FIRST COMPUTER SCIENCE COURSE

Faye Tadayon-Navabi, Arizona State University, Mary R. Anderson-Rowland, Arizona State University, James S. Collofello, Arizona State University and Debra L. Banks, Arizona State University

It is well known that many students struggle and eventually are unsuccessful in their attempt to complete their first computer science course. At Arizona State University, the first course taken by computer science majors and a few other majors is CSE 110. CSE110 teaches first year college students basic programming principles using the Java programming language. In order to do well in this course, students need to not only have a background in basic logical thinking, but also need to know basics about using computers along with internet and File Transfer Protocol. To address this problem, a CSE110 workshop has been designed for incoming freshmen who have little or no background in computers. This paper defines the content and instruction of this workshop as well as an assessment of its effectiveness. To help ensure that future freshmen are better prepared, software development curriculum materials are being developed for use at the high school level. Two summer teacher workshops have already been held and a third is planned.

Session T3A: Interactive Session: Feminist Frontiers

Chair: Susan Lord, University of San Diego

Time and place: Thursday, October 21, 3:00 p.m. - 5:00 p.m. *Chatham*

INTERACTIVE SESSION - FEMINIST FRONTIERS

Susan M. Lord, University of San Diego, Elizabeth A. Eschenbach, Humboldt State University, Alisha A. Waller, Georgia State University and Eileen Cashman, Humboldt State University

This interactive session explores the feminist frontiers of science, technology, engineering, and mathematics education. The goals of the session are 1) to assist participants in developing their definitions of feminism; 2) to assist participants in developing their definitions of feminist pedagogy; and 3) to encourage participants to begin to explore specific ways to implement feminist pedagogy in their classrooms and ways it may be useful to engineering education. The session will be of interest to faculty who are interested in new pedagogical methods and/or increasing diversity in their classrooms. Together we will consider our current understanding of feminism and review scholarly distinctions between types of feminism. Then we will explore the tenets of feminist pedagogy and how it is implemented in the classroom. Finally, we will discuss how engineering education can benefit from feminist pedagogy. Examples and resources will be shared with participants to make the ideas more concrete.

Session T3B: Interactive Session: The NSF Broader Impacts Criterion -- Why and How

Chair: Roger K. Seals, National Science Foundation

Time and place: Thursday, October 21, 3:00 p.m. - 5:00 p.m. *Savannah*

INTERACTIVE SESSION - THE NSF BROADER IMPACTS CRITERION-WHY AND HOW

Sue C Kemnitzer, National Science Foundation, Roger K. Seals, National Science Foundation and Krishna Vedula, National Science Foundation

The goal of the interactive session is to engage the audiences in an interactive manner to enable them develop a better understanding of the broader impact criterion of the National Science Foundation s Review Criteria and, therefore, prepare proposals that are more responsive to this particular criterion. Specific and individual attention will be given to the following five principal elements of the criterion. • The advance of discovery and understanding. • Improvement of the participation of underrepresented groups. • Enhancement of the education/research infrastructure. • Broad dissemination of results. • Benefits of the activity to society at large. After brief introductory remarks, participants will generate ideas and activities that can be incorporated into their proposals, which are responsive to each of the listed elements. Following each of the participants efforts, NSF Program Officers will comment on the proposed ideas/activities as well as provide examples of exemplary practices. Suggestions will be placed in the context of the specific program or program track. The session will be devoted to an interactive exploration of the five elements noted above.

Session T3C: Laboratories: Distance Learning Options

Chair: Sheng-Jen Hsieh, Texas A&M University

Time and place: Thursday, October 21, 3:00 p.m. - 5:00 p.m. *Waterfront North*

ON-LINE LABORATORIES FOR UNDERGRADUATE DISTANCE ENGINEERING STUDENTS

John L Watson, University of North Dakota, George Bibel, University of North Dakota, Kenneth Ebeling, North Dakota State University, John Erjavec, University of North Dakota, Hossein Salehfar, University of North Dakota and Marcellin Zahui, University of North Dakota

Undergraduate students enrolled in the accredited Distance Engineering Degree Program at the University of North Dakota (UND) are required to spend up to three weeks each summer on the UND campus taking condensed engineering laboratories. This imposes a significant financial and social burden on the students, who are typically married with families and full-time jobs. To reduce this time on campus, a three-year project funded by the Department of Educations FIPSE program was initiated in 2002 to design several 50% on-line laboratory courses. The on-line assignments that have been developed include simulations (packaged and developed programs), and real time operation of equipment located in UND and North Dakota State University (NDSU) engineering laboratories. Simulations include process analysis, electrical circuit analysis, materials selection, and programmable logic control. Real time assignments detailed in the paper include process dynamics and control, electrical circuit analysis, steam turbine electricity generation, vibration analysis and programmable logic control.

TEACHING INFORMATION WARFARE WITH LAB EXPERIMENTS VIA THE INTERNET

Doug Jacobson, Iowa State University

Iowa State University has offered a course in information warfare for the past 8 years to both on campus and off campus students via streaming media. The class looks at computer security from an attack/defend view point. We study attacks and look at methods to stop the attacks. The course has several lab experiments where student will try out attack tools and defense mechanisms. Both on-campus and off-campus students access the lab via the internet which creates a unique set of challenges of trying to keep the attacks off the internet.. The largest lab experiment is where the students are given the web site address to a company that was designed for the experiment. They are to break into the company and gather as much information as they can about the company and its employees. The students must submit a report where they document every step they took to break-in and then develop a plan to fix the problems.

INFORMATION ECONOMY AND EDUCATIONAL OPPORTUNITIES: A LATENT VARIABLE MODEL OF LEARNING SKILLS

Zoë Georganta, University of Macedonia and David Warner Hewitt, Educational Consultant

As internet economic forces are transforming traditional companies and jobs, colleges are attempting to foster in their students transferable skills that will improve their chances in the digital workplace, where employers look for potential employees not only possessing technical expertise, but who are also capable of and personally responsible for continually refreshing their knowledge base to keep pace with rapid technical change. In this paper a latent variable model is constructed to analyze the direct and indirect relationships between learning skills, educational performance, collaboration, family environment and personal stress of sophomores in applied informatics, economic and business sciences. While the obtained maximum likelihood estimates show significant dependencies between collaboration and learning, they strongly reveal a non-skill oriented educational system. It seems to reward lack of learning skills with success. This work underlines an urgent need to reform the curricula and the fundamental teaching and grading methodologies.

WORK IN PROGRESS - VIRTUAL LABORATORY WITH A REMOTE CONTROL INSTRUMENTATION COMPONENT

Carmen Ciubotariu, University of Calgary, Alberta, Canada and Garwin Hancock, University of Calgary

The virtual laboratory of the Department of Electrical and Computer Engineering of the University of Calgary comprises all laboratory components of the department, with two locations already developed for long distance education: a remotely controlled instrumentation laboratory, SelfLab@Home, and a digital design experiments collection where the operation of the basic digital circuits is simulated with html applets. The students are invited to take a virtual visit of the laboratory rooms in which they will perform course required experiments in order to easier locate the devices to be used as well as operate them appropriately. The main objective of SelfLab@Home was to become a self-paced remotely accessed training site for the use of four basic laboratory devices: oscilloscope, waveform generator, DMM and a power supply. The digital devices experiments demonstrate the logic operation of digital circuits and a remotely controlled traffic light with its computer visual interface application.

WORK IN PROGRESS - A DISTANCE LABORATORY SYSTEM USING AGILENT TEST EQUIPMENT

Tom Eppes, University and Peter Schuyler, University of Hartford

The authors have developed an internet accessible distance laboratory system that employs Agilent test and measurement equipment. The system is called ALTE (Automated Laboratory Test Environment) and will be pilot-tested in Fall 2004. Instructors and students within the Electronic and Computer Technology (ECT) Department will begin using ALTE to remotely conduct experiments over the Internet. Access is 24x7, and the system supports multiple users on the same lab station. ALTE s architecture consists of a management server that provides access control as well as managing the course/ experiment database. The management server interfaces to any number of lab stations. Each lab station consists of a dedicated PC that uses LabView s virtual instrument interface to send commands and retrieve data from active Agilent test equipment. A typical lab station consists of a networked-PC that is GPIB interfaced to an Agilent programmable DC power supply, Arbitrary Waveform Generator, Digital Multimeter and Mixed-Signal Oscilloscope.

WORK IN PROGRESS - VIRTUAL LAB FOR ELECTRONIC ENGINEERING CURRICULA

Francesco Colace, Università degli Studi di Salerno, Massimo De Santo, University of Salerno and Antonio Pietrosanto, Università degli Studi di Salerno

During last years the interest on distance learning techniques has grown steadily as far as the use of electronic instruments in experimentation is concerned. Due to the higher and higher number of students accessing the university educational structures, the cost of laboratories for didactical electronic applications is going to be very high. As a consequence, a number of software tools and environments have been developed to help users to share distributed laboratory resources and realize virtual experiments. Nevertheless, further solutions have to be explored when students must be trained and experienced in the instrumentation programming. In this paper, we exploit modern software technologies to design and implement a distributed architecture for virtual labs allowing the approach previously described. Services integrated in this architecture aim to support students both to keep contact with real instruments both to remotely program instrumentation. This distance learning methodology is discussed and some reports from students experience with the system are showed

Session T3D: Internationalization Projects

Chair: Manuel Castro, Universidad Nacional de Educación a Distancia

Time and place: Thursday, October 21, 3:00 p.m. - 5:00 p.m. *Waterfront South*

THE DEVELOPMENT OF A SUMMER STUDY ABROAD PROGRAM FOR ENGINEERING AND COMPUTER SCIENCE STUDENTS AT BAYLOR UNIVERSITY

Cynthia C. Fry, Baylor University

The Baylor In Maastricht (BIM) Summer Study Abroad Program is a 41-day study abroad program in the Netherlands. Baylor In Maastricht is a summer program that is sponsored by the School of Engineering and Science of Baylor University in Waco, Texas, in conjunction with the Universiteit Maastricht, in the Netherlands. The program gives engineering and computer science students an opportunity to take two Baylor courses (six hours), while also providing an abroad experience in the heart of Europe. It also answers the charge given four years ago by the Dean of the School of Engineering and Computer Science to get our students out of the building! This paper will discuss the goals and objectives of such a program, and will chronicle the design, development, and execution of the resulting study abroad program. We will explore, in depth, the number and type of participants, the details of trip planning and organization, the decision on which courses to offer, planned weekend group trips, the facilities and support of the Universiteit Maastricht, and accommodations. This paper will also discuss the execution of the first two study abroad programs to Maastricht, the Netherlands what worked, what didn t work, what was good, where we have improved. A summary of the student evaluations from the program is included.

WORK IN PROGRESS: MULTIDISCIPLINARY ENGINEERING PROJECT ABROAD

Pilar Moyano, Union College and Cherrice Traver, Union College

The convergence of scientific and engineering disciplines in current applications requires engineers to have multidisciplinary teamwork skills. This paper describes an international experience that brought together students in engineering, science, social science and the humanities to work on a project that requires technical, foreign language, and research skills. The focus of the experience was to have students work in multidisciplinary teams to develop a chronological map of the city of Córdoba, Spain. They used a Geographical Information System (GIS) application to develop the map layers, and they constructed web pages that are linked to the map. This paper summarizes experiences from the first offering in the summer of 2003. We also present planned improvements for the evaluation of the next offering in December, 2004.

WORK IN PROGRESS - INTEGRATING INTERNATIONAL COMPETENCE INTO BACCALAUREATE DEGREES

Jack R. Lohmann, Georgia Institute of Technology and Howard A. Rollins, Georgia Institute of Technology

Globalization is a fact of life. As such, U.S. universities have made concerted efforts to infuse international components into their educational programs. Despite these efforts, one-tenth of U.S. undergraduates participate in an international academic experience and only one-tenth of those are majors in the physical sciences, computer sciences, mathematics, and engineering. The problem is that U.S. universities have yet to combine all of the critical components of a meaningful international education into coherent, cost-effective programs that prepare large numbers of students to apply their disciplinary knowledge in a global context. To address this problem, Georgia Tech is developing a program that integrates international competence into disciplinary curricula, especially the highly sequenced curricula in technical fields, and that can be delivered on a large scale without undue burden to the students or institution.

ANALYZING THE PROBLEMS OF THE IMPLEMENTATION OF THE EUROPEAN CREDIT TRANSFER SYSTEM IN A TECHNICAL UNIVERSITY

Edmundo Tovar, Universidad Politécnica de Madrid

The creation process of the European Higher Education is not possible without a common qualification framework to accommodate the huge diversity of European educational awards. This framework should establish a consensus about credits, levels, selected generic types of qualifications, and should allow a full recognition, and a real transparency between the education systems. The European Credit Transfer System, ECTS, has been designed to facilitate the transfer of educational credits between institutions in European countries and in particular to enhance the quality of student mobility. The key features of the ECTS contrast occasionally with the traditional way of measuring the size and effort involved in the courses of a determined country. This is the case of Spain where credits were based on the number of hours spent in class on a course, whereas the ECTS is centered on the student workload required to achieve the objectives of a program. Here, the objectives are preferably specified in terms of learning outcomes. The process of converting from the unit system to the ECTS is not trivial because it has repercussions on the work of the student in relation to such issues as the number of hours in class, the preparation that students need before and after the class, the work done independently by the student or the professor s method of teaching. This paper presents the results and lessons learned as a consequence of the work carried out by a network of all the universities of Madrid which offer a degree in Computer Engineering, in the context of an experimental pilot project initiated by Madrid s public administration.

WORK IN PROGRESS - FISHING ENGINEERING EDUCATION IN THE AGE OF INTERNATIONALIZATION LEARNING

Claudio da Rocha Brito, COPEC - Council of Reseaches in Education and Sciencesr and Melany M. Ciampi, COPEC

Science has developed itself in a kind of knowledge fragmentation, generating the super specialties, divorced from the global context that they are part, atrophying the ability of integrating and evaluating the issue in its context. The New World order demands a new kind of professional, capable to think global without loosing the dimension of local and vice-versa. With the goal to defeat this challenge the Engineering Coordinating Team of Council of Researches in Education and Sciences in Brazil has conceived a different kind of approach to a Fishing Engineering Program. It includes in the program what is called “Tapé-Apó” , which are extra classes of peculiar areas of human knowledge, specially selected to make the students to develop their abilities of applying their skills in the global context with success. They are engineers with solid theoretical knowledge of management, economy and law and possessing great engineering bases.

THE POLIPARA TODOS PROGRAM

Itana Stiubiener, UNIVERSIDADE DE SÃO PAULO, Ian Korolkovas, Escola Politécnica da Universidade de São Paulo, Luiz Fernando de Biase, Universidade de São Paulo, Sérgio Rodrigo, Escola Polit´cnica da universidade de São Paulo, Regina Melo Silveira, Universidade de São Paulo, Tereza Cristina Melo de Brito Carvalho, Universidade de São Paulo and Wilson Vicente Ruggiero, Universidade de São Paulo

Nowadays information concentration is one of the most cruel ways of exclusion in the world. People who don t have information access are more and more away from the modern world. And not only information is important but also knowledge and how to use and profit from this knowledge. This paper presents the Poli Para Todos program that is opening and offering, for free, all the content of undergraduate courses of Escola Politécnica da Universidade de São Paulo.

Session T3E: Innovative Curricula & Programs

Chair: Larry Richards, University of Virginia

Time and place: Thursday, October 21, 3:00 p.m. - 5:00 p.m. *Sloane*

EDUCATIONAL DESIGN, EVALUATION, & DEVELOPMENT OF PLATFORMS FOR LEARNING

Tom Thompson, Oregon State University, Donald Heer, Oregon State University, Shane Brown, Oregon State University, Roger Traylor, Oregon State University and Terri S. Fiez, Oregon State University

Systemic reform in undergraduate engineering education is critical to improving student ability and understanding. Electrical Engineering and Computer Science at Oregon State University has worked in collaboration with university science and math education researchers to implement large-scale curriculum reform based on a platform for learning . To successfully approach such a large systemic problem and introduce major education reform, an approach called design research has been used. Design research involves a team of education designers that manage a series of iterative cycles of design, implementation, and evaluation. Each cycle provides the empirical evidence needed to improve instruction, and refine the education theory related to platforms for learning. The design research process has brought a much richer and expansive understanding of the platforms for learning concept and engineering education in general. In part concepts like cross-cutting competencies (which include enhancing community building, student innovation and design skills, depth, breadth and professionalism), educational hardware design, and horizontal and vertical inter-class connections have been better understood through the research. This paper summarizes the design research process as it is used at OSU to reform engineering education. Findings specific to a platform for learning and generally applicable to engineering education are discussed. Finally, implementation changes that resulted from the design research process are presented.

WORK IN PROGRESS: ESTABLISHING FORMAL ACADEMIC PROGRAMS IN ENGINEERING EDUCATION

Heidi Diefes-Dux, Purdue University, Deborah Follman, Purdue University, Kamyar Haghighi, Purdue University, P. K. Imbrie, Purdue University, Robert Montgomery, Purdue University, William Oakes, Purdue University and Phillip Wankat, Purdue University

The national need for engineering education reform is widely recognized. Long-term and sustainable engineering education reform requires a pipeline for educating future engineering faculty and professionals interested in pursuing careers in K-12 teaching and administration. Purdue University is evaluating the development of a new framework for promoting engineering education reform. As part of this framework, new undergraduate and graduate degree programs in engineering education (B.S., M.S., and Ph.D.) are being considered. We will present for discussion a vision to legitimize, institutionalize, and advance the establishment of formal academic programs in engineering education and provide descriptions of the proposed programs, program coursework, admissions criteria, and anticipated job opportunities for graduates of such programs.

INFORMATION TECHNOLOGY MEDIATED EDUCATION REVOLUTION NOT EVOLUTION

Tom Lookabaugh, University of Colorado and Douglas C. Sicker, University of Colorado

Information technology, and in particular distance education technology, is becoming more prevalent across society and throughout higher education. But as information technology mediated education moves from trials towards educating non-trivial numbers of students, we can expect established universities to resist wholesale adoption; particularly when it threatens core perceptions of what students want and need and the culture and financial model of the institution. The resulting increasing tension creates the potential for sudden and dramatic shifts rather than gradual adoption. Applications and practices that can signal the maturation of information technology mediated education include course importation and remote laboratory experiences. For institutions, successful development of information technology mediated education may require autonomous units. For individuals, the decision revolves around whether to participate and, if so, in what manner, particularly given academic culture and the potential for institutional resistance.

ENGINEERING A MATHEMATICS COURSE AT THE UNITED STATES MILITARY ACADEMY

Keith A. Landry, United States Military Academy and Kip P. Nygren, U.S. Military Academy

Civil & mechanical engineering majors at West Point must complete a five semester mathematics sequence as part of their Accreditation Board for Engineering and Technology accredited academic program. Given the increased interest in multidisciplinary team teaching and the use of technology within their respective academic programs, the Heads of the Departments of Civil & Mechanical Engineering and Mathematical Sciences decided to re-examine the content, structure and teaching of the last course in that five course sequence - MA364 Engineering Mathematics - in an attempt to better motivate engineering majors to study key mathematical concepts in detail and to further strengthen inter-departmental ties.

This paper describes the two-pronged approach adopted to engineer the mathematics course in question. Particular attention is given to the integration of technology across the course and the planned use of a team teaching approach involving engineering and mathematics faculty.

DEVELOPING RECRUITMENT AND RETENTION STRATEGIES THROUGH "DESIGN4PRACTICE" CURRICULUM ENHANCEMENTS

John T. Tester, Northern Arizona University, David Scott, Northern Arizona University, Jerry Hatfield, Northern Arizona University, Rand Decker, Northern Arizona University and Fonda Swimmer, Northern Arizona University

Northern Arizona University s (NAU) College of Engineering and Technology (CET) has an energetic program to identify pre-degree student populations, bring educational resources to these populations to enable recruitment into the NAU CET learning environment, and retain these students throughout the CET degree programs through graduation. The program, the Engineering Talent Pipeline, builds upon the student-oriented Multicultural Engineering Program (MEP) and the Design4Practice (D4P) design curriculum. A study was undertaken to understand successful recruitment and retention efforts of other universities, in order to apply the best practices to the D4P curriculum. This paper will primarily address the information gathered from best practices research that lead to our current D4P curriculum enhancement efforts. The D4P courses provide all engineering majors with interdisciplinary, team-based design projects throughout their four-year program. Also determined were evaluation metrics that demonstrate improvement in recruitment and retention; these metrics were considered for integration into the assessment reports associated with the future curriculum enhancements. We present our findings of the above activities and preliminary strategies for enhancing those D4P courses which most impact our recruitment and retention: The freshman and sophomore design courses.

WORK IN PROGRESS - CREATING AN ONLINE MANAGEMENT DEGREE IN CONCERT WITH A TECHNICAL DEGREE

Michael L. Nelson, International College

As a small and relatively young private college, the creation of a graduate program is a major step forward. Our undergraduate degree is technical in nature, but marketing analysis indicated a large demand for a graduate IT management degree. We attempted to get double-duty out of a single degree by offering both technical and managerial courses. That worked great for those with a technical background, but students with other backgrounds found the additional undergraduate preparatory course requirements to be rather daunting. As such, we used the management portion of the technical degree to create a management degree. Also, it has been our experience that management courses often work well in an online environment, whereas technical courses generally work better in a more conventional environment. Therefore, the new management degree is also available all online.

Session T3F: Educational Research 2

Chair: Matt Ohland, Clemson University

Time and place: Thursday, October 21, 3:00 p.m. - 5:00 p.m. *Vernon*

WORK IN PROGRESS UTILIZING ASSESSMENT AS A MEANS TO INCREASED LEARNING AWARENESS

Tristan T. Utschig, Lewis-Clark State College

A student-centered classroom is enhanced when students are more aware of learning goals they are pursuing and learning outcomes expected of them. Assessment is an effective means of increasing student learning awareness. When the goals of the assessment are tailored appropriately, students learn to focus quickly on aspects of their learning and how to present evidence of that learning. Simultaneously, students learn to recognize their strengths and weaknesses as learners, thus providing opportunity for accelerated growth. This work in progress describes how the Strength, Areas for Improvement, and Insights (SII) style of assessment has been implemented into one introductory engineering and one calculus-based physics course. Consistent with the SII spirit, strengths, areas for improvement, and insights gained from the implementation of this technique are discussed. Preliminary results from a survey utilized for one semester in each of the two classes are also introduced.

WORK IN PROGRESS: A CONCEPT INVENTORY FOR HEAT TRANSFER

Anthony Jacobi, University of Illinois, Jay Martin, University of Wisconsin-Madison, John Mitchell, University of Wisconsin and Ty Newell, University of Illinois

A concept inventory has been developed for heat transfer, which is typically taken in the junior or senior year in mechanical engineering. The subject builds on material previously introduced in thermodynamics and fluid mechanics, and

the concepts in these subjects are intertwined. The course has been given as a pretest in one course. An item analysis of the inventory has been made to assess the validity of the inventory, showing that further work needs to be done. The inventory will be given as a posttest and then modifications to the inventory will be made. The current draft inventory is available for testing and evaluating.

EFFECT OF HYPERMEDIA DISPLAY INTERFACES IN FACILITATING ACHIEVEMENT OF LEARNING OBJECTIVES

Wei-Fan Chen, The Pennsylvania State University

This experimental study was designed to compare three different types of hypermedia display interfaces in hypermedia design. They are (1) browser-scroll, (2) frame-based, and (3) popup-window interfaces. This study also investigated the potential interaction between the interface and students' prior knowledge, since prior knowledge has long been considered an important learning variable for acquiring new information. 145 undergraduate students participated in the study. A statistical multivariate analysis of variance (MANOVA) was performed to analyze collected data. Results showed significant main effects of the independent variables in all the criterion tests except for the treatment effect on the comprehension test.

USING ONLINE TUTORS FOR LEARNING WHAT DO STUDENTS THINK?

Amruth N Kumar, Ramapo College of New Jersey

Educators and researchers in various disciplines are developing online tutors to help students learn. Such tutors often promote active learning and problem-based learning. They facilitate individualized learning and provide instant feedback. What do students think about their experience using such online tutors? Do they think that the tutors help them learn? Do their opinions reflect their experience using the tutors? Do they feel favorably about using online tutors? In this paper, we will attempt to answer these questions based on our evaluations of two tutors that we have developed for programming topics. We believe that our results will be of interest to developers of online tutors who are interested in the affective learning of their students.

WORK IN PROGRESS USING BLOOM S TAXONOMY AS A FORMAT FOR SELF-EVALUATION OF DESIGN EDUCATION ACTIVITIES

Tokio Abe, Akita Keizai Houka University and Patrick J. Starr, University of Minnesota

We have developed a take-apart exercise for beginning engineering students where the Design Process is used as a format to structure and interpret the take-apart activity. The approach has been tested many times with favorable responses from students, but we still wonder whether design skills are being developed. We explored the taxonomy of educational objectives, originally published by Bloom in 1956 and revised in 2001, as a means of identifying the knowledge and cognitive dimensions of our exercises, and further to express design skills in terms of learning objectives. This Work in Progress describes how we as typical design educators, applied the taxonomy of educational objectives to one phase of the take-apart exercises.

GATHERING AND TIMELY USE OF FEEDBACK FROM INDIVIDUALIZED ON-LINE WORK

Matthew Hall, Michigan State University, Joyce Parker, Michigan State University, Berhouz Minaei-Bigdoli, Michigan State University, Guy Albertelli, Michigan State University, Gerd Kortemeyer, Michigan State University and Edwin Kashy, Michigan State University

Technology has enabled instructors to efficiently create and distribute a wide variety of educational materials, assignments, assessments, etc. These include numerous types of formative conceptual and algorithmic exercises for which prompt feedback and assistance can be provided to students as they work on assigned tasks. At the same time, the technology records and dynamically organizes a vast amount of information on students' interaction with and understanding of these materials. We present recent developments that allow rapid interpretation of such data in identifying students' misconceptions and other areas of difficulty, so that concurrent or timely corrective action can be taken. This information also facilitates detailed studies of the educational resources used and can lead to redesign of both the materials and the course.

Session T3G: Assessment and Accreditation Issues

Chair: Edwin Jones, Iowa State University

Time and place: Thursday, October 21, 3:00 p.m. - 5:00 p.m. *Percival*

WORK IN PROGRESS PREPARING FOR TC2K ON A LARGE SCALE

Dhaneshwar Lall, Penn State, John Wise, The Pennsylvania State University and Dhushy Sathianathan, Penn State

Preparation for compliance with TC2K for ABET accreditation is being carried out at twelve campuses which offer one or more of nine different engineering technology programs. A system-wide continuous quality improvement plan is in place. It includes the courses restructuring to reflect meeting the TC2K criteria, providing feedback for faculty members, and for assessing the way in which the educational objectives, program outcomes, and learning outcomes are being met. In order to facilitate the effectiveness of learning outcomes several short surveys were developed for some programs while others are in the process of development. These targeted student performance, faculty perception, and student perception regarding learning outcomes in each specific program and course. Complementary to these were exit surveys, alumni and employee surveys that strive to provide information about programs. Currently, data collection is in progress using these surveys in order to judge their effectiveness with plans to offer them online and automated to a database.

FACULTY GOVERNANCE EMBRACES OUTCOMES ASSESSMENT

Lance Schachterle, WPI

Outcomes assessment of student learning typically originates with academic administrations, because they have the resources for gathering and analyzing data and usually are responsible for preparing for accreditation visits. However, for such assessment to be really effective as well as sustained, faculty buy-in is crucial. This paper describes four steps which led to responsibility at WPI for undergraduate outcomes assessment being shifted from the administration only to the faculty as well. The paper provides background on each of these steps to help other institutions in normalizing assessment work within the faculty/administrative nexus, and discusses the work to date of the faculty subcommittee formed to oversee outcomes assessment.

MINIMIZING THE PAIN AND MAXIMIZING THE GAIN OF ASSESSMENT

Deborah Mechtel, United States Naval Academy and Robert Voigt, United States Naval Academy

This paper presents a snap shot of the evolving, flexible assessment process used in the Electrical Engineering Department at the United States Naval Academy. The assessment process was initiated to meet the new accreditation requirements for engineering programs required by the Accreditation Board for Engineering and Technology (ABET). To circumvent becoming process centered and maintain faculty support, efforts are continuously focused on program improvement. To simplify the implementation of the assessment process, ideas were borrowed from other programs and workshops and modified to fit the department s mission and culture. When the assessment process didn t clearly return results that supported program improvement, it was modified. This paper will describe the optimization of the assessment process, including faculty buy-in, document creation and process efficiency. Key course and program level assessment tools are included and their use justified.

ASSESSMENT OF CAC SELF-STUDY REPORT

Curtis Cook, Oregon State University, Pankaj Mathur, Oregon State University and Marcello Visconti, Universidad Tecnica Federico Santa Maria

In 2000, the Accreditation Board for Engineering and Technology, Inc. (ABET) changed the way computer science (and engineering) programs are accredited from a checklist approach to an outcomes-based approach. While this approach gives more freedom to the program to establish its own set of objectives, it has also created considerable anxiety among people who are responsible for preparing their programs for accreditation. The Self-Study Report which plays an important role in the ABET accreditation process, describes how the computer science program satisfies the statement of intent and standards of the accreditation criteria. However, preparation of the Report has become more difficult with the change to an outcomes-based approach. We have developed model of an ideal program based on CAC guidelines and standards and a tool that assesses the thoroughness and completeness of the Report compared to the model. Programs seeking accreditation can use the tool to get information on any deficiencies prior to submitting the Report to the evaluation team.

DESIGNING AN ABET ACCREDITATABLE COMPUTER SCIENCE BACHELOR S PROGRAM WITHIN THE CONSTRAINTS OF A TEACHING UNIVERSITY

Carol Wellington, Shippensburg University

The Computer Science Department of Shippensburg University has recently embarked on the pursuit of ABET Accreditation. While our existing curriculum was supported by the ACM Curriculum Guidelines, our assessment tools were insufficient for accreditation. In addition, since Shippensburg is a small teaching school, accreditation poses some significant logistical issues in the areas of teaching load and faculty development. As a result, we completely re-designed the structure of our program to meet these challenges. Our goal was a program where all of our students learn traditional computer sci-

ence topics and basic software engineering principles and where they are allowed the opportunity to specialize in areas like software engineering, computer graphics, and real-time systems. Our required teaching load is 24 credits per year which makes professional development difficult. We significantly modified the structure of the program to allow each of our faculty members to teach no more than three courses and two preparations in a semester. This paper outlines the challenges, the process we used to address those challenges, and the resulting curriculum and assessment plan.

APPLYING LESSONS LEARNED FROM SOFTWARE PROCESS ASSESSMENTS TO ABET ACCREDITATION
James Collofello, Arizona State University

The Software Engineering Institute Capability Maturity Model (CMM) has been widely utilized in the software development community as a means of assessing the maturity of a software development organization and providing a framework for improvement. ABET 2000 is also now being utilizing as a means for assessing engineering education programs and providing a framework for improvement. In addition to sharing the same general objectives of assessment and process improvement there are other similarities in both approaches and their application within organizations and universities respectively. Due to these similarities academic organizations embarking on ABET accreditation activities can learn from the numerous lessons from organizations which have undergone CMM activities. This approach was followed at Arizona State University. Since several ASU faculty have been heavily involved in CMM activities over the last decade, it was easy for them to recognize the similarities between accreditation and CMM assessment. They utilized their knowledge of lessons learned from CMM assessments and integrated them into the ASU accreditation effort. The results of this activity are described in this paper. The paper begins with a discussion of the similarities of CMM and ABET. Both technical and non-technical similarities such as the impact of employee / faculty buy-in and management / administrative support will be addressed. A review of lessons learned from organizations engaging in CMM activities will then be presented in the context of how they might help academic organizations in their ABET activities and how ASU applied each lesson.

Session T3H: Computer Science Education 2

Chair: David R. Luginbuhl, Western Carolina University
Time and place: Thursday, October 21, 3:00 p.m. - 5:00 p.m. *Verelst*

WORK IN PROGRESS - PROBABILITY & STATISTICS IN COMPUTER ENGINEERING CURRICULA
Pradip K. Srimani, Clemson and Murali Varanasi, University of North Texas

The purpose of this work in progress report is to discuss the probability and statistics body of knowledge as defined in the Computer Engineering Volume to be published by IEEECS/ACM curricula series; this includes only the topics that are to be included in all the CpE programs as core topics.

MAKING A CASE FOR HCI: COMPARING MATERIALS FOR CASE-BASED TEACHING
Jacob Somervell, University of Virginia's College at Wise, C. M. Chewar, Virginia Polytechnic Institute and State University and D. Scott McCrickard, Virginia Polytechnic Institute and State University

This paper investigates case-based methods for bridging the conflicting goals of providing both topic coverage and practical experience in teaching human-computer interaction (HCI). We evaluate benefits and limitations of five types of case materials--contemporary articles, professionally prepared cases, familiar interfaces, ongoing development projects, and incomplete information (jigsaw)--to probe how they should be structured and approached by an HCI instructor. Through an experience that assessed case-based activities in an undergraduate HCI course, we determined tradeoffs relating to student participation, preparation characteristics, and short- and long-term learning outcomes. Based on our results, we can make several conclusions that should influence selection and development of materials for case-based pedagogy, and we illustrate the need for structured case creation processes that can be performed conjointly with system development efforts.

