

THURSDAY SESSIONS

Session T1A: A Mini-Workshop on How People Learn

Chair: Louis Everett, National Science Foundation

Time: Thursday, October 13, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room LaCroix C

A MINI-WORKSHOP ON HOW PEOPLE LEARN

Louis Everett, Susan Finger, Don Millard, Russell Pimmel, Janis Terpenney and John Yu

Don't give me the theory, just show me how to do it! Have your students ever said that? Theory is what allows someone to know why something works and whether you might expect it to work in a new context. Education theory does the same, yet the theories and principles are difficult to gather, digest and apply. This workshop is intended to introduce a small but effective set of learning theories. You will not be an expert, but you should be able to develop proposal ideas that are founded on proven theories.

Session T1B: Mini Workshop - Innovation for a Crowded Curriculum: Learning Modules for Tomorrow's Energy Engineers

Chair: Donna Riley, Smith College

Time: Thursday, October 13, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room LaCroix D

MINI WORKSHOP - INNOVATION FOR A CROWDED CURRICULUM: LEARNING MODULES FOR TOMORROW'S ENERGY ENGINEERS

Donna Riley

As energy technology evolves to meet demands for development and ecological sustainability, engineers need to have up-to-date skills and knowledge to meet the creative challenges our energy problems demand. However, current engineering thermodynamics textbooks are grounded in historical developments of the steam engine in Europe and subsequent fossil fuel technologies. A set of course modules has been designed to take a fresh look at the engineering knowledge and skills required for current and emerging energy challenges. Stand-alone modules facilitate integration with existing courses and curricula and are adaptable to a variety of settings. Modules employ innovative engineering pedagogies that foster student engagement. Because energy engineers will need the full range of capabilities outlined in ABET's learning outcomes, modules address outcomes not often addressed in conventional thermodynamics courses: design within realistic social and technical constraints, professional ethics, effective communication, understanding social contexts of engineering, lifelong learning, and a knowledge of contemporary issues. Modules also focus on policy analysis for energy technology selection, and incorporate contributions from the global South. The mini-workshop will demonstrate the use of the modules in core engineering courses. Participants will individually design a plan for implementing a module of their choice in one of their courses.

Session T1C: Examples of Progress in Online Learning: Assessment and New Contexts

Chair: Manuel Castro, Spanish University for Distance Education

Time: Thursday, October 13, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room LaCroix B

WORK IN PROGRESS - ASSESSING COGNITIVE SKILLS IN ASYNCHRONOUS ONLINE DISCUSSION: A CASE STUDY OF STUDENT CENTERED E-LEARNING ENVIRONMENT IN INDONESIA

Harry Budi Santoso, Oenardi Lawanto, Zainal Arifin Hasibuan and Rizal Fathoni Aji

Asynchronous online discussion is used to facilitate communication between instructor and student, and also among fellow students. Although this communication tool is a frequently-used feature of e-learning systems, there is still a limited number of studies evaluating the cognitive implications of this online discussion. This study aims to evaluate students' discourse in online discussion by using a cognitive framework analysis. The goal is to identify factors that influence the construction of discussion patterns from a cognitive perspective. The discussion topics are selected based on several criteria, including the content of discussion topics, the person who initiates the discussion, the number of discussion threads, and the type of selected courses. This paper provides preliminary results of the data collection process from four courses in a Computer Science program available in the Student Centered E-Learning Environment: Database I, Foundation of Programming, Linear Algebra, and Discrete Mathematics II.

WORK IN PROGRESS - CLASSROOM AND DISTANCE COMPONENTS OF A GK12 PROGRAM PLACING GRADUATE STUDENTS IN HIGH SCHOOL CLASSROOMS

Justin Brough, Mary Baker and Dominick Casadonte

As our national mathematics and science scores continue to fall below expectations, creating environments that

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engage the professional scientific and engineering communities in public education becomes increasingly important. Most mathematics and science teachers in high schools do not have a professional background in mathematics, science, or engineering (STEM) fields; thus, students in the public education system rarely interact with STEM professionals, and know little about the opportunities for careers in these fields. The NSF GK12 program supports graduate students who spend time in K12 classrooms for the purposes of learning to share their research with a non-technical community. In year 3 of this specific GK12 program, a distance component was implemented by placing the graduate student in the classroom, virtually, through online streaming video. This paper discusses the technology, both hardware and software, that is used in this arrangement, as well as the challenges associated with implementing the technology in the school. This paper also describes the approach taken in designing and deploying an interdisciplinary learning module via distance. Finally, the paper describes the plans for continued distance components of the program.

WORK IN PROGRESS – PERFORMANCE EVALUATION OF ONLINE LEARNING TOOLS

Alexander A. Kist and Andrew P. Wandel

Remote Access Laboratories (RAL) are tools that provide off-campus students with video supported access to practical activities on campus. A key success factor of any online activity is the quality of the student experience. As these systems use the Internet, quality depends not only on the learning activity design but also on access speed, geographical location and network traffic. Currently only anecdotal evidence exists regarding the relationship of technical performance parameters and the quality of user experience. This project proposes a systematic evaluation of the Quality of Experience of students using online learning tools. It will collect technical data as well as the subjective user experience of students using RAL systems. This paper introduces a framework and methodology that are used to evaluate the quality of the student learning experience.

SUCCESSFUL PRACTICES FOR ONLINE COMPUTING, ENGINEERING, AND TECHNOLOGY COURSES

Carol J. Romanowski, Rajendra K. Raj and S. Manian Ramkumar

Distance learning has been one vehicle of course delivery at the Rochester Institute of Technology since the early 1990s. Building on the authors' experience in teaching completely online and blended (partly on-campus and partly online) courses to both undergraduate and graduate students, in diverse areas of computing, engineering, and technology, this paper explores issues in delivering online classes in these disciplines. One particular focus is on conveying the traditional in-class laboratory experience to a similar one in the online world while another focus is to leverage the modalities available in online to create newer and richer experiences for students and instructor. The paper presents the challenges and pitfalls in totally asynchronous learning, from assessment to assignments, from lectures to labs, and from participation to plagiarism. For each challenge, the authors provide examples of practices that succeeded, building on experience with those that did not. To place this work in perspective, the paper also examines related work in online computing and engineering education.

WORK IN PROGRESS – ONLINE TEACHING AND LEARNING STRATEGIES FOR PROGRAMMING-INTENSIVE COURSES

Venkat N. Gudivada, Chunbo Chu and Dhana L Rao

For the last several years online enrollments have been growing substantially faster (9.7%) than overall higher education enrollments (1.7%), according to a 2007 report of a study sponsored by the Alfred P. Sloan Foundation. The findings of this study are based on responses from more than 2,500 colleges and universities. Improving student access to courses has been cited as the overriding goal for offering online courses and degree programs. Online courses call for more discipline on the part of students. Faculty acceptance of online instruction is a barrier for wide-spread adoption of online education. Using the general guidelines for online teaching and learning as a backdrop, we have investigated best practices that are effective specifically in the context of computer science courses that involve extensive programming and hands-on laboratory explorations.