EMPOWERING STUDENTS AND BUILDING CONFIDENCE IN NOVICE PROGRAMMERS THROUGH GAUNTLET
Thomas Flowers, United States Military Academy, Curtis A. Carver, United States Military Academy and James Jackson, United States Military Academy

All freshmen at the United States Military Academy take an Information Technology Course in which they learn fundamental programming skills using Java. For novice programmers, Java s compile-time errors can be undecipherable. Instructors noted that students made the same mistakes and became frustrated trying to understand the error messages and correct their code often wasting hours of time on a simple error. Given our focus on problem solving in the course as

opposed to debugging code, we needed to new approach. Our initial premise was that we could significantly enhance the student experience and instructor workload by catching and explaining the top fifty programming errors in an pre-compiler. To empower the students, we developed a program called Gauntlet that pre-processes student source code and explains in layman s terms each of the syntax errors. Gauntlet also finds many common novice-level semantic errors that do not necessarily result in syntax errors. Gauntlet empowers students to solve their own problems.

VIEW/EDIT/COMPILE/RUN WEB-BASED PROGRAMMING ENVIRONMENT

Richard Perry, Villanova University

A web-based environment has been developed for students to perform C, Java, and shell programming. The environment runs on a Unix server, uses password authentication, and provides each student with separate project subdirectories that can not be seen by other students. Options are available to view files, edit source code, compile, run, run in debug mode, run with output plotted and displayed as a GIF image, display C preprocessor output, display generated assembly code, display optimized assembly code, and insert compiler error messages as comments into the source code. The environment is implemented using a combination of C code, perl, and shell scripts, and is freely available (open source). The source code of the environment itself can be used as examples in an advanced Unix/C programming or security course. The environment has been used successfully in both sophomore and senior-level C programming courses, a graduate Unix/C programming course (C and shell programming), and a senior/graduate computer communications security course (Java programming).

NON-COMPETITIVE PROGRAMMING CONTEST PROBLEMS AS THE BASIS FOR JUST-IN-TIME TEACHING

Owen Astrachan, Duke University

We report on the successful use of small programming assignments that augment a just-in-time approach to teaching programming, and problem solving in the first year of computer science. The emphasis in these assignments is on algorithmic problem-solving rather than on object-oriented design and programming. Students are given a terse explanation of a problem and several non-exhaustive test cases. A programmed solution uses no I/O, but is tested via a web-based submission system that reports success or failure for between 10 and 40 test cases. Students compile, test, and debug via the online web-based system. There is no limit on the number of times students can test their solutions. After submission for grading, solutions are judged solely on whether they pass tests, all of which can be seen via the online testing mechanism, and not on the so-called quality of the code submitted.

A PROGRAMMING LABORATORY FOR ELECTRONIC COMMERCE

Alfred C. Weaver, University of Virginia

With support from NSF DUE CCLI [1], we developed a programming laboratory to provide interactive experience with the tools, techniques, and principles of e-commerce. The first lab explored the wide range of web innovation, the last lab was a mock patent infringement trial, and the eleven other labs were chosen from a set of independent modules on HTML, CSS, JavaScript, Perl, CGI, regular expressions, SQL, ASP, PHP, Flash, XML, and C#. The first lab offering used weekly, three-hour physical labs; students enjoyed the material but rejected the fixed time weekly format. The next offering will transition to the course to utilize virtual labs that will better align the programming experience with the 24/7 nature of the Internet and e-commerce.

Session F1A: Interactive Session: Model-Eliciting Activities: A Framework for Posing Open-Ended Engineering Problems

Chair: Heidi Diefes-Dux, Purdue University
Time and place: Friday, October 22, 2004, 8:00 a.m. - 10:00 a.m. *Chatham*

INTERACTIVE SESSION - MODEL-ELICITING ACTIVITIES: A FRAMEWORK FOR POSING OPEN-ENDED ENGINEERING PROBLEMS

Heidi Diefes-Dux, Purdue University, Tamara Moore, Purdue University, Deborah Follman, Purdue University, Judith Zawojewski, Illinois Institute of Technology and P.K. Imbrie, Purdue University

This interactive session is for engineering and technology faculty interested in curriculum reform, real-world engineering problem-solving, addressing ABET Criteria, and empowering under-represented populations of students. Participants will take part in a Model-Eliciting Activity (MEA) group problem-solving session and learn the fundamental principles for developing a 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 map the components of a MEA to the ABET Criteria and learn how MEAs serve under-represented populations.

A FRAMEWORK FOR POSING OPEN-ENDED ENGINEERING PROBLEMS: MODEL-ELICITING ACTIVITIES

Heidi A. Diefes-Dux, Purdue University, Tamara Moore, Purdue University, Judith Zawojewski, Illinois Institute of Technology, P.K. Imbrie, Purdue University and Deborah Follman, Purdue University

Integrating more engineering contexts, introducing advanced engineering topics, addressing multiple ABET Criteria, and serving under-represented student populations in foundation engineering courses are some of the opportunities realized by the use of a new framework for developing real-world client-driven problems. These problems are called Model-Eliciting Activities (MEAs), and they are based on the models and modeling perspective developed in mathematics education. Through a NSF-HRD Gender Equity Project that has funded the development, use, and study of MEAs in undergraduate engineering courses for increasing women s interest in engineering, we have found that the MEA framework fosters significant change in the way engineering faculty think about their teaching and their students. In this paper, we will present the six principles that guide the development of an MEA, detail our motivation for using the MEA framework to construct open-ended problems, and discuss the opportunities and challenges to creating, implementing, and assessing MEAs.

DEVELOPING MODEL-ELICITING ACTIVITIES FOR UNDERGRADUATE STUDENTS BASED ON ADVANCED ENGINEERING CONTENT

Tamara Moore, Purdue University and Heidi A. Diefes-Dux, Purdue University

Are you interested in creating open-ended, client-driven, realistic engineering tasks for undergraduate students that will introduce them to the world of engineering early in their academic careers? With the support of the National Science Foundation, Model-Eliciting Activities (MEAs) were created and implemented with first-year engineering students at Purdue University. These tasks are open-ended modeling problems that introduce advanced engineering content yet are suitable for undergraduate engineering students. In this paper, we will give a personal account of the research and development of the Nano Roughness MEA. We will focus on the attainment of the six principles that guide the development of an MEA and the main development challenges: identifying aspects of an advanced engineering topic suitable for undergraduate students, making the task realistic, creating the need for team interaction, making the model reusable in similar situations, and preparing for task implementation in the classroom.

Session F1B: Interactive Session - Collaborative Partnerships: Writing in the Engineering Classroom

Chair: Sharon B. Fellows, State University of New York at Binghamton
Time and place: Friday, October 22, 2004, 8:00 a.m. - 10:00 a.m. *Savannah*

INTERACTIVE SESSION - COLLABORATIVE PARTNERSHIPS: WRITING IN THE ENGINEERING CLASSROOM (USING UNDERGRADUATE COURSE ASSISTANTS FROM THE ENGLISH DEPARTMENT TO IMPROVE WRITING SKILLS IN SCIENCE AND ENGINEERING STUDENTS)

Sharon Fellows, SUNY Binghamton, Roy T.R. McGrann, Binghamton University and Matt Laferty, Binghamton University

This interactive session will demonstrate the use of undergraduate course assistants (UCAs) from liberal arts majors, typically the English department, to promote the effective written communication skills of freshman engineering students. The session demonstrates a collaborative learning experience that will allow participants to create a similar learning experience in their classroom and/or institution. One presenter has successfully used UCAs from the English Department in the freshman engineering program for ten years. For the past three years, UCAs, under the guidance of the authors, have worked in the Materials Science course for sophomores, and the Senior Design Capstone Project. The objective of this session is to provide participants with a model and help them develop a model of their own that will improve the written communication skills of science and engineering students by incorporating the use of UCAs into the engineering classroom.

Session F1C: Software Engineering Education 1

Chair: Edmond Tovar, Universidad Politécnica de Madrid

Time and place: Friday, October 22, 2004, 8:00 a.m. - 10:00 a.m. *Waterfront North*

SIMPLE TYPE THEORY: SIMPLE STEPS TOWARDS A FORMAL SPECIFICATION

William M. Farmer, McMaster University and Martin V. Mohrenschildt, McMaster University

Engineers, particularly software engineers, need to know how to read and write precise specifications. Specifications are made precise by expressing them in a formal mathematical language. Simple type theory, also as known as higher-order logic, is an excellent educational and practical tool for creating and understanding formal specifications. It provides a better logical foundation for specification than first-order logic and is a better introductory specification language than industrial specification languages like VDM-SL and Z. For these reasons, we recommend that simple type theory be incorporated into the undergraduate engineering curriculum.

INCORPORATING TEAM SOFTWARE DEVELOPMENT AND QUALITY ASSURANCE IN SOFTWARE ENGINEERING EDUCATION

Peggy Doerschuk, Lamar University

One of the most important things that students can learn in a course in software engineering is how to effectively work in a team to develop software that is too large for a single individual to produce. It is also important that students learn the value of assuring software quality at each step of the development process. This paper describes how to incorporate a UML-based team project into an object oriented software engineering course. The project gives students hands-on experience in software development and quality assurance at each stage of the software lifecycle, including analysis, design, implementation, and integration. The project is divided into separate interacting parts, with each part assigned to a different team member. Students on each team assume alternate roles of software developer and quality assurance inspector/tester at alternate phases of the lifecycle. This paper describes the approach and an example project, including the problem requirements, timetable of deliverables, and sample deliverables.

SECURITY TESTING IN SOFTWARE ENGINEERING COURSES

Andy Ju An Wang, Southern Polytechnic State University

Writing secure code is at the heart of computing security. Unfortunately traditional software engineering textbooks failed to provide adequate methods and techniques for students and software engineers to bring security engineering approaches to software development process generating secure software as well as correct software. This paper argues that a security testing phase should be added to software development process with systematic approach to generating and conducting destructive security test sets following a complete coverage principle. Software engineers must have formal training on writing secure code. The security testing tasks include penetrating and destructive tests that are different from functional testing tasks currently covered in software engineering textbooks. Systematic security testing approaches should be seamlessly incorporated into software engineering curricula and software development process. Moreover, component-based development and formal methods could be useful to produce secure code, as well as automatic security checking tools. Some experience of applying security testing principles in our software engineering course teaching is reported.

TECHNIQUES FOR PROVIDING SOFTWARE ENGINEERING EDUCATION TO WORKING PROFESSIONALS

Heidi J. C. Ellis, Rensselaer at Hartford and Gregory W. Hislop, Drexel University

As the pace of change of technology increases, software engineering professionals are experiencing a pressure to maintain currency in recent developments in the software engineering field. Providing effective education to this population of working professionals is of increasing importance. This paper is an initial investigation of effective education techniques that may be employed when teaching working professionals. The paper will attempt to answer two main questions: 1) What techniques does prior research indicate might be effective in teaching working professionals? 2) How might these techniques be employed in software engineering courses for working professionals? Survey-based feedback from prior software courses taught to working professionals will be used to provide baseline insight into techniques in current courses and to suggest directions for future efforts. This feedback is taken from multiple courses taught to adult working professional students spanning several semesters and two U.S. institutions.

TEST-FIRST TEACHING: EXTREME PROGRAMMING MEETS INSTRUCTIONAL DESIGN IN SOFTWARE ENGINEERING COURSES

Mark A. Ardis, Rose-Hulman Institute of Technology and Cheryl A. Dugas, Indiana State University

Test-first development is a practice of extreme programming designed to produce reliable software quickly. Rather than writing the code first, a software engineer first creates the tests that will demonstrate that the software works correctly. Coding follows and is often guided by the tests. Practitioners of this method claim that the discipline of developing the tests before the code focuses their attention on the right problems and yields cleaner code. Test-First Teaching is a method of course development that incorporates Instructional Design methods to create more effective instruction. The instruments that will be used to test students day-to-day learning of the course material assignments and quizzes are created first, and instruction is developed to meet the students needs. Components of Test-First Teaching are applied at both course and lecture levels. Test-First Teaching has been used successfully to develop courses for the new Bachelor of Science in Software Engineering program at Rose-Hulman Institute of Technology.

TEACHING HCI IN SOFTWARE ENGINEERING

Jennifer A. Polack-Wahl, Mary Washington College

The creation of graphical user interfaces (GUI) can be an invigorating but a complex challenge. Gone are the days when a programmer could build an interface with little or no thought of the user. As the complexity of interfaces increases, and interfaces become user centric, programmers now consider interface design well before the first programming keystrokes are entered. The problem is teaching students during their college years about Human Computer Interaction (HCI) [8]. Here at Mary Washington College, HCI is an elective that has only been offered twice. With this in mind, many students do not get the opportunity to take an HCI course. The purpose of this paper is to describe one methodology of teaching HCI in a Software Engineering course.

Session F1D: Distance Learning: Methods and Technologies 3

Chair: Fani Zlatarova, Elizabethtown College

Time and place: Friday, October 22, 2004, 8:00 a.m. - 10:00 a.m. *Waterfront South*

EVALUATION OF AN M.S. PROGRAM USING SYNCHRONOUS DIGITAL VIDEO COURSE DELIVERY TO REMOTE STUDENTS, AND ITS EXPANSION, ENHANCEMENT AND IMPROVEMENTS

Patrick E. Mantey, University of California Santa Cruz and Timothy D. Johnson, University of California San Diego

The Baskin School of Engineering at the University of California Santa Cruz has the Silicon Valley in its service area, and has working engineers from industry enrolled in its graduate engineering programs. In FIE 1996 [1], we reported on plans to use a digital data link between a matched pair of classrooms (separated by a distance of about 30 miles and a range of coastal mountains) to link these students with our Santa Cruz campus graduate program, and thereby synchronously deliver an M.S. program in Network Engineering to Silicon Valley. In this paper we describe how our implementation matched our design, and evaluate the success of this undertaking from student and faculty perspectives. We also examine this program: it successes, the challenges faced, and the student and faculty experience and feedback. We discuss potential planned expansion of the program, and the some of the necessary or planned changes or modifications to the facilities used, including expansion to multiple sites, and extending from synchronous distance learning to uses of asynchronous delivery of some courses.

PRACTICAL SELECTION OF AN ELECTRONIC COURSE WORK SUBMISSION PROCEDURE

George R. S. Weir, University of Strathclyde

This paper offers an appraisal of commonly available electronic submission methods and acknowledges the need to accommodate local factors in the process of identifying a suitable method. We offer a selection procedure that enables each educator to evaluate alternatives, in a manner that accommodates individual circumstances and subjective weighting of key factors, in order to arrive at a 'best fit' of submission method to local context. This employs a general decision procedure, similar in approach to conjoint analysis, applicable to any context in which an individual wishes to choose between a set of alternative items by subjectively rating their desirability across any set of criteria. The procedure assists by easing the task of identifying the preferred option. We illustrate the use of this selection procedure for electronic coursework submission methods and present a simple software tool that assists in this process.

FOR AN ONLINE COURSE ENCOMPASSING TRADITIONAL CAMPUS STUDENTS : HOW, WHERE, AND WHEN STUDENTS WORK AND ENGAGE WITH THE COURSE MATERIAL

Jonathan P. Mathews, The Pennsylvania State Univerisity, Noela A. Haughton, The Pennsylvania State University, Sarma Pisupati, The Pennsylvania State University, Alan W. Scaroni, The Pennsylvania State University and David DiBiase, The Pennsylvania State University

The data presented here reveal how traditional college students cope with a totally online class experience. The largest enrollment online course at The Pennsylvania State University is the general education offering Energy & the Environment , developed jointly by the Department of Energy & Geo-Environmental Engineering and the John A. Dutton e-Education Institute. Within the first 2-years >1,000 students (mostly on-campus residential students) have been engaged, online. Students work independently or in self-forming cohorts reading text, listening to audio, watching movie clips, and interacting with imagery or simulations online. The majority of students fit the traditional profile in terms of age and on-campus residential status. The class is consistently 60% male. The students are predominantly sophomores (41%), although all academic standings are present within this general education course. One of the main reasons given for enrolling is flexibility. Roughly half of the student activity (56%) is after the traditional workday of 8 AM to 5:00 PM. Only 10% of the online activity occurs within the traditional morning hours. In a class with weekly Friday evening deadlines, there was little activity (measured by number of page requests) occurring on Saturday (5%), Friday has the bulk of the activity (27%). About 72% of the students accessed the material from home with a high-speed connection. About 17% did the bulk of their work at a computing laboratory, despite the fact that 96% of the class has a personal computer. While the students gained content specific knowledge, they also learned self-discipline and other professional behavior, and had exposure to online learning and course management software.

WORK IN PROGRESS - TEACHING STATISTICS IN THE DISTANCE LEARNING MODE

Larry G. Richards, University and Stephanie Scheer, University of Virginia

One of us (LGR) has taught in the distance-learning mode for many years, and has offered a graduate level statistics course for many more. This year, we offered Statistics for Scientists and Engineers in the distance-learning mode for the first time. With the assistance of an instructional designer (Scheer), we have redesigned this class to incorporate the advantages of the interactive video-conferencing environment. Our goal was to adapt best practices of the modern classroom to the distance-learning environment. The class was diverse including on-grounds students from a variety of disciplines, and working engineers from sites around Virginia and other states. We will review our innovations, the results we achieved, and student assessments of their experiences in this course.

SECURITY METHOD IN DISTANCE-LEARNING

Jamal Bari, Eastern Michigan University, Richard M. Sullivan, Student and Jim Blair, Student

New information and communication technologies have become major resources for teaching and learning in higher education. Technologies have multiple capabilities to support different instructional strategies and provide an efficient way of delivering course material and improving comprehension. Unlike a classroom discussion, where students and instructors are bound to course packs and books, online discussions actually enhance student learning by the vast number of additional resources that are easily accessible, important, and up-to-date. Yet administering tests to distance learners presents unique challenges. Giving a closed-book exam on site, for example, involves commuting or special arrangements with proctors local to each student. In a distance-learning environment, this can cause inconveniences that overcome the benefits of students taking classes on-line. This paper presents an idea for allowing closed-book exams local to the student, while reducing the likelihood of cheating to equal that of the traditional classroom environment. It employs a network of audio and video communication-enabled personal computers capable of alleviating many of the issues mentioned above. Specifi-

cally, it implements a Classroom Local Area Network as a beginning concept/prototype development and then broadening these concepts to the distance learner.

VALIDATING A CRITERIA SET FOR AN ONLINE LEARNING ENVIRONMENT

Maxine S. Cohen, Nova Southeastern University and Timothy J. Ellis, Nova Southeastern University

This paper presents the continuing effort to gain a better sense of what constitutes quality in an online course. This work was initially presented at FIE 2002, and expanded in a Journal of Engineering Education article accepted as part of the Best of FIE edition (April, 2004). Our research started with a broad view that entailed an initial brainstorming activity followed by a series of rank-ing and rating processes and a factor analysis to create a set of quality indicators from the student perspective. The current research extends the process by examining the va-lidity of the factors. There are different approaches to performing valida-tion activities; we choose the Nominal Group Technique (NGT), which has been used successfully to generate a group consensus for over 30 years. Thirty two students were divided into five groups; one for each of the factors generated from the earlier research efforts. Each group was tasked with developing a detailed definition of the con-tent and construct underlying the assigned factor. Online educators are often unsure of how to structure their courses since few have any experience as students and little experience as teachers in the environment. By following a clear and reproducible methodology, using multiple constituencies, and re-evaluating at different steps in the process, this study provides online educators a meaningful framework upon which to structure course activities.

Session F1E: Instructional Models for Learning

Chair: Kevin W. Bowyer, University of Notre Dame

Time and place: Friday, October 22, 2004, 8:00 a.m. - 10:00 a.m. *Sloane*

AN ACTIVE LEARNING, STUDENT-CENTERED APPROACH TO TRAINING GRADUATE TEACHING ASSISTANTS

Michael J. Pavelich, Colorado School of Mines and Ruth A. Streveler, Colorado School of Mines

For over a decade, new graduate Teaching Assistants (TAs) from four departments at the Colorado School of Mines have been part of a three-day training program prior to the start of the fall semester. The unique feature of this training program is the strong emphasis on active learning philosophy and methods. Our goal is to teach new TAs how to employ active learning methods in their laboratory and recitation teaching. We do this by having TAs experience most of their training as students in active learning classes and then having them discuss the activities for form, student involvement, and purpose. The TAs spend half their time together focusing on general aspects of effective teaching and the other half with their respective Department faculty focusing on the specific course they will teach. This paper will present specifics of activities, logistics, teaching sound bites, and feedback on this TA Training program. We feel that it is a model adaptable to other institutions.

HOW DO ENGINEERING FACULTY USE INSTRUCTIONAL TECHNOLOGY?

Catherine E. Brawner, Research Triangle Educational Consultants, Richard M. Felder, North Carolina State University, Rodney H. Allen, COMP-AID and Rebecca Brent, Education Designs, Inc.

The Southeastern University and College Coalition for Engineering Education (SUCCEED) was an NSF-Sponsored Engineering Education Coalition that functioned from 1992 through 2002, comprising eight engineering schools that accounted for approximately 1/13 of all U.S. engineering degrees awarded. As part of its ongoing program assessment activities, SUCCEED periodically surveyed the 1600+ engineering faculty members on its member campuses to assess their usage of various teaching practices and their opinions about the importance of teaching at their institution. Surveys conducted in 1999 and in 2002 specifically addressed uses of technology-based methods in both on-campus and off-campus course offerings. This paper briefly outlines the survey response analysis methodology and summarizes the principal results related to technology use.

EFFECTIVE FEEDBACK TO SMALL AND LARGE CLASSES

Harald Sondergaard, The University of Melbourne and Doreen Thomas, The University of Melbourne

Educational experts appear to be in broad agreement when it comes to the importance of feedback for effective learning. Students benefit from plenty of opportunity and encouragement to express their understanding, and from informed, supportive, possibly challenging, feedback. At the same time, we observe that many students at our university do not find that they receive helpful feedback. One in three engineering students disagree or strongly disagree with the Quality of Teaching questionnaire's "I received helpful feedback on how I was going" in the individual course, and most other disci-

plines find themselves in a similar situation. For the university as a whole, student responses to this question are clearly less positive than to other questions on quality of teaching, intellectual stimulation, staff interest, workload, and so on, and this state of affairs seems quite common in the Australian context. We discuss best practice in feedback provision, partly based on our interviews with students and staff. We have been particularly interested in identifying cost-effective ways of providing informed and constructive feedback to large classes. Feedback is often understood, by engineering students and staff alike, simply as comments on submitted work - typically written assignments. We argue in favour of a broader concept that covers a multitude of ways for a student to develop deep learning through conversation, including questions and answers provided by others, team work, study groups, and formative teacher-provided feedback during an assessment task. We emphasise the coaching role of the teacher, and feedback designed to encourage students to monitor own learning. Large classes pose particular logistic problems. We identify staff development as a crucial factor for consistent, effective feedback, and point to web-based feedback provision as a workable solution to some logistic problems. We briefly discuss the role of information technology more broadly, both for learning enhancement and for automated feedback provision.

VERTICALLY INTEGRATED MULTIDISCIPLINARY TEAMING: AN INSTRUCTIONAL FRAMEWORK ADAPTED TO A NON-ENGINEERING COURSE

Jennifer Comito, The University of Akron, Tracie A. Kittinger, The University of Akron, Francis S. Broadway, The University of Akron, Edward A. Evans, The University of Akron and Rex D. Ramsier, The University of Akron

We present a case study of the use of vertically integrated multidisciplinary teams in a non-engineering general science course. We constructed our teams from students with different majors, genders, and class ranks, reflecting several of the ingredients for effective teaming discussed in the literature. This type of multidisciplinary and stratified team member distribution helped to build a sense of community and shared ownership in the learning process. Our experience demonstrates that vertically integrated teaming concepts can be successfully adapted as an instructional framework in multidisciplinary general-audience courses. In this paper, we discuss content analyses of student journal entries, self-reflection reports, and survey responses. .

WORK IN PROGRESS CLASSICAL BALLET STRUCTURE AND PRACTICE APPLIED TO ENGINEERING CLASS SESSIONS

Blair London, Cal Poly State University and Lisa Deyo, Deyo Dances Dance Company

Classical ballet classes have a universal structure that fosters active in-class learning. This structure creates a safe environment for students to try, fail, be corrected, and succeed. Engineering classes lack a common structure; most learning in engineering occurs outside of class. Engineering classes could move toward adopting a similar structure to ballet to improve in-class learning and mirror engineering culture and practice. The paper describes aspects of ballet class structure and practices that work and how these can apply to engineering classes. A new engineering class session structure is presented following the ballet model where engineering students are motivated to participate and learn during the class.

WORK IN PROGRESS EMPLOYING A LEARNING MODEL ON A TRADITIONAL ENGINEERING COURSE

Cordelia M. Brown, Vanderbilt Universtiy and Arthur J. Brodersen, Vanderbilt University

This paper explores the development of a general learning model that uses as a test bed a course on the introduction to digital logic. The learning model is based on techniques validated by researchers Richard Felder, Eric Mazur, John Bransford, and Shelia Tobias. The learning model features a weekly learning session, structured collaborative laboratory sessions, and challenge projects. A comparative research study is being conducted at Vanderbilt University School of Engineering (VUSE). The study contrasts the traditional instructional with the learning model. The traditionally instructed sections will primarily receive lecture-based instruction. Surveys from students, instructors, and teaching assistants will be used as a means of monitoring the effectiveness of the instructional method used. The study will evaluate the students performance, attitude toward their instruction, retention, success rate, failure rate, and confidence levels of students in both the traditionally taught sections and the modified instruction sections. Through this study, strategies will be developed an effective model for instruction studying laboratory-based engineering courses. Preliminary results for the study conducted in the Spring 2004 will be presented.

Session F1F: Educational Research 3

Chair: Gül E. Okudan, The Pennsylvania State University

Time and place: Friday, October 22, 2004, 8:00 a.m. - 10:00 a.m. *Vernon*

WORK IN PROGRESS - BLOWN AWAY ON THE VERY FIRST DAY - MEASURING OUTCOMES FOR STATICS & MECHANICS OF MATERIALS

Doug Oppliger, Michigan and Jim Hertel, Michigan Technological University

In an effort to measure desired outcomes of our Statics and Mechanics of Materials course, a trial is being conducted where students are given a relatively complex problem on the first day of class and then given the same problem on the final exam. The problem in this research involves the structure of a cantilever boat dock. To determine the change in understanding during the course, both problems are graded using a rubric to gage the levels of understanding relative to five tasks: 1) identify the likely failure location, 2) identify the different load types, 3) combine the effects of multiple loadings, 4) calculate the stresses within the structure, 5) calculate the safety factor. Results will also be compared to the previous semester (Fall 2003) where the same problem was given on the final exam but not discussed earlier in the course. A further objective of this work is to stimulate curiosity by challenging students to solve a combined statics and mechanics problem.

WORK IN PROGRESS: ANALYSIS OF RELIABILITY OF THE FLUID MECHANICS CONCEPT INVENTORY

Jay K. Martin, University of Wisconsin-Madison, John Mitchell, University of Wisconsin-Madison and Ty Newell, University of Illinois Champaign-Urbana

A Fluid Mechanics Concept Inventory (FMCI) has been developed via a cooperative effort between faculty at the University of Wisconsin-Madison and the University of Illinois, Champaign-Urbana. This concept inventory has been developed to assess student understanding of undergraduate fluid mechanics as taught in mechanical engineering. Now in the third version, the FMCI has been tested in pre-course and post-course assessment. As a result of this testing, the reliability of the inventory is being evaluated through item examination of specific questions included on the FMCI.

AN ARTICULATION OF THE CONCEPTS AND SKILLS WHICH UNDERLIE ENGINEERING STATICS

Paul S. Steif, Carnegie Mellon University

Many instructional approaches are being developed with the goal of improving learning in Statics. This paper is aimed at providing guidance to such developments by articulating the conceptual basis for Statics. This paper recognizes the primary science prerequisite to Statics, freshman Newtonian mechanics, and addresses the essential ways in which Statics differs from freshman physics. A set of four concept clusters is proposed, together with a set of skills for implementing these concepts. Then, typical errors committed by students are presented. Examples of these errors are extracted from student solutions to Statics problems. These typical errors are then explained by appealing to the proposed concepts and skills. It is hoped that this paper can provide an impetus for mechanics educators to come to a community-wide agreement on a conceptual structure of this subject that can inform future instructional developments.

WORK IN PROGRESS: COMBINING CONCEPT INVENTORIES WITH RAPID FEEDBACK TO ENHANCE LEARNING

John C. Chen, Rowan University, Jennifer Kadlowec, Rowan University and Dexter Whittinghill, Rowan University

In this project our goal is to adapt the Concept Inventory for frequent classroom use, and to implement it in a system to provide rapid feedback to students of their understanding of key concepts being presented. The feedback system acts as the focal point and catalyst to encourage students, working in pairs, to assist each other in correcting misconceptions or deepening each other s understanding of the topic at hand. Furthermore, the system allows the professor to assess the students level of comprehension (or misconception) in a just-in-time fashion, and thus guides his or her pacing and coverage of the material. The rapid feedback is enabled through wireless-networked handheld computers. In this first year of the study, we have implemented the system in a lower-level, core-engineering course (engineering mechanics: statics). This paper will focus on the motivation for and the design of this project; our presentation will describe results from the first implementation.

CNT: CONCEPT-MAP BASED NAVIGATION AND DISCOVERY IN A REPOSITORY OF LEARNING CONTENT

James H. McClellan, Georgia Tech, Lonnie D. Harvel, Georgia Tech, Rajbabu Velmurugan, Georgia Tech, Milind Borkar, Georgia Tech and Chris Scheibe, Georgia Tech

In this paper, we present a tool that automatically connects keywords in student generated concept maps to relevant learning components in our digital repository. Currently, there are over 6,000 heterogeneous components available in our systems, with more than 1,000 dedicated to the teaching of ECE 2025, an introductory course in Signal Processing. These components consist of captured lectures, support material, multi-media examples, worked problems and others. The CNT (Concept Navigation Tool) connects concept map nodes to course content based on keywords embedded in the concept

nodes. CNT goes beyond just integrating search techniques with a map-authoring tool. The concept maps constructed by students become the navigation tool that allows them to explore the relevant content and improve or expand their concept maps as their understanding grows. This environment was designed to increase the depth of a student's conceptual understanding of course material. The paper includes details about the design and implementation of the CNT system and the supporting data systems.

WORK IN PROGRESS - IS ATTITUDE TOWARD MATHEMATICS A MAJOR OBSTACLE TO ENGINEERING EDUCATION?

Mohammed Fadali, University, Norma Velasquez-Bryant, University of Nevada and Mike Robinson, University of Nevada

Many topics in most engineering curricula are taught using mathematics and mathematical models. Knowledge of the prerequisite background in mathematics is therefore necessary for students to learn such topics. In recent years, there has been a growing concern among educators about the competence of incoming freshmen in mathematics. Most engineering educators believe that deficiencies in students mathematics backgrounds are a major impediment to learning and may be the cause of an unacceptable high attrition rate. To remedy this problem, we need to study the underlying causes of these deficiencies in some detail. This paper seeks to test the hypothesis that one of the major causes for the problems that some students have with learning mathematics is attitude towards the subject. It is well known that attitude significantly affects learning in general. However, surprisingly few results are available on the impact of attitude toward mathematics on engineering education. We will investigate the link between attitude and competence in mathematics for engineering freshmen. For this purpose, we have designed an attitude assessment tool that was administered to engineering freshmen enrolled in ENGR 101 Introduction to Engineering at the University of Nevada, Reno. The paper will present the results of the survey together with a statistical analysis to assess the importance of attitude toward mathematics learning as an obstacle in engineering education.

Session F1G: Topics in Assessment 1

Chair: Ron Barr, University of Texas

Time and place: Friday, October 22, 2004, 8:00 a.m. - 10:00 a.m. *Percival*

INDIVIDUAL STUDENT ASSESSMENT IN TEAM-BASED CAPSTONE DESIGN PROJECTS

Wils L. Cooley, West Virginia University

In our senior design sequence a two-credit writing-intensive course in which students propose to develop a product is followed by a three-credit course in which students carry out detail design, implementation, and prototype testing of their product. Students in four different majors work in multi-disciplinary teams of three to five. The faculty are challenged to find ways to assess student achievement that accurately measure individual accomplishment while avoiding excessive faculty effort. Key issues include: fair assessment of relative contributions of hardware designers versus software designers, differing expectations for different majors, assessing a team that cannot demonstrate a functioning integrated system, and fair weighing of contributions among creativity, technical knowledge, analytical ability, ability to debug or troubleshoot, team management, and communication. We share a number of measures we have developed to assess student performance, and discuss how these measures are used to determine both individual student grades as well as assess overall achievement of program learning outcomes.