Session T1D: Strategies for K-12 Initiatives: Engineering Projects and Teaching Development

Chair: Jennifer S. Kay, Rowan University

Time: Thursday, October 13, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room 101

IMPROVING ENERGY LITERACY AMONG MIDDLE SCHOOL YOUTH WITH PROJECT-BASED LEARNING PEDAGOGIES

Jan E. DeWaters and Susan E. Powers

Energy literacy was measured among a sample of middle school students (n=865) before (pre) and after (post) their middle-level physical science course using a written quantitative questionnaire developed for this research. Overall, students demonstrated significant cognitive gains, with no significant change in their energy-related affect,

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self-efficacy, or behavior scores. A sub-set of students who participated in project-based energy curricula demonstrated greater cognitive gains, particularly on items that related to topics that were more practical and related to everyday life. One group of project-oriented students who were academically challenged demonstrated significant gains on every non-cognitive subscale score. Qualitative outcomes indicate that most project-oriented students thought more about their energy consumption and made a greater effort to conserve energy, after studying energy in school. They also reportedly talked more with their families about saving energy, felt more strongly about saving energy, developing and using renewable energy resources. The findings underscore the complex relationship between knowledge, affect, and behavior, confirming that energy-related behaviors are more strongly related to affect than to knowledge, and support the benefits of project-based instruction for improving students' broad energy literacy.

EVALUATION OF A K-8 LEGO ROBOTICS PROGRAM

Tanja Karp and Andreas Schneider

In this paper we describe the evaluation results from an annual LEGO robotics competition for students in elementary and middle schools held at Lubbock, Texas, that aims at increasing interest in science, technology, engineering, and math. In a before-after questionnaire we collected information on participants' attitudes toward the scientific method of investigation, robotics in general and LEGO robotics in particular, and problem solving in groups. We also collected demographic data of the participants to see in how far our program is able to attract females, minorities, and socio-economically disadvantaged students.

WORK IN PROGRESS - INITIATING THE BEAVER CONTEST ON COMPUTER SCIENCE AND COMPUTER FLUENCY IN ISRAEL

Bruria Haberman, Haim Averbuch, Avi Cohen and Valentina Dagiene

Attracting students to computer science studies has always been a challenge. Contests play an important role as a source of inspiration and can increase students' interest in the contest's related domain. The Beaver international contest on computer science and computer fluency was established with the goal of conveying computer science concepts to as many youngsters as possible and of motivating them to become more interested in computing. For the last few years the contest has been operating in several countries in Europe (<http://www.bebas.org>). Recently, in order to attract youngsters to study computer science, it was planned to initiate the Beaver project in Israel, while adapting its framework to the requirements of the national educational system.

HIGH SCHOOL TEACHER DEVELOPMENT WORKSHOPS THAT CREATE LONG-TERM STUDENT IMPACT

Jane Petrus, James Nelson, Galen Turner and Kelly Crittenden

Increasing the number of STEM graduates is critical to our nation's future. High school teachers play an essential role in accomplishing this goal by preparing and encouraging students to pursue STEM fields in college. This paper describes a series of workshops, referred to as TechSTEP, that focus on equipping teachers with tools, techniques, and skills they can immediately implement in their classrooms so as to better prepare students to successfully pursue STEM degrees. The specific workshop described in this paper involves building prototype fuel cell vehicles. In addition to the science of fuel cells and the engineering involved in vehicle design, the project also incorporates a model for natural resource depletion and includes other related economic, environmental, social, and political issues. The ultimate goal of TechSTEP is to increase the number of students successfully pursuing STEM degrees at the university. Even though TechSTEP includes high school students, the primary focus is on high school teachers. We believe long-term impact is more likely to result from the interactions and relationships developed with these teachers. On average, there has been a 39% increase in the number of students enrolling in STEM majors at Louisiana Tech University from schools participating in TechSTEP.

WORK IN PROGRESS - NEESACADEMY AS A CYBER-ENABLED LEARNING EXPERIENCES FOR K-16 EARTHQUAKE ENGINEERING AND SCIENCE EDUCATION

Sean Brophy, Jason Lambert and Thalia Anagnos

NEESAcademy is under development to support more effective organization, assessment, implementation, and dissemination of learning experiences related to earthquake science and engineering. One source of content is the education and outreach products developed by NEES researchers, but anyone can contribute resources. Using well documented instructional design approaches, a framework for defining and planning the content, assessment, and design-based implementation of learning experiences has been developed. This framework illustrates how a large array of existing individual learning activities can be grouped thematically to provide more comprehensive learning experiences for learners. NEESAcademy is built on the HUBzero technology that provides users with tools to easily create richer content and reuse that same content for high impact learning experiences. Pilot programs are underway to engage K-16 educators in testing and developing content.

Session T1E: Instructional Technologies and Course Design: Synergies

Chair: Miguel Rodriguez-Artacho, Spanish University for Distance Education - UNED

Time: Thursday, October 13, 2011, 8:00 a.m. - 9:30 a.m.

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WORK IN PROGRESS - ENHANCING COMMUNICATIONS AMONG COURSES LINKED WITH PREREQUISITES

Ziliang Zhou

This paper addresses the communication barrier exists among courses linked with prerequisite by proposing an active feedback system so that the instructor teaching the prerequisite can proactively report the student performance at each detail subject level and make it available to instructors requiring the course as prerequisite. It serves three purposes: (1) the instructors receiving such information have a better understanding of the incoming student readiness for the class, and if necessary, can offer a review session before starting a new chapter; (2) the prerequisite instructor can assess and improve his or her teaching effectiveness at each subject level by re-assigning the appropriate amount of time in each chapter; (3) the academic advisor can also use this information to recommend additional study between semesters in certain subject areas to help student to achieve academic success, if they demonstrate some weakness in those areas.

EDUCATORS + TECH-HEADS = ED-TECHS, THE SYMPHONY

Patrick Keleher and John Mark

When academics and computer technicians do not work in unison a dissonance can occur in the learning provided to students as the best software application or technical solution and the most appropriate or engaging learning experience may not be harmoniously orchestrated. At CQUniversity, Australia, out of the cacophony of experiences, frustration and limitations approaches have been developed and implemented to enable successful and innovative learning and teaching approaches. Over a number of years academics and computer technicians have collaborated to instigate Ed-Tech solutions including interactive technologies into the classroom and also for academics on the move and needing to access resources or communicate with students. CQUniversity is a very versatile and strongly region-based institution, offering its Bachelor of Engineering over three campuses, at Mackay, Rockhampton and Gladstone, in Queensland, Australia and in flexible study mode throughout Australia. Consequently the technical and academic elements, within the discipline of Engineering, have developed a supportive and collaborative approach to implementing strategies for bridging the geographical distances and improving digital literacy of academics in order to facilitate and enhanced e-learning and teaching. This dynamic relationship has enabled innovative ways in which degree programs are offered across multiple campuses and in flexible study mode. These innovations extend to web based communications (web conference between students through 'Scorpia'), application sharing (Citrix Main Frames Application Delivery via http for applications such as Matlab, Microsoft Office, AutoCAD and other CAD applications, Strand 7 and Visual Studio – on both Apple and Microsoft platforms for students and academics) and secure access outside of university networks. The collaborative relationship, between technical staff and academics, has developed over a period, from one where academics would propose an approach to incorporate IT into the program delivery to assist with teaching over distance. However, for the most part, a large investment in exploring a product, its features and possible implementation or adaptability for delivery of courses was thwarted by technical realities or deficiencies of the current system or by financial constraints. With academics and the technical staff working more closely from the outset the possibilities and the practical were more appropriately balanced and with great success of implementation such that a more 'education technologist', or Ed-Tech solution prevails. This has ensured 'outside the box' thinking and far more realistic Information Technology outcomes have been implemented to improve lecturer delivery and student learning.

IGRAF: AN INTERACTIVE GRAPHICAL SOFTWARE FOR CSET EDUCATION

Reginaldo do Prado, Anarosa Alves Franco Brandao and Leonidas de Oliveira Brandao

An important discipline in the basic education of CSET students is related to mathematical functions and associated issues. Therefore, technology advances on building and delivering software to support such subject had been benefited students all over the world. However, most of such software are stand alone systems that don't provide support for their integration to Learning Management Systems – LMS. In this paper we present iGraf - interactive Graphics on the Internet, a new software that provides the basic resources for general-purpose plotting tools, as well as resources that make possible its easy integration with LMS. Moreover, it provides a simple model for authoring and automatic assessment features. Both, authoring and automatic assessment were designed based on a systematic study of the literature related to Calculus and K-12 math courses. In order to produce a proof of concept, it was integrated to Moodle with the iAssign package and some experiments with K-12 math teachers and undergraduate students were conducted. iGraf can be freely downloaded from <http://www.matematica.br/igraf>.

ACCOUNTABILITY AND THE USE OF CLASSROOM RESPONSE DEVICES

Edward F. Gehringer and Mridu Baldevraj Narang

Classroom response devices, such as clickers, have proved effective in improving student engagement during class time. We performed a study to investigate how much of this improvement was due to heightened accountability, either because students were required to take and pass a pre-quiz over the lecture material, or because students were given credit for each answer submitted. We found that the presence of a pre-quiz was associated with a much higher response rate, 38.5% vs. 29.3%. Giving credit for answering questions also boosted the response rate, from 30.3% to 43.2%. We also found that asking more questions during class tended to be associated with a lower response rate. When only one question was asked, the response rate was above 60%, but if more than five questions were asked, the response rate was barely 30%. These findings suggest that accountability is important in making effective use of classroom response devices.

TOWARDS FLEXIBILITY ON IMS LEARNING DESIGN SCRIPTS

Luis de-la Fuente-Valentin, Derick Leony, Abelardo Pardo and Carlos Delgado Kloos

IMS Learning Design is considered by many authors the "de facto" standard in educational modeling languages. The versatility of the framework enables its use in very different situations. However, such versatile framework is usually hidden by its complex management. One handicap identified in practical experiences is the lack of flexibility of scripted courses during the enactment phase. The activity sequence and learning resources are rigidly defined during authoring. This fact makes difficult to react to unexpected events that may happen in live courses. Also, this rigidity does not allow instructors to give "their personal touch" to courses. This paper presents the improvements made on GRAIL - an IMS LD compliant player- aimed at the support of a flexible enactment phase. Two types of modifications are considered: the modification of the learning flow and the management of course content with a wiki engine. Finally, this paper discusses how the integration of third party services in the activity sequence relaxes the rigidity of scripted learning flows. Experiences deployed in real scenarios allowed analyzing how such integration offered flexibility in practical situations.

Session T1F: Advances in Engineering Design: Capstone Course and Project-based Learning

Chair: Eric Pappas, James Madison University

Time: Thursday, October 13, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room 201/202

ENHANCING CAPSTONE DESIGN EDUCATION IN CIVIL ENGINEERING: THE POTENTIAL SYNERGIES BETWEEN ACADEMICS AND PRACTITIONERS

Waddah Akili

The trend toward increasing design component in civil engineering curricula is part of an effort to better prepare graduates for the practice. While some design projects are still of the "made up" type; majority of projects today deal with "real-world problems" and are usually conducted by student's teams. The paper begins first by briefly reviewing the design as a "thought" process, focusing on "design thinking" and how "design thinking" skills are acquired. Second, the paper reports on the development, implementation, and subsequent evaluation of a senior design course at an international university, where practitioners from the Region have played a major role in teaching the capstone course. The restructured design course has met its objectives and exposed students to design practice. This industry-driven experience has also provided information on curricular content and capabilities of graduates. Outputs from the course can be used to provide guidance into: curricular changes, teaching methods, and civil engineering practice in the Region. Also, helps in establishing enduring connections with the industrial sector.

ENGINEERING CAPSTONE PROJECT AN INDIVIDUAL APPROACH

Carlos Miguel Tobar Toledo, Ricardo Luis de Freitas and Juan Manuel Adan Coello

This article presents a capstone project (CP) approach based on a two-semester effort developed individually to build up and reinforce skills fostered during a computer-engineering curriculum. The CP result is an artifact to be inserted in a context, which is developed, under guidance and monitoring. Besides the student, there are other three roles involved: the advisor for methodological issues; the co-advisor, for technical issues; and the client, to be the source for context knowledge. The student is responsible by planning, developing and managing the project, reporting it in a monograph that is presented in a public defense together with the artifact. The artifact must present a level of complexity that allows measuring some considered major skills. Student and co-advisor choose a methodology for the development effort, whose activities are planned and scheduled. The student should identify open problems in the considered context. One of these problems is chosen as an objective, which should be assessed. Assessment is considered an important issue in the development process. Results are promising: artifacts became real solutions, some even patented; students began graduation because of their CPs or were invited to work because of the acquired knowledge and skills; and students succeed with high self esteem and better communication skills.