USING CONCEPT MAPS TO ASSESS DESIGN PROCESS KNOWLEDGE

Judith E. Sims-Knight, UMASS Dartmouth, Richard L. Upchurch, UMASS Dartmouth, Nixon Pendergrass, UMASS Dartmouth, Tesfay Meressi, Dr., Paul Fortier, UMASS Dartmouth, Plamen Tchimev, UMASS Dartmouth, Rebecca VonderHeide, UMASS Dartmouth and Madeleine Page, UMASS Dartmouth

If engineering educators are to incorporate assessment of student learning outcomes into their curricula, they need assessments that are reliable, valid and feasible within the time constraints of coursework. We are engaged in an NSF supported project to develop such measures for design skill. This paper describes our exploration of the use of student-generated concept maps to assess students understanding of how various aspects of the design process go together. Students in three senior-level engineering courses constructed concept maps of the design process. The resulting maps could be reliably sorted into patterns that presumably represent distinctly different ways of understanding the process. In addition, subpatterns of the concept maps were used to assess specific units of knowledge (e. g., the relation between feasibility, on the one hand, and requirements and preliminary design, on the other). These two components comprise an easily created report that provides detailed and useful pointers toward course and curricular improvement.

PROJECT ORIENTED TUTORING ON MILESTONE BEHAVIOR USING CONTRACT MANAGEMENT

Enrique Espinosa, Monterrey Institute of Technology and Julieta Noguez, Associate Professor

We present a study that identifies student behavior during a college-level, project-oriented, and online, compilers course. Assessment of behavior characterized as skills and knowledge under these circumstances is hard to achieve, but useful for effective coaching. Such capacities are commonly induced using tools derived from behavioral and cognitive sciences: psychology, linguistics and cognitive sciences (PLICS). Qualitative and quantitative evidence can be interpreted during coaching to detect flaws during learning: teamwork conflicts, absence of knowledge acquisition, or sheer lack of interest. We contribute by demonstrating internet-assisted coaching methods for motivating students to learn cooperatively while acquiring key capacities and managing social conflicts such as competition and individualism. We show how the instructor crafts negotiations and performs key actions for helping learners complete an IT consulting project with clear goals, restrictions, and deliverables. These serve as relevant guidelines for Project Oriented Learning (POL) and help assess PLICS usage on e-Learning courseware.

REMOTE VERSUS HANDS-ON LABS: A COMPARATIVE STUDY

James E. Corter, Teachers College, Columbia University, Jeffrey V. Nickerson, Stevens Institute of Technology, Sven K. Esche, Stevens Institute of Technology and Constantin Chassapis, Stevens Institute of Technology

Advocates of hands-on laboratories and advocates of simulation have debated for years. Proponents of hands-on laboratories argue that student engineers need to be exposed to the physical experiences - and the uncertainties - of real environments. Advocates of simulation argue that physical labs are wasteful they tie up badly needed space, and consume student s time in menial set-up and tear-down procedures. Now remote laboratories have appeared as a third option. These laboratories are similar to simulation techniques in that they require minimal space and time, because the experiments can be rapidly configured and run over the Internet. But unlike simulations, they provide real data. It is unknown what the relative effectiveness of hands-on, simulated, and remote laboratories is. This paper presents a model for testing this relative effectiveness, and discusses the results of a preliminary assessment study comparing versions of remote labs versus hands-on labs in a junior-level mechanical engineering course on machine dynamics and mechanisms.

WORK IN PROGRESS IMPACT OF A REMEDIAL 3-D VISUALIZATION COURSE ON STUDENT PERFORMANCE AND RETENTION

Norma Boersma, Michigan Technological University, Amy Hamlin, Michigan Technological University and Sheryl Sorby, Michigan Technological University

The purpose of this study was to assess whether a remedial spatial visualization course impacted student retention and success in lower level engineering courses. Engineering freshmen who score below 60% on the Purdue Spatial Visualization Test: Visualization of Rotations (PSVT:R) are encouraged to take an optional 1-credit remedial spatial visualization course in their first semester. Course grades and retention rates of students who failed the PSVT:R and either chose to take the optional course (n=169) or chose not to take the course (n=173) were compared. It was found the remedial course had a positive impact on retention, both at the university and in engineering. Students who took the optional course also earned higher grades in two introductory engineering courses and in a combined statics and mechanics of materials course.

WORK IN PROGRESS: THE RELATIONSHIP BETWEEN OBJECTIVE AND/OR SUBJECTIVE ADMISSIONS CRITERIA AND SUCCESS OUTCOMES IN UNDERGRADUATE ENGINEERING

Mohammed A Sattar, Texas A&M University, Chang J Lee, Texas A&M University and Rita Caso, Texas Engineering Experiment Station (TEES)

University admissions policies throughout the country are undergoing review and revision, and universities are considering options which range from basing admissions most heavily upon objective criteria, such as SAT/ACT scores and/or High School rank, to favoring more holistic approaches, including individualized subjective reviews of accomplishments and characteristics reported in applications, and application essays. Variations of these approaches have been in practice at Texas A&M University for quite some time, yet little was known about how these admission practices were actually predicting the retention, academic performance, and graduation of students throughout the institution. Moreover, less was known about how accurately university-wide objective and/ or subjective admission criteria predicted success for the students of very different colleges. This study identifies the admission criteria, which have best predicted academic success among engineering students from freshman cohorts 1997 through 2001. It specifically examines the predictive effectiveness of using objective merit-based criteria, in combination with subjective criteria, vs. using only objective admission criteria. Success outcomes of the sub-population of students exempt from admission review due to high school rank or high SAT/ACT, are examined in relation to objective criteria only. The outcomes of the students who did not meet exemption

criteria and were admitted due to favorable review of both objective and subjective admission criteria are examined in relation to objective criteria alone, and also in relation to objective and subjective criteria together. Results are observed and reported for Male & female, White, Hispanic & African American subpopulations.

Session F1H: Exhibitor Showcase

Chair: Robert J. Hofinger, Purdue University at Columbus
Time and place: Friday, October 22, 2004, 8:00 a.m. - 10:00 a.m. *Verelst*

Session F2A: Interactive Session: Whose Technology Is It Anyway?

Chair: Danial J. Neebel, Loras College
Time and place: Friday, October 22, 2004, 10:30 a.m. - Noon *Chatham*

INTERACTIVE SESSION: WHOSE TECHNOLOGY IS IT ANYWAY?

Danial J. Neebel, Loras College, Todd Swift, Loras College and Michael Morrow, University of Wisconsin Madison

Today it is common for students to have a handheld or notebook computer in the classroom. As with any form of educational technology, there are challenges for the instructor to make good use of the technology and motivate the students to do the same. At education innovation conferences like FIE, there is a strong need to model good teaching methods where people discuss the latest techniques as applied to teaching and learning of Engineering and Computer Science. Engineering and Computer Science faculty often develop cutting edge technology. However, we sometimes lag behind in the use of technology for teaching and learning. Keeping up with the fast pace of technology change can make it difficult to develop new applications of technology to teaching and learning. This session seeks not only to disseminate ideas but to also generate new ideas.

Session F2B: Theme Panel: Expanding Educational Opportunities through Partnerships and Distance Learning

Chair: Joseph L. A. Hughes, Georgia Institute of Technology
Time and place: Friday, October 22, 2004, 10:30 a.m. - Noon *Savannah*

THEME PANEL: EXPANDING EDUCATIONAL OPPORTUNITIES THROUGH PARTNERSHIPS AND DISTANCE LEARNING

Joseph L. A. Hughes, Georgia Institute of Technology, Mary R. Anderson-Rowland, Arizona State University, Thomas P. Barnwell, Georgia Institute of Technology, Manuel Castro, National Distance University of Spain (UNED), Haniph A. Latchman, University of Florida and Daniel S. Papp, University System of Georgia

The FIE 2004 Theme Panel brings together a group of experienced educators to address the two key elements of the conference theme: educational partnerships and distance learning. Drawing on their experience and continuing involvement in these areas, the panelists will offer insights and engage the attendees in a discussion of likely challenges and new approaches for expanding educational opportunities in engineering, technology, and computing. Addressing these challenges will require engineering educators and institutions to find new solutions and to continue pushing forward the frontiers. This panel continues FIE s role as a leading international forum for sharing new ideas, technologies, and education research results.

Session F2C: Software Engineering Education 2

Chair: Jennifer A. Polack-Wahl, Mary Washington College
Time and place: Friday, October 22, 2004, 10:30 a.m. - Noon *Waterfront North*

WORK IN PROGRESS: USE OF FORMS IN SUPPORTING STUDENT PROJECTS

Vladan Jovanovic, Georgia Southern University

This paper describes use of forms as mechanisms supporting student s work on organizing projects in a capstone Software Engineering (SE) course Unique features of the approach are: a) use of project meta-model to present concepts involved as they relate to each other, b) related collection of form used to prepare decisions and c) criteria.

WORK IN PROGRESS - PROBLEMS AND PROGRESS IN SOFTWARE ENGINEERING CURRICULUM MATERIALS

Gregory W Hislop, Drexel University, Thomas B Hilburn, Embry-Riddle Aeronautical University, Michael J Lutz, Rochester Institute of Technology, W Michael McCracken, Georgia Institute of Technology and Mark J Sebern, Milwaukee School of Engineering

SWENET, The Network Community for Software Engineering Education, is an NSF funded project to develop curriculum modules of value to faculty members desiring to incorporate software engineering concepts in new or existing courses. By design, the modules are self-contained instructional units ranging from a single lecture to approximately one week of course material. In this way, instructors can adopt, adapt, and arrange modules as appropriate to their courses. This presentation will provide an update on the status of the project including a report of current progress and problems encountered. The session will also address the future of the course materials collection and solicit input on ways to provide ongoing support to the community of software engineering researchers.

A MODEL FOR SWE COURSE SOFTWARE ARCHITECTURE AND DESIGN

Orlando Karam, Southern Polytechnic State University, Kai Qian, Southern Polytechnic State University and Jorge Diaz-Herrera, Rochester Institute of Technology

This paper presents a model for the course "Software Architecture and Design" in our software engineering undergraduate program. This course is a part of our efforts in the ABET accreditation preparation. As systems grow bigger, so grows the need for understanding large scale, complex, and distributed systems. Software Design (including architecture and detailed design) studies how to describe the high-level structure of software systems. It is a discipline whose importance is growing more and more apparent. It is also one of ten essential areas recommended by Computing Curriculum Software Engineering (CCSE) 2003. In spite of its importance, there are almost no dedicated courses at the undergraduate level covering this important discipline, although there is definite interest \cite{EduArch}. At Southern Polytechnic State University, as part of our BS in Software Engineering, we have started offering a course on Software Architecture and Design, which focuses on designing software, at the highest level (software architecture) and the detailed level. In this paper we detail the contents and the pedagogical approach of that course. We describe the structure of this course, its knowledge units, which include design principles, design strategies, architectural design and attributes, detailed design, component-oriented design, and design support tools and evaluation. We also describe the topics in each knowledge unit (for example, design patterns is a topic in detailed design).The Strategies for choosing design styles and patterns based on the trade-off of system attributes and combinations of various architectural styles and design patterns are also emphasized. We also present assessment of course outcomes, our experience in teaching this course and plans for further enhancements.

STUDENT-DIRECTED LEARNING IN A GRADUATE SOFTWARE ENGINEERING COURSE

Heidi J. C. Ellis, Rensselaer (RPI) Hartford

Adult students share a unique set of learning characteristics, one of which is a strong desire to control their learning experience. Ideally, software engineering education for adults should support students desire for self-direction by allowing students to absorb material in the manner in which each individual learns best, while at the same time allowing students the freedom to explore topics of interest. This paper describes an investigation into self-directed learning in a Web Application Design and Development course which uses a student-defined project approach. Results of an ongoing survey-based study performed by the instructor to determine student attitude toward the student-defined project are discussed. Students were surveyed on their opinions at the beginning and end of the semester. Results indicate that students enjoy the self-deterministic approach used in the project, and approval of the student-directed approach showed an increase from the beginning of the semester to the end.

WORK IN PROGRESS - UNEXPECTED STUDENT OUTCOME FROM COLLABORATIVE AGILE SOFTWARE DEVELOPMENT PRACTICES AND PAIRED PROGRAMMING IN A SOFTWARE ENGINEERING COURSE

Chih-wei Ho, North Carolina State University, Kelli Slaten, North Carolina State University, Laurie Williams, North Carolina State University and Sarah Berenson, North Carolina State University

There has been low representation of women in Computer Science. This paper describes the initial findings of a three-year research project about women in the field of information technology. The goal of this research is to examine the effect of pair programming and agile software development on students. During the first semester of this project, pair programming was used in a junior/senior software engineering class at North Carolina State University. In this paper, we share the grounded theory analysis of three interviews and thirteen project retrospective essays of the female students. Theoretical models were developed to describe (a) the factors of students enjoyment in a software design course that employs agile

software methods, (b) context that influenced students study habits, and (c) the effectiveness of pair programming and agile methods. Initial findings indicate that pair programming is an effective practice for the female students, but it also brings new challenges for the instructors.

Session F2D: K - 12 Experiences

Chair: Susan Powers, Clarkson University

Time and place: Friday, October 22, 2004, 10:30 a.m. - Noon *Waterfront South*

WORK IN PROGRESS - THE TRIANGULATED LEARNING MODEL FOR ENGINEERING EDUCATION

Pamela Cantrell, University of Nevada, Reno, Norma Velasquez-Bryant, University of Nevada, Reno, Gokhan Pekcan, University of Nevada, Reno and Ahmad Itani, University of Nevada, Reno

The Triangulated Learning Model is a framework for implementing the engineering analysis and design process with middle school students in their science classrooms. The model is inquiry-based and integrates the components of simulation, construction, and connection. The model was piloted in eight middle school science classrooms using three teacher-developed modules that included web-based simulations, a construction phase, and specific activities designed to promote connections to underlying scientific and mathematical concepts. This paper describes early indicators of the effectiveness of the model from data collected through classroom observations of the eight teachers.

ARTVENTURES IN ENGINEERING AT ARIZONA STATE UNIVERSITY

Shawna L. Fletcher, Arizona State University and Melanie Ohm, Director

ArtVentures in Engineering (AVIE) is a series of community workshops and educational K-12 outreach projects designed to examine and explore the interdependence of science and the arts. This project was conceived from a unique partnership formed between the Katherine K. Herberger College of Fine Arts and the Women in Applied Science and Engineering (WISE) Program at Arizona State University. The primary goal of this collaboration is to educate and bring community awareness to a diverse population through the exploration of interdisciplinary principles and to value the contributions of artists to science and scientists to the arts. To date, four workshops have been completed and a fifth workshop is scheduled for Spring, 2005. Preliminary workshops described will serve as a basis for statewide and national models to train teachers and educators in bringing multi-disciplinary learning and integrated teaching into the classroom. Results of each workshop were examined on an immediate basis however, future research will include both short-term and long-term assessment components to examine program effectiveness. An overview of workshops will be presented as well as future program expansion including preliminary discussions of teacher education and teacher training.

NOT JUST FOR NERDS: EMBEDDING SCIENCE ACTIVITIES WITHIN A DESIGN, ENGINEERING, AND TECHNOLOGY (DET) ENVIRONMENT

Dale Baker, Arizona State University, Senay Yasar, Arizona State University, Sharon Robinson Kurpius, Arizona State University, Steve Krause, Arizona State University and Chell Roberts, Arizona State University

Design, Engineering, and Technology (DET) holds the promise of interesting students in STEM (science, technology, engineering, and math) careers and developing a better understanding of STEM in their own lives. However, the current K-12 curriculum devotes little time to DET concepts despite their being addressed in the National Science Education Standards. This paper presents data from a DET course developed for science education graduate students which uses the existing curriculum for introducing DET into the classroom. Data from lesson plans, weekly reflections on readings, trial activities in K-12 classrooms, and focus groups tracked changes in understanding DET and the ability to embed DET into existing science activities. Data was coded using qualitative techniques and a rubric with six categories (engineering as a design process, gender and diversity, social relevance of engineering, technical self-efficacy, tinkering self-efficacy, and transfer to the classroom) that measured achievement of course goals. Understanding and progression of metacognition was linked to instructional activities and readings.

DESCRIPTION OF A TEN YEAR STUDY OF THE PRE-ENGINEERING PROGRAM FOR UNDER-REPRESENTED, LOW INCOME AND/OR FIRST GENERATION COLLEGE STUDENTS AT THE UNIVERSITY OF AKRON

Paul Lam, The University of Akron, P. Ruby Mawasha, Wright State University, Tirumalai Srivatsan, The University of Akron and John Vesalo, The University of Akron

This paper summarizes Ten years efforts of a pre-engineering program to improve the recruitment and retention of under-represented students pursuing careers in Science, Mathematics, Engineering, and Technology (SMET) at The Uni-

versity of Akron. This study, evaluates The University of Akron s successful operations of the special high school Upward Bound and the Pre-Engineering Programs to increase the number of under-represented students in SMET. The programs are in collaboration with the College of Engineering s Minority Engineering Program, Increasing Diversity in Engineering Academics (IDEAs). The effectiveness of the programs are measured by: (a) high school GPA before and after participating in the programs, (b) retention rate for students returning from previous year, and (c) percentage of students majoring in SMET upon graduation. The end results of these strategies are that the targeted students, who have expressed an interest in mathematics and science, are highly motivated and excited about SMET careers.

WORK IN PROGRESS - PRISM: A PORTAL WITH A PURPOSE

Patricia Carlson, Rose-Hulman Institute of Technology

Accomplishing change in education must start where learning begins: with the classroom teacher. The Report to the Nation from the National Commission on Mathematics and Science Teaching in the 21st Century was unequivocal in its message (Before It s Too Late, September 2000). The way to improve learning in science, mathematics, and technology is to improve teaching. And better teaching can be achieved through better preparation, professional development, and working conditions for our nation s teachers. Rose-Hulman Institute of Technology, with support from the Lilly Endowment, is constructing a Web portal dedicated to improving middle school science, mathematics, and technology (SMT) instruction. Essentially, this gateway emulates emerging corporate practices of knowledge management (KM) and process re-invention through information technology (IT).

Session F2E: First Year Issues

Chair: John Tester, Northern Arizona University

Time and place: Friday, October 22, 2004, 10:30 a.m. - Noon *Sloane*

CRITICAL-TO-QUALITY FACTORS ASSOCIATED WITH ENGINEERING STUDENT PERSISTENCE: THE INFLUENCE OF FRESHMAN ATTITUDES

Joan Burtner, Mercer University

National studies have revealed numerous explanations for the lack of student persistence toward a science, math, or engineering degree. At many institutions, the greatest predictor of student success has been shown to be a combination of high school grades and SAT scores. However, at Mercer University, regression analyses show that differences in high school grade point averages and SAT scores account for less than 25% of the variability in the data describing student persistence toward an undergraduate degree. We believe that student attitudes and perceptions influence decisions to remain in an engineering curriculum, and have developed a series of studies to test this hypothesis. The current study focused on a cohort of students who entered our engineering school as first-time, full-time freshmen in the fall 2000 semester. We found significant attitudinal and belief differences between those who left engineering and those who persisted to the fourth year of college. Five critical-to-quality factors were identified.

WORK IN PROGRESS: CURIOSITY IN THE EDUCATION OF THE ENGINEER

Tim Healy, Santa Clara University

It is assumed here that the development of intrinsic motivation to learn is critical to the success of the engineer and to the process of lifelong learning. This paper presents a theory of the role of curiosity in engineering education, and describes an ongoing project to encourage the development of curiosity. The paper begins by making a case for curiosity. Kuhn's concept of a paradigm and Kolb's concept of learning are then used as the basis for a theory of curiosity development. The paper then moves to the implications that these ideas have for teaching and learning. The parallel to the ABET continuous improvement cycle is noted.

WORK IN PROGRESS: TEACHING THE ART OF LEARNING IN ENGINEERING EDUCATION

Melinda Piket-May, University of Colorado and James Avery, University of Colorado

With new technological breakthroughs occurring related to engineering almost daily, it is getting harder and harder to cover all the essential material in a four year degree. Some engineers feel we should be sticking to the fundamentals while others think we should be exposing the students to all the leading edge technology. Another response to this information explosion has been that many educators are examining the concept of teaching learning through various engineering concepts. The idea stems from the concept that if we teach the students how to learn for themselves they will be much better prepared for the lifetime of learning that awaits them, especially with respect to complicated new engineering concepts.

WORK IN PROGRESS A FRESHMAN COURSE FOR ENGINEERING AND COMPUTER SCIENCE STUDENTS

Odis Hayden Griffin, Virginia Polytechnic Institute & State University, Edward A. Fox, Virginia Polytechnic Institute & State University, Calvin J. Ribbens, Virginia Polytechnic Institute & State University, Thomas D. Walker, Virginia Polytechnic Institute & State University, Nathaniel J. Davis, Virginia Polytechnic Institute & State University, Richard M. Goff, Virginia Polytechnic Institute & State University, Jenny L. Lo, Virginia Polytechnic Institute & State University, Vinod K. Lohani, Virginia Polytechnic Institute & State University, Michael H. Gregg, Virginia Polytechnic Institute & State University and Dwight Barnette, Virginia Polytechnic Institute & State University

Primarily as a result of the move of Computer Science into the College of Engineering, the first-semester engineering course taken by all first-year engineering students at Virginia Tech was significantly redesigned. The primary goal of the redesign was to switch from an inherently procedural programming language (Matlab) to an object-oriented language (Alice). This object-oriented approach to learning programming was also believed to be better for students bound for computer science and computer engineering. In addition, coverage of ethics, which had been constrained to engineering topics, will be broadened to include software issues. Previously implemented hands-on early design portions of the course will not be significantly modified. The first offering of the new course will be in Fall Semester 2004, with approximately 1,200 students enrolled.

WORK IN PROGRESS LAB-ON-A-CHIP MICROMANUFACTURING WITH A NANOTECHNOLOGY COMPONENT FOR A FIRST-YEAR ENGINEERING PROGRAM

David L Tomasko, The Ohio State University, John Merrill, The Ohio State University, Paula J Stevenson, The Ohio State University, Tiffany Schofield, The Ohio State University, Yong Yang, The Ohio State University, Yosef Allam, The Ohio State University and Stuart Brand, The Ohio State University

Engineering students with interests in microelectromechanical systems (MEMS) and nanotechnology typically can only gain exposure to this new field in late undergraduate curricula, research offerings, or graduate school. Early exposure to this field is not typically an option in engineering programs. Perhaps the first of its kind, this Lab-on-a-chip Micromanufacturing Lab with a Nanotechnology component is piloted and offered to regular first-year engineering students as an alternate lab section in the standard Fundamentals of Engineering course (ENG 183) for Winter and Spring 2004 at Ohio State University. Students participate in a hands-on design and fabrication of a working Lab-on-a-chip to detect the presence of a biological antibody through fluorescent antigen-antibody binding. They construct a simple photosensor to detect emission from the bound antigen. Coincident with the hands-on activity are Nanotechnology modules and lab tours that expose the students to the challenges in manufacturing at the nanoscale for similar devices.

Session F2F: Active & Cooperative Learning 2

Chair: Lisa Huettel, Duke University

Time and place: Friday, October 22, 2004, 10:30 a.m. - Noon *Vernon*

A WEB-BASED SYSTEM TO DOCUMENT LEARNING OUTCOMES IN A MANDATORY COOPERATIVE EDUCATION PROGRAM

Bryan E Dansberry, University of Cincinnati, Jon Krech, University of Cincinnati and Brian Becker, University of Cincinnati

For 97 years, paper evaluations have been an essential tool for University of Cincinnati co-op faculty to track and evaluate a student s learning progression resulting from co-op experience. However, large-scale studies involving large numbers of students and employers were prohibitively labor intensive. This year an on-line evaluation system has been created so that large-scale studies of the effects and benefits of cooperative education can more easily be monitored and reported. This system will provide digital records of student and employer assessment data as well as the capability to analyze this data on a much larger scale to better document the pedagogic benefits of co-op for students. In addition, this system will allow for improved feedback to degree granting colleges and the ability to generate new surveys easily and quickly for evaluation of new experiential learning methods or developing market trends. This paper will address the development, function and potential impact of this online evaluation system.

ASYNCHRONOUS COLLABORATIVE LEARNING USING PROJECT-BASED ASSIGNMENTS

William Hafner, Nova Southeastern University and Timothy J Ellis, Nova Southeastern University

The value of collaboration as a tool to promote learning is becoming increasingly more evident. Students engaged in collaborative efforts are typically more actively engaged in the learning activity and retain the information being learned longer. Collaborative activities also parallel the work environment and prepare the student for life after school. Promoting

collaboration in a classroom setting is diffi-cult and often resisted by both teachers and students. This difficulty is magnified for courses offered in an online learning environment.As a result, educators are faced with a dilemma: both students and academic institutions are flocking towards asynchronous learning networked courses, but there is no clear understanding of how to fos-ter collaboration, one of the most promising pedagogical tools. Asynchronous online environments can provide mean-ingful collaborative assignments. This paper details a five-step systems approach for fostering project-based, collabo-rative learning in an asynchronous learning environment. The steps are illustrated with examples from a graduate-level course in multimedia systems in which asynchronous collaboration was a featured assignment.

WORK IN PROGRESS: ALUMNI MENTORING OF ENGINEERS IN A TECHNICAL COMMUNICATION COURSE

Julie E. Sharp, Vanderbilt

This pilot project integrated the Vanderbilt Engineering Alumni Council mentoring initiative in a technical communication course for all engineering majors. An opportunity for networking with alumni and learning about workforce communication was designed into a two-and-a-half-week report writing assignment. Working individually and in groups, 41 students interviewed 18 alumni and other professionals about workplace communication and reported their findings. Project components included an alumnus guest speaker and a post-project, alumni-sponsored luncheon attended by 27 students. Results showed that graduates spent a large portion of their work time on various written and oral communication tasks. Alumni and student questionnaire responses indicate that the project was beneficial and should be continued. Using an analytical five-point scale, students rated including a mentoring project next semester with a 4.1/5.0 while alumni rated it 4.6.

WORK IN PROGRESS A FRESH LOOK AT CASE STUDIES

Jeffrey L. Newcomer, Western

Students in the Manufacturing Engineering Technology Program at Western Washington University complete two assignments in which they must research and prepare a written and/or oral report on an engineering case study. Student-researched case studies address a number of learning objectives, including EAC Criteria 3.f-j and TAC Criteria 2.g-j, they can be used to address technical learning objectives, and they increase student motivation and often provide a fresh look at the case and the lessons it teaches. The most significant challenge to using student-researched case study assignments is developing well structured assignments that are open-ended, but have clear expectations.

EXTENDING RECORD AND PLAYBACK TECHNOLOGIES TO SUPPORT COOPERATIVE LEARNING

Esha Rey, University of Massachusetts Amherst, Ken Watts, University of Massachusetts Amherst and W. Richards Adrion, University of Massachusetts Amherst

We have long-term experience with developing and employing multimedia materials for on-campus and distance education. We also are assessing the efficacy of cooperative learning where groups of learners explore, with guidance from an instructor, the learning environment and construct models of meaning based on their shared learning experiences. Our core technologies capture and store classroom events, but are record-and-playback technologies focused on delivering content to individual learners. We describe an extension of our technology, Cooperative Learning in MANIC (CLIMANIC), which allows groups of learners and teachers to collaborate and communicate. We describe our current assessment of CLIMANIC and future plans for more extensive evaluation.

Session F2G: Computer Science Education 3

Chair: George R. S. Weir, University of Strathclyde

Time and place: Friday, October 22, 2004, 10:30 a.m. - Noon *Percival*

PUMPX: AN EXPERT SYSTEM FOR PUMP DIAGNOSIS

Mario A. Garcia, Texas A&M University-Corpus Chrsiti, John Clements, Texas A&M University-Corpus Christi and William Shelton, Texas A&M University-Corpus Christi

Diagnosing problems with centrifugal pumps usually requires personnel with extensive experience or education. Centrifugal pumps represent the largest power consumption of any type of liquid movers in industrialized countries. Diagnosis of problems with recommendations from a computerized assistant would be highly useful. This paper describes the implementation of PUMPX, an expert system for diagnosis of pump problems and for recommendation of corrective action. Four main symptoms are included: vibration/noise, high temperature, leaks and low performance. The use of this program can lead to utilization of lower experience personnel for diagnosis and can be used for training. The correct and timely

diagnosis and correction of pump problems will lead to reduced power consumption and avoid unnecessary expenditures for upgrades.

ESTABLISHING STRUCTURED SUPPORT FOR PROGRAMMING STUDENTS

Ioanna Stamouli, Trinity College, Dublin, Eileen Doyle, Trinity College, Dublin and Meriel Huggard, Trinity College, Dublin

This paper describes the structure, implementation, and impact evaluation of a Programming Support Centre for engineering and computing students. The main focus of this centre is to provide a positive, supportive atmosphere where students can voluntarily seek one-to-one assistance with programming difficulties. The support offered is specifically structured to nurture and leverage each student s motivation for taking a programming course whilst providing them with individually tailored advice and practical help. A qualitative and quantitative evaluation of the centre s operation is presented, together with analysis of statistics on student motivation. The results of this research suggest that the newly developed programming support centre has had a positive impact on student learning.

STATE MODELS FOR INTERNETWORKING TECHNOLOGIES

Stanislaw Paul Maj, Edith Cowan University, George Murphy, Edith Cowan University and Gurpreet Kohli, Edith Cowan University

New, diagrammatic state models of a switch and router were designed. The router state model can be used for all the main Interior Gateway Protocols distance vector (RIP, IGRP), link state (OSPF) and balanced hybrid. (EIGRP). Preliminary work indicates that it also supports an Exterior Gateway Protocol (BGP). The switch state model can be used for both basic and advanced switch operation (STP, VTP and VLANs). Both router and switch models employ modularity hence both these models provide a basic model whose functionality can be enhanced by the inclusion of additional state tables. Furthermore these models are diagrammatic, self-documenting and easy to use. They employ leveling and hence provide hierarchical top down decomposition thereby controlling technical detail. These models were used as the pedagogical foundation of network curriculum and the results evaluated. It was found that these models very significantly improved student learning.

WORK IN PROGRESS - MYTHSIM: THE MYTHICAL SIMULATOR FOR REAL STUDENTS

Jason Peter Vroustouris, University of Illinois at Chicago and Mitchell D. Theys, University of Illinois at Chicago

MythSim is a cross-platform control-code simulator being used at the University of Illinois at Chicago. This mythical 8-bit processor gives students experience with concepts in computer architecture. MythSim has been redesigned from the ground up based on the changing needs of instructors and students. An improved multi-windowed interface, color-coding system and reference card allows students to learn the architecture quickly so they can focus on developing and debugging there programs. To facilitate future development, the source code is hosted online in a distributed development environment. Feedback from instructors and students has been positive. This paper presents improvements made in the new version, feedback from students and the support we provide for instructors.

WORK IN PROGRESS - COMPARING ASSESSMENT TOOLS IN COMPUTER SCIENCE EDUCATION: EMPIRICAL ANALYSIS

Pavel Azalov, Pennsylvania State University, Stephen Azaloff, THUNDERBIRD, The Garvin School of International Management, Glendale, AZ and Fani Zlatarova, Elizabethtown College, PA

The paper discusses the usage of multiple-choice and open-ended constructed response questions for measuring the performance of undergraduate students in computer science courses. A goal of this research is to investigate if guessing plays a significant role in multiple-choice answering. An experiment was constructed in two academic institutions over a two-semester period involving students in four introductory programming classes. The quizzes consisted of pairs of similar questions, where each pair contained a multiple-choice and an open-ended constructed response question of equal difficulty and weight.

Session F2H: Exhibitor Showcase

Chair: Robert J. Hofinger, Purdue University at Columbus
Time and place: Friday, October 22, 2004, 10:30 a.m. - Noon *Verelst*

Session F3A: Interactive Session: Developing Engineering Education Research Questions

Chair: Sally Fincher, University of Kent

Time and place: Friday, October 22, 2004, 2:30 p.m. - 4:00 p.m. *Chatham*

INTERACTIVE SESSION- DEVELOPING ENGINEERING EDUCATION RESEARCH QUESTIONS: WHAT DO THEY LOOK LIKE? HOW DO I GET ONE?

Sally Fincher, University of Kent, UK and Robin Adams, University of Washington

A critical skill in engineering education research is the ability to formulate good research questions. As David Hilbert states, he who seeks for methods without having a definite problem in mind seeks for the most part in vain . Issues researchers need to consider in formulating research questions include: what is the nature of the phenomenon, will this study have implications for theory or practice, and who is the audience for this research. A good research question will be timely, focused, generative, and align with disciplinary research design principles.

Session F3B: Panel: A Report on the Model Curriculum for Computer Engineering

Chair: David L. Soldan, Kansas State University

Time and place: Friday, October 22, 2004, 2:30 p.m. - 4:00 p.m. *Savannah*

PANEL SESSION: A REPORT ON THE MODEL CURRICULUM FOR COMPUTER ENGINEERING

David L. Soldan, Kansas State University, Victor P. Nelson, Auburn University, Andrew McGettrick, University of Strathclyde, John Impagliazzo, Hofstra University and Alan Clements, University of Teesside

The Computer Society of the Institute for Electrical and Electronic Engineers (IEEE-CS) and the Association for Computing Machinery (ACM) established the Joint Task Force on Computing Curricula 2001 (CC2001) to undertake a major review of curriculum guidelines for undergraduate programs in computing. The effort was to match the latest developments of computing technologies in the past decade and last through the next decade. The Computing Curriculum 1991 and other previous efforts of the IEEE-CS and ACM did not distinguish computer science from computer engineering programs. The IEEE-CS and ACM established the Computing Curriculum - Computer Engineering (CCCE) Task Force in 2001 to develop a separate volume on computer engineering curricula to complement the CC2001 report. The work of the CCCE Task Force appears as a report available for review on the web. This report has undergone extensive review, including an NSF-sponsored workshop. By the time of this conference, the final report will have been presented to the IEEE-CS and ACM, and made available for distribution. This panel presents an overview of that report.

DEVELOPMENT OF THE MODEL CURRICULUM FOR COMPUTER ENGINEERING

David L. Soldan, Kansas State University, Victor P. Nelson, Auburn University, Andrew McGettrick, University of Strathclyde, John Impagliazzo, Hofstra University, Pradip Srimani, Clemson University, Mitchell D. Theys, University of Illinois at Chicago and Joseph L. A. Hughes, Georgia Institute of Technolgy

The field of computer engineering has emerged as one of the principal areas of study throughout the world, making the subject area critical in the development of new computer systems, devices, and products. A Joint Task Force of the IEEE Computer Society and the ACM has recently published a report on its three-year study of Computing Curricula for Computer Engineering (CCCE). This paper presents a summary of the CCCE report. It will describe the elements constituting computer engineering, identify the process that has resulted in the publication of the computer engineering report, and give an overview of the final publication.

Session F3C: Computer Science Education 4

Chair: Jinhua Guo, University of Michigan-Dearborn

Time and place: Friday, October 22, 2004, 2:30 p.m. - 4:00 p.m. *Waterfront North*

RMI: OBSERVING THE DISTRIBUTED PATTERN

Dan-Adrian German, Indiana University Bloomington

This paper presents a software design pattern that capitalizes on the object-oriented patterns already representing the foundation of Java RMI. Providing complete separation between the design and deployment stages, the pattern (not to be confused with an API) allows its user to write code that can run either locally on a single virtual machine, or over the network across several virtual machines, without any modification. The only restrictions placed on the user s code are those specified by Java RMI.

TEACHING OO CONCEPTS - A NEW APPROACH

Lena Kallin Westin, Umeå University and Marie Nordström, Umeå University

In recent years, students have become less active, resulting in lower attendance in lectures and practical sessions. In addition to this, the number of students enlisting in our programmes has decreased. Moreover the passing rates for initial courses have dropped severely. This generates problems because the students failing first year courses cannot move on to higher level courses. Not only can this be devastating for individual students, but it can also affect the variety of higher level courses. In an attempt to prevent these problems we focused on the introductory programming courses (CS1) in order to enhance the oppor-tunities for the students to become successful. One action taken was a research project initiated to radically change the way object-oriented programming is taught in CS1. Another action was to introduce the Supplemental Instruction programme (SI). SI helps students master content while they develop and integrate learning and study strategies. This paper will give a short introduction to these ac-tions. Results are presented along with a discussion con-cerning the problems in teaching object-oriented concepts and problem solving.

WORK IN PROGRESS DEVELOPING AN INTERACTIVE VISUALIZATION TOOL IN TEACHING SYNCHRONIZATION PRINCIPLES

Bo Hatfield, Salem State College, Mei Zhang, Cadence Design System and Lan Jin, California State University, Fresno

Synchronization is a very important concept in computer science and engineering. It is a required topic in courses of various levels concerning operating systems, system programming, uniprocessor/multiprocessor systems, distributed systems, computer networks, and databases. Nevertheless, due to the dynamic nature of the computing events involved, synchronization is difficult for instructors to teach and difficult for students to understand. The proposed work is intended to develop an interactive visualization software tool that can be used to (1) demonstrate the existence of synchronization problems and (2) illustrate the principles and workings of the synchronization techniques used to solve those problems. The tool, implemented in Java, allows the user to dynamically configure a synchronization environment. The user can choose one of several synchronization techniques, such as binary semaphores, counting semaphores, or monitors, to remedy a problem. Similarly, the synchronization of the interacting processes is animated.

WORK IN PROGRESS STUDENT RETENTION AND RECRUITMENT IN COMPUTER SCIENCE PROGRAMS

Tyson R Henry, California State University Chico, Hilary Holz, California State University Hayward, Catherine Reed, California State University Hayward, Clarke Steinback, California State University Chico and Akanksha Baid, California State University Hayward

The majority of research on Computer Science student recruitment and retention has focused on underrepresented groups, mostly women. Dwindling Computer Science enrollment is raising interest in recruitment and retention of not just underrepresented students, but all students. This paper describes an effort to build a research collaborative in order to (1) develop research on student recruitment and retention, (2) collect data about student recruitment and retention, and (3) develop new approaches to improve student recruitment and retention. This paper also discusses results from a California State University workshop on Computer Science student recruitment and retention.

WORK IN PROGRESS RE-EXAMINING CLOSED LABORATORIES IN COMPUTER SCIENCE COURSES

Thomas B. Horton, University of Virginia, Ruth E. Anderson, University of Virginia and Christopher W. Milner, University of Virginia

We present early results of a project that ultimately seeks to define how best to design, implement and deliver the next generation of laboratories for courses in computer science. In response to Computing Curriculum 1991 many computing programs adopted closed laboratories, especially for early courses. But advances in computing since 1991 raise questions about why closed laboratories should be used. The project has begun with a re-examination of the goals and strengths of the closed laboratory model. We have defined a classification of the types of activities students carry out in closed laboratories, along with set of rationales for why an activity might be included in a closed laboratory. These results were used to modify some closed laboratories in our CS1 course. We believe that the more complete understanding that our analysis of closed laboratories provides will help us design more effective practicum-oriented experiences for students in computing courses.

Session F3D: K - 12 Outreach Programs

Chair: Patricia Carlson, Rose-Hulman Institute of Technology

Time and place: Friday, October 22, 2004, 2:30 p.m. - 4:00 p.m. *Waterfront South*

TEACHING BEHAVIOR BASED ROBOTICS THROUGH ADVANCED ROBOCAMPS

Matthew Krugman, Colorado School of Mines

Through Colorado School of Mines Robocamps program, teaching materials presenting behavior based robot concepts were developed and taught to middle and high school aged students. The weeklong workshop goal has been to introduce the difference between traditional, or sequential, programming and behavioral, or reactive, programming styles for mobile robots. The topics of what, how, why, and when appropriate situations to implement either control paradigm is covered through hands-on activities. To create reactive agents, students use Brainstem microcontrollers, C language, various sensors, and LEGO materials. Instructional activities lead the students to develop robots that avoid objects, seek a particular goal, and to wander autonomously while allowing particular behaviors to subsume and delegate appropriate robot reactions. Each student's progress is measured through individual journals, qualitative (short answer questions) and quantitative (multiple choice questions) assessments, and oral presentations to parents. Assessment evaluation for this workshop has demonstrated that, if presented properly, more advanced concepts in mobile robotics can be learned by students in this age group. A pretest and posttest on fundamental concepts showed a significant increase in knowledge of behavioral robotics. In addition, evaluation of answers to essay questions demonstrated a stronger depth of understanding of these topics. It has also been observed that the success of this camp could in part be a result of the high level of motivation and enthusiasm of the students. Future camps will attempt to verify and support the pedagogical developments with a fresh group of students, which are new to the Advanced Robocamps program.

BRINGING ENGINEERING FORWARD TO THE HIGH SCHOOLS: ONE UNIVERSITY S EXPERIENCE IN STARTING AN ENGINEERING SUMMER CAMP PROGRAM

Bryen E. Lorenz, Widener University

The concept of Engineering Forward has proven successful in increasing freshman engineering retention, despite the heavy course loading in mathematics, chemistry and physics, which are typically taught by faculty outside of engineering. Under this doctrine, students are engaged early in their college stay through innovative courses with the aim of establishing an engineering identity. The success of this model can be seen in that most engineering curricula now employ some form of the Engineering Forward concept. The author, however, contends that the full potential of this approach lies not only with the engineering freshmen but also at the high school level, where a similar set of imposed mandates has shaped the curricular offerings. To address this problem, many universities have instituted an engineering camp. This paper presents a description of the objectives, planning, methodology, administration and statistical results for the Engineering Summer Camps offered at Widener University. Although many engineering camps exist, this paper is intended to relate how one university, with limited resources, was able to meet this challenge.

INNOVATIVE MODULES TO INTRODUCE ADVANCE SCIENCE AND ENGINEERING CONCEPTS

Grisselle Centeno, University of South Florida, LaNetra Clayton, University of South Florida, Luis Daniel Otero, University of South Florida and Souheil Zekri, University of South Florida

STARS (Students, Teachers and Resources in the Sciences) is a National Science Foundation GK-12 funded project whose objective is to foster systemic change in elementary curricula and enrich math, science and long-term professional development of teachers. The program aims to decrease the current educational gap in science and math present in schools within the same school district, as reflected in the Florida Comprehensive Assessment Test (FCAT). One challenging task is the development of new and innovative modules that introduce advanced science and engineering concepts to third, fourth and fifth grade students from diverse backgrounds. The modules have been designed by graduate Fellows (resources) with knowledge in science, engineering, math and technology. This paper discusses the methodology for module development, formatting and design of the lessons, and implementation in the classroom. A discussion regarding the modules from the viewpoint of teachers, students and Fellows is also provided.

CREATING PROJECT-BASED LEARNING EXPERIENCES FOR UNIVERSITY- K-12 PARTNERSHIPS

Susan E. Powers, Clarkson University and Jan DeWaters, Clarkson University

The development of University K-12 partnerships to promote increased interest in and knowledge of STEM (science, technology, engineering and math) disciplines requires well-planned and implemented curricular content. The content must meet several constraints, including interest to the partner-teacher, relevance to the students to help engage them, and consistency with state and national standards. Through four years of experience, we have developed a process to create new project-based experiences that are used by college students who teach in middle school classrooms. The process involves input from partner-teachers, development of activities and lessons by college students, and oversight and refinement of the content by program administrators. The project-based learning approach is consistent with national and state

standards and has been shown to improve the understanding of basic concepts, to encourage deep and creative learning, and to develop team-work and communication skills. The essential elements of the development process for our project-based curricula are included here.

WORK IN PROGRESS SCIENCE IN THE AFTERNOON: A NEW PUBLIC-PRIVATE OUTREACH PARTNERSHIP

Bill Barker, University of Wisconsin - Madison, Sonya Brown, University of Wisconsin - Madison, Megan Chrysler, University of Wisconsin - Madison, Julie Foertsch, University of Wisconsin - Madison and Kevin Niemi, University of Wisconsin - Madison

The University of Wisconsin - Madison and the Boys and Girls Club of Dane County recently formed a partnership to offer a sustained after-school informal science program to children ages 7-12. Designed to improve scientific literacy and engender an affinity for science, the program provides inquiry-based, hands-on learning opportunities stressing the interdisciplinary nature of science. With an initial focus on the ecology of the local watershed, participants explore methods of scientific inquiry, the nature of watersheds, connections between human activity and water quality, and the ecosystem impacted by the watershed. Given the opportunity to discover scientific and ecological principles firsthand, participants are encouraged to become stewards of their own environment and share what they have learned with friends and families. Sustained exposure to informal science activities will lead to improved performance in science classes and increased likelihood that these children will consider science and engineering careers.

Session F3E: Service Learning

Chair: Mario A. Garcia, Texas A&M University-Corpus Chrsiti
Time and place: Friday, October 22, 2004, 2:30 p.m. - 4:00 p.m. *Sloane*

PEER-CENTERED SERVICE LEARNING

Mark A. Holliday, Western Carolina University and David R. Luginbuhl, Western Carolina University

We believe that improved learning by the undergraduate computer science major is intrinsically linked with improving student engagement. We have developed a framework aimed at encouraging student engagement. Most of the individual ideas are not especially innovative. However, we think others will be interested in how we have integrated them and made them a visible and central part of our undergraduate educational experience. We focus on three particular areas identified as critical for improving student engagement: student-faculty interaction, active and collaborative learning, and experiences outside the classroom. It requires that students take on roles that either previously did not exist or were the sole province of the faculty. The key to this approach is the integration of two techniques that others have identified: peer learning and service learning. Because the service learning is centered on the peer of the student providing the service we use the term peer-centered service learning.

IMPLEMENTATION AND INITIAL ASSESSMENT OF THE DESIGN THAT MATTERS PROGRAM AT MIT AND OTHER UNIVERSITIES

Timothy Prestero, MIT and Neil Cantor, Codirector

This paper describes how Design that Matters has worked with engineering capstone design courses at MIT, Worcester Polytechnic Institute and the University of Cambridge, allowing successive student teams from different universities and engineering disciplines to collaborate on real-world projects for underserved communities in such areas as clean water, medical devices, renewable energy and access to education. We give a short list of projects students have worked on, and we point to some initial indicators of program effectiveness, including survey results and community implementations. We conclude with an overview of lessons learned.

WORK IN PROGRESS - CASE STUDY: IN SERVICE LEARNING INCORPORATED INTO CLASS WORK

Jean Uhl, Georgia Southern University

This work in progress case study involves a nontraditional concept of incorporating an in service learning experience with a course lecture for class credit. In the Construction Management program at Georgia Southern University, we have applied the Habitat for Humanity house construction experience as the lab portion of our Wood Structures course. The students learn about wood structures and wood construction during the lecture portion of the class and then are required to complete their lab at the Statesboro Habitat for Humanity construction site. It is an important experience for the students since they receive a real life look at their lecture material. This active and cooperative learning also provides an opportunity for them to volunteer in the local community. The spring 2004 semester was the second semester that the Habitat for

Humanity lab was in use. It is an ongoing pilot program that initially appears to be successful. We will continue to evaluate this learning environment by student participation, response and Habitat for Humanity feedback.

WORK IN PROGRESS: ESTABLISHING AN ENGINEERING DESIGN CENTER FOR SERVICE-LEARNING AT WESTERN MICHIGAN UNIVERSITY

Andrew Kline, Western Michigan University, Edmund Tsang, Western Michigan University, Carol Crumbaugh, Western Michigan University, Paul Vellom, Western Michigan University and Bill Cobern, Western Michigan University

This paper describes the first-year activities of the Engineering Design Center for Service-Learning jointly established by the College of Engineering and Applied Sciences and the College of Education at Western Michigan University. The Center works in partnership with the local K-12 school system and campus volunteer groups to provide teaching materials, manipulatives, training, and after-school activities to support science, technology, engineering, and mathematics (STEM) instruction. The materials allow K-12 teachers to engage their students in hands-on learning of STEM topics, are designed to be age appropriate, and meet applicable state and school instructional standards. The Center also integrates service-learning within the engineering curriculum. The outcomes for education students are that these future teachers will be capable of describing the work of engineers and technologists to K-12 students, and are able to use stimulating examples of real-world engineering and technology in teaching STEM topics. Engineering students can see an immediate impact of their work in the community outside their regular campus-related engineering studies.

WORK IN PROGRESS - SERVICE LEARNING OPPORTUNITY: A UNIVERSITY AND COMMUNITY PARTNERSHIP IN CREEK RESTORATION

Camilla M. Saviz, University of the Pacific

A service learning opportunity has been incorporated as part of a required upper-division course in Civil Engineering. A collaborative relationship was established between homeowners along Five-Mile Creek, an urban creek in Stockton, CA, and the University of the Pacific Civil Engineering Department. Like most surface waters in California, the creek serves multiple beneficial, and sometimes conflicting, uses. Consequently, it is affected heavily by human activities and experiences water quality problems. Creek analysis and restoration projects have been conducted as part of a Water Resources Engineering course and have provided students with opportunities to develop and apply field, analytical, and technical skills. Students examine and develop solutions for this 'real world' problem; communicate with homeowners; and research political, social, environmental, and regulatory issues. This pilot project serves to demonstrate that community involvement (or "Service Learning") projects can serve an important role in support of learning while providing mutually beneficial opportunities for students and for the community.

Session F3F: Active & Cooperative Learning 3

Chair: Chris Taylor, Milwaukee School of Engineering

Time and place: Friday, October 22, 2004, 2:30 p.m. - 4:00 p.m. *Vernon*

WORK IN PROGRESS - MALE AND FEMALE ENGINEERING STUDENT ROLES AND INTERACTION STYLES ON ONLINE COLLABORATIVE LEARNING TEAMS

Deborah K. Follman, Purdue University, Carla V. Liguore, Purdue University and Cynthia T. Watkins, Purdue University

New types of open-ended problems called model eliciting activities have been implemented in Purdue s required freshman engineering course Engr 106: Engineering Problem-Solving and Computer Tools to promote higher level learning. By requiring a broad skill set, emphasizing technical topics in a broad social and environmental context, and incorporating teaming, these problems could also promote a more equitable learning environment. To this end, we are interested in investigating the types of interactions in which students engage as they solve these problems in teams of four. Transcripts of the discussion boards of sixteen Engr 106 student teams collaboratively solving the problems online have been examined. In this paper, we will provide descriptions of the types of roles (e.g. facilitator, critic, validator) students adopt on teams and the styles (e.g. authoritative, collaborative) with which they enact their roles as well as an overview of the qualitative research techniques and the theoretical framework we employed to identify these roles and styles. Preliminary data including coding reliabilities, the frequencies with which male and female engineering students adopt certain roles or styles, and the enactment of power within the student teams will be presented. Such knowledge will provide insight on how to better teach teaming and diversity awareness, set up student teams, and assess effective teamwork.

A SOCIAL RESPONSIBILITY LEARNING MODULE FOR USE IN COOPERATIVE EDUCATION

Bryan E Dansberry, University of Cincinnati and Cheryl L Cates, University of Cincinnati

Students at the University of Cincinnati are following a new co-op curriculum centered on a set of learning outcomes covering the areas of organizational culture, technology, professional ethics, integration of theory and practice, and social responsibility. Division of Professional Practice faculty have created learning modules tied to these key learning outcomes to be completed by students during their work experience, one module per co-op term. Each module is designed to utilize the work-based learning environment to engage the students in critical thinking exercises which provide insight into these issues as well as generate measurable assessment of student understanding. The social responsibility learning module was created to increase students understanding of their employer s ability to be a corporate citizen, and the impact of corporate citizenship on their co-op employer and on society. This paper will document the learning module on social responsibility which will be integrated into the Professional Practice curriculum at UC beginning in the winter quarter of 2005.

AN ADAPTIVE STRATEGY FOR PEER REVIEW

Raquel M. Crespo, Carlos III University of Madrid, Abelardo Pardo, Carlos III University of Madrid and Carlos Delgado Kloos, Carlos III University of Madrid

Peer review has been widely used in multiple contexts ranging from childhood education to academic research. Numerous documents describe different aspects of the reviewing process. Interestingly, barely any discussion is found about how to better match peer assessors and assesses. In this paper an application of peer review in an educational environment is presented. In such context, it is considered as a pedagogical tool to improve the overall learning experience. It is shown that by carefully assigning reviewers to authors, peer review can be oriented to maximize the benefits of the process. Normally, the mapping between authors and reviewers is simplified to a blinded, random association. The proposed adaptive strategy suggests an effective method for assigning reviewers and authors depending on user profiles and based on fuzzy classification techniques. The strategy requires a set of prototypes (typical author-reviewer pairs) and a set of corresponding weights specifying the interest of each prototype. Genetic algorithms are used to obtain a solution to optimize the assignments of reviewers to authors.

WORK IN PROGRESS - USING USER EXPERIENCE RESEARCH TO DEVELOP NEEDS ASSESSMENT SKILLS OF UNDERGRADUATES

Laura Moody, Mercer University and Joan Burtner, Mercer University

In this paper, a case study of using faculty research as an educational tool for undergraduate students is described. In this case, a preliminary study aimed at developing an integrated understanding of the functional and emotional aspects of user experience with products was conducted. In addition to the primary objectives associated with this aim, the study serves as a educational tool for undergraduate students in industrial engineering and industrial management. The primary objectives of the study are to explore and use a variety of methodologies for developing an integrated understanding of user experience. Undergraduate students in three separate courses participated in the research by: 1) serving as study participants; 2) observing study sessions; and finally, 3) evaluating results. The researchers used the experience to help students improve data analysis skills and to use the results of human factors studies to identify customer needs. Based on the success of this initial endeavor, a variety of follow-up activities are planned.

FROM PEER ASSESSMENT TOWARDS COLLABORATIVE LEARNING

Stephan Trahasch, University of Freiburg

Peer assessment is one form of innovative assessment which aims to integrate learning and assessment. Peer assessment can also be seen as a special type of collaborative learning, where the task can be specified by using so called collaboration scripts. This implies the application of a more or less rigid schema (collaboration script) for structuring the task. Although peer assessment has positive effects on knowledge acquirement there is a lack of web-based collaborative peer assessment systems. Thus we have implemented a peer assessment application for review and discussion of artifacts. In our approach it is new that students use presentation recording tools to create personal presentations. It is possible to use these continuous documents for peer assessment. With this approach we lift restrictions to submit only static documents for peer review.

Session F3G: Topics in Assessment 2

Chair: Melinda Picket-May, University of Colorado

Time and place: Friday, October 22, 2004, 2:30 p.m. - 4:00 p.m. *Percival*

PARTITIONED RECORDING OF TEST AND HOMEWORK SCORES AS A PRACTICAL MEANS OF PRESERVING USEFUL DATA FOR ASSESSMENT

Marion O. Hagler, Mississippi State University

Recording only the total scores for work by each student destroys potentially useful and detailed information about students relative performance on different problem types and subjects. With contemporary software, it has become practical to record and collect scores on homework, tests and laboratory exercises to any level of desired detail and, from this recorded data, to compute, with only modest effort, measures of student performance for each topic listed on the course syllabus or according to measurable outcomes for educational objectives of the course. Because a teacher constructs the assessment workbooks in real time during the course, the workbook provides real-time feedback about student performance that the teacher can use to adapt the program of study during the term. This paper describes assessment spreadsheet workbooks developed for three different electrical and computer engineering courses at Mississippi State University.

UNDERGRADUATE SUMMATIVE ASSESSMENT EXPERIENCES

Robert Winston Brown, RMIT University

Summative assessment is used to qualify students and award accreditation. Employers, learned bodies and associations, contractors of services, patients and a myriad others, expect such qualifications and accreditation to be true and reliable evaluations of the capabilities of the person concerned. However, measuring capability is a complex and difficult undertaking normally involving a range of processes. The matter is complicated by a global increase in cheating driven by high stakes and ready availability of methods and opportunities to dishonestly defeat the assessment processes. There is also a drive for more efficient assessment with lower cost and quicker turnaround. Obtaining individual assessment is logistically more difficult in the face of large student cohorts, and less reliable because of indistinct boundaries between individual work and collaborative work particularly for projects and laboratories. In this paper, some experiences with summative assessment and examination processes including extracting individual measures from team projects, the application and structure of examinations, the use of different types of questions and the efficacy of partially automated grading, will be reviewed.

COMPARING ALUMNI SURVEY DATA OVER TIME TO CLOSE THE ASSESSMENT LOOP

David M. Rooney, Hofstra University and Richard J. Puerzer, Hofstra University

A valid outcomes assessment program exhibits consistency as well as accuracy and fairness in its use of tools. The authors developed an alumni survey several years ago to gauge program success in meeting EC 2000 guidelines. The current paper examines how administering a nearly identical survey to graduates of the intervening years since the last cohort provides some closure to the assessment loop. The more recent survey should give evidence whether departmental actions meant to address shortcomings highlighted in the earlier survey were indeed effective in increasing perceived preparation levels in the areas of concern. If no betterment is recorded, that may be evidence of a more systemic curricular problem requiring yet further attention. In any case, adhering to a regular and timely schedule of administering alumni surveys utilizing an essentially common format fortifies the consistency of an assessment program while also giving the program an all-important temporal scale to validate its efficacy.

DEVELOPING STATICS KNOWLEDGE INVENTORIES

Scott Danielson, Arizona State University

Following the lead of the physics community, engineering faculty have recognized the value of good assessment instruments for evaluating the learning of their students and to evaluate changes in teaching. As a result, significant efforts are underway to develop engineering subject assessment tools. These efforts have focused on developing concept inventories for determining student understanding of the subject s fundamental concepts. But for most engineering subjects, concepts are closely linked to skill components. However, concept inventory developers appear to have relied on a I know it when I see it approach when distinguishing between a concept and a skill. In this paper, a cognitive psychology-based taxonomy of declarative and procedural knowledge is discussed in relation to knowledge assessment in the engineering education literature. This foundation can be used to help distinguish concepts from skills and guide question construction. In addition, the paper describes the process used and resulting delineation of important statics concept and skill statements. An ongoing Delphi process to refine the inventory of these statements, validating their form, and establishing their relative importance by a broad group of subject matter experts is described.

WORK IN PROGRESS - WORK SAMPLING OF BEHAVIORAL OBSERVATIONS FOR PROCESS-ORIENTED OUTCOMES

Mary Besterfield-Sacre, University, Elaine T. Newcome, University of Pittsburgh, Matt Tokorcheck, University of Pittsburgh, Larry Shuman, University of Pittsburgh and Harvey Wolfe, University of Pittsburgh

Recent accreditation practices are migrating towards direct measures of student achievement of the eleven enunciated engineering outcomes. Though common examinations are capable of measuring certain outcomes, they are not fully capable of assessing many of the more process-oriented outcomes such as teamwork, problem solving, design, etc. Rich, in-depth assessment methods such as behavioral observation are desirable because they enable us to investigate student learning outcomes and thus evaluate the students ability to function in the higher level learning domains. Our best current method for doing this (100% observation) requires considerable time and resources. Industry has learned that activities can be assessed using statistical methods that sample the observable environment. Work sampling and related methods use probability theory to reduce the amount of time necessary to observe events or activities that do not occur in a systematic manner without loss of information. We are bridging this gap between educational assessment and industry practices by extending these methods to the observation of intervals that capture the cognitive, behavioral and affective domains of student learning outcomes. This paper describes the research involved in developing sampling intervals and provides preliminary results for one process-oriented outcome that of teamwork.

Session F3H: Exhibitor Showcase

Chair: Robert J. Hofinger, Purdue University at Columbus
Time and place: Friday, October 22, 2004, 2:00 p.m. - 4:00 p.m. *Verelst*

Session F4A: Interactive Session: Surviving Distance Teaching: mistakes to avoid, bullets to bite, and opportunities to make the most of

Chair: Veronica Burrows, Arizona State University
Time and place: Friday, October 22, 2004, 4:30 p.m. - 6:00 p.m. *Chatham*

INTERACTIVE SESSION - SURVIVING DISTANCE TEACHING: MISTAKES TO AVOID, BULLETS TO BITE, AND OPPORTUNITIES TO MAKE THE MOST OF

Veronica Burrows, Arizona State University and Susan Haag, Arizona State University

This session will provide FIE participants at all levels of experience with distance learning specifically, internet-based distance learning an opportunity to focus on the opportunities and pitfalls common to teaching in this medium. This session will focus on three areas: 1) common mistakes of both novices and experienced practitioners and how to avoid them, 2) the unavoidable challenges unique to distance learning and strategies for meeting them, and 3) opportunities for applying distance learning approaches, techniques, and experiences to enhancing research efforts, developing multiple-duty instructional materials, and envisioning engineering education significantly ahead of the cutting edge .

Session F4B: Invited Panel: HP-Funded Engineering Retention Initiative

Chair: Elsa Q. Villa, University of Texas at El Paso
Time and place: Friday, October 22, 2004, 4:30 p.m. - 6:00 p.m. *Savannah*

PANEL - HP-FUNDED ENGINEERING RETENTION INITIATIVE: METHODOLOGIES AND FINDINGS OF FOUR DIVERSE UNIVERSITIES/COLLEGES

Sandy Brooks, Hewlett-Packard Company, Susan W. Brown, New Mexico State University, Pamela Mack, Morgan State University, John Moya, The University of Texas at El Paso and William Oakes, Purdue University

Hewlett Packard (HP) Philanthropy and Education has a long and distinguished history of providing resources to improve education. Most recently, HP created an initiative that invites universities to transform engineering and computer science gatekeeper courses into gateways through curriculum reform, technology integration, and/or improved instruction/ pedagogy. The initiative is targeted at two- and four-year institutions with which HP currently has a recruiting or research relationship. This panel builds on the HP-hosted, one-day symposium that was held at the 2003 FIE Conference that convened over 35 HP partner institutions and will include four institutions that demonstrated significant progress in improving targeted course(s) through innovation in curriculum reform, technology integration, and/or improved instruction /pedagogy. Each of the panel members will present an overview of the curriculum redesign, outcomes, and findings of their

work. The proposed session will provide a venue for the audience to engage in meaningful dialogue with the panel members and other audience members.

ENGINEERING LEARNING COMMUNITIES APPROACH AT THE UNIVERSITY OF TEXAS AT EL PASO
Judith H. Munter, The, John Moya, The University of Texas at El Paso and Elsa Q. Villa, The University of Texas at El Paso

With funding from Hewlett Packard, the Colleges of Engineering and Education at The University of Texas at El Paso have developed an inter-disciplinary research project to measure and analyze the outcomes of reformed processes of teaching and learning. The targeted course is a required sophomore level course for electrical engineering and computer science majors. It had been taught using a traditional lecture mode yielding low pass rates and effectively functioning as a gatekeeper. The reform process included revision of the pedagogical framework, implementation of new policies and practices, and evaluation of these reform efforts utilizing quantitative/qualitative methodology. Initial analysis has generated insights about the potential for educational research methods to clarify key issues in improving engineering education for diverse undergraduate student populations.

HEWLETT PACKARD AND NMSU TOGETHER EQUALS SUCCESS FOR NMSU ENGINEERING AND COMPUTER SCIENCE STUDENTS!
Susan Wightman Brown, New Mexico State University

At NMSU, Math 115: Intermediate Algebra, is identified as an early gatekeeper (a point where multiple barriers can interfere with progress of minority and other CS/Engr students). Beginning the math sequence at this level presents significant barriers to students progression; yet 40% of CS/Engr students must take Math 115 - presenting them with formidable social-psychological, economic, and cultural barriers which may cause students to change their major or to drop out all together. To address this problem and promote success in math, students declaring engineering or computer science as their major participate in a two hour (one credit) auxiliary course, SMET-SI (Science, Mathematics, Engineering, and Technology Supplemental Instruction currently taught as CE 198), that provides discussions and further exploration of mathematical concepts with an inquiry approach that applies these concepts in solving engineering or computer science problems using technology as an additional investigative tool. By helping the students see the practical engineering application of mathematics and use of technology at this early stage of their college career, the student will stay enrolled as an engineering or computer science major.

Session F4C: Computer Science Education 5

Chair: Andy Ju An Wang, Southern Polytechnic State University
Time and place: Friday, October 22, 2004, 4:30 p.m. - 6:00 p.m. *Waterfront North*

TEACHING UNDERGRADUATES DATA MINING IN ENGINEERING PROGRAMS
Debra L. Banks, arizona state university, Guozhu Dong, Wright State University, Huan Liu, ASU Main Campus and Amit Mandvikar, ASU Main Campus

The Teaching Undergraduates Data Mining in Engineering Programs project was supported by the National Science Foundation. The project was jointly executed between universities. The project objectives were to: (1) develop an undergraduate data mining course that could be taught in semester or quarter systems and within institutions of varying demographics, (2) establish vehicles and approaches to increase student retention in such a course, and (3) identify data mining skills essential to problem solving. This paper reports on the results of our research effort regarding teaching engineering undergraduates data mining techniques in two different university environments in 2003.

A SIMULATION TOOL TO HELP LEARNING OF OBJECT ORIENTED PROGRAMMING BASICS
Micaela Esteves, Escola Superior de Tecnologia e Gestão de Leiria and Antonio José Mendes, University of Coimbra

In this paper we present the OOP-Anim learning environment. It was developed to help our students to learn the basic concepts of object oriented programming and to develop their programming capabilities using this paradigm. To achieve those goals students must practice intensively the development and debugging of programs. We believe this environment can help, since it uses animation to facilitate program understanding and error detection / correction. This debugging process has a lot of educational potential, as students can learn when correcting their own mistakes. When they reach a working solution, their experience and confidence normally improves, facilitating further learning. In the paper we describe the environment main features, some possible uses and the educational advantages associated with that utilization.

WORK IN PROGRESS - PROMOTING CRITICAL THINKING WHILE LEARNING PROGRAMMING LANGUAGE CONCEPTS AND PARADIGMS

Rosita Wachenchauzer, Facultad de Ingeniería. Universidad de Buenos Aires

The main objective of a course in programming language concepts and paradigms is to introduce the future engineer to the syntax, semantics and pragmatics of programming languages. The emphasis is not put upon a particular language but on the ability to analyse any new one. Thus, an important goal of this kind of course is to furnish the student with critical thinking related to programming languages and programs. Nevertheless, it was very difficult to achieve this goal when a traditional format was used. During the last terms we tried a different format, based on active and co-operative learning. Students work in teams and each team specialises in one language (usually new for them) through the entire course. When new concepts are introduced they confront their language with these concepts. They are also invited to look for innovative characteristics in their languages. Each team communicates these explorations through papers, oral expositions and debates.