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WORK IN PROGRESS - A COMPARISON OF MENTORING FUNCTIONS IN CAPSTONE COURSES ACROSS ENGINEERING DISCIPLINES

James J. Pembridge and Marie C. Paretti

In the literature describing capstone courses, authors typically classify their work as “mentoring,” though the term has also been used interchangeably with coaching, supervising, and managing. Yet few studies define these terms concretely, and consistency across studies is unclear. This ambiguity has led to confusion concerning the responsibilities of faculty in the course, and in turn hindered faculty development efforts. To address this gap, the present study seeks to develop a concrete description of faculty-student interactions in the capstone course. We use the term “mentoring” because it implies a relationship between a more experienced professional and a novice, where the mentor seeks to aid in the development of the protégé. In the case of capstone design, this development focuses on the integration of engineering theory and practice and the ability to comprehend and navigate the open-endedness of design problems. To provide the design education community with a working understanding of this relationship, this study applies Kram’s theory of mentoring to the context of capstone design to determine the prominent mentoring functions operating in this context, and identifies variations by engineering disciplines.

ON PROJECT-BASED LEARNING THROUGH THE VERTICALLY-INTEGRATED PROJECTS PROGRAM

Chin-Hui Lee, Meredith Baxter, Byungki Byun, Edward J. Coyle, Tuan Dang, Thomas Dwyer, Ilseo Kim, Ross Llewallyn and Nashlie Sephus

Georgia Tech’s Colleges of Engineering and Computing initiated the Vertically-Integrated Projects (VIP) program in January 2009. Undergraduate students that join VIP teams earn academic credit for participating in design efforts that assist faculty and graduate students with research and development issues in their technical areas. The teams are: multidisciplinary – drawing students from around the university; vertically-integrated – maintaining a mix of sophomores through PhD students each semester; and long-term – each undergraduate student may participate in a project for up to six semesters. We describe the Video and Image Annotation VIP (VIA-VIP) project, which provides undergraduates unique opportunities to learn and apply state-of-the-art video-mining algorithms by processing a large archive of football videos recorded from GT football games. Their results are documented. Based on their feedback we believe the VIA-VIP course is on track to meet the needs of undergraduates in areas they don’t usually see in the traditional undergraduate classroom.

WORK IN PROGRESS - PEER-DIRECTED LEARNING IN A PROJECT BASED MODEL

Andrew McNally

Iron Range Engineering is a new, unique, undergraduate program using problem-based learning. One guiding principle is student responsibility for learning. In order to facilitate learning, faculty and students alike have come up with several learning methods. Learning modes may include self-directed learning, peer-directed learning, one-on-one faculty-directed learning, or industry mentored learning. Peer-directed learning often manifests in the form of learning groups (a group of students learning similar competencies), led by either a faculty member or a student who has previously excelled in that competency and has taken an interest in pursuing advanced credit. Recently, Iron Range Engineering has begun to incorporate student written and student led model eliciting activities. These show promise for creating engagement, exposing misconceptions, and providing high-level learning opportunities for peer-students and peer-teachers. The initial results of these methods have been very positive. A high level of engagement and a high level of desire to complete self-directed learning have been observed from peer-teachers and students. Students getting the opportunity to lead these learning groups comment on a newfound interest and clarity in the subject matter. Both sides are able to gain metacognitive knowledge which will help them as a student, engineer, and in future academic careers.

Session T1G: Approaches to Development Global Competency

Chair: Peter Golding, University of Texas at El Paso

Time: Thursday, October 13, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room 205

A SENIOR SERVICE-LEARNING DESIGN PROJECT IN ECUADOR

Rob Gradoville and Dan Budny

International service-learning projects are an effective educational tool for universities striving to meet the ABET engineering criterion, while also providing transformational experiences to their students and a service to needy populations in the world. This paper discusses the benefits of international service-learning projects for the students and the university. Demand for these projects from students as well as supply of worthy projects in developing countries is also discussed. The ABET engineering criterion are then discussed, with specific attention to the criterion that are harder to address with traditional engineering education. Finally, the year-long process of development and piloting of the first international humanitarian engineering service-learning project within the University of

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Pittsburgh's Department of Civil Engineering is presented. This pilot project was a collaboration between the Pitt senior design course and a local chapter of Engineers Without Borders. A discussion of related efforts that emerged from this initiative is also presented.

GLOBAL SYSTEMS: ADVANCING GLOBAL COMPETENCY IN AN INNOVATIVE COURSE FOR SOPHOMORES

Ronald Rosenberg

Twenty-first century engineers are practicing their profession in an increasingly globalized world. It has been widely recognized that the process of globalization should have an influence on how engineers are educated. This paper describes the goals for, and the design of, a course for sophomores – Global Systems – with a focus on the assessment strategies used. The main student learning objectives are to demonstrate content awareness of globalization, demonstrate growth in communication and teamwork skills, demonstrate the ability to frame complex issues systematically, and demonstrate motivation to act professionally and as a global citizen. Several assessment strategies were employed, including written examinations, video capture of solo and group presentations, and a self-assessment report based on guided reflection. Overall the course was successful in meeting its objectives in a cost-effective manner. Opportunities for improvement were identified by the assessment process and will be incorporated in subsequent course offerings.

WORK IN PROGRESS - THE PROCESS OF EVALUATING THE IMPACT OF AN INTERNATIONAL EXPERIENCE ON STUDENTS' GLOBAL ENGINEERING SKILLS

Catherine T. Amelink, Nicole Sanderlin, Elizabeth Tront and Joseph G. Tront

This paper describes the pedagogy, including the related international experience, being employed in the College of Engineering at a Research I university that is designed to develop competencies associated with a global engineer. In addition, the assessment methodology that has been developed to determine the extent to which students are developing the skills needed for engineering in a global context and their perceptions of a global engineer as a result of this comprehensive experience is discussed.

HUMAN SIDE OF ENGINEERING: DEALING WITH COMPLEX AND ETHICAL CHALLENGES

Melany M. Ciampi and Claudio da Rocha Brito

The globalization phenomenon that started in the second half of the 20th Century has instigated in scientists, educators and some politicians worldwide the search for sustainable development with social promotion of individuals and society. It is one of the key elements for the surviving of human kind on earth. It is not only a matter of environmental issues that need to be solved but also the social aspects of the mutant world that contemporary society is living in the 21st. Century. It is the application of science to help society to reach the goal of achieving the same level of development as the technological. Sustainability has become an important aspect for any project development. Engineering is the key factor that drives the development of present society and so it can add to the discussions of social goals no matter the community. Many educational institutions are addressing this new demand for the formation of engineers and developing programs that include sociology and practical experiences in loco. The results are very humble however this can not discourage the initiatives. It is important to keep searching for ways to enhance social awareness in the students of engineering programs.