CONCEPTS OF PARALLELISM IN AN INTRODUCTORY COMPUTER ARCHITECTURE COURSES WITH FPGA LABORATORIES

Sally L. Wood, Santa and Chris Dick, Xilinx, Inc.

The introductory course in computer architecture or machine organization required of most electrical and computer engineering students has evolved substantially in recent years as technological advances have led to ever increasing processor sophistication. In most cases the introductory course is still built around traditional instruction set architectures (ISA) using actual or simulated processors. However the future will require that working engineers be able to effectively use highly integrated distributed arrays of computational resources. With the widespread use of field programmable gate arrays (FPGA) in student laboratories, it is now possible to introduce basic concepts of parallel structures, such as those used in special purpose high performance graphics processing or digital signal processing, without confronting the complex communication and synchronization issues associated with arrays of processors. An introductory architecture course has been modified to include concepts of parallel structures as well as traditional ISAs. The same FPGAs that can be used to create a simple processor with a basic instruction set can also be used to implement simple structures for parallel computation. Although the design methodology and performance evaluations for these parallel designs are not as mature as the traditional ISA based design, it is still possible to introduce perspectives of parallel design in the introductory course. This paper describes the course and some of the laboratory experience.

WORK IN PROGRESS - ADAPTATION OF A COMPUTER NETWORKS CURRICULUM FOR NON-TECHNICAL AUDIENCE

Jay Pfaffman, University of Tennessee and Itamar Elhanany, University of Tennessee

A variety of computer networks related courses are being offered as part of mainstream curricula at the undergraduate as well as graduate level in many engineering and computer science programs. The pervasiveness of computer networks in all aspects of industry and education make a basic understanding of networking as important to non-science majors as other scientific disciplines such as physics and chemistry. Understanding how the Internet works is a fundamental part of modern engineering education, but there are few opportunities for those in non-technical fields to learn about networking. As networking becomes increasingly important to business and K-12 education, those without engineering background will become more likely to be in positions that require them to make decisions about how networks will be deployed and used. This paper describes first steps in adapting a standard computer networking curriculum, as required by most science and engineering programs, to the needs of those outside of engineering disciplines. The paper is divided into two sections; the first addresses the parts of the curriculum that we are initially concerned with implementing. The second section discusses educational techniques that we are using to help students learn these unfamiliar concepts in ways that should enable them to use the knowledge when appropriate.

Session F4D: K - 12 Pre-engineering Courses, Modules, and Curricula

Chair: Ismail Fidan, Tennessee Technological University

Time and place: Friday, October 22, 2004, 4:30 p.m. - 6:00 p.m. *Waterfront South*

THE DEVELOPMENT OF A PRE-COLLEGE ENGINEERING CURRICULUM FOR HIGH SCHOOL STUDENTS: DESIGN AND IMPLEMENTATION

Dale Harrell, University of West Florida, Mohannad Bataineh, University of West Florida, Eman El-Sheikh, University of West Florida and John Spolski, Choctawhachee High Shool

In an effort to increase awareness in science and engineering education in the northwest Florida region, the University of West Florida engineering department initiated a pre-college engineering program to be implemented over the four years of high school education, The program is designed to include four basic and intermediate level courses specifically tailored towards electrical and computer engineering and computer science majors. Statistical data show increasing demand for engineers in the northwest Florida region due to possible increase in scientific activities at two of the largest navy and air force bases in the nation. This trend seems to be the case at the national level as well. Participating students who successfully complete the four year program will earn university credits fully transferable to the University of West Florida, and possibly other public and private universities and colleges throughout the United States. Simultaneously students will satisfy high school graduation requirements and receive weighted credits.

THE USE OF APPLIED PROCESS CONTROL SYSTEMS DESIGN TO ATTRACT ENGINEERING STUDENTS

Jeffrey R. Mountain, The University of Texas at Tyler

Hands-on, design oriented experiences have been shown to increase awareness of engineering as a profession and to attract students to enter engineering programs. Most of these programs, while very successful, specifically target highly specialized industries. In an effort to appeal to a wider variety of engineering disciplines, the University of Texas at Tyler, with the aid of National Science Foundation grant funding, has proposed to use the multidisciplinary process control industry as a theme to attract students into the engineering profession. The topic area of process controls has applicability to a wide range of engineering disciplines including agricultural, chemical, electrical, mechanical, and petroleum engineering. This paper will describe how the Process Control Breadboard, a proof of concept system developed to attract and retain engineering students, is being used as both a demonstration tool and a hands-on design, build, test activity for K-12 outreach activities. Preliminary results from initial outreach activities will be presented along with the plan for future activities to stimulate interest, awareness and enrollment of highly qualified engineering students.

WORK IN PROGRESS INTEGRATION OF SENSORS INTO HIGH SCHOOL CLASSROOMS

Adam Crowley, University of Maine, Stephen Godsoe, Bangor High School, Constance Holden, Univeristy of Maine and John Vetelino, Univeristy of Maine

The GK-12 Sensors! program is a collaborative effort between the University of Maine (UM) and Maine high schools. The program is focused on sensor technology, which is a high profile research area at UM. Sensors, which cover many engineering and science disciplines, have been integrated into high school courses such as chemistry, physics, mathematics, computer science and also civics. It is anticipated that students exposure to sensors will encourage them to follow career paths in science and engineering. The program, which is completing year two, has had a significant impact on a number of Maine high schools, high school teachers and students, and UM graduate students. The program operation, accomplishments and activities are presented with plans for the program s future.

A PROJECT IN EMBEDDED SYSTEMS DESIGN AND DEVELOPMENT: A PARTNERSHIP WITH AREA HIGH SCHOOL SCHOLARS

Patrick Otoo Bobbie, Southern Polytechnic State University, Jennifer Uboh, South Cobb High School and Brian Davis, Kennesaw Mountain High School

The project described in this paper is on a partnership program between Southern Polytechnic State University (SPSU), Kennesaw Mountain High (KMH) School, and South Cobb High (SCH) School, all in Cobb County, Georgia. The project is driven by an overarching goal of establishing a community-based partnership, which focuses on an integration of education, research, and training in the design and development of embedded systems. The motivation for the project stems from the plausibility of 1) extending embedded system research / knowledge to high school (K-12) students and 2) enhancing their interests and opportunities in the field. The project involves several high school students and computer science and computer engineering technology undergraduates and graduates. The college students serve as role models, working side-by-side with the high-school students. The students are trained in the design and development of hardware/software systems for embedded applications. The project, dubbed as a Community-based Partnership for Integrated Research and Education (COPIRE), is housed in the COPIRE Research laboratory at SPSU.

WORK IN PROGRESS - CROSSING THE BRIDGE: AN ENGINEERING PRELIMINARY PROGRAM

Mario León de la Barra, Universidad Técnica Federico Santa María, Guillermo León de la Barra, Universidad Técnica Federico Santa María and Ana María Urbina, Universidad Técnica Federico Santa María

In Chile the transition from high school level to university is characterized as a process full of challenges and difficulties. Good secondary level students fail in their initial assessments and grades, suffering traumatic consequences that severely damage their self esteem. During 2003 academic terms Santa Maria Technical University (UTFSM) at Valparaiso, Chile, offered a pilot program to good last level high school students who had previously to be recommended by their corresponding Math or Physics teacher. They could attend first year Engineering Courses such as Math and Introduction to Engineering (Module I) or Physics and Introduction to Engineering (Module II). Afterwards, if they succeeded in these courses and if they decided to enter UTFSM through the Chilean SAT, those subjects could automatically be validated.

Session F4E: Technology Supporting Learning

Chair: Renee Rogge, Rose-Hulman Institute of Technology

Time and place: Friday, October 22, 2004, 4:30 p.m. - 6:00 p.m. *Sloane*

TECHNOLOGY ENABLED CURRICULUM FOR A FIRST-YEAR ENGINEERING PROGRAM

Larry D. Stetler, SD School of Mines & Technology, Stuart D. Kellogg, SD School of Mines & Technology, Jon J. Kellar, SD School of Mines & Technology, David J. Dixon, SD School of Mines & Technology, Glen A. Stone, SD School of Mines & Technology, Larry A. Simonson, SD School of Mines & Technology, Zbigniew J. Hladysz, SD School of Mines & Technology, Carter J. Kerk, SD School of Mines & Technology, Jason T. Ash, SD School of Mines & Technology and Heidi L. Sieverding, SD School of Mines & Technology

For the past three years, all first year engineering students at the South Dakota School of Mines & Technology have enrolled in a common introduction to engineering course. The course features a common curriculum contained on a course CD, utilization of technology tools, an engineering design project, and introduction to technical writing. All sections of the course are taught in a single classroom that is set up with tables and equipped with wireless notebook PCs. Technology tools are focused on collection, manipulation, and presentation of data using electronic portfolios, a permanent digital archive, spreadsheet tools, and data loggers. The use of spreadsheets for solving engineering problems is illustrated through example problems and several tutorial exercises that are both contained on the curricular CD. Portable data loggers are utilized in lab projects for collecting data that is then manipulated and analyzed on a spreadsheet. The design project requires students teams to function within specified design parameters, construct a simple device that is then used to collect data, analyze the data, and present the results both in an oral presentation and a formal technical document. In this paper, examples of technology uses in the curricular materials, engineering problems, and design projects used will be illustrated and discussed.

LEARNING ENGINEERING MECHANICS THROUGH VIDEO PRODUCTION

Glenn W. Ellis, Smith College, Kathryn S. Lee, Smith College and Alyssa Tham, Smith College

This paper presents an approach to integrating student-produced videos into an engineering mechanics class. Each student worked in a production team to produce a two- to three-minute educational video investigating a combined translational/rotational motion. Through this experience students expanded their communication skills by becoming familiar with the technical and creative skills of video production. They also expanded their understanding of mechanics by studying real-world applications and communicating their results. Throughout the project, students received extensive assistance from the college s media services staff including workshops on managing and planning production, shooting and editing. Once the videos were completed, students were encouraged to reflect upon their experience through peer reviews and group reflections. Student feedback is presented and supports the success of the activity.

SUPPORTING FACULTY GOALS DURING STUDENT PRESENTATIONS VIA ELECTRONIC NOTE-TAKING

Evan Golub, University of Maryland

As we have moved to a more technology-based classroom, much attention has been paid to using computers to present material. Computer-based presentations can be a powerful tool for faculty, but as more and more students are coming to class with laptop and tablet computers, attention is being paid to questioning the opportunities this could present to these students in the form of enhanced note-taking opportunities. This paper explores the idea of faculty (rather than the students) using a computer note-taking system during student presentations to support interaction, evaluation, and feedback. Good annotations and records of a presentation can assist in more organized and effective feedback both during class as

well as after class. It can also be beneficial in the evaluation of grades during the assignment stage of a faculty member's work. The techniques discussed can be extended to a wide variety of student presentation assignments.

WORK IN PROGRESS SUPPORTING AUTOMATIC CAPTURE IN PROBLEM BASED LEARNING ENVIRONMENTS

Lonnie D. Harvel, Georgia Institute of Technology, Wendy Newstetter, Georgia Institute of Technology, Khai Truong, Georgia Institute of Technology and Gregory D. Abowd, Georgia Institute of Technology

Previous work at Georgia Tech has demonstrated the usefulness of classroom capture in traditional lecture settings [1]. Students use captured experiences in a variety of ways: study, reference, and exploration are a few. However, to provide ubiquitous and distributed support for capturing educational experiences, we need to extend capture to non-lecture learning environments. Study groups, Problem Based Learning (PBL) groups, tutoring sessions, individual study, and seminars are all examples of learning environments that are not lecture driven. In this paper, we describe the ongoing design and development of a system that automatically captures the meetings of a PBL group in biomedical engineering. We have based the system design on an initial study of student behavior in existing PBL groups and the ad hoc capture strategies that they employ. We discuss our observations and the resulting design criteria we have developed. We conclude with a description of the ongoing research and the next stage of experiments.

WORK IN PROGRESS - REMOTE LECTURE DEMONSTRATIONS AND EXPERIMENTS FOR COMMUNICATION ENGINEERING

Ladimer Nagurney, University of Hartford

This work in progress describes the development of remote lecture demonstrations and experiments for communication engineering. The remote panel feature of LabVIEW is used to allow access to Virtual Instruments (VI s) through a web browser. The experiments, themselves are located in the laboratory, saving the time and effort off moving all the equipment to the classroom. Full experiments, rather than simulations of the phenomena are used. In the classroom the remote panels are accessed through a wireless internet link. This work-in-progress will conclude with a discussion of several extensions of these ideas.

Session F4F: Innovative Courses & Programs

Chair: Jeffrey Newcomer, Western Washington University

Time and place: Friday, October 22, 2004, 4:30 p.m. - 6:00 p.m. *Vernon*

MODELING NATURE: AN INNOVATIVE APPROACH IN BIOENGINEERING

George D. Catalano, SUNY Binghamton

The newly formed bioengineering department at the State University of New York at Binghamton has taken an innovative step in integrating a technical elective in bioengineering with sufficient humanities content to qualify as a humanities course according to the university criteria.

WORK IN PROGRESS A FOUR YEAR FOLLOW-UP: INTEGRATION OF MATH, PHYSICS AND ENGINEERING, A PILOT STUDY FOR SUCCESS

Brett H. Hamlin, Michigan Technological Univ. and Gretchen L. Hein, Michigan Technological Univ

The inherent integration between mathematics, physics, and engineering is obvious to experienced engineers and faculty, however, many incoming students find it hard to see the connections. During the 1999-2000 academic year, a pilot study was conducted to see the effects of cohort scheduling students into integrated sections of calculus, physics, and first year engineering courses. Calculus-ready student were chosen randomly and asked to participate in this study. Those declining our offer were used as our control group. The control and the test groups had similar compositions of majors, SAT/ACT scores, and high school backgrounds. Initial results of this study show that students in the test group scored significantly higher on common exams. One year follow-up analysis shows that these students continue to have overall higher grade point averages, and self-report a high level of academic confidence. This work in progress highlights the integration process, including the active collaborative teaching/learning styles used, and shows the progress of the cohort students four years after the initial study. It builds heavily on prior work of these authors.

MUSICAL STRINGS AND SOUND BOARD MATERIALS NEW EXERCISES FOR MATERIALS ENGINEERING

Kathleen L. Kitto, Western Washington University

Two years ago, students in Introduction to Materials Engineering began studying basic subject areas within the course in the broad context of musical instrument design. Results from the initial assessment data show that the students enjoy the

course more and score higher, as a group, on certain examination questions. For example, a classic set of problems involves calculating stress, strain, yield, and the elastic constant given load and elongation data. The new way to introduce these same concepts is to use the tuning and design process for a stringed instrument. While many students are unaware that objects strain under load, they do know that musical strings change pitch as the load is changed during tuning. Once the students understand the underlying concepts based on idealized musical strings, they more easily transition to classical problems. This paper describes the new exercises and design problems that were developed; it also gives the data needed to develop many additional exercises. Lectures and data sets will be available on a CD. The paper concludes with the initial assessment data and goals for changes in the course.

COMMUNICATING BEYOND THE CAMPUS: PREPARING ENGINEERS FOR THE PROFESSION

Marjorie T. Davis, Mercer University

Technical communication for engineering students should focus on the real demands of professional communication in the workplace. Since 1893, engineering educators have called for education in engineering English, and today technical communication faculty are partners in delivering appropriate courses. This paper describes one successful junior-level course at Mercer University.

A CURRICULUM FRAMEWORK FOR EVOLVING AN INFORMATION TECHNOLOGY PROGRAM

Kenneth L. Alford, United States Military Academy, Curtis A. Carver, U.S. Military Academy, Eugene K. Ressler, U.S. Military Academy and Charles W. Reynolds, U.S. Military Academy

CCurriculum development is always a challenging and interesting experience since it usually must be done while continuing to teach and support an existing curriculum. This paper outlines a methodology for the creation of a new Information Technology major at the United States Military Academy at West Point, New York. The methodology uses the notion of a three-course thread of existing courses that typically have a shared prerequisite structure. Over time, these threads can evolve as new courses and new threads are developed. The new West Point Information Technology major consists of a four-course core curriculum, multiple three-course threads, and a senior-level integrative experience. Information Technology threads cover a wide range of topics in depth, including such diverse subjects as sensors, computer programming, information assurance, electrical engineering fundamentals, computer science fundamentals, computer theory, information systems engineering, databases, network and web technologies, and human factors. Students are allowed to select three threads.

Session F4G: Capstone Design 1

Chair: Russ Meier, Milwaukee School of Engineering

Time and place: Friday, October 22, 2004, 4:30 p.m. - 6:00 p.m. *Percival*

ON BECOMING A WINNING STUDENT TEAM: PLACING THIRD IN AN INTERNATIONAL DESIGN COMPETITION

Margaret R. Heil, North Carolina State University, Robert J. Fornaro, North Carolina State University, Nathan D. Green, Bureau of Labor Statistics, Jeremy W. Maness, SmartPath and Whitmel H. Webb, Hydrill, Inc.

In the Senior Design Center of the Computer Science Department at North Carolina State University, a model has been outlined that uses teaming as a framework to support professional communication and software development process to improve student project performance. The model described above was used as the basis to form a team of computer science students who entered the IEEE Computer Society International Design Competition (CSIDC 2003). The theme of CSIDC 2003 was Added Value: Turning Computers Into Systems. The NC State student team created "Diet Download," a system that uses a bar code scanner coupled with a PDA to assist a person with following a diet plan as he or she does grocery shopping. This paper describes the experience of the CSIDC 2003 student team on their journey from the formation of their team to their third place finish in this worldwide competition.

TEACHING FUNCTIONAL DECOMPOSITION FOR THE DESIGN OF ELECTRICAL AND COMPUTER SYSTEMS

Chris Coulston, Penn State Erie, The Behrend College and Ralph M. Ford, Penn State Erie, The Behrend College

Clearly defining a detailed and realistic design is often challenging, and the failure to do so leads to problems in the subsequent implementation phase. They range in severity from difficulties in testing, to a partial or complete redesign, or a failed design. The method of functional decomposition is a powerful tool for designing computer and electrical systems that addresses these problems. The formal application of functional design techniques improves the quality of designs

developed in capstone projects, and is widely applicable to many domains. This paper advocates and addresses the teaching of the functional design technique for computer and electrical systems.

WORK IN PROGRESS ART TO PART IN ENGINEERING EDUCATION

Paul Zang, Kettering University, Pavan Devanahalli, Kettering University and Maciej Zgorzelski, Kettering University

This paper reports on the work-in-progress of a unique course offering in the Mechanical Engineering Department of Kettering University tentatively called Art to Part. The mission of the course is to bring together a number of previous computer and design courses into a senior level design-based manufacturing course. Students model and analyze their designs, and then using either a Z-Corp Rapid prototyping machine or EMCO Lathe or Turning Centers, manufacture their designs. Once the students designs are produced, the 3-D models are checked against the original computer model through the use of a Coordinate Measuring Machine to validate the models accuracy. Extensive collaborative student teamwork is developed using computer Product Lifecycle Management software. This course is sponsored by the Manufacturing Division of General Motors.

HOLISTIC MECHANICAL ENGINEERING EDUCATION WITH A MECHATRONIC PLATFORM FOR LEARNING

Vojislav Gajic, Oregon State Univeristy, Donald Heer, Oregon State University, Matt MacClary, Oregon State Universitry, Geoffrey Frost, Oregon State University and Terri S. Fiez, Director

A new platform for learning has been developed for mechanical engineering programs at Oregon State University with great success. This new platform provides hands-on experience, encourages innovation, and presents the means for a more holistic education of mechanical engineering graduates. By combining experiences in electronics, programming and a heavy dose of mechanical theory and practice students can use the platform to build exciting projects and test benches.

SYSTEMS AND CREATIVE THINKING AND STUDENT EXPERIENCE OF DESIGN

Cecelia M. Wigal, The University of Tennessee at Chattanooga

The design process takes an initial idea or problem and converts it to a final product or solution. Some state that creative thinking occurs when the initial idea is novel and becomes a valued product for a specific application. A definition of systems thinking states it as a means for working through the design process. It helps define a phenomenon holistically by its contents, objectives, interactions, relationships, and environment and uses analysis and synthesis to form new conclusions. This paper describes the basic theories behind systems thinking and creative thinking and relates them to the design process. The paper emphasizes the application of system and creative thinking in the freshman design course at the University of Tennessee at Chattanooga (UTC). This course emphasizes the use of systems and creative thinking in its instruction and application of the design process.

Session F4H: Exhibitor Showcase

Chair: Robert J. Hofinger, Purdue University at Columbus

Time and place: Friday, October 22, 2004, 4:30 p.m. - 6:00 p.m. *Verelst*

Session S1A: Interactive Session: Concept-based Engineering Education: Designing Instruction to Facilitate Student Understanding of Difficult Concepts in Science and Engineering

Chair: Ruth A. Streveler, Colorado School of Mines
Time and place: Saturday, October 23, 2004, 8:00 a.m. - 10:00 a.m. *Chatham*

INTERACTIVE SESSION: CONCEPT-BASED ENGINEERING EDUCATION: DESIGNING INSTRUCTION TO FACILITATE STUDENT UNDERSTANDING OF DIFFICULT CONCEPTS IN SCIENCE AND ENGINEERING
Ronald L. Miller, Colorado School of Mines, Ruth A. Streveler, Colorado School of Mines, Barbara M. Olds, Colorado School of Mines and Mary A. Nelson, University of Colorado-Boulder

This Interactive Session will provide an active learning environment where participants will: Review and analyze the results of three difficult concepts studies in engineering and science, Engage in discipline-based discussions about the difficult concepts in their respective fields and, Begin to design instruction that fosters student conceptual understanding. The session will expand upon the successful FIE 03 Interactive Session Why are Some Science and Engineering Concepts So Difficult to Learn? Identifying, Assessing, and Repairing Student Misunderstanding of Important Concepts. However, participants do not need to have attended that session to benefit from this one.

Session S1B: Undergraduate Research and Life-Long Learning

Chair: Elizabeth A. Eschenbach, Humboldt State University
Time and place: Saturday, October 23, 2004, 8:00 a.m. - 10:00 a.m. *Savannah*

A RESEARCH INITIATIVE TO CLOSE THE GAP BETWEEN UNDERGRADUATE AND GRADUATE SCHOOL IN ENGINEERING
Miguel A. Labrador, University of South Florida, John Wolan, University of South Florida, Grisselle Centeno, University of South Florida, Ashok Kumar, University of South Florida, Gray Mullins, University of South Florida and Rudiger Schlaf, University of South Florida

Recent statistics indicate a declining population of undergraduate engineering students that continue toward advanced engineering degrees. This steady downturn in the number of graduate engineering students has fueled fears that the future of the nation s manufacturing and high technology industry will be damaged by a severe shortage of skilled engineers unless urgent steps are taken to halt and reverse the decline. In response, The College of Engineering (CoE) at the University of South Florida implemented an internal Research Experience for Undergraduates (REU) initiative designed to provide the student with a valuable research encounter. What has resulted is an important retention in the number of engineering undergraduate students enrolling in our graduate program following their REU experience and a systematic approach to integrate a large number of undergraduate students into the research efforts of the college. In this paper we describe our experience and provide guidance for other interested institutions to implement this initiative. Our initial results show that 64% of our graduates continued toward graduate engineering degrees as a direct result of their research experience.

IMPLEMENTING IRDA ON THE MSP430: A PROJECT DEVELOPMENT UNDER THE UNDERGRADUATE RESEARCH/CO-OP EDUCATION MODEL
Manuel Jimenez, Univ. of Puerto Rico at Mayaguez and Melisa Nuñez-Arzuaga, University of Puerto Rico at Mayaguez

The combination of undergraduate research and co-op education has been found to be an effective way of building successful relations between academia and industry, as reported by the application of the undergraduate research/co-op educational model (UR/Co-op) developed at the University of Puerto Rico at Mayagüez. This paper illustrates the successful application of the UR/Co-op model for developing an industry-sponsored project in the implementation of the Infrared Data Association (IrDA) protocol on the Texas Instruments MSP430 microcontroller. This protocol has become the defacto industry standard for short-range infrared data exchange between portable computing and communicating devices. We describe how the structure of the UR/Co-op educational model was used in the development of the project, while providing some technical details of the protocol, which highlight the student learning process. The discussion illustrates how the application of the model provided a framework for a symbiotic relation where both the sponsoring company and the students involved benefit in the exercise.

CIRC/METS: A SCHOLARSHIP PROGRAM TO ASSIST ENGINEERING TRANSFER STUDENTS TO GRADUATE AND TO ATTAIN A GRADUATE DEGREE

Mary R. Anderson-Rowland, Arizona State University, Donna M. Zerby, Arizona State University and Paul C. Johnson, Arizona State University

The CIRC/METS project Collaborative Interdisciplinary Research Community/Maricopa Engineering Transition Scholars is an academic scholarship program funded by the National Science Foundation to retain students in engineering degree programs and to create interest in pursuing an advanced degree in engineering. This pilot program targets women and underrepresented students who transferred from community colleges to four-year engineering degree programs to address their unique needs as transfer students. Many engineering schools have developed retention programs to assist entering engineering freshmen adjust to college life. However, little attention has been given to the community college transfer student entering a four-year engineering school. The goal of CIRC/METS is to provide students encouragement and support to complete an undergraduate degree in engineering with the goal that the students will aspire to attain an advanced degree in engineering. The paper reports on the recruiting process for the program and on the CIRC/METS workshops (five per semester). The workshops concentrated on connecting students with ASU faculty to get research experience and on strategies for how to best present themselves when applying to graduate programs. The paper also reports on student feedback and what we have learned about strategies to motivate CIRC/METS students to pursue an advanced degree in engineering.

SMALL GROUP, SELF-DIRECTED PROBLEM BASED LEARNING DEVELOPMENT IN A TRADITIONAL ENGINEERING PROGRAM

Kevin C. Bower, The Citadel, Timothy W. Mays, The Citadel and Christopher M. Miller, The University of Akron

Criterion 3 of ABET 2003-2004 Criteria for Accrediting Engineering Programs [1] requires that all engineering programs demonstrate that their graduates possess the ability and desire to become lifelong learners as well as an ability to formulate and solve engineering problems. Self-directed problem based learning is a pedagogical approach that can help students learn and retain material while developing skills for lifelong learning. The question this paper seeks to answer is can this approach be applied effectively by a single professor in a program where students are accustomed to traditional teaching techniques? The justification and description of the pedagogical approach used and preliminary results are presented which show a shift in students learning preferences and motivation toward lifelong learning. In addition, the impact this pedagogy has on students performances and results from teaching evaluations are compared to data gathered from semesters where the class was taught using traditional lecture based instruction.

AN INTERNET DELIVERED COURSE: INTELLECTUAL PROPERTY LAW FOR ENGINEERS AND SCIENTISTS

Howard B. Rockman, Univ. of Illinois at Chicago

Practically every engineering and science student will someday come face to face with the intellectual property laws that grant exclusive rights in inventions and creative works. However, the engineering and science school curriculums in a majority of our technology education institutions are conspicuously void of courses directed to this important subject. To address this situation, an internet based course titled Intellectual Property Law for Engineers has been created and presented for several years at the College of Engineering at the University of Illinois at Chicago. The substantive material of the course can be properly presented by a series of internet audio lectures that maintain the interest of the students. Student questions and comments are handled by e-mail and synchronous chat room sessions are available with all students participating.

WORK IN PROGRESS - ADAPTIVE EXPERTISE: BEYOND APPLY ACADEMIC KNOWLEDGE

Sean Brophy, Vanderbilt University, Lynn Hodge, Vanderbilt University and John D. Bransford, University of Washington

A common attribute related to expertise is the speed and efficiency experts display as they apply what they know to solve novel problems in their domain. Much of our assessment methods focus on this ability to process information quickly and identify solutions to common problems as a display of competency in a particular skill and/or depth of domain knowledge. However, as we review certain examples of expertise we begin to see that this fluency only provides one dimension of the kinds of expertise students should display after graduation. In some cases students may only be able to displaying routine expertise for specific problems. We want our learners to have flexible knowledge that allows them to invent ways to solve familiar problems and innovative skills to identify new problems. We suggest that the more desirable definition of expertise relates to students adaptive-ness to identifying and solving novel problem. This display of adaptive expertise

ultimately leads to students depth of knowledge and habits of mind that lead to success in their career and enable them to be innovators in their field. This paper explores the characteristics of adaptive expertise and its implication for instruction and assessment in undergraduate engineering education.

Session S1C: Faculty Development

Chair: Trond Clausen, Telemark University College

Time and place: Saturday, October 23, 2004, 8:00 a.m. - 10:00 a.m. *Waterfront North*

CENTERS FOR EXCELLENCE IN ENGINEERING EDUCATION: A CASE STUDY

Helen M. Grady, Mercer University School of Engineering

In 2000, Mercer University established a Center for Excellence in Engineering Education (CE3) to promote excellence in teaching and to support engineering faculty in their efforts to use technology to improve student learning of engineering and science. This paper will report the results of various CE3 initiatives, such as workshops, biweekly faculty brown-bag lunch sessions (LunchBytes), individualized technical support, a Center website with technology tips, an electronic newsletter, a digital library, instruction in technology use, creation of on-line faculty home pages and course templates, instructional design, and online math labs. The efficacy of these various initiatives will be discussed.

TIME PROFESSORS SPEND IMPROVING THEIR TEACHING

James E. Mitchell, Drexel University

Drexel University s Outcomes Experiment explored whether there is a correlation between time invested in improving teaching skills and a plausible measure of student learning. Voluntary participants were given a financial incentive to engage in self-selected teaching improvement activities. To receive the reward ($40 per hour, deposited into a discretionary account), they had to report their time spent on all activities related to improving their teaching in a selected course over multiple, clearly defined periods. The data collected over five years show that teaching improvement is a tiny part of most engineering professors time use, even when there is a monetary incentive the median reported was 0.5% of a normal work week, whereas we expected more than four times that amount based on extrapolations from national surveys. In interviews, participants reported that competing time demands simply made teaching-related professional development a luxury they could not afford, despite their interest and a financial incentive. This, in itself, says much about the culture in which engineering faculty operate.

PROMOTING ACADEMIC INTEGRITY IN YOUR FIRST CLASSROOM

Valerie Maier-Speredelozzi, University of Rhode Island

Many new engineering educators are not fully aware of the prevalence of cheating among undergraduates. As many as 60-75% of graduating engineering students self-report cheating during undergraduate school. New faculty members need to be aware of academic dishonesty statistics and take steps in their first classroom to prevent cheating and promote a culture of academic integrity. This preliminary research study consists of a qualitative survey of assistant professors within the first five years of their career and graduate students preparing for an academic position. Respondents were asked to provide their best estimates of cheating statistics, as well as descriptions of situations they have personally encountered and how they were handled. This paper presents the survey results and summarizes advice for new engineering educators who wish to promote academic integrity in their first classroom setting.

UNDERSTANDING AND IMPROVING FACULTY PROFESSIONAL DEVELOPMENT IN TEACHING

Jean Layne, Texas A&M University, Jeff Froyd, Texas A&M University, Nancy Simpson, Texas A&M University, Rita Caso, Texas A&M University and Prudence Merton, Texas A&M University

Various entities within and related to higher education offer activities designed to promote professional development of faculty in the area of teaching. A critical challenge to these efforts is the lack of understanding of the actual process of faculty development in teaching. Insight into what faculty members believe about learning, assessment, and teaching, and how those views change, would assist efforts to improve faculty development opportunities. This paper will describe the current status of assessment of faculty professional development activities related to teaching. Working from this foundation, it will suggest how to improve assessment strategies and begin the process of measuring the impact of specific program activities on faculty beliefs and practices. In addition, it will describe ways of investigating and drawing conclusions about professional development process paths in the area of teaching, variables that influence and enhance development trajectory, and roles of various types of faculty development activities in this process.

WORK IN PROGRESS: THE MOUNTAIN DID COME

Mauricio Dziedzic, UnicenP and Marcos José Tozzi, UnicenP

The present paper describes how the FIE 2003 papers were employed by the Civil Engineering faculty at Centro Universitário Positivo in order to improve learning through curriculum-wide actions. Before the beginning of the 2004 academic year, each Civil Engineering Professor selected one session from the FIE 2003 proceedings, from which an overview was presented in a faculty mini-conference. During the academic year, some of the ideas discussed are being applied, with preliminary results being included at the time of writing.

WORK IN PROGRESS - COMPUTER SECURITY FACULTY DEVELOPMENT WORKSHOP

Doug Jacobson, Iowa State Univeristy and James A. Davis, Iowa State University

The Information Assurance Center at Iowa State University received support from the National Science Foundation to create a computer security faculty development workshop. Faculty members from Universities in neighboring states participate in an intensive workshop on information assurance and security education, with the goal of introducing security concepts into courses in their home departments. Participants are given access to streaming media versions of the lectures from four of our core security classes along with other supporting material that helps faculty integrate security concepts into their existing courses. Our target audience includes faculty members who are teaching computer science, computer engineering, information systems, or related fields, and are committed to initiating education or research efforts in security in their own departments. This paper describes the workshop, the intended outcomes, the curriculum, and feedback from past workshops. We will also discuss issues related to recruiting faculty, integration of faculty with different backgrounds into a cohesive multidisciplinary security program, and ongoing faculty support.