AN EVALUATION OF THE AUSTRALIAN ENGINEERS WITHOUT BORDERS CHALLENGE FROM THE COURSE COORDINATORS' PERSPECTIVES

Stephanie Cutler, Dan Loden and Maura Borrego

One of the challenges for engineering professors is providing realistic design projects for their students to work on. Since 2007, Engineers Without Borders, Australia (EWBA) has coordinated a national first year engineering design challenge for students attending Australian universities. The EWB Challenge offers students the opportunity to work in a team on a real world problem aiming to improve conditions in a disadvantaged community. Since its inception, the EWB Challenge has had over 18,000 students at 31 universities participate. A majority of the participating universities have integrated the Challenge into their first year engineering course focusing on professional engineering. In 2010, the first semester course coordinators working with the Challenge were interviewed about their experience working with EWBA on the Challenge. These interviews were one component of an overall program level evaluation that began at the end of the first semester in 2010. The course coordinators are in a unique role of translating the provided EWBA resources into a learning exercise that is appropriate for their students. Coordinators emphasized the importance of utilizing the Challenge to provide the students with a real-world problem that would impact an actual community. The coordinators also discussed a number of different challenges they were facing that were not limited to working on the Challenge such as keeping their students motivated, finding the right balance of providing information and having the students conduct research on their own, as well having trouble facilitating

teams and emphasizing communication skills.

Session T1H: Advances in Software Engineering Education: Teams and Projects

Chair: Maria Earle, The University of Houston

Time: Thursday, October 13, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room 206

WORK IN PROGRESS - INNOVATIVE TEACHING OF SOFTWARE ENGINEERING COURSE: INTEGRATING WITH A MINI PROJECT

Padmashree Desai, Gopalkrishna H Joshi, Karuna Gull and M Vijayalakshmi

The course on Software Engineering is important for both the undergraduate and postgraduate programmes of computer science. This is particularly so in terms of making the students industry ready by exposing them to the processes and practices of life cycle activities of software development. The traditional approach to teaching the course on Software Engineering has not been able to make a positive impact on learning because: the course instructors mostly lack exposure to industry practices, the course material being referred while teaching the course fails to establish the context as the case studies referred are alien to the students and assessment focusing mainly on memory oriented questions. Thus teaching the course on Software Engineering has got reduced to monotonous lecturing, in the absence of experience and case studies. An attempt to address the issues referred above is made by the authors. The theory course on Software Engineering was redesigned by tightly integrating a mini project course with it. Different activities are designed along with class room teaching to make Software Engineering as joyful course for the students. The proposed methodology helped the students to improve their Software Engineering concepts and quality of capstone projects. The paper discusses the approach followed, the results obtained and the experience gained.

WORK IN PROGRESS - ELASSYS: ONLINE TOOL FOR TEAMWORK ANALYSIS AND ASSESSMENT IN SOFTWARE ENGINEERING EDUCATION

Alexandr Mamei, Rainer Todtenhoefer and Dragutin Petkovic

Teaching software engineering (SE) is now critical part of all major curricula in computer science programs. The ultimate goals of such programs include development of teamwork practices and techniques important for software (SW) development and application of modern SE practices and processes. One of the most challenging parts in these activities is the assessment process whose goal is to evaluate student's achievement of those learning objectives, namely adherence to the software engineering process and their ability to develop adequate SW product. The challenges of the assessment process include the following: a) Fairness of the assessment process – reflection of individual performance and contribution as well as of ability of students to work in collaborative environment and support teamwork; b) Effectiveness, efficiency and ease of implementation; c) Fast and timely access to the relevant feedback about performance and collaboration of the students; d) Automation of the process and availability of the recorded data for further analysis. To address these questions we have designed a tool Elassys for assessment and analysis of teamwork and individual student performance in software engineering projects.

TEACHING STUDENTS SOFTWARE ENGINEERING PRACTICES FOR MICRO-TEAMS

Shweta Deshpande, Joe Bolinger, Thomas D. Lynch, Michael Herold, Rajiv Ramnath and Jayashree Ramanathan

Standard methodologies, which have been developed for large software development teams, and Agile practices, developed for small teams, make up the software engineering practices taught in the Computer Science classroom. However, we have found that there is a significant prevalence of “micro” teams doing business-critical software development in the field. Thus, software development best practices for micro teams must be incorporated into the software curriculum. Towards this end, we created a multiple-case case study (comprising five micro team projects) showing how micro teams handle the software development process. Through each of these projects, we seek to showcase what practices from existing software development methodologies are undertaken by the developers of the projects, to achieve similar ends as developers in larger teams. Specifically, the case study highlights how existing software development methodologies need to be modified, adapted or extended for micro teams. The case study and micro team guidelines were presented to students in a software engineering class within the Computer Science department at a large R1 university. The teaching was assessed using a mix of surveys and structured interviews. Initial evaluations showed promise. Students were positively inclined to accept the lessons, and showed good recall of the concepts taught in tests.

DEVELOPING CASE MODULES FOR TEACHING SOFTWARE ENGINEERING AND COMPUTER SCIENCE CONCEPTS

Salamah Salamah, Massood Towhidnejad and Thomas Hilburn

Although many software engineering (SE) and computer science (CS) texts use case studies to explain the different concepts, these case studies tend to focus on a specific subject such as object oriented design and implementation or requirements analysis and specification. In addition, these case studies usually lack instructor guidelines on how to use the material in teaching these concepts. The Digital Home Case Study addresses these issues by providing a complete set of artifacts associated with software development, and an extensive set of case study exercises for teaching different topics in software engineering and computer science, as well as guidance for instructors on how to use these case modules. In this paper, we motivate the use of the case study approach in teaching SE and CS concepts. We provide a description of the Digital Home case study and the associated artifacts and case modules. We also report on our use of the developed material.

HOW TO INVOLVE STUDENTS IN FOSS PROJECTS

Heidi J.C. Ellis, Gregory W. Hislop, Mel Chua and Sebastian Dziallas

Software projects are frequently used to provide software engineering students with an understanding of the complexities of real-world software development. Free and Open Source Software projects provide a unique opportunity for student learning as projects are open and accessible and students are able to interact with an established professional community. However, many faculty members have little or no experience participating in an open source software project. In addition, faculty members may be reluctant to approach student learning within such a project due to concerns over time requirements, learning curve, the unpredictability of working with a "live" community, and more. This paper provides guidance to instructors desiring to involve students in open source projects.

Session T1J: Topics in Engineering Education 1

Chair: G. Jimmy Chen, Salt Lake Community College

Time: Thursday, October 13, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Ponderosa Room

PROPOSAL OF METHODOLOGY FOR LEARNING OF STANDARD MECHANICAL ELEMENTS USING AUGMENTED REALITY

Jorge Martin-Gutierrez

Learning and teaching procedures need to evolve, considering the high technological profile most students have. Today's university students are steeped in a culture of technology and new devices such as smartphones, PDAs and laptops. These have found a place in students' lives as an important tool for studying. The use of these devices is widely used and seen when entering a first-year class, and most students work or take notes with them. This paper describes a physical interface (augmented book) based on augmented reality technology for learning standard mechanical elements. This book was included in the curriculum of an engineering graphics subject in a Mechanical Engineering Degree of a Spanish University. A validation study of didactic material was carried out by Twenty-five students that used this augmented book for studying the representation and designation of standard mechanical elements. A control group consisting of twenty-two students used traditional class notes with static images to study the same contents. We have analyzed the results through an evaluation test and a usability survey. The results show that the experimental group students enjoyed studying through the use of AR technology and even obtained better results in a contents evaluation test.

RESULTS FROM A PILOT SURVEY OF ENGINEERING AND ENGINEERING TECHNOLOGY STUDENTS IN 2-YEAR AND 4-YEAR INSTITUTIONS

Michael T. Gibbons, Elizabeth T. Cady, Catherine Didion and Norman L. Fortenberry

Taking full advantage of community colleges as sources of science and engineering majors is a critical component of U.S. science and technology policy. Although data are available on the number of degree recipients in engineering and engineering technology (e/et) at the associate's degree level, there are not reliable data on either the number of community college students who intend to transfer to baccalaureate e/et programs or the number who successfully make the transition. As a first step in examining this issue, the current project is a pilot study with a purposeful sample of 35 community colleges and 15 engineering colleges in the U.S. The survey of the identified institutions is completed. Institutions provided information on the number and demographic information of students who have or will transfer to four-year e/et programs. Issues with data collection and results are discussed.

ASME VISION 2030: HELPING TO INFORM MECHANICAL ENGINEERING EDUCATION

Scott Danielson, Allan Kirkpatrick and Edie Ervin

In July 2008, the ASME Center for Education formed an engineering education task force, subsequently entitled ASME Vision 2030. The committee was composed of representatives from industry and education, including both engineering and engineering technology educators. This paper provides a summary of the extensive survey effort undertaken by ASME to gather input from industry (both supervisors and early career engineers) and academia about the strengths and weaknesses of mechanical engineering graduates. The number of survey respondents totals almost 3000. This paper summarizes data highlights and relevant issues revealed by them. Of special interest to educators are the areas where the academic view is either contradictory to, or aligned with, the view of industry practitioners. In addition, the professional development needs of early career engineers provide insight into improvements needed in both current curricula and post graduate educational offerings. The salient points stemming from these data also apply to engineering disciplines beyond mechanical engineering.

WORK IN PROGRESS - DEVELOPMENT AND INTEGRATION OF AN ONLINE SOIL MAPPING WEB APPLICATION

Laura A Kocur, Ronald J. Glotzbach, Darrell G Schulze and Christopher C Miller

Mapping technologies are abundant on the Web as well as through boxed software; however, the ability to overlay ones own maps onto the surface in order to provide enriched detail is not found in most typical software. "Integrating Spatial Educational Experiences (Isee) into Crop, Soil, and Environmental Science Curricula" is a USDA-funded project focused on making soil data in the form of maps more accessible and easy-to-use for undergraduate students. The current solution integrates the Google Earth API, GeoWebCache, PHP, MySQL, and JavaScript in the form of a website. Although the differences in GIS software usability are generally unknown, the Isee prototype may serve as a viable model of an approach applicable at other universities. The purpose of the research is to collect quantitative data to determine if differences in software with various interfaces influence a student's satisfaction and performance. The "Isee" website will be among the compared software, in which students will attempt to answer questions based on the information they can find with the software. The researcher will record performance data quantitatively throughout the session. Afterwards, students will report preferences and perceptions in a survey.

MJELIOT: ICT SUPPORT FOR INTERACTIVE TEACHING OF PROGRAMMING

Arnold Pears and Moritz Rogalli

Conceptual weaknesses have been identified in previous research that contribute to student learning difficulties related to computer programming. We postulate that improved learning can be achieved by using a tool that combines approaches from active learning and visualisation. We describe the architecture and features of a tool that supports mobile phone input to an interactive code execution framework which interfaces with Jeliot 3. Mobile users are able to contribute code snippets, and make predictions about execution behaviour of code executing in the tool. Individual feedback is provided to mobile devices in real time, allowing us to provide customised feedback to individual learners during a period of instruction.

Session T2A: Special Session - Cognitive Processes Critical for Ill-Defined Problem Solving: Linking Theory, Research, and Classroom Implications

Chair: Senay Purzer, Purdue University

Time: Thursday, October 13, 2011, 10:00 a.m. - 11:30 a.m. Civic Center Room LaCroix C

SPECIAL SESSION - COGNITIVE PROCESSES CRITICAL FOR ILL-DEFINED PROBLEM SOLVING: LINKING THEORY, RESEARCH, AND CLASSROOM IMPLICATIONS

Senay Purzer and Jonathan C. Hilpert

Research on ill-defined problem solving and design thinking is rich but spread across diverse disciplines. Some of the signature work had been done over previous decades by cognitive scientists while other work, such as research on design thinking, is more recent. During this special session, our goal is to present and discuss this literature with engineering educators who are interested in researching ill-defined problem solving and related ways to support student learning in their classrooms. As we examine these studies within the context of engineering, we will introduce key theories such as cognitive dissonance. We will also discuss how these studies inform teaching and student learning.

Session T2B: Panel - What Is Global Engineering Education For?: The Making of International Educators

Chair: Gary Downey, Virginia Polytechnic Institute and State University

Time: Thursday, October 13, 2011, 10:00 a.m. - 11:30 a.m. Civic Center Room LaCroix D

PANEL - WHAT IS GLOBAL ENGINEERING EDUCATION FOR?: THE MAKING OF INTERNATIONAL EDUCATORS

Gary Downey and Kacey Beddoes

Leading educators who have made risky career commitments to international engineering education have often experienced challenges beyond the boundaries of home countries that made them critical analysts of their work and identities. This panel introduces the unique research process that helped sixteen educators make visible how their goals and motivations extend far beyond the commonly invoked image of global competence as a new skill. Short presentations follow from five contributors to the recently-published *What is Global Engineering Education For?: The Making of International Educators*. Their accounts of struggles and successes highlight the difficulties in moving international and global engineering education from the margins to the core of engineering curricula. Subsequent open discussion invites commentary from all present about strategies for maximizing the extent to which students gain access to international and global engineering education and genuinely confront and rethink assumptions and career trajectories born in home countries.