Session S1D: Engineering Technology Topics 1

Chair: Bill Hutzel, Purdue University

Time and place: Saturday, October 23, 2004, 8:00 a.m. - 10:00 a.m. *Waterfront South*

INTERACTIVE MULTIMEDIA AND DISTANCE LEARNING

Ehsan Sheybani, University Of Southern Mississippi and Giti Javidi, usm

The advancement in technology is shaping every aspect of our life, including education. One decade ago, the Internet was not critical to education. However, now, it has become an integral part of learning process. In this study, it is argued that simply presenting non-interactive text-based information to online learners may not be the best way for distance learning to occur in some abstract subject areas. In order to provide learning opportunities to online students, educational institutions continue to develop online courses that represent electronic versions of text-based traditional classes. These electronic versions often contain materials that lack any significant level of creativity and/or interactivity. This issue is magnified in some area such as Science and Engineering that require hands-on work. The focus of this study is on an Engineering Technology course, Fundamentals of Computer Networks, where the students are required to gain practical experience and/or need to have the means to visualize the network operations.

MICROPROCESSORS: FROM THEORY TO PRACTICE, A DIDACTIC EXPERIENCE

Edson Pedro Ferlin, UnicenP and Valfredo Pilla Jr, UnicenP - Centro Universitário Positivo

The study of microprocessors in Computer or Electronic Engineering Programs faces a great problem: the migration from theory to practice, from the abstract concepts to laboratory experimentation. In this work we present the learning methodology adopted by us in the last years in the Microprocessor Course. In this methodology the student is driven from the classroom theory to laboratory experimentation. Several tools are applied, as the hardware description language for microcomputers systems modeling and FPGA implementations, microcontroller experiments based on proto-o-board assemblies and more complex microprocessor applications based on electronics kits previously developed in the Computer Engineering Program. This methodology applied in this course has been gradually improved through the time, and the improvement process continues, although we believe to have reached a format that integrates theory and practice, where the students have control of the process, involving microprocessors and its applications.

THE CURRENT STATUS OF GRAPHICAL COMMUNICATION IN ENGINEERING EDUCATION

Ronald Edward Barr, University of Texas at Austin

Graphics has always been a requisite form of communication for engineering practice. The history of major engineering accomplishments is replete with examples of graphical communications: from styli etchings on clay tablets to near-recent blueprint drawings. In the last two decades, engineering graphics instruction has been significantly influenced by the

advancement of computers and other new technologies. During this short span, the discipline has gone from teaching manual drafting and pencil drawings to the use of 3-D computer modeling and simulation software. This paper briefly reviews the evolution of graphical communication in engineering practice, and focuses on the current status of graphical communication in the engineering curriculum. This report is bolstered by results of a recent survey conducted at the 2003 Annual Meeting of the Engineering Design Graphics Division of ASEE. The survey proposed an extensive list of student outcomes for engineering graphical communication, as mandated by the new ABET EC2000 outcomes requirement criterion 3 (g): an ability to communicate effectively. Graphics faculty ranked these graphics student outcomes, and accompanying performance criteria, on level of importance in the modern curriculum. The results represent a consensus of current thinking on engineering graphical communication education.

BACHELOR OF APPLIED SCIENCE: AN INNOVATIVE DEGREE PROGRAM

Dale Palmgren, Arizona State University and Scott Danielson, Arizona State University

The Associate of Applied Science (A.A.S.) degree often is considered a terminal degree, used to gain access to the workforce. There are a number of technical A.A.S. degrees leading to employment in the broader engineering community. Many individuals who originally gained entrance into the engineering workforce via these degrees have successful careers up to a point. In the authors experience, significant numbers of people face the requirement of additional degree qualifications before advancement in job responsibilities or career change can occur. Unfortunately, the poor transferability of the A.A.S. degree coursework into Bachelor of Science engineering or engineering technology programs greatly inhibits people from pursuing a new degree. This paper provides details of Arizona State University s successful Bachelor of Applied Science (B.A.S.) program and how it serves this special portion of the engineering workforce. Only a few years old, the B.A.S. s engineering-related concentrations have already produced satisfied and successful graduates. The majority of the coursework is technical and is drawn from existing ABET-accredited engineering technology programs.

WORK IN PROGRESS - MULTI-DISCIPLINARY REAL-TIME AND EMBEDDED SYSTEMS LABORATORY AND COURSE SEQUENCE

James R Vallino, Rochester Institute of Technology and Roy S Czernikowski, Rochester Institute of Technology

Small electronic products for the mass market are increasingly incorporating programmable components. The software in these devices has constraints that are markedly different from software designed for a general-purpose computer. Most computing curricula deal almost exclusively with developing software for that general-purpose class. Real-time and embedded systems have increased in complexity; they no longer lie within a single discipline. Developers now must be cognizant of software engineering design methodologies and underlying hardware constraints. RIT is addressing this by developing a three-course sequence of cross-disciplinary real-time and embedded systems courses. We are teaching these courses in a studio-lab environment teaming computer engineering and software engineering students. The courses will introduce students to programming both microcontrollers and more sophisticated targets, use of a commercial real-time operating system and development environment, modeling and performance engineering of these systems, and their interactions with physical systems.

Session S1E: Ethics 1

Chair: Eric Soulsby, University of Connecticut

Time and place: Saturday, October 23, 2004, 8:00 a.m. - 10:00 a.m. *Sloane*

THE ROLE OF MORAL PHILOSOPHY IN PROMOTING ACADEMIC INTEGRITY AMONG ENGINEERING STUDENTS

Brian K. Etter, Kettering University, Trevor S. Harding, Kettering University, Cynthia J. Finelli, University of Michigan and Donald D. Carpenter, Lawrence Technological University

Academic dishonesty is nothing new, yet it is particularly disturbing to find among engineering students, whose professional lives need to be guided by the highest ethical standards. Moral philosophy may illuminate some of the conditions for recovering a sense of the ethical for engineering students. Classical moral philosophers held that people belong to communities in ways that inform their sense of obligation. Recognition of these communities would make concrete the engineer's responsibility for the health, safety and welfare of the public. A further difficulty is that the primary community that students know is simply that of their peers in school or the workplace, which does not form a sufficient context for the sense of moral obligation inherent in the engineer's role. This paper seeks to define the moral obligation of the engineer using traditional moral philosophy and describe how this obligation might be translated into a more positive definition of success. It will also address means by which educators can help engineering students to better understand their moral obligation.

INCORPORATING ETHICS IN COMPUTING COURSES AND EXTRA CLASS ACTIVITIES

Fani Zlatarova, Elizabethtown College

Teaching ethics in undergraduate computing-oriented courses is important because the specific nature of the development and application of software products affects the professional and personal interests of so many people. Two different approaches in teaching ethics for computer science and information systems students are described here. The first approach consists of incorporating ethical concepts into the teaching material of several computing courses. The second approach implements miscellaneous forms of extra class activities. Both approaches can be united through service learning applications related to the respective academic community. The description of practical solutions relevant to the different methods of teaching cyberethics is discussed below.

CASES FOR TEACHING ENGINEERING ETHICS

Marilyn A. Dyrud, Oregon Institute of Technology

This paper offers suggestions for integrating ethics education into engineering classes, primarily by using a case-based approach. It focuses on both micro and macro cases in three engineering disciplines: software, civil, and mechanical.

MEETING THE ETHICS CHALLENGE IN ENGINEERING EDUCATION: RE-ACCREDITATION AND BEYOND

José A. Cruz, University of Puerto Rico at Mayaguez, William J. Frey, University of Puerto Rico at Mayagez, Halley D. Sanchez, University of Puerto Rico at Mayaguez and Miguel A. Torres, University of Puerto Rico at Mayaguez

Our experience has shown that one of the most effective and efficient ways to meet the ABET EC 2000 ethics challenge is a program of ethics across the curriculum integrated with an elective stand alone course in engineering ethics. In this presentation we describe the tools and strategies we have used to foster ethics across the curriculum in engineering at our university and to instantiate its continuous improvement. We will highlight faculty training by focusing on the two-day workshop we have developed that has proven to be effective in providing engineering faculty with the skills to enable them to integrate ethics into mainstream engineering courses. We will argue that our approach effectively fosters the ethics integration aimed at by ABET criteria. An integral part of our approach has been the use of ethics tests which allow for the integration of ethical considerations into engineering decisions and projects without requiring that engineers master the underlying ethical theory.

WORK IN PROGRESS - ASSESSMENT OF THE EFFECTS OF A COMPUTER ETHICS COURSE ON STUDENT ATTITUDES

Jeffrey A Slomka, Texas State Unversity at San Marcos

The Computer Science Department at Texas State University, San Marcos, recently added a new stand-alone Computer Ethics course to the required undergraduate curriculum at the sophomore level. A pre and post course assessment instrument was developed and administered for the first time in the Fall 2003 semester. The assessment instrument presented commonly occurring professional and general computer-related situations and asked the student to rate the ethics of the action presented in the scenario. As there was intense discussion within the department of the most appropriate level and prerequisites for the course, the assessment instrument also gathered information about the effects of student age, work experience, and prior introductory philosophy coursework on student performance. This paper will describe the ethics course, as well as the preliminary results of the assessment.

WORK IN PROGRESS ETHICS INTEGRATED INTO ENGINEERING COURSES

David A. Rogers, North Dakota State University and Paulo F. Ribeiro, Calvin College

The very nature of engineering implies a commitment to ethics. Ethics education can occur in a wide variety of engineering courses. Beginning with first-year courses and continuing through the curriculum, students are taught to sort through the facts and constraints of engineering projects and search for solutions that best serve the user. Many students experience a philosophical, historical, and professional approach to the general topic of engineering ethics and social responsibility by taking a formal course in engineering ethics. Professional ethics can be integrated into course or capstone projects. In graduate courses, students receive explicit instruction in research ethics. The graduate who has been through a variety of ethics education experiences will be in a better position to leave the university and accept the very serious demands of the vocation.

Session S1F: Educational Research 4

Chair: Dan Budny, University of Pittsburgh

Time and place: Saturday, October 23, 2004, 8:00 a.m. - 10:00 a.m. *Vernon*

LINKING STUDENT LEARNING OUTCOMES TO INSTRUCTIONAL PRACTICES PHASE II

Paolo Davidian Moore, National Academy of Engineering, Stephanie M. Cupp, National Academy of Engineering and Norman L. Fortenberry, National Academy of Engineering

In previous work, we identified five student learning outcome areas that might productively augment the current engineering accreditation criteria. In this work we review the literature on a) how these outcomes might be assessed and b) what instructional practices may encourage their attainment. Multiple assessment instruments are identified for the five student learning outcome areas. We offer examples of instructional practices that appear to align with developing a) multidisciplinary systems perspectives, b) appreciation for diversity, and c) familiarity with business matters. We see the research base underlying instructional practices as lacking adequate breadth and depth.

PHYSICS EDUCATION RESEARCH: A MODEL FOR INTRODUCTORY LABORATORY REFORM

Teresa Larkin, American University and Mark Mathis, Johns Hopkins University

During the 2002 2003 academic years a decision was made at American University to reform the introductory General Education science classes by increasing the number of credit hours from 3 to 4. The intent of this reform effort was to add more substance to the introductory courses by increasing the laboratory experiences offered, and to make them comparable in credit hours to most introductory science courses around the country. As a result of this reform effort, the introductory physics classes were required to double the number of laboratory activities performed by the students during a given semester. The main objective behind increasing the number of laboratory activities was to increase the hands-on experiences of the students for the various topics covered within the curriculum. Through an internal grant award from American University, a significant amount of new laboratory equipment was purchased in spring 2003 and a number of new laboratory activities were created during the summer of 2003. The design and development of the new laboratory activities will be described as they relate to current research in physics education. The research in this field has clearly shown that student learning can be enhanced through the use of content-specific, interactive engagement (IE) strategies. Tips regarding the choice of equipment for the introductory physics laboratory will also be shared. In addition, the overall reform effort within the introductory physics classes and laboratories will be presented through a discussion of effective pedagogical strategies. The new laboratory activities were successfully piloted with over 100 students during the fall 2003 semester. This paper will highlight student and instructor experiences with the new activities during the pilot semester. A description of the newly-created laboratory activities through the lens of current research in physics education should provide faculty teaching laboratory-based, introductory physics or engineering courses with some useful ideas and techniques for reforming or refreshing their own courses.

INCORPORATING SIMULATION INTO THE COMPUTER SECURITY CLASSROOM

Lori L. DeLooze, US Naval Academy, Paul McKean, US Northern Command, John R. Mostow, Atlantic Consulting Services and Christopher Graig, Atlantic Consulting Services

Attacks on Department of Defense computer systems are a serious and growing threat. The cornerstone to the protection of these highly valuable networks is education and training. The U. S. Naval Academy is examining a new tool to teach computer security to determine if the complex concepts relating to computer security can be more effectively taught by including simulations in the classroom. The simulation environment under investigation consists of both an Internet Attack Simulator and a Network Simulator. The Internet Attack Simulator has a menu of attacks that can be launched against the Network Simulator s virtual network. The system is essentially an interactive virtual cyber world which requires the student defender to implement security measures and respond to attacks. Novice computer science students and information technology professionals benefit from the visualization of cyber behavior afforded in the risk free environment that simulation provides. The simulation reinforces the lecture in both concurrent demonstrations of the principles being taught, and later, in individual practical exercises.

WORK IN PROGRESS - AN INTERACTIVE TEACHING-LEARNING WORLD WIDE WEB SYSTEM FOR A CLASSROOM INSTRUCTION

Yung-Sheng Chen, Yuan Ze University

Distance and asynchronous learning systems can provide a possibly unlimited time and space merit for teacher s teaching and student s learning. However, to learn effectively a professional course in Engineering, the teaching and learning interaction in classroom is still an essential element in most universities. To overcome the problem of short time space in classroom, the web technology can be embedded in an interactive teaching-learning system to improve and assess the

teaching-learning performance for a classroom instruction. Based on the interactive teaching-learning system, the teaching-learning assessments including teaching quality, learning quality, student s participation degree, individual and global learning performance, can be easily analyzed and visualized.

WORK IN PROGRESS - FROM LIVE TO ONLINE : A FEASIBILITY STUDY

Wenyi Ho, Penn State, Doug Hogan, Penn State, John Wise, The and Thomas Litzinger, Penn State

The web based training program developed by the National Education Group (NETg) was adapted to substitute for lectures in an introductory computer course. This change from a traditional lecture format to an online format was initiated in order to lessen graduate assistants teaching workload in the heavily enrolled general education computer skills courses as well as to enhance students hands-on experience in using computer software programs. This paper reports on our study of the feasibility of incorporating this adapted online program as a content delivery component. Students in an introductory computer course were given the option to complete the course requirements online without any attendance requirement. Analysis of outcomes showed no significant differences between the students who attended class only and the students who studied online only in their ability to complete the assignments. Analysis of student surveys revealed a dislike for the online format and a desire that face-to-face education not be abandoned.

REUSE OF HOMEWORK AND TEST QUESTIONS: WHEN, WHY, AND HOW TO MAINTAIN SECURITY?

Edward F. Gehringer, North Carolina State University

It is always difficult to obtain good homework problems and test questions. Instructors can save time and polish their work by using the same questions they used before. And they would do so semester after semester, except for one obvious risk: that students would simply copy or memorize the answers rather than learning the material. This paper presents the results of a survey of hundreds of postsecondary educators. How frequently do they reuse questions, and how do they prevent students from getting advance access to the answers? How much trouble have they had with files kept by fraternities, sororities, and ethnic groups? Do they consider it cheating to copy or memorize answers? Has the increasing use of electronic resources made it easier or harder to maintain security? Do they typically alter their policies when they begin to put material on line? The answers to these questions can guide all of us to more realistic and secure reuse policies.

Session S1G: Diversity -- Programs and Outreach

Chair: Melany M. Ciampi, COPEC - Council of Researches in Education and Sciences, Brazil

Time and place: Saturday, October 23, 2004, 8:00 a.m. - 10:00 a.m. *Percival*

THE BINGHAMTON SUCCESS PROGRAM: INSTITUTIONALIZING A MINORITY ENGINEERING PROGRAM

George D. Catalano, SUNY Binghamton and Karen Catalano, SUNY Birghamton

The Binghamton Success Program, which is part of the N.S.F. funded L.S. Stokes Alliance for Minority Participation in New York State, seeks to increase both enrollment and retention of historically under-represented groups in mathematics, the sciences and engineering. The program has achieved success over the course of its seven-year existence.

A STUDENT MENTORING AND DEVELOPMENT PROGRAM FOR UNDERREPRESENTED GROUPS IN ENGINEERING

Gretchen Hein, Michigan Technological University and Amy Monte, Michigan Technological University

The Graduate, Undergraduate Initiative for Development and Enhancement (GUIDE) program creates a supportive environment for first year engineering students from underrepresented groups. This 4 year NSF program has just completed its second year of funding. GUIDE provides first year students with student mentors, financial assistance and faculty advisors to assist them with the transition to university life. In addition, the GUIDE scholars attend engineering seminars and career workshops. This paper describes the GUIDE program and the skills students gain from participating in the program. It also outlines the logistics involved in a student mentoring program that is coupled with seminars and workshops.

THE ENGINEERING EXPOSITION A MODEL FOR ENGINEERING DIVERSITY AND OUTREACH

Bret P. Van Poppel, UNITED STATES MILITARY ACADEMY, Daisie D. Boettner, UNITED STATES MILITARY ACADEMY and A. Özer Arnas, United States Military Academy

In September 2003 the United States Military Academy (USMA) hosted its first annual Engineering Exposition (Expo). More than just a college fair, the Expo was an evening event to promote engineering at USMA and across the Mid-Hudson (New York) region. The objectives of the 2003 Expo included: Promote engineering and diversity in engineering across all disciplines, Promote membership in engineering societies, Provide an outreach event to local and regional high school and middle school students. The Expo specifically addressed diversity in engineering in the Mid-Hudson region and

at USMA. The Mid-Hudson and West Point Student Chapters of American Society of Mechanical Engineering (ASME), Society of Women Engineers (SWE), and American Society of Civil Engineers (ASCE) supported the event.

USING ISSUES TO TEACH DIVERSITY: AN INTERACTIVE LEARNING APPROACH

Ralph Ocon, Purdue University Calumet

This paper discusses how to teach students about diversity in the workplace and how to develop the multicultural leadership skills necessary to manage a diverse workforce. Based on my research, and experience as a teacher, consultant and Affirmative Action Officer, the twelve critical diversity issues that students need to be aware of and understand if they are going to be effective multicultural leaders have been identified. Under each issue are several articles related to that issue. Because the twelve diversity issues are relevant, contemporary and controversial, students have responded well to this learning method. Using an issues based approach is an alternative and effective way to introduce, discuss and learn about diversity management. The issues can stand alone as complete learning modules, are adaptable to the experience and expertise of the instructor, and have been used successfully with traditional classroom courses, distance learning courses and training workshops for industry.

IMPLICATIONS OF AFRICAN AMERICAN ENGINEERING STUDENT PERCEPTIONS OF CAMPUS CLIMATE FACTORS

A. Ramona Brown, City College of CUNY, Carole Morning, Higher Ed. Extension Service and Charles B. Watkins, City College of CUNY

This study investigated African American undergraduate engineering student perceptions of institutional and personal/social campus climate factors to determine how these perceptions influence their academic experiences and performance. Data collection was accomplished through use of a quantitative and qualitative survey instrument administered to a national sample of subjects. The survey collected data on the subjects demographic characteristics as well as their perceptions. The study investigated the aggregate pattern of student perceptions and also examined associations among perceptions and demographic characteristics. In addition, interrelationships among student perceptions were examined. Perceptions of personal/social and institutional campus climate variables were found to be largely positive. However, perceptions of racism and discrimination were not as positive as perceptions of other climate variables and were connected with weaker academic performance.

WORK IN PROGRESS TEACHING DIVERSITY ONE MINUTE AT A TIME

Tristan T. Utschig, Lewis-Clark State College

Diversity and globalization are both buzzwords in engineering education. How can these concepts be successfully integrated into a curriculum such that they avoid sacrificing content, pique student interest, and provide measurable learning outcomes? Many instructors have diverse experiences or origins, yet rarely are details shared with students. The diversity minute is an effective way of transmitting knowledge and understanding of diverse cultures or viewpoints without sacrificing valuable class time. It is simply a one or two minute break between sections of a class period where the instructor fields questions about their diverse experiences, cultural background, or other perspectives. Students find these minutes refreshing while their brains process the previous lecture information and prepare them mentally for the next part of the class. Over a full semester, these breaks can add up to approximately one class period, which is substantial enough to construct a reasonably coherent picture of a culture or diverse perspective that may otherwise never enter the classroom.

Session S1H: Computer Science Education 6

Chair: John Impagliazzo, Hofstra University

Time and place: Saturday, October 23, 2004, 8:00 a.m. - 10:00 a.m. *Verelst*

PROBLEM-BASED LEARNING OF THEORETICAL COMPUTER SCIENCE

Wilhelmiina Hämäläinen, University of Joensuu

In this paper, we report our first experiment in teaching the theory of computability in the problem-based way. As far as we know, this is the first experiment of applying the problem-based method to a purely theoretical course of computer science. Performing the course consisted of three parts: First, the new subjects were learnt according to the classical seven step method, which contains both individual and group work, and problem reports were written. Second, the students participated in a traditional exercise session, in which the new techniques were practised in details. And third, the students kept a learning diary, in which they processed the subjects further, tried to construct an overall schema of things learnt, and supervised their own learning. The results were really successful: the students committed themselves well and the drop out

percentage was very small; they achieved very deep understanding of the subjects measured by their grades and quality of learning diaries; the experience was enjoyable for both the students and the teachers; and finally, the method supported different kinds of learners very well.

WORK IN PROGRESS PUTTING A COURSE IN CONTEXT

Alan Clements, University of Teesside

An undergraduate course can be characterized by its breadth and its depth. Breadth is a measure of the range of topics covered and depth is a measure of the rigor with which they are taught. To provide students with the tools necessary to help them find employment, undergraduate courses in computer science concentrate on depth at the expense of breadth. Consequently, students often lack a historical perspective on their own subject and do not know how it developed. All too frequently students are not even aware of alternative approaches to computer-based problem solving. Nowhere is this truer than in computer architecture education. This work in progress describes the construction of a website that provides a background for computer architecture courses by putting material in a historic and social context and by introducing alternative computing mechanisms such as neural networks, analog computers and quantum computers.

WORK IN PROGRESS MOBILE COMPUTERS IN A CLOSED LAB ENVIRONMENT FOR CS MAJORS

Mikhail S. Brikman, Salem State College and Edward J. Wilkens, Salem State College

The paper describes the usage of mobile laptop computers in closed labs for the Computer Science majors. The Computer Science Department at Salem State College, Salem, MA modified the Computer Science major curriculum in 2001 to add closed labs to all appropriate Computer Science major and minor courses (more then sixty percent of the total number of courses taught). One of the consequences of this decision was the need to conduct several simultaneous closed and open labs in parallel. The existing laboratory infrastructure was insufficient to support this additional load and we decided to introduce a laptop based mobile lab to satisfy the increased computer hardware and lab space requirements. We describe the steps taken to implement the lab and present the analysis of the results and the problems encountered during the two-year usage of this new teaching environment.

GAMES AS A MOTIVATION FOR FRESHMAN STUDENTS TO LEARN PROGRAMMING

María Feldgen, Universidad de Buenos Aires and Osvaldo Clúa, Universidad de Buenos Aires

Programming is a difficult skill to acquire. It is best learned by practice and, if students are to learn effectively, at least some of this practice will have to be self-directed. Instructor's key role is to persuade our students to do this and thus to motivate them. In the past, our students identified programming as a vital skill in demand by industry. Consequently they were motivated to acquire a useful skill that would be relevant in some future job or lucrative career. Nowadays, our WEB age students have no idea why they have to study programming. Programming courses are seen simply as mandatory parts of the degree course to be negotiated. Their world of computing is multithreaded computer programs with impressive human interfaces for games and WEB. They cannot relate them with the classical programming exercises that ask for single-threaded programs performing a sequence of calculations. Given this, we decided to introduce our students in problem solving using what they view as real-world problems such as games and WEB-programming.

WHAT WE SHOULD TEACH, BUT DON T: PROPOSAL FOR A CROSS POLLINATED HCI-SE CURRICULUM

Pardha S Pyla, Virginia Tech, Manuel A Pérez-Quiñones, Virginia Tech, James D Arthur, Virginia Tech and Rex H Hartson, Virginia Tech

Software engineering (SE) and usability engineering (UE), as disciplines, have reached substantial levels of maturity. Each of these two disciplines is now well represented with respect to most computer science (CS) curricula. However, the two disciplines are practiced almost independently missing opportunities to collaborate, coordinate and communicate about the overall design and thereby contributing to system failures. Today, a confluence of several ingredients contribute to these failures: the increasing importance of the user interface (UI) component in the overall system, the independent maturation of the human computer interaction area, and the lack of a cohesive process model to integrate the UI experts usability engineering (UE) development efforts with that of software engineering (SE). This in turn, we believe, is a result of a void in computing curricula: a lack of education and training regarding the importance of communication, collaboration and coordination between the SE and UE processes. In this paper we describe the current approach to teaching SE and UE and its shortcomings. We identify and analyze the barriers and issues involved in developing systems having substantial interactive components. We then propose four major themes of learning for a comprehensive computing curriculum integrating SE, UE, and system architectures in a project environment.

MONITOR PREPROCESSOR FOR PTHREADS

Jinhua Guo, University of Michigan-Dearborn and Stan Seely, University of Michigan-Dearborn

A monitor construct is an abstract data type, which encapsulates private data with public methods to operate on that data. Mutual exclusion is provided implicitly by ensuring that procedures in the same monitor are not executed concurrently. Condition synchronization in monitors is provided explicitly by means of condition variables. This makes a concurrent program easier to develop and easier to understand. Although the Pthread library contains dozens of functions for threading and synchronization, it does not provide direct support for the monitor. Students must explicitly provide mutual exclusion around monitor procedures using mutex locks. However, monitor procedures by definition execute with implicit mutual exclusion. This makes it hard to teach the monitor concept in class and explain the semantic differences between monitors and semaphores. To solve this problem, we have designed and implemented a monitor preprocessor for Pthreads that provides explicit support for monitors in Pthreads.

Session S2A: Panel: Computing Accreditation Commission Moves to General and Program Specific Criteria

Chair: Doris K. Lidtke, Towson University

Time and place: Saturday, October 23, 2004, 10:30 a.m. - Noon *Chatham*

PANEL: COMPUTING ACCREDITATION COMMISSION MOVES TO GENERAL AND PROGRAM SPECIFIC CRITERIA

Doris K. Lidtke, Towson University, Han Reichgelt, Georgia Southern University and Jim Leone, Rochester Institute of Technology

The panelists will discuss the proposed ABET Computing Accreditation Commission (CAC) General Criteria and the Program Specific Criteria for computer science, information systems and information technology. The General Criteria for Accreditation of Computing Programs is currently on the ABET website and comments are being solicited. When this General Criteria is approved it will apply to all programs accredited by the CAC. Programs in computer science, information systems and information technology will also have to meet the Program Specific criteria for their own area. The criteria for these programs have been developed and are currently in the approval process. The Program Specific Criteria will, if approved by the ABET Board in November, also be available for public comment.

Session S2B: Partnerships -- Local and International

Chair: Dan Moore, Rose-Hulman Institute of Technology

Time and place: Saturday, October 23, 2004, 10:30 a.m. - Noon *Savannah*

TECH SCHOLARS LEARNING COMMUNITY: A COLLEGE-UNIVERSITY PARTNERSHIP PROGRAM FOR ACADEMICALLY AND ECONOMICALLY DISADVANTAGED STUDENTS

Chih-Ping Yeh, Wayne State University, Silverenia Kanoyton, Wayne State University and Deborah Daiek, Schoolcraft College

This paper describes a college-university partnership program, namely the Tech Scholar Learning Community, formed by the Division of Engineering Technology at Wayne State University in Detroit, Michigan and the Schoolcraft College in Livonia, Michigan. The objective is to increase the number of academically and economically disadvantaged students who transfer from community colleges to baccalaureate programs. The strategies adopted to improve transfer rates are presented, and the criteria for selection of the target students and the factors affecting the transfer of the target group are discussed.

METS: A COLLABORATION TO ASSIST STUDENTS TRANSITIONING INTO ENGINEERING FROM THE COMMUNITY COLLEGES TO THE UNIVERSITY

Mary Anderson-Rowland, Arizona State University, Debra L. Banks, Arizona State University, Mary I. Vanis, Maricopa Community Colleges, Bassam Matar, Chandler-Gilbert Community College, Elizabeth Chain, Chandler-Gilbert Community College and Donna M. Zerby, Arizona State University

The METS project Maricopa Engineering Transition Scholars is a two-year pilot collaboration between Arizona State University (ASU) and Maricopa County Community College District (MCCCD) funded by the National Science Foundation. The project is designed to 1) recruit, 2) retain and 3) graduate engineering transfer students. The project targets MCCCD women and underrepresented minority students. The research-grounded project activities were designed based on

analysis of best practices piloted over many years at both MCCCD and ASU. Three of the METS activities include: Be an Engineer event designed to interest students in engineering by allowing them to participate in hands-on engineering activities at local community colleges, Pizza with a Professor to allow students to interact with an ASU professor, and METS workshops on survival strategies for students who have transferred from a community college to the ASU Fulton School of Engineering. The paper discusses what we have learned to date about the METS activities which are the most effective to assist community college students who transition into engineering. METS activities also assist community college students transferring from a two-year community college to a 4-year engineering program at ASU. In addition, the paper provides an analysis of community college students seeking engineering degrees by demographics, motivation, and needs and provides trends in enrollment, retention, and graduation.

WORK IN PROGRESS NATIONAL CENTER FOR ENGINEERING AND TECHNOLOGY EDUCATION

Kurt Becker, Utah State University, Christine Hailey, Utah State University and Maurice Thomas, Utah State University

The National Center for Engineering and Technology Education (NCETE) links technology educators with engineering educators in a symbiotic alliance to build capacity for research, nurture a cadre of talented, diverse leaders in engineering and technology education and infuses engineering design and analytical skills into K-12 schools. NCETE recently received funding from National Science Foundation as one of the 17 Centers for Teaching and Learning in the country. NCETE addresses an important niche in the overall portfolio for the NSF-funded Centers for Learning and Teaching program as the only center addressing technology and engineering education. This powerful combination of research, graduate education, and professional development could be applied to many levels. We have chosen to focus on grades 9 to 12.

BUSINESS COMPUTING - A SHARED CURRICULUM PROPOSAL FOR THE SPANISH-PORTUGUESE BORDER UNDER THE AUSPICES OF THE NEW EUROPEAN HIGHER EDUCATION AREA

Francisco J. García, University of Salamanca, José A. Gomes, Technical and Management College of Bragança, Portugal, Luis Alonso, University of Salamanca, Luís A. M. Amaral, University of Minho and José L. Pérez, University of Salamanca

The Bologna Declaration is leading to a change of paradigm in the context of higher education in many countries of the European Community; it has a significant impact at the level of curriculum and learning models. Therefore, any reflection and decision work on the processes of teaching/learning imposes the curricular reformulation of higher courses in an innovating way, supported by new references and assumptions. In the context of a project financed by European Community program Interreg III A, we have created a workgroup to o propose the reformulation of several courses that belong to Business Computing, from ESTiG-Portugal and from ESPZ-Spain, in an attempt to create harmony between both study plans, considering the socio-economic specific context of the border region between Bragança (Portugal) and Zamora (Spain). This article intends to describe a case-study related to the work done to achieve a curriculum for Business Computing; it describes the changes due to the recent recommendations of Bologna and governmental reflections of Portugal and Spain.

WORK IN PROGRESS DEVELOPING AN INTERNATIONAL FIELD PROJECT IN CHINA

Dan Budny, University of Pittsburgh and Teresa Larkin, American University

ENGR0035 is an optional three-credit study abroad opportunity offered jointly by the school of business and engineering as a follow-up to the freshman writing assignments. The course consists of a field study trip to Valparaíso, Chile; Nanjing, China; Prague, the Czech Republic; or Augsburg, Germany. The course involves lectures at the local universities, company visits and sightseeing. It culminates in a group research paper and a presentation focused on one of the visited companies, as well as in the national and global industry in which it operates. The groups consist of both business and engineering students, thus their view points are considered in the paper and in the presentation. This paper will outline the course layout for the China component.