Session T2C: Integrating Sustainability, Teamwork, and Communication with Engineering Courses

Chair: Dan Budny, University of Pittsburgh

Time: Thursday, October 13, 2011, 10:00 a.m. - 11:30 a.m. Civic Center Room LaCroix B

WORK IN PROGRESS: DATA-RICH LEARNING ENVIRONMENTS FOR ENGINEERING EDUCATION

William DeLuca, Aaron Clark, Jeremy Ernst and Nasim Lari

Green Research for Incorporating Data in the Classroom (GRIDC) is a National Science Foundation project designed to improve instructional practices in the curricula areas of science, technology, engineering, and mathematics (STEM). The project uses data collected from renewable energy technologies at the NC Solar House, and enables students in engineering and education to analyze, synthesize, and evaluate downloadable data. Students and instructors create data-driven and conceptual models to explain information obtained from the project's website using a variety of methods involved in technical data presentation. This paper explains the GRIDC project and how students in engineering and pre-service technology, engineering and design teacher education develop higher-order thinking skills. Preliminary research has been conducted on the effective use of these materials in college level environmental engineering classes and technical animation courses in engineering graphics. This research provides a base for continued research and development on using data-rich learning environments to further develop higher-order thinking skills for students across the country.

WORK IN PROGRESS - ADAPTING TEAM-BASED LEARNING TO THE FIRST CIRCUIT THEORY COURSE

Robert M. O'Connell

The purpose of this work-in-progress paper is to report progress made in adapting the learning strategy known as team-based learning for use in the required sophomore-level electric circuit theory course. The project is motivated by the desire to introduce students to self-directed independent learning and to learning in groups early in their programs, both of which concepts are, in theory, provided by team-based learning. Despite the potential benefits, several practical challenges have been encountered while attempting to implement the strategy. These include motivating students to study and learn new material outside of class and before encountering it in the classroom; and motivating them to follow a prescribed model of good group work. The paper describes progress in overcoming these and other challenges, and changes being implemented to improve the approach.

WORK IN PROGRESS - MATCH OR MISMATCH? THE TEACHING AND LEARNING OF TEAMWORK AND COMMUNICATION SKILLS

Holly M. Matusovich, Marie Paretti, Andrea Motto and Kelly Cross

Communication and teamwork skills remain top-priority outcomes for engineering graduates. Yet researchers and educators alike know comparatively little about the teaching and learning epistemologies engineering faculty employ, or about how faculty epistemologies affect the learning mechanisms of engineering students. Our research seeks to address this gap by first examining student and faculty beliefs about effective practice and transferable learning

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outcomes with respect to communication and teamwork, and then by developing and testing interventions to enhance the teaching and learning of these important skills. The overall study uses a mixed methods approach including interviews and focus groups with faculty and students, followed by surveys of a broader audience, and finally both qualitative and quantitative assessments of the interventions. Preliminary results from the first phase of the project indeed show a gap between faculty and student beliefs about the teaching and learning of teamwork and communication skills in engineering.

A GROUNDED THEORY APPROACH TO EFFECTS OF VIRTUAL FACILITATION ON TEAM COMMUNICATION AND THE DEVELOPMENT OF PROFESSIONAL SKILLS

Uyen Mai, Daniel Swift, Tracey Wiggins and Ray Luechtefeld

This article reports on a grounded theory study into the effects of virtual facilitation on team communication, a critical professional skill for engineering students. Facilitation may assist in that process because it encourages information sharing in order to promote effective teamwork. To aid in online team communications, a virtual facilitator has been developed. This research involves a quasi-experimental study of 40 community college students working on group projects. The students were sorted into treatment and control groups, and asked to work in an online forum designed for team collaboration. In the control group, the virtual facilitator was programmed to remain inactive. For teams in the treatment group, the virtual facilitator intervened with prompts when it was triggered by certain keywords and phrases. Using the grounded theory approach, researchers reviewed and analyzed transcripts to find themes and patterns, which were then coded. In addition, researchers explored communication differences between control and treatment groups.

A NOVEL PEDAGOGICAL TOOL INTEGRATING SUSTAINABILITY COMPETENCE INTO ENGINEERING DEGREES

Yolanda Bolea and Antoni Grau

The environmental and social crisis has forced the University to have a considerable influence on the society in an active manner and it faces new challenges such as the need to educate professionals that take respectful decisions towards the environment, the sustainability, the social commitment and human development. Many universities, and specifically the Technical University of Catalonia UPC, have included in their curricula a compulsory competence regarding the Sustainability and the Social Commitment in a transversal way. In this paper authors propose a new pedagogical tool oriented to scientific and technological higher education related with modeling and simulation of dynamic systems. This resource consists of a set of didactic materials divided into different themes (water and waste management, renewable energy...). These materials are in web format, and this tool is aimed at helping faculty to integrate the competence into the specific competences of every subject. This pedagogical tool has been used, tested and assessed in "Dynamic Systems Simulation" subject in the Industrial Engineering Degree at UPC. The use of this pedagogical tool has provided satisfactory and encouraging results at all levels, knowledge, procedures and attitudes.

Session T2D: Enhancing Student Success and Development via Introductory Engineering Courses

Chair: Koenraad Gieskes, Binghamton University

Time: *Thursday, October 13, 2011, 10:00 a.m. - 11:30 a.m.*

Civic Center Room 101

MIXED REALITY FOR DEVELOPMENT OF SPATIAL SKILLS OF FIRST-YEAR ENGINEERING STUDENTS

Jorge Martin-Gutierrez, Rosa E. Navarro and Montserrat Acosta Gonzalez

This paper follows up on the validation and usability study done on augmented reality, which is based on an application for the development of spatial skills in engineering students. In this phase, the training has been implemented in new Engineering degrees adapted to the new European Higher Education framework at a Spanish University. In this paper, the results obtained by students when improving spatial ability while carrying out their training, are shown and related to academic performance and drop-out rates, which are from current academic courses as well as previous ones. Additionally, a pilot study is introduced where a group of students use Head Mounted Displays (HMDs) for visualizing the real scene with augmented objects, so spatial ability improvement results and time spent, are compared to others belonging to the group using the PC monitor instead. Results confirm the training's validity and technical data which are collected to improve the interface's application as well as the augmented book. This has allowed the training to be made available to education centers which are waiting for the academic implementation through a commercial edition.