Session S2C: Topics in Electrical Engineering 2

Chair: John Orr, Worcester Polytechnic Institute

Time and place: Saturday, October 23, 2004, 10:30 a.m. - Noon *Waterfront North*

WORK IN PROGRESS: THEME-BASED REDESIGN OF AN ELECTRICAL AND COMPUTER ENGINEERING CURRICULUM

Lisa Huettel, Duke University, April Brown, Duke University, Michael Gustafson, Duke University, Hisham Massoud, Duke University, Gary Ybarra, Duke University and Leslie Collins, Duke University

TThe goal of this work-in-progress is to develop an innovative ECE curriculum that focuses on ECE fundamentals within the construct of real-world integrated system design, analysis, and problem solving. The curriculum will be formulated around the theme of Integrated Sensing and Information Processing (ISIP). The foundation of this new curriculum will be a hands-on theme-based introductory course. This course, taken in the freshman year, will introduce students to the major subdisciplines of ECE in the context of real-world applications. In the laboratory, which will be tightly coupled to the lecture, students will apply basic concepts of sensing, information transmission, information analysis, storage and networking to design and implement an ISIP system, such as a health or weather monitoring station. In this way, students will immediately begin to understand the relationships between the major topic areas of ECE as well as be motivated to explore these topics in further depth. Other components of the redesign include the integration of core and upper-level courses into the ISIP theme, the introduction of new ISIP-related design courses, and the integration of MATLAB throughout the curriculum.

WORK IN PROGRESS - INCORPORATION OF OPNET SIMULATION INTO A TELECOMMUNICATIONS SYSTEMS LABORATORY COURSE

Hazem H. Refai, The and James J. Sluss, The University of Oklahoma

An integral part of the curriculum for the newly developed Telecommunications Systems M. S. degree at The University of Oklahoma (OU) Tulsa is a course entitled Telecommunications Systems Laboratory. The course is designed to enhance the understanding of computer networking theories and concepts through simulation and hands-on networking exercises. Students utilize the resources of the OU-Tulsa Telecommunications Interoperability Laboratory to build flexible and interconnected network model configurations using multi-vendor ATM, IP, TDM, and WDM equipment, including fixed and mobile wireless components. Various testing equipment are used to evaluate network performance. For simulation, we have chosen OPNET Modeler, from OPNET Technologies, Inc., as the software of choice. The role of simulation in the course is two-fold: to improve student comprehension of computer networking concepts and theories and to complement the hands-on experiments. This work-in-progress paper discusses our preliminary experiences with integrating OPNET Modeler into the Telecommunications Systems Laboratory course.

THE APPLICATION OF NUMERICAL ANALYSIS VISUALIZATION AND MULTIMEDIA TECHNOLOGY IN THE TEACHING OF ELECTRICAL ENGINEERING

Ma Bo, North China Electrical Power University, Li Xin, North China Electrical Power University, Cui Xueshen, North China Electrical Power University, Luo Yingli, North China Electrical Power University and Xie Chen, Shisanling Pumped Storage Power Station

An important content in the teaching of electrical engineering courses is how to explicitly illustrate the spatial structure and operating principle of some complicated power facilities. In this paper the multimedia technology and the visualization technology on the basis of numerical analysis is carefully combined with the traditional teaching mode. The combination is sufficiently embodied in the electric machinery course. The cognition of the principle and some concepts involved in the electromotive force calculation is exemplified to illustrate the blending of teaching methods. The spatial structure of the generator can be shown in the three-dimensional multi-angle simulation model. The space and time distribution of the electromagnetic quantities is presented with the combination between the animated visualization and finite element analysis on magnetic field. Therein the man-machine interactive technology is applied to better the understanding of the cognitive difficulties. With the comprehensive application of teaching methodology blended with such newly devised technology aids, the study efficiency of learners has been greatly improved.

INTERACTIVE NUMERICAL AND SYMBOLIC SIMULATION: A NEW PARADIGM FOR TEACHING CIRCUITS

Jean-Claude Thomassian, Central Michigan University and Edwyn D. Smith, University of Toledo

Too little time is made available in modern four-year electrical engineering and computer science curricula to teach introductory electric circuits and electronics in the traditional manner. The best way to improve the outcome of what can be done is to base it strictly on computer methods including especially the newly developed symbolic circuit simulators as Analog Insydes. Some insight is offered on how the complexity of expression barrier is overcome followed by three examples intended to show the proposed method at work. A concluding section argues that the time spent teaching circuit anal-

ysis by computer simulation, numerical and symbolic, is a sound investment. It too can be learned in graded steps, and what is learned integrates immediately and seamlessly into everything that follows.

WORK IN PROGRESS - DEVELOPMENT OF AN INNOVATIVE CURRICULUM FOR UNDERGRADUATE ELECTRICAL AND COMPUTER ENGINEERING STUDENTS

Mark Paulik, University of Detroit Mercy, Mohan Krishnan, University of Detroit Mercy and Nizar Al-Holou, University of Detroit Mercy

This work reports on an ongoing NSF-funded effort to develop plans for a new Electrical and Computer Engineering curriculum with an embedded systems focus. The program specifically addresses the needs of the automotive and related industries. Project goals include the development of a comprehensive roadmap that comprises course offerings, topical content, the necessary technology and software acquisitions, and a time-bound plan for phasing in the new curriculum. An initial concept statement and framework for the curriculum, developed on the basis of an assessment of similar efforts at other universities as well as consultations with an advisory panel, will be presented at the conference.

Session S2D: Engineering Technology Topics 2

Chair: Ehsan Sheybani, Virginia State University

Time and place: Saturday, October 23, 2004, 10:30 a.m. - Noon *Waterfront South*

A THERMAL PROCESS CONTROL LABORATORY

John C. Anderson, Purdue University

Thermal systems are an important segment of engineering design, but practical, realistic laboratory models are not plentiful. There are some educational oriented systems models, but these are expensive and typically the design details of the machine are not furnished with the purchase of the equipment, making deviation from the original intent of the equipment difficult. This paper describes the development of a small, portable, and inexpensive system that allows students a wide range of educational experiences. Students may study the overall design and construction of the system, selection and cost of components, and the effect of different control schemes. The laboratory apparatus is built around an industry standard, low cost PLC. The control scheme may be changed from a simple OFF-ON control to a PID loop by a software routine on the PLC. Heating and sensing devices are those used typically in plastics manufacturing equipment and the controlled device may be varied to simulate the effect of process conditions and raw material on the thermal control system. Data logging is available to allow students to record and observe the system effect of process changes. The apparatus may be fabricated at a low cost (under $500), is small in size and portable, and may be powered from available single phase AC voltage. This has important implications in programs where lab space or funding is an issue, and also may be integrated into distance education programs. Examples of integration into courses are addressed.

CHARACTERIZING EFFECTS OF ADAPTIVITY WITHIN AN INTELLIGENT TUTORING SYSTEM

Sheng-Jen Hsieh, Texas A&M University, Patricia Yee Hsieh, The Texas A&M University System and Dongmin Zhang, Texas A&M University

This study aims to characterize the effects of adaptivity within an intelligent tutoring system (ITS). An ITS authoring tool was used to create adaptive and non-adaptive (sequential) versions of lessons on programmable logic controller timer instructions. In the Adaptive versions, the content and number of practice questions asked varied based on student performance. The Sequential versions were identical to the Adaptive versions except that they asked a practice questions from a predetermined list. Students in both groups showed statistically significant improvement in post-test performance, and there was no difference between groups in the amount of improvement. Students in the Sequential group answered practice questions more accurately than students in the Adaptive group. However, students in the Adaptive group required significantly less time to complete the lessons. Correlation data suggest that the Adaptive lessons were more efficient for knowledgeable students. This research suggests that adaptive approaches can make learning more efficient, but are not necessarily more effective than pedagogically sound non-adaptive approaches. It also demonstrates effective data collection and analysis techniques for studying ITS features such as adaptivity. Use of these techniques can facilitate the design of instructionally effective ITSs and inform design of other tools for ITS research and evaluation.

DISTANCE DELIVERY OF A LABORATORY BASED CONTROLS FOR MANUFACTURING AUTOMATION COURSE-A SUCCESS STORY

Subramaniyan Kandasamy, Rochester Institute of Technology and Ramkumar S. Manian, Rochester Institute of Technology

Over the years, distance learning (DL) has proven to be very effective for many theoretical courses, but is challenging if courses include hands-on laboratory modules. Bringing students several times a quarter to campus and conducting lab sessions imposes inconvenience on the students. It also restricts the geographic locations of the student body that can benefit from this program. This was the case with the Electrical/Mechanical Engineering Technology program at the Rochester Institute of Technology (RIT). To overcome this issue, RIT has effectively utilized the web, multimedia techniques and simulation tools to bring the laboratory experience to DL students on demand. This paper discusses the stages in the evolution of a DL course and how a hands-on laboratory course is being successfully offered over the Internet, benefiting students far and wide.

WORK IN PROGRESS: ESTABLISHING MULTIPLE CONTEXTS FOR STUDENT S PROGRESSIVE REFINEMENT OF DATA MINING

David Kwartowitz, Vanderbilt, Sean Brophy, Vanderbilt University and Horace Mann, Fisk University

Students systematic investigation of challenges from different prospectives provides a richer learning experience than lecture and traditional book based learning. Students in a course in Data Mining, which was taught through a computer science department, were presented challenges in the field of Biomedical Engineering in addition to text book problems that targeted a variety of domain areas. The combination of focused inquiry around two contexts provides students with multiple examples to apply and differentiate their knowledge. This paper presents preliminary results from this pilot implementation of the instructional method and next steps for the course offering in the spring semester.

REMOTELY ACCESSIBLE SOLAR ENERGY LABORATORY FOR HIGH SCHOOL STUDENTS

William Hutzel, Purdue University and David Goodman, Purdue University

A remotely accessible solar energy laboratory has been developed for real-time experimentation using solar heating and photovoltaic equipment that is physically located at Purdue University. Indiana high school students are the first customers for this on-line resource. In addition to sensor data, the web-based laboratory includes lesson plans, tutorials, assessment questions, and a feedback utility. This project is helping science teachers meet new state science standards from the Indiana Department of Education, which call for hands-on laboratory activities and real time data analysis. Remotely accessed labs are becoming popular because they offer the opportunity for large numbers of students to learn from state-of-the-art equipment. The cost of expensive laboratory equipment is easier to justify if it can be widely used.

Session S2E: First Year Design Experiences

Chair: Kevin C. Bower, The Citadel

Time and place: Saturday, October 23, 2004, 10:30 a.m. - Noon *Sloane*

USING DESIGN-BUILD PROJECTS TO TEACH AND REINFORCE ENGINEERING SKILLS TO FIRST-YEAR ENGINEERING STUDENTS

Steven York, Virginia

At Virginia Polytechnic Institute and State University, a series of hands-on and early-design projects have been incorporated into the first- year curriculum. The purpose of these projects is to introduce students to the engineering design process, teamwork, technical writing and other basic engineering skills. As part of the on-going implementation of these projects, we have recently introduced a series of small design-build projects into our first semester engineering course. This paper will discuss the development and implementation of the project (MacGyver) box program from conception through implementation. Specific topics include the design of project assignments, the project box inventory, the evaluation of projects, and the stepping-up from the smaller first semester projects to the open-ended second semester projects. The paper will also address responses from students and lessons learned during program implementation.

WORK IN PROGRESS - EVOLUTION & IMPLEMENTATION OF A ROLLER COASTER (DESIGN-BUILD) PROJECT FOR A FIRST-YEAR PROGRAM

John Merrill, The, Stuart Brand, Ohio State and Michael Hoffmann, Ohio State

The Fundamentals of Engineering (FE) sequence at The Ohio State University consists of two courses that involve skill development applicable for all engineering disciplines. The second course includes a new design-build project, imple-

mented in the Winter of 2004. From a curriculum standpoint, the goal has been to create a project that is challenging, sustainable, and cost-effective. Total construction time for students was reduced by providing a set of interchangeable and interlocking parts leaving students more time to experiment with multiple designs and orientations, and to solve real-world problems. In order to ensure the use of design methods that would result in accurate models, a physics-based approach was used, and all teams had to have a paper design approved before construction. Complete project documentation, a final systems test, and an oral presentation by each team serve as culminating events for the project.

WORK IN PROGRESS - DEVELOPMENT OF MOBILE ROBOTIC PLATFORMS AS FRESHMAN ENGINEERING DESIGN PROJECT

Abhijit Nagchaudhuri, University of Maryland Eastern Shore

System integration and design of a mobile robotic platform that has the ability to interact with its environment using appropriate sensors has been implemented as a freshman design project at University of Maryland Eastern Shore (UMES). The project included design alternative analysis, engineering drawing, manufacturing, identification, acquisition and integration of suitable mechanical, electrical, electronic, computing and sensing systems and components as well as appropriate programming of the embedded computer to achieve desired interaction of the mobile robotic platform with its environment. The project also provided the platform to introduce various software programs such as EXCEL, POWERPOINT, MS WORD, LOGO Programming language, etc. The tools not only allowed the students to perform engineering analysis but also emphasized communication skills both oral and written associated with successful project implementation and information dissemination. The students could relate to the newly coined term mechatronics that represents the synergy in mechanical design, electronics, soft-computing and control in the context of the project. They could readily appreciate the benefits of teamwork and the pitfalls of compartmentalizing the engineering design process according to traditional disciplinary boundaries in the progressive environment of engineering education and practice in the new millennium. In the educational arena reform efforts have been facilitated largely by the new accreditation criteria of the Accreditation Board of Engineering and Technology (ABET). The new criteria have brought about significant changes in engineering education throughout the nation and have enabled a closer alignment of education and practice of engineering profession.

INTEGRATING FIRST-YEAR ENGINEERING DESIGN AND PRE-SERVICE SCIENCE EDUCATION: A MODEL FOR ENGINEERING AND EDUCATION COLLABORATION TO ENHANCE K-16 STEM EDUCATION

Carol Crumbaugh, Western Michigan University, Paul Vellom, Western Michigan University, Andrew Kline, Western Michigan University and Edmund Tsang, Western Michigan University

The purpose of this paper is to describe the emerging results of a collaboration between education and engineering using science activities and instructional devices produced in a specially-designed undergraduate course, Introduction to Engineering and Technology (ENGR 101). These materials were used and evaluated by senior-level education students who then provided feedback regarding the clarity of the manual, the appropriateness of the activities, and the user-friendliness of the activities and devices. The process wherein education students used and assessed the instructional activities is described. In addition, preliminary findings are provided and future work outlined.

WORK IN PROGRESS TEACHING DIGITAL ELECTRONICS CONCEPTS IN A PROJECT-BASED FRESHMAN ENGINEERING DESIGN COURSE

Sohail Anwar, Penn State University, Altoona College and Edwin Sell, Penn State University, Altoona College

Engineering Design and Graphics 100 (ED&G 100) is a project-based introduction to engineering design course for all freshman baccalaureate engineering students at the Altoona College of the Pennsylvania State University. In this three credit-hour course, an engineering approach to problem solving is taught with an emphasis on team work, communication, creativity, ingenuity, and computer aided-design tools. This paper presents a description of the engineering design component of ED&G 100 course.

Session S2F: Active & Cooperative Learning 4

Chair: Carol Wellington, Shippensburg University

Time and place: Saturday, October 23, 2004, 10:30 a.m. - Noon *Vernon*

AGE OF COMPUTERS: AN INNOVATIVE COMBINATION OF HISTORY AND COMPUTER GAME ELEMENTS FOR TEACHING COMPUTER FUNDAMENTALS

Lasse Natvig, Norwegian University of Science and Technology, Steinar Line, Norwegian University of Science and Technology and Asbjørn Djupdal, Norwegian University of Science and Technology

Age of Computers (AoC) is an online multiplayer game used in teaching of computer fundamentals in a M.Sc. study in computer science. It supplements traditional auditorium lectures by a rich set of problems in a computer game like environment. The story of the game is linked to the historical periods (epochs) of computers, and the content is organized in rooms or places on a map. A chat window for each historical period is used for communication with other students and teaching assistants. The first version of AoC was used in a class with 250 students. Almost all students agreed that AoC is more motivating than traditional exercises , and a majority claimed that they learn more through AoC than by traditional exercises. We are currently working on an improved version of AoC for the 2004 fall semester based on the feedback from an extensive questionnaire.

COLLABORATIVE LEARNING IN AN OPERATING SYSTEMS COURSE: AN EXPERIENCE REPORT

Swaminathan Natarajan, Rochester Institute of Technology

Circumstances a 5-week course format with two 4-hour evening classes each week impelled an alternative approach for the introductory operating systems course at Rochester Institute of Technology in Summer 2003. We used a co-operative learning approach based loosely on the Jigsaw methodology. Students were divided into teams, and each assigned to prepare one subtopic of the material for each course session. Each class consisted of a lecture session, followed by team sessions where each member explained their portion of the lecture material and the team discussed it. This format proved very successful in increasing student involvement and making sure that nearly all students came away with at least a basic understanding of the material. The paper presents the details of the format, challenges faced, positive outcomes and limitations, and data and perspectives from student surveys.

THE CHALLENGES OF INTERNATIONAL COMPUTER-SUPPORTED COLLABORATION

Kathleen Swigger, University of North Texas, Ferda Alpaslan, Middle East Technical University,, Robert Brazile, University of North Texas, Brian Harrington, University of North Texas and Xiaobo Peng, University of North Texas

This paper discusses results of a study analyzing how cultural factors affect the performance of distributed collaborative learning teams. Participants in the study included computer science students from the University of North Texas and students from the Middle East Technical University in Ankara, Turkey. The results indicate that a team s cultural attributes are a significant predictor of its performance on programming projects. Cultural attributes most strongly correlated to group performance were those associated with attitudes about organizational hierarchy, organizational harmony, trade-offs between future and current needs, and beliefs about the influence individuals have on their fate. The type of programming task affected the strength of the relationship between culture and performance. These results may provide distance-learning programs a way to identify at-risk work teams.

COMPUTERS AND SOCIETY IN CS0: AN INTERACTIVE APPROACH

Tammy Bailey, Duke University and Jeffrey Forbes, Duke University

One of the challenges in developing introductory computer science courses for non-majors is attracting and engaging a diverse population of students. Incorporating the social, legal, and ethical issues in computer science into the course material is one effective way to introduce students to the concept of computing as a science and to demonstrate the relevance of the discipline to their everyday lives. In this paper, we propose a series of classroom and web-based activities in which the students take an active role in researching and learning the societal impact of the current technical subject studied in class. Once presented with a particular development in computing, students will first research its impact and consequences and the social, legal, and ethical questions raised as a result. The Internet should be used as a primary research tool as well as a forum for discussion in the next activity. Following their research, students will select a set of questions and outline either a supporting or dissenting argument for each. They will make this information publicly available to the class, and as the next step they will read the arguments of other students and prepare and publish counterarguments. As the final step the students will have a formal in-class debate, where students perform one of three roles: affirmative, opposition, or judge. These activities culminate in a final project. Discussing the interplay of society and computing can promote the understanding of a student's rights and responsibilities and an awareness of their personal role in the discipline. This strategy is well suited for non-majors as it emphasizes research skills, written composition and oral presentation without detracting

from the technical content of the course, and will furthermore make the class an enjoyable and satisfying learning experience and promote interest in future course offerings.

PEER LEARNING WITH LEGO MINDSTORMS

Ciarán Mc Goldrick, Trinity College Dublin and Meriel Huggard, Trinity College Dublin

Reciprocal peer learning involves students learning from, and with, each other. This paper details a peer learning centred course where small teams of students design and develop a multifunctional robot using LEGO Mindstorms . In particular, it describes how students were introduced to the concept of peer learning and outlines how the learning environment was managed and sustained. Particular emphasis is placed on acknowledging and rewarding peer collaboration as part of the assessment procedures, thus encouraging active student engagement with the peer learning process.

Session S2G: Capstone Design 2

Chair: Jim Rowland, University of Kansas

Time and place: Saturday, October 23, 2004, 10:30 a.m. - Noon *Percival*

A MODEL FOR TEACHING MULTIDISCIPLINARY CAPSTONE DESIGN IN MECHANICAL ENGINEERING

Lewis Thigpen, Howard University, Emmanuel Glakpe, Howard University, Gerald Gomes, GMNA Product Development and Terrence McCloud, GMVO-CCRW

This paper describes a model for a multidisciplinary approach to teaching capstone design in mechanical engineering. The multidisciplinary approach described in this paper includes the involvement of four departments that have not traditionally collaborated effectively in providing capstone design experiences for students. Students in the mechanical engineering department work in teams with students from the departments of electrical engineering, marketing in the school of Business, and art in the Division of Fine Arts of the College of Arts and Sciences to complete an industry sponsored capstone design project. The level of involvement of the industrial partner and the process of defining meaningful design projects that meet the goals of the mechanical engineering curriculum are described. Examples of student team solutions to design problems from the automotive industry are presented to demonstrate the multidisciplinary nature of the design projects in meeting the goals and objectives of the mechanical engineering program. The roles played by faculty from the four collaborating departments, the grading process, resource requirements, and the summative evaluation process of the educational experience are described. Finally, the paper concludes with a discussion of challenges involved in carrying out capstone design projects with multidisciplinary teams and suggestions for overcoming such obstacles.

MOBILE ROBOTICS AS THE PLATFORM FOR UNDERGRADUATE CAPSTONE ELECTRICAL AND COMPUTER ENGINEERING DESIGN PROJECTS

Ashraf Saad, Georgia Institute of Technology

Research grade mobile robots are no longer restricted to robotics laboratories. Now that they are available and affordable through several vendors, they can be used for undergraduate capstone electrical and computer engineering design projects. Several important educational considerations have supported this decision, including: providing students with a platform for their projects that enables integrating both hardware and software development as well as dealing with real-time programming issues. We present our experience in using the AmigoBot from ActiveMedia for capstone senior design projects. Our work has focused on integrating a variety of sensors to the robot control architecture, most notably the integration of an IEEE 1394 Firewire digital CCD camera. That in turn has enabled students to develop and test computer vision algorithms. Additional system capabilities included wireless communication of video streams captured by the digital camera. Integrating the ability to remotely control the AmigoBot can also enable using it for indoor surveillance applications.

PROCESSES FOR ENSURING QUALITY CAPSTONE DESIGN PROJECTS

Ralph M. Ford, Penn State Erie, The Behrend College and William C. Lasher, Penn State Erie, The Behrend College

A series of processes to ensure high quality capstone design projects have been developed. They address several aspects of the capstone design experience, including project selection, problem definition, ABET (Accreditation Board for Engineering and Technology) accreditation requirements, teamwork, program outcome evaluation and assessment, and relationships with industrial sponsors. The processes were developed and implemented over a period of 12 years, and the results have been positive. Project quality has continually improved, and difficulties associated with poorly performing teams have been reduced.

EARLY INTRODUCTION OF CAE TOOLS ENHANCES SUCCESS IN STUDENT DESIGN COMPETITIONS

Craig J. Hoff, Kettering University, Travis Slagle, Kettering University, Alan Lo, Kettering University, Paul Zang, Kettering University and William K Waldron, Kettering University

The Society of Automotive Engineer s (SAE) Formula Car events are the premier competitions for automotive engineering students worldwide. Student teams from accredited engineering educational institutions are asked to design and build small open-wheel, Formula-One style vehicles. Younger members on the teams (freshman and sophomores) are often asked to design parts for the vehicle, long before they have completed the necessary core engineering courses. At Kettering University early introduction of CAE tools in the curriculum has helped to enhance the student s ability to compete. With a high level of motivation, the team members are able to leverage their basic understanding of engineering and engineering tools to perform engineering analysis and design at a much higher level than one would expect. The early exposure to CAE tools has resulted in a number of successes for the Kettering Formula Car team including a 6th placed finish (out of 140 vehicles) in the Formula SAE design event

WORK IN PROGRESS - PRACTICAL KNOW-HOW IN ENGINEERING: DISSECTION LABS & CAPSTONE DESIGN

Greg Leo Rohrauer, University of Windsor, Bruce Minaker, University of Windsor and Peter Frise, University of Windsor

Based on a series of previous studies to identify the design engineering body of knowledge, methods are being sought to effectively implement a know-how skill set within the mechanical / automotive / materials engineering curriculum. Aside from acquiring competence in the standard engineering sciences and analytical methods, greater emphasis is being put towards establishing an innate feel for machinery, precision measurements, manufacturing methods, team based project work and a range of professional practice issues. Lack of sufficient exposure to an experiential knowledge base is being overcome though a series of dissection and rebuild laboratories plus team projects with shop-intensive content requiring conceptualization, planning, detail design, manufacturing, prototype assembly and testing. The Capstone Design experience is being implemented with a view towards establishing engineering design teams operating within a virtual company who report to a management board constituting the diverse interests in a corporation. These include senior engineering, expert consultants, the manufacturing division, finance, marketing and clients.

Session S2H: Women in Engineering

Chair: Jill L. Auerbach, Georgia Institute of Technology

Time and place: Saturday, October 23, 2004, 10:30 a.m. - Noon *Verelst*

RECRUITING AND RETAINING WOMEN IN ENGINEERING: A KENTUCKY COLLABORATION

John Sasser, Midway College, G. T. Lineberry, University of Kentucky and Sue Scheff, University of Kentucky

According to the Engineering Workforce Commission, women received approximately 21% of the nation s B.S. degrees in engineering in 2000. If bio-related fields are omitted, the percentage drops well below 20%. Only modest improvement has been made in these statistics since, beginning in the mid-1980 s, many U.S. engineering colleges focused attention on the issue of diversifying the engineering workforce. Current research indicates that eliminating the significant gender incongruity in engineering requires improvement in recruitment, retention, and advancement practices. In an effort to increase the number of B.S.-level women engineers in Kentucky, a partnership has been forged between Midway College and the University of Kentucky (UK). In this program, students enrolled in full-time study at Midway College may fulfill lower-division electrical engineering course requirements at UK while remaining predominately on the Midway campus. Students may earn an A.S. from Midway and a B.S. from UK in four years. Earning such a degree is becoming increasingly difficult in Kentucky, as smaller schools offerings of pre-engineering curricula have diminished markedly over the past decade. Obstacles that have interfered with the recruitment, retention, and advancement of women in engineering are being countered in this innovative educational partnership. Despite dissimilar profiles, the two institutions embarking on this experiment possess notable similarities with respect to their commitment to gender diversity in engineering and their awareness of the need to increase the number of engineers in Kentucky.

A RESEARCH AND MENTORING PROGRAM FOR UNDERGRADUATE WOMEN IN COMPUTER SCIENCE

Peggy Doerschuk, Lamar University

This paper describes a new program for female undergraduate computer science students. The program uses recognized strategies for engaging women in computer science. It includes multi-faceted mentoring, community building activities, and a research program with significant educational components. The research component gives women an opportunity to

work in research teams under the direction of a female faculty member who serves as role model. While there are other programs that allow students to work with female faculty on their research, this research program was designed to develop our female students. The research team presents its research at an appropriate conference each year. The team members also reach out to other students by participating in recruiting activities and presenting their research to high school students at local career days. Our program is currently in its second year. This paper describes the program and changes that we have made based on what we learned during the first year.

GENDER TRENDS IN ENGINEERING RETENTION

Maura Jenkins, University of Southern California and Robert G. Keim, Associate Dean

We know that fewer women than men choose to begin college in an engineering major, but is there a difference in the graduation rates of male and female engineering students? Is the average GPA of female students leaving engineering higher or lower than that of the male students? Are the critical semesters different for each group? Likewise, do the same relationships hold for minority vs. nonminority students? In this paper, we report on analysis of graduation data for four cohorts and retention data for six cohorts of engineering students. Statistical analyses were performed to determine significant differences between groups of students and which characteristics are most strongly correlated to retention in engineering. Gender and minority status were included in the analyses. The purpose of this study was to identify trends in female engineering student retention to guide future program development. Overall, the graduation/retention rates and GPAs of female students were found to be higher than those of the male students. Brief examples of how these findings can be applied are also offered.

ON THE GENDER ORIENTATION OF THE DESIGN TASK DOMAIN: EMPIRICAL STUDY RESULTS

Gül E. Okudan, Penn State and Susan Mohammed, Penn State

This paper is a sequel to the FIE conference paper published in 2002, which highlighted the potential effect of the gender orientation of the product design task domain on the performance of design teams with different gender compositions. Building on the previous work, this study presents a designed experiment where reasons underlying the perceived gender orientation of the task domain were studied using six sections of an introductory engineering (ED&G 100) course during Fall 2003. Data collection included both quantitative (survey items) as well as qualitative (focus groups, open-ended questions) methods. This paper reveals survey study results of the study focusing on understanding task domain s gender orientation. The major finding of the study is that when a task domain is deemed favoring a gender, the reasons for doing so are related to the gender associations of the institutions, objects, actions, and related knowledge. This finding s implications are that if a task s domain is framed in a way to neutralize the gender orientations, a more equitable education environment can be established both for male and female students.

THE COALITION OF MINORITY ENGINEERING SOCIETIES AND THE SOCIETY OF WOMEN ENGINEERS (CEMSWE): COLLABORATIVE RETENTION EFFORTS WITH INTEL

Dana C. Newell, Arizona State University, Eugenia Echols, Intel Corporation and Adzoa Kwawu, Arizona State University

The Coalition of Engineering Minority Societies and the Society of Women Engineers (CEMSWE) was created in 1998 and operates out of Center for Engineering Diversity and Retention (CEDAR). In the fall of 2003, CEMSWE collaborated with Intel to provide a more comprehensive retention program geared at improving student GPA s. The program, known as the CEMSWE 3.0 Program, has an academic excellence component, weekly monitoring and peer cluster meetings. Those students enrolled in the program that show the largest increase in GPA over the period of fall 2003 semester and spring 2004 semester will receive a $1000 scholarship. To date, over 60 students are enrolled in the program. This paper will further detail the program, analyze its success and make recommendations on how universities and corporations can use this model to strengthen their own retention efforts for underrepresented populations in engineering.

Session S3A: Open Forum: Issues in Engineering, Technology, and Computing Education

Chair: William E. Sayle, Georgia Institute of Technology

Time and place: Saturday, October 23, 2004, 1:30 p.m. - 3:30 p.m. *Chatham*

OPEN FORUM: ISSUES IN ENGINEERING, TECHNOLOGY, AND COMPUTING EDUCATION

Joseph L. A. Hughes, Georgia Institute of Technology and William E. Sayle, Georgia Institute of Technology

The FIE 2004 Open Forum provides an opportunity for conference attendees to make short presentations on topics of interest related to engineering, technology, and computing education. The primary goal is to allow attendees to raise new and/or controversial topics in order to engage FIE participants in thinking about and discussing the issues.

Session S3B: Computer and Web-Based Software 2

Chair: Howard B. Rockman, University of Illinois at Chicago

Time and place: Saturday, October 23, 2004, 1:30 p.m. - 3:30 p.m. *Savannah*

TRANSITIONING STUDENTS TO FINITE ELEMENT ANALYSIS AND IMPROVING LEARNING IN BASIC COURSES

Paul S. Steif, Carnegie Mellon University and Edward Gallagher, Associate Engineer

Much engineering practice today involves computer aided engineering tools. While the associated underlying theory is often beyond the abilities of many undergraduates, we still must prepare students who will be expected to use such tools in the workplace after graduation. At the same time, computer-based tools may also be used to improve learning in even the most basic subjects. For example, a significant aid in learning mechanics of materials is visualizing the basic patterns of deformations. Using readily deformable objects in class, such as foam bars, is one aid to visualization. This paper describes a very simple web-based finite element program, which can serve two purposes. First, it acquaints students with the basic steps in carrying out a finite element analysis. Second, this program makes a wide range of deformation patterns available for visual inspection, and thereby can facilitate an increased understanding of some of the variables of importance in mechanics of materials.

COMPREHENSIVE EVALUATION OF ANIMATED INSTRUCTIONAL SOFTWARE FOR MECHANICS OF MATERIALS

Timothy A. Philpot, University of Missouri - Rolla and Richard H. Hall, University of Missouri - Rolla

During the past three years, the Basic Engineering Department at the University of Missouri Rolla has been developing a second-generation suite of instructional software called MecMovies for the Mechanics of Materials course. In the Fall 2003 semester, MecMovies was integrated into assignments throughout the entire semester for one of the six UMR Mechanics of Materials sections. This paper presents a comparison of student performance in the experimental section with student performance in five control sections along with discussion of student qualitative ratings and comments.

A COMPARISON OF J2EE AND .NET AS PLATFORMS FOR TEACHING WEB SERVICES

Sandeep Kachru, Blackbaud, Inc. and Edward F. Gehringer, North Carolina State University

NET and J2EE are the two leading technologies in enterprise-level application development. They are also the platforms of choice for developing Web services. We compare the two platforms using parameters such as features present in each platform, tools and resources offered by the two and compatibility with the rest of the curriculum. .NET offers integrated, native support for various phases of Web services development, while the Java platform achieves this with several new libraries. We compare the Web-services development process in IBM s Websphere (for J2EE) and Microsoft s Visual Studio .NET and find them remarkably similar. Arguments in favor of J2EE are platform independence, multiple vendor support, the popularity of Java in universities, and a larger number of tools and resources from which to choose. Points favoring .NET include support for multiple languages, and integrated (rather than add-on) support for Web services. The disadvantage of single-vendor support in .NET must be weighed against J2EE s single-language support.

WORK IN PROGRESS  DEVELOPMENT AND USE OF A SOFTWARE TOOL FOR IMPROVING THE AVERAGE STUDENT CAPACITY IN THE GREEK HIGHER EDUCATION SYSTEM

Catherine C. Marinagi, Technological Educational Institution of Kavala, Vassilis Th. Tsoukalas, Technological Educational Institution of Kavala and Vassilis G. Kaburlasos, Technological Educational Institution of Kavala

An inherent problem of higher education in Greece regards the absence of regular homework assignments due, at large, to limited teaching resources. Work is currently in progress for overcoming the aforementioned problem by the development, followed by implementation, of a customized software tool namely Platform for Adaptive and Reliable Evaluation of Students or PARES for short. The basic idea behind PARES is to regularly give students short exams, including multiple-choice questions, in response to homework assignments. This work presents technical features as well as our first experience of using PARES at a large-scale in practice. A statistical evaluation of PARES is also described.

DEVELOPING COLLABORATIVE TOOLS TO PROMOTE COMMUNICATION AND ACTIVE LEARNING IN ACADEMIA

Scott Frees, Lehigh University and G. Drew Kessler, Lehigh University

Groupware applications such as AOL s Instant Messenger and Microsoft's NetMeeting have been growing in popularity in the general public for many years, starting with students on college campuses and more recently gaining acceptance in the business world as effective tools to aid in communication and productivity. Although many of these technologies were first popularized on college campuses, their use has yet to be integrated into the student/instructor teaching relationship, remaining more widely used between students for social purposes. In this paper we present the Cimel Collaborative Tools, a set of integrated groupware applications designed to improve communication between students and instructors and promote an active learning environment for students. In addition to the standard contact list and text messaging functionality, the Cimel Collaborative Tools provide a desktop sharing tool and a course-specific frequently asked questions (FAQ) database.

WORK IN PROGRESS A WEB-BASED VISUAL SYSTEM FOR ASSESSMENT GENERATING

Xiaosong Li, UNITEC New Zealand

This paper introduces a project: creating a software system, VISAGE, which can generate an assessment automatically. The project not only provides a useful tool to our teachers and students, it also provides an experimental bed for Web-based software development and maintenance. VISAGE is implemented on the ASP.NET platform with web client server architecture and XML support. Like most of the web-based learning/assessment systems, the system produces multiple versions of an assessment, accepts parameters and creates different levels of difficulty for a question. This paper introduces a special feature of the system, which is the visual representation of the questions and the assessment structures, allowing the users to construct an assessment visually. For implementation, we need to address issues of direct manipulating graphical objects within a web-based client server environment. This paper describes and discusses the system requirements, architecture and data storage, as well as the visual environment and visualization framework. It also discusses the design and creation of the learning objects.

Session S3C: Multidisciplinary Teaming

Chair: Leonard Bohmann, Michigan Technological University

Time and place: Saturday, October 23, 2004, 1:30 p.m. - 3:30 p.m. *Waterfront North*

WORK IN PROGRESS INTERDISCIPLINARY LABORATORY-BASED ADVANCED MEMS COURSE FOR UNDERGRADUATES

Tina Hudson, Rose Hulman Institute of Technology and Ed Wheeler, Rose Hulman Institute of Technology

We have developed a two-course sequence in MEMS for undergraduate students at Rose-Hulman. The second course in this two-course MEMS sequence and the focus of this WIP has an integral term-length laboratory project. The study of MEMS provides a rich environment in which to provide students with truly interdisciplinary work and to present them with design problems having real constraints. Challenges include faculty coordination in these team-taught courses and delivering educational materials to a relatively disparate student audience.

DEVELOPING A REMOTE CONTROLLED VEHICLE FOR ENVIRONMENTAL STUDIES

Carl Steidley, Texas A&M University Corpus Christi, Rafic Bachnak, Texas A&M University Corpus Christi, Wien Lohachit, Texas A&M University Corpus Christi, Alexey Sadovski, Texas A&M University Corpus Christi and Gary Jeffress, Texas A&M University Corpus Christi

Water quality data collection in shallow water areas can be a challenging task. Obstacles encountered in such environments include difficulty in covering large territories and the presence of inaccessible areas due to a variety of reasons such as a soft bottom or contamination. There is also a high chance of disturbing the test area while placing the sensors. This paper describes a NASA-funded project, which has had a great deal of student involvement and is currently in the test phase, to develop a remote-controlled, shallow-draft vehicle designed as a supplemental tool for our studies of the South Texas Coastal waters. The system transmits environmental data wirelessly via a radio to a docking and control station in real-time.

TEAM TOOLBOX: ACTIVITIES & SUGGESTIONS FOR FACILITATING PROJECT TEAMS

Mark Tichon, University of Tennessee and Janie Elaine Seat, University of Tennessee

This paper shares the experience of facilitating project design teams and offers practical suggestions and activities for improving workgroup performance. The activities presented here represent a series of mini-lectures and class exercises used to promote team development in a yearlong engineering project design course for first-year students. These short activities are useful in engaging college students and getting them to examine the effectiveness of their own teams. Attention is paid to group process, with different activities throughout the project design cycle, from icebreakers at team inception through reflection on strengths and areas for improvement at project completion. Included in this paper are semi-structured exercises for many various situations, including increasing communication, examining group norms, managing conflict, providing guidelines for creative brainstorming, monitoring team progress, and utilizing strengths of all team members. The information offered here is intended to give fresh ideas to those who work with teams so that they may more easily and confidently incorporate a focus on group process into project design courses.

USING INTERNET BASED CONCURRENT ENGINEERING TOOLS TO EDUCATE MULTINATIONAL STUDENTS ABOUT THE DESIGN, PROCESS PLANNING AND MANUFACTURE OF NEW PRODUCTS

David E. Culler, Costa Rica Institute of Technology and José Antonio Pérez García, University of Vigo

The data rich manufacturing environment provides an excellent educational platform for working in the emerging fields of E-Engineering and distance learning. Engineers of the future, who are currently in their formation stages at universities around the world, will be responsible for the design and process specification for all types of products and components. Therefore, it is extremely important that different aspects of Concurrent Engineering are analyzed to develop appropriate teaching techniques for the next generation. Four universities have come together to design an experience which educates students about interdisciplinary team building, virtual work groups and international standards by creating an environment of true Collaborative Engineering. Teams were composed of students from three institutions; a conceptual design group, a prototype development group and an industrial production group. Product ideas were based on simplifying computer interaction for the disabled. The project demonstrated the complexity of the entire art-to-part process and exposed obstacles and cultural differences that teams had to overcome.

TEAMING ASSESSMENT: IS THERE A CONNECTION BETWEEN PROCESS AND PRODUCT?

Richard L. Upchurch, University of Massachusetts Dartmouth and Judith E. Sims-Knight, University of Massachusetts Dartmouth

It is reasonable to suspect that team process influences the way students work, the quality of their learning and the excellence of their product. This study addresses the relations between team process variables on the one hand, and behaviors and outcomes, on the other. We measured teaming skill, project behavior and performance, and project product grades. We found that knowledge of team process predicts team behavior, but that knowledge alone does not predict performance on the project. Second, both effort and team skills, as assessed by peers, were related to performance. Third, team skills did not correlate with the students effort. This pattern of results suggests that instructors should address issues of teaming and of effort separately. It also suggests that peer ratings of teammates tap aspects of team behavior relevant to project performance, whereas declarative knowledge of team process does not.

USING DESIGN BUILD PROJECTS TO PROMOTE INTERDISCIPLINARY DESIGN

Richard Goff, Virginia Tech, Mitzi R Vernon, Virginia Tech, William R Green, Virginia Tech and Clive R Vorster, Virginia Tech

The activity of real world design is a collaboration of individuals from more than one discipline. To address this important future work environment, student interdisciplinary design projects were created. For the past seven years, teams of students from the first year Engineering Design Graphics course in the College of Engineering and the second year Industrial Design Studio in the College of Architecture and Urban Studies have been teamed together to pursue design build projects. In the initial years, push-pull toys were designed and constructed. Then LEGO Programmable RCX bricks were chosen as a medium for the interdisciplinary design projects. Last year, the students were charged with designing and building a Walkmobile walking device using a rechargeable electric screwdriver as the power source. The paper describes the project evolution over the years and serves as a record of an exciting and creative foundation design effort that promotes true collaborative interdisciplinary design.

Session S3D: K - 12 Projects

Chair: Jeffrey Mountain, University of Texas at Tyler

Time and place: Saturday, October 23, 2004, 1:30 p.m. - 3:30 p.m. *Waterfront South*

CLASSIFICATION OF EXERCISES IN A VIRTUAL PROGRAMMING COURSE

Veijo Meisalo, University of Helsinki, Erkki Sutinen, University of Joensuu and Sirpa Torvinen, University of Joensuu

The ViSCoS program (Virtual Studies of Computer Science) provides Finnish high school students with an opportunity to study first-year university level Computer Science courses over the Internet. For the time being, the fourth group of high school students participates in this program. Almost half of the content in ViSCoS deals with programming. Programming has proven to be the most difficult part of our on-line study process. Of the students who dropped out of the ViSCoS program, the majority dropped out in the Programming I or II courses. A more focused analysis of the exercises submitted in the Programming I course highlighted the main problem in the course: the difference between the expected and observed level of difficulty of the exercises. Teachers were not able to recognize the internal difficulty of the exercises which prevented unconfident students from solving or submitting them and subsequently, led them to give up the course. Our findings will help us to improve course settings in several ways. We are presently working to further develop a certain group of tasks in order to minimize the number of dropouts. We are creating a larger pool of tasks to offer both teachers and students the possibility of selecting the best ones for each authentic learning situation. There is also a need for more open and creatively designed exercises.

VOCATIONAL SCHOOL INTERDISCIPLINARY AS A KEY TO SUCCESS

Trond Clausen, Telemark University College

Since 1977 the Law of Secondary Training has governed Norwegian secondary schools, regardless if they were offering theoretical or practical training. Through this quarter of a century, the practical training offered by the vocational school has changed significantly, thanks to tight links between the Ministry, the employers' confederations and the Labor Organization. These powerful partners have methodically changed the scope and content of the vocational schools in particular from traditional training to a theoretically based training resembling technical education. "Interdisciplinary" has been a keyword governing the transformation process. On the other hand, carrying out interdisciplinary has also contributed to concealing the value of the "new" vocational school as an important source of engineering school recruitment. Thus, the interdisciplinary learning program for the training of electricians is described and test results presented indicating why vocational school graduates are now considered attractive applicants for electrical engineering programs.

THE DEVELOPMENT OF AN ONLINE ENGINEERING ALPHABET

Ismail Fidan, Tennessee Tech University, Marketta Laurila, Tennessee Tech University and Robert J. Clougherty Jr.,, Tennessee Tech University

Engineering is an unknown profession to many children, as current research proves that almost all of Pre-K, Kindergarten, and first grade students do not understand the scope of engineering concepts. In this study, the authors developed a WebCT-based tool to teach the US Alphabet using engineering pictures and animations. Currently, each letter is illustrated with sample pictures and animations starting with that letter. In addition to the alphabet-teaching module, this tool also has a number of oral and virtual quizzes. Sections describing famous engineers, different engineering majors, and an engineering glossary are also part of the current development as well. The first phase of this development was beta-tested in local public schools during the summer of 2003. Students and teachers responded that the tool was very effective as an instructional source web-book for introducing the field of engineering to young children. In this paper, the authors report current development and the results of the beta testing.

WORK IN PROGRESS- A 6-12 INITIATIVE FOR INTEGRATED STUDY OF ENGINEERING SCIENCES, TECHNOLOGIES, AND ART

John Mativo, Ohio Northern University and Arif Sirinterlikci, Ohio Northern University

This paper presents a 6-12 initiative to capture and maintain interest of unrepresented secondary school students in Information Technology intensive Science, Technology, Mathematics, and Engineering fields. It is a cross-disciplinary integrated study of these topics with inclusion of art. Inquiry based complex problem solving is promoted through design and construction of dynamic and interactive animated toys and robots providing a fun learning atmosphere in team environments. Yearlong weekend program prepares students for the summer capstone experience. The program encompasses a mix of formal ways of learning such as classes/laboratory exercises and informal means such as independent study through Web-CT, electronic discussions, research for possible capstone projects through electronic databases, and utilization of

electronic journals. The paper also elaborates on feasibility of the project, learning outcomes, and evaluation. It is concluded with preliminary developments, projected status, and future work.

WORK IN PROGRESS: SUCCESSES AND LESSONS LEARNED FROM A GK-12 NSF GRANT PROJECT

Debbie Kinne, University of Cincinnati, Anant R. Kukreti, University of Cincinnati, Thaddeus W. Fowler, University of Cincinnati, Karen Davis, University of Cincinnati, Shafiqul Islam, University of Cincinnati, Richard A. Miller, University of Cincinnati, Edward N. Prather, University of Cincinnati and Suzanne W. Soled, University of Cincinnati

This paper presents the lessons learned as a result of the NSF funded GK-12 Fellows Project STEP Science and Technology Enhancement Program, which is designed to educate, nurture, and encourage university engineering, science, mathematics, and education students in secondary math and science instruction. The students are trained and expected to bring their experiences and knowledge as well-developed activities into urban and sub-urban schools in the greater Cincinnati area. This paper presents the lessons learned related to the training, recruitment, and selection of the graduate fellows.

FIELD-BASED TECHNOLOGY EDUCATION: TEACHING TEACHERS

Sarah Irvine Belson, American University and Teresa L. Larkin, American University

This paper will outline the current status of technology integration in schools from the perspective of researchers and policy makers. The focus of the paper will then turn to how teacher education programs in the U.S. have been preparing future teachers to use technology. In order to illustrate the complex issues that must be addressed when preparing teachers to use technology, this paper will report on and summarize the past seven years of an intensive field-based course given at American University in Washington, DC. This course has provided students with an opportunity to experience technology within a real-life school setting while providing local teachers with knowledge and practical skills on integrating technology into their classrooms.

Session S3E: Ethics 2

Chair: Marilyn Dyrud, Oregon Institute of Technology

Time and place: Saturday, October 23, 2004, 1:30 p.m. - 3:30 p.m. *Sloane*

PARTNERING WITH INDUSTRY TO PROMOTE ETHICAL BUSINESS PRACTICES IN A CAPSTONE DESIGN COURSE

Kathleen A. Kramer, University of San Diego

Efforts to increase student awareness of ethical business conduct within a senior-level capstone design course through interaction with two major engineering corporations, Northrop Grumman and Sun Microsystems, are described. With the help from leaders within Sun Microsystems Business Conduct Office and Northrop Grumman s Ethics and Business Conduct Office, an exercise within the senior-level engineering capstone design sequence was developed based upon corporate training materials and their feedback-based assessment. The exercise included a 10-question assessment instrument that was modeled after the industry approach and used similar content. These topics and standards were used within the professional practice portion of a capstone design course, augmenting the traditional professional ethics coverage taken by the students in a course devoted to engineering ethics.

WORK IN PROGRESS - ETHICS INSTRUCTION FOR THE WORKPLACE

Scott Danielson, Arizona State University

Ethics has long been a part of engineering education and practice. Thus, engineering educators have adopted various strategies for teaching ethics, including the use of various codes of ethics promulgated by professional organizations. Additionally, case studies have been used to introduce the subtleties and complexities of engineering ethics within engineering projects. This paper describes another approach to engineering ethics instruction, one that can be used in lieu of, or in conjunction with, other common ethics instruction scenarios. The approach focuses on various aspects of ethics important to young engineers as they enter industry, e.g., workplace ethics. The materials developed cover a variety of practical subjects important for a new engineer to know when entering the engineering workplace. The teaching materials are based on the experiences of a group of practicing engineers.

INTEGRATING ETHICS INTO THE FRESHMAN YEAR EXPERIENCE

George D. Catalano, SUNY Binghamton

Various attempts are described in an effort to integrate ethics into the freshman year engineering classes. The attempts include formal lectures on moral reasoning theories, ethics focused videos/DVDs, environmentally focused design

projects, design projects that force students to consider societal and global issues. A somewhat different type of design project, Compassion Practicum, is also described. The Compassion Practicum requires students to use an engineering design methodology to identify, design a solution an implement that solution with the charge to the student stated as do something compassionate for some being other than you.

AN ELECTIVE COURSE IN BIOMETRICS AND PRIVACY

Kevin W Bowyer, University of Notre Dame

In the aftermath of 9-11, the area of biometrics has taken on increased importance. There is a need for more graduates who are familiar with the principles of biometric technology, and with the social and ethical issues raised by use of this technology. This paper describes a course that covers the fundamentals of the major biometric technologies, as well as privacy and security concerns. Experience from teaching a first section of this course is discussed. Modules from this course could also be used in a more general Social Impact of Computing course, or could be used in a Pattern Recognition or Artificial Intelligence course to introduce social and ethical issues.

WORK IN PROGRESS TECHNOLOGY IN PLAGIARISM DETECTION AND MANAGEMENT

George R. S. Weir, University of Strathclyde, Margaret Anne Gordon, Mellow Internet Training and Grant MacGregor, University of Strathclyde

The detection of intra-cohort plagiarism is often difficult in virtue of the quantity of material that must be compared. This can be limited by imposing constraints on the granularity of comparisons and through heuristic approaches to content comparison. Plagiarism sourced out with a group cohort is more difficult to detect, although Internet-based resources are the principal basis for such comparisons. This paper describes a survey of course work submissions from several computer science classes. The survey purpose was to determine the historical level and extent of plagiarism across electronically submitted assignments. This paper also describes our plans for using automated means of detecting plagiarism against future submissions. An approach to document tagging is described which supports the detection of contamination across documents within a cohort.

ACADEMIC HONESTY IN CROSS-BORDER EDUCATION - OPINIONS OF INVOLVED STUDENTS

Satu Alaoutinen, Lappeenranta University of Technology, Nina Kontro-Vesivalo, Lappeenranta University of Technology, Danila Medvedev, Lappeenranta University of Technology, Jan Voracek, Lappeenranta University of Technology and Alexei Uteshev, St. Petersburg State University

This paper analyzes the specific features of academic honesty in cross-border degree education between Finland and Russia, as seen by students involved in this process. We collected valuable information concerning particular cases of dishonesty as well as some relevant system-level data by doing a Web-based survey. The survey was carried out on our own freshmen and advanced students and on our distance students in Russia. This research was primarily quantitatively oriented, and we used several independent techniques to discover significant dependencies in the feedback provided. The results clearly show the students' interest in the topic itself and the evident existence of culture-dependant honesty issues, which cannot be underestimated in the case of a long-term educational partnership.

Session S3F: Learning Environments & Models

Chair: Ken Reid, Indiana University - Purdue University at Indianapolis

Time and place: Saturday, October 23, 2004, 1:30 p.m. - 3:30 p.m. *Vernon*

NARROWING STUDENT ACADEMIC PERFORMANCE GAPS

James R. Rowland, University of Kansas

Students aspire to master key concepts in each course to earn grades corresponding to their desired levels of learning. Differences in what students should learn and what they have actually learned creates one kind of gap. Another gap, sometimes due to a lack of focus during the heat of examinations, is the difference between what students have actually learned and what they demonstrate on examinations. Together, these differences combine to form a student academic performance gap for each student. Both professors and students work together to maximize the learning process. Checks and balances are necessary to ensure that the learning process is working well and that the two kinds of gaps noted above are minimized for each student. This paper describes a five-step process somewhat like the process being required in accreditation planning to improve the learning process. Assessment data from examinations in three courses are analyzed and plans of action devised to narrow the student performance gap.

KNOWLEDGE MANAGEMENT IN LEARNING ENVIRONMENT DESIGN

Inés Friss de Kereki, ORT Uruguay University, Javier Azpiazu, Polytechnical University of Madrid and Andrés Silva, Polytechnical University of Madrid

Knowledge management can be seen as the process of integrating information, to get sense out of incomplete information and to renew it. Codification converts knowledge into accessible, applicable formats, making it as organized, explicit, portable and easy to understand as possible. Communities of practice are groups of people who have practice and knowledge in common. These related concepts -knowledge management, codification and communities of practice- are applicable to learning, since learning involves acquisition and modification of knowledge, skills, strategies, attitudes and behaviors. A learning environment is the space where it is possible to manage knowledge or, rather, ignorance. We propose a new model, based on knowledge management, codification and communities of practice. We analyzed different models but did not find a learning environment with these characteristics. We developed an environment applying the model. Students who used it show remarkably improved problem solving skills and better capacity to transfer knowledge from one situation to another.

SUCCESSFULLY APPLYING THE SUPPLEMENTAL INSTRUCTION MODEL TO ENGINEERING AND PRE ENGINEERING

Catherine M. Blat, University of North Carolina at Charlotte and Kathleen Nunnally, University of North Carolina at Charlotte

Supplemental Instruction (SI) is a non-remedial program that utilizes peer-assisted review sessions and targets historically difficult academic courses. SI has been used nationally for decades in non-engineering and pre-engineering courses, however, there is very little literature on its application in engineering courses. In UNC Charlotte, offering SI in core engineering courses began in 1996 when the College of Engineering joined forces with the University s established SI program. Using grant funding, SI was piloted in three engineering gateway courses with low participation and results that initially were not as impressive as those in chemistry and biology courses. Yet students and faculty began to recognize the potential of this new program. Since then, assessment results indicate that SI is making a positive impact on final course grade sand on DFW rates. This paper focuses on the development, implementation, assessment, and continuous improvement of the program. Actual assessment results and lessons learned are presented.

RESEARCH AND TRAINING ENVIRONMENT FOR DIGITAL DESIGN AND TEST

Raimund J Ubar, Tallinn Technical University and Heinz- Dietrich Wuttke, Ilmenau Technical University

An environment directed to e-learning is presented for teaching test generation and fault diagnosis in digital circuits. The environment consists of a set of Java applets for learning basics of test preliminary and of a set of low-cost tools for research oriented training in more advanced topics of test. The tools support university courses on digital electronics, computer hardware, testing and design for testability. They help to learn by hands-on exercises how to generate tests, how to build self-testing systems, how to analyze the quality of tests or testing hardware and how to localize faults in hardware. The tasks chosen for hands-on training represent simultaneously real research problems, which allow to foster in students critical thinking, problem solving skills and creativity.

PREPARING COMPUTER SCIENCE STUDENTS TO QUESTION AND IMPROVE A SOFTWARE DEVELOPMENT PROCESS

Carol Wellington, Shippensburg University

Shippensburg University offers a B.S. in Computer Science degree with a concentration in Software Engineering. In addition to a core of computer science classes, this concentration contains three four credit software engineering courses. The main goal of this concentration is to prepare the students to be able to measure the software development process and enact appropriate modifications. This requires that they must be aware that there are a variety of software process alternatives and when various aspects of each process might be beneficial. In addition, they need to be able to apply appropriate statistical analysis to assess the process. In order to accomplish this, our Software Engineering concentration includes three software engineering specific courses: Traditional Lifecycle, Testing & Extreme Programming, and Software Metrics/ Project Management. In the first two courses, the students work in teams to develop products for customers using two disciplined, but very different, processes (a variation of TSP[3] and XP[6]). By comparing these experiences, the students learn about making the choices that software engineers have to make regularly. In Software Metrics, we study methods of assessing risks, the process, and modifications to the process. This paper will describe these courses and the results of our assessment of these courses.

INTEGRATING PEER MENTORING INTO THE FRESHMAN CURRICULUM

Dan Budny, University of Pittsburgh and Cheryl A. Paul, University of Pittsburgh

The transition from high school to college can be very difficult for many students. At the University of Pittsburgh, we have a system of courses and academic counseling that is designed to address these issues and help with this transition. One major component to help the freshman make this major transition is a series of mentoring courses that the entering student can select for the first semester. The student must also enroll in a Freshman Problem Solving course that details the use of various computer tools. This paper will discuss how these courses are integrated and describe the interaction of counseling with the first semester engineering problem solving course. The paper will also discuss the mentor selection process, the mentor-training program, and the topics covered in the mentoring sessions.

Session S3G: Topics in Assessment 3

Chair: Victor Nelson, Auburn University

Time and place: Saturday, October 23, 2004, 1:30 p.m. - 3:30 p.m. *Percival*

OUTCOME ASSESSMENT: PRACTICAL REALITIES AND LESSONS LEARNED

David G. Meyer, Purdue

The challenges of implementing ABET 2000 outcome assessment strategies for a sequence of three computer engineering courses (spanning sophomore-level to senior design) are described in this paper, with a focus on practical realities and lessons learned. Issues addressed include formulation of outcomes, choice of evaluation instruments, static vs. dynamic assessment thresholds, instructor overhead, maintaining consistency with prior grading practices, and remediation strategies. Outcome demonstration success rate data are presented for representative trials.

ASSESSING STUDENT OUTCOMES IN A PEDAGOGICALLY REFORMED ENGINEERING SERVICE COURSE

Dawn M. Zeligman, Michigan State University, James S. Fairweather, Michigan State University and P. David Fisher, Michigan State University

Michigan State University (MSU) received an educational research grant from the GE Fund in 1997 for the purpose of seeking ways to reform the early undergraduate engineering learning experience. This educational research project which is now in its seventh year has investigated strategies for augmenting introductory core courses with innovative instructional approaches, including cross-disciplinary experiences in teamwork, design, and the use of advanced teaching technologies. Project goals include: improving the quality of the undergraduate student learning experience, encouraging faculty use of innovative instructional techniques, and institutionalizing these reforms. This paper presents a description of one of the course s evolution during the project, methods used to evaluate the course, and the effect of instructional innovations on student learning outcomes.

WORK IN PROGRESS - EDUCATION AND PRACTICE: ASSESSMENT FOR ARCHITECTURE EDUCATION

Elizabeth Petry, University

Architectural education has always been a complicated issue. In Building Community: A New Future for Architecture Education and Practice, Boyer and Mitgang concluded, "that architectural education is really about fostering the learning habits needed for the discovery, integration, application, and sharing knowledge over a lifetime." The University of Hartford s Architecture Program is based on the blending academic-based theoretical studies with industry-based problem solving. Our practice oriented architecture department has developed and implemented an innovative assessment plan. This plan implements both traditional and innovative methods for evaluation. Key to the assessment plans success is the involvement of our advisory board members and other practicing professionals. The challenges to architects and educators regarding architectural education are sometimes daunting. Concerns over lack of integration of technical and practical knowledge into design work is probable the single most widespread area of program weakness. The unique roles of the advisory board members and other practicing professionals help to overcome these challenges. Faculty, administrators, and professionals are working together to develop and implement a solid program for it s students, graduates, and the profession.

COMPREHENSIVE TESTING AND OUTCOMES ASSESSMENT IN THE CHEMICAL ENGINEERING PROGRAM

Gennaro J. Maffia, Widener University

A variety of assessment tools are being used to determine how well graduates from the chemical engineering program are meeting the established outcomes. These tools include student, faculty, employer and alumni surveys, as well as place-

ment data, results of standardized tests, and performance in contests and research presentations. In order to further enhance the objective nature of the outcomes assessment process, an industrial board of advisors has been established to help with the development of additional tools. Members consist of alumni, research collaborators and representatives from a broad spectrum of industry. One of the new tools that have been developed is a 24-hour comprehensive test given as part of the capstone process design class. Problems and suggested solutions are provided by the advisors and tend to be open-ended, covering most of the program outcomes. The response of the students has been favorable and valuable data has been obtained and incorporated into the assessment process. Specifically, the importance of open-ended questions and case studies has become more apparent. Program details and initial results of the comprehensive testing process are presented in this paper.

WORK IN PROGRESS: PRELIMINARY ANALYSIS OF DEVELOPING TEAM BUILDING SKILLS IN COMMUNITY COLLEGE STUDENTS

Leah M. Akins, Dutchess Community College and Daniel C Barbuto, Dutchess Comminuty College

Ability to function in teams , good team building skills , teamwork , are all now common phrases in the classifieds. It is increasingly important in society today, both in social and work environments, to be a good team player. But how do we actually develop those skills in our students and ourselves? And 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? This paper presents an assessment tool developed to track and improve students team building skill as well as a brief description of its implementation. An analysis is performed and reported on based on data collected over a year of study in electronics for a group of community college students.

WORK IN PROGRESS: SUMMARY OF FIE 2003 ASSESSMENT

James Avery, University of Colorado and Melinda Piket-May, University of Colorado

During FIE2003 a new assessment program was implemented to attempt to get better feedback with respect to many aspects of the conference. In this presentation we will discuss the program, how we implemented it, and the FlE2003. Overall aspects of the conference will be discussed as well as the response to specific formats (papers, panels, special sessions). Feedback to individual authors (with all identifying features removed) will be discussed as well. We hope that this will be a working session at which ideas for improvement will be made by the attendees.

Session S3H: Computer Science Education 7

Chair: Han Reichgelt, Georgia Southern University

Time and place: Saturday, October 23, 2004, 1:30 p.m. - 3:30 p.m. *Verelst*

WORK IN PROGRESS - USING THE KOLBE CONATIVE INDEX FOR IMPROVING RETENTION OF COMPUTER SCIENCE STUDENTS

Robert Lingard, California State University, Northridge, Elizabeth Berry, California State University, Northridge and Brenda Timmerman, California State University, Northridge

A large number of students who begin the computer science program at California State University, Northridge never finish. Although many students who leave the computer science program eventually graduate in other fields, the high number of drop outs is of concern. Previous studies have shown that computer science students nearing graduation tend to have common characteristics as measured by the Kolbe A index. These studies also indicate that changes in instructional techniques could have positive effects with respect to retention. The position here is that many students who could benefit from the Computer Science program, and who could in turn benefit the field, are being discouraged from continuing. In the current study, the Kolbe results of all students entering the computer science program will be used to suggest improvements in advisement and recommend changes in the learning environment to improve student retention.

SCALABLE PERSONALIZED LEARNING

Paul F. Reynolds, Jr., Univ of Virginia, Chris Milner, University of Virginia and Timothy Highley, University of Virginia

We describe an approach to teaching mid-sized Computer Science classes in a highly personalized manner. We began with an enumeration of fundamentals that reflect commonly recognized benefits of tutoring: student accountability, customized instruction, clear expectations, emphasis on discussion, and regular evaluation and feedback. For classes of 75 or more some of these appeared unattainable without an army of teaching assistants. But we succeeded, experimenting first in a senior level class of 23 with a design that has remained surprisingly stable as we have transitioned it into discrete math

classes of 75 to 80. Our approach includes a novel mix of old and new teaching tactics and techniques combined to create a discussion oriented, high-feedback, personalized, group learning environment. We evaluate the costs and benefits associated with our approach, including the surprising result that individual, video-taped exit interviews add little to the instructor's and TA's burden, when all costs and benefits are evaluated.

THE EVOLUTION OF DATA STRUCTURES

James Harris, Georgia Southern University and Ardian Greca, Georgia Southern University

For over 20 years, the data structures course has been a pillar of computer science programs at colleges and universities. This paper looks at how the data structures course has evolved over time from a course that emphasized algorithmic concepts to a course that emphasizes syntactical and design concepts. It illustrates how the evolution of programming languages and concepts can introduce gratuitous complexity into algorithms. Specific algorithms and abstract data types are compared in past and present data structures texts using a suite of software metrics. A comparison is performed between algorithms from data structures texts across different programming languages and across procedural and object oriented paradigms. The results are compared to provide evidence of how the course has evolved over time.

A COMPREHENSIVE ANALYSIS OF OBJECT-ORIENTED DESIGN: TOWARDS A MEASURE OF ASSESSING DESIGN ABILITY

Tracy L. Lewis, Radford University, Manuel A. Perez-Quinones, Virginia Tech and Mary Beth Rosson, Pennsylvania State University

Throughout literature, there are varying schools of thought on what constitutes object-oriented design (OOD). Does OOD encompass the selection of the appropriate interfaces? Does reusing classes represent good OOD? And what about UML, if we have class interaction diagrams, is this OOD? There is a need to establish a set of requisite competencies to guide teaching of OOD. Within this paper, we present a comprehensive analysis of seven essential principles of object-oriented design. In order to validate the effectiveness of the guiding principles OOD, we developed the Design Readiness Assessment Scale (DRAS). The DRAS provides a classification of one s design ability in relation to the testing population. We further discuss a study of the DRAS using a subject pool consisting of freshmen computer science (novice designers) and graduate/professionals (expert designers). We present the preliminary results of this study and its impact on the future OOD education.

WORK IN PROGRESS - ENHANCING CS0 COURSES USING HISTORY

John Impagliazzo, Hofstra University and John A.N. Lee, Virginia Tech

This work in progress shows how instructors can make courses interesting by using history when teaching introductory courses in computer science. The presentation will show how connecting with established computing museums and other historical entities can enhance interest in the subject and develop greater understanding of topics under discussion. It will also demonstrate how storytelling can enhance learning and add a different dimension to courses when teaching elements of computer science, especially to those students who are not majoring in the subject.

WORK IN PROGRESS - PROGRAM LIKE HELP REGARDING HUMAN AS COMPUTER

Masachika Miyata, Kanazawa Institute of Technology

Although most of popular application programs have online help, it is difficult for beginners to do what they want. This paper proposes a plain text help which is described using a programming language regarding a student as a computer input from screen and output to mouse or keyboard. For example, Menu('F', 'S') denotes to select File (F) from the main menu and Save (S) Ctrl+S from the submenu. Functions Wait(Internet Options) and Continue( ) are used to move cursor to the Internet Options dialog box and to omit explanation. It is desirable to develop a translator from such a help to a hypertext help for supplementary information.