A PASS/FAIL OPTION FOR FIRST-SEMESTER ENGINEERING STUDENTS: A CRITICAL EVALUATION

Ken Stanton and Tom Siller

The first semester of a collegiate engineering program can be quite stressful for a student, resulting in anxiety and decreased academic performance. While there are various factors leading to these outcomes, the pressure of grades early in an engineering program can be a significant contributor. GPA is typically used to determine a student's academic success, but the reality is that the student often needs time to learn how to earn and keep good grades in college before they accurately reflect the student's performance and potential. Considering this, Colorado State University recently offered an option for incoming engineering students to take all of their first-semester classes as pass/fail. For the fall semester of 2010, 138 of 448 first-year students enrolled in the pass/fail option. In this first semester of the program, success was determined from a few measures by comparing performance of students in the pass/fail option to those in traditional A-F grading. In the first analysis described herein, GPA was reviewed for both groups of students, which revealed that students who selected the option received lower grades than those who did not. Authors review the program critically, often holding opposing viewpoints on whether outcomes have been and will be positive.

AN INTRODUCTORY ELECTRONICS COURSE ORIENTED TO DEVELOP REAL-LIFE-ENGINEERING DESIGN SKILLS

Ariel Lutenberg, Sebastian Carbonetto, Mariano Garcia Inza, Daniel Rus, Gabriel Venturino, Luciano Natale and Federico Zacchigna

This paper presents an electronics course, which based solely on elementary electromagnetic concepts, introduces in one term the topics of Semiconductor physics, MOSFET and BJT transistors, CMOS gates, and elementary amplifiers. The course follows the bond-model approach, instead of the more traditional approach based on quantum mechanics, what enables the course to be advanced two semesters in the curriculum. Two Laboratory Assignments, one focused on a N-MOSFET device and another focused on a NPN-BJT device, are developed where the students have to experimentally measure the transistors curves and compare the results with SPICE simulations and datasheet information. The final project of the course challenges students to design a class-A audio amplifier under certain realistic requirements, such as a standard 600 Ohms microphone, a 32 Ohm headphone, and a 5 Volts power supply, thus developing real-life-engineering design skills. The course organization and the Laboratory Assignments are discussed, and results gathered in two years of experience are presented.

WORK IN PROGRESS - EXTENDING PARALLELISM EDUCATION TO THE FIRST YEAR WITH A BOTTOM-UP APPROACH

Gregory Lammers and Cordelia Brown

Parallel programming is quickly becoming a major focus of computer engineering education. This leads to the natural question of how to best introduce aspiring computer engineers to the topic. A bottom-up approach to computer architecture and programming was implemented in an experimental course at Purdue University and was offered to first year students. A study of that course's effectiveness is currently underway using a mixed-methods study. The Concurrency Concepts Inventory, an objective examination, and a focus group of past students will be the primary methods of evaluation. A pilot focus group was held in order to design a survey that accurately reflects students' understanding of the topics in question using concept maps and other methods. Initial findings using the Concurrency Concepts Inventory suggest that parallelism can certainly be grasped by first year students, and also show a small negative correlation between a student taking a traditional course in computer programming and that student's understanding of parallelism concepts. Further data analysis and a full focus group will be used to provide a recommendation on whether this method of introducing parallelism is effective in an engineering curriculum.

WORK IN PROGRESS – DESIGN AND THE ROBOTICALLY-CONTROLLED MINI-PLANT IN FRESHMAN CHEMICAL ENGINEERING

Bill B. Elmore

Through an iterative process over nine semesters, the freshman Chemical Engineering Analysis course in Mississippi State University's Swalm School of Chemical Engineering has evolved into a problem-based design experience using the LEGO NXT® robotics kits integrated with Vernier® sensor technology and auxiliary bench-scale equipment (e.g. pumps, valves, piping and tanks). Integrating a variety of skills important to engineering practice, this course engages students in critical thinking; team-building; integration of mathematics, chemistry and physics; a systems approach to open-ended problem solving; and, the application of concepts, data collection and analysis with actual systems construction and testing. The use of the reasonably-priced LEGO NXT® robotics kits allows replication of multiple robotically-controlled "mini plant" units across a large class (60+), enabling student design teams to simultaneously, yet creatively and uniquely develop solutions to a variety of process design problems.

Session T2E: Engineering Frontiers of Instructional Technologies

Chair: Gordana Jovanovic Dolecek, Institute INAOE

Time: Thursday, October 13, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room 102

WORK IN PROGRESS - LOM4CE: LOM FOR THE CONTENT ECOSYSTEM

Alfonso Vicente, Regina Motz, Martin Llamas-Nistal and Manuel Caeiro

E-Learning is as much or more related to learning than technologies, but technology specialists have been commissioned, often alone, to create specifications and standards for E-Learning, focusing much more on technologies than learning. Learning is an internal process that occurs in the minds of people, so it is always a personal process. As each student has their own cognitive style and learning preferences, a goal that began with the application of technology to education is the personalization of instruction. One of the main obstacles to automate personalization is the lack of specifications and standards for describing learning objects at different levels of granularity. This work extends the concept of Content Ecosystem, giving semantic definitions for each Educational Object in the hierarchy.

WORK IN PROGRESS - DEVELOPING A COGNITIVELY BASED DIGITAL LOGIC CALCULATOR

Joseph Handzik and Geoffrey Herman

Cognitive research in digital logic has shown that students struggle to organize their knowledge of concepts and tools into meaningful categories that facilitate problem solving or design. When students learn about digital logic design tools, they must practice using these tools independently and often come to think of these tools as “problems-unto-themselves,” rather than as tools that can be used to solve more complicated problems. To help students properly organize their knowledge of digital logic design tools, we propose the creation of a digital logic calculator that helps students learn the purposes and functionality of the different digital logic design tools.

THE THIRD DIMENSION IN OPEN LEARNING

Colin Allison, Alan Miller, Thomas Sturgeon, Indika Perera and John McCaffrey

Virtual worlds continue to attract considerable interest as an innovative means of engaging students through the use of immersive, collaborative environments. They allow for the dynamic creation of content and for that content to be programmed. They empower students to explore learning environments that would be inaccessible to them in the real world. Learners achieve presence through the proxies of avatars, and consequently are aware of and may interact with fellow learners within the virtual environment. Interactivity ranges from simple exhibits as might be found in a museum to configurable, complex simulations rendered in a 3D space. At the same time there are now numerous open learning initiatives which seek to encourage the sharing of independently produced educational resources through the Internet, but these are mostly web-based, so the challenge of producing open learning materials based on virtual worlds remains. This paper identifies the challenges which need to be met to support the use of virtual world technologies in the emerging open learning context and presents two case studies of moving from 2D web-based learning environments to 3D virtual world versions of the same topic. These examples illustrate the type of innovative 3D learning environments that can be shared in the open learning context.

WORK IN PROGRESS: A VIDEO GAME FOR TEACHING DYNAMICS

Brianno Coller

The paper describes work in progress on an effort to create a video game called Spumone to help teach key concepts and problem-solving skills in Engineering Dynamics. In addition to being an educational tool, Spumone is being designed as a research tool that will allow one to investigate how different types of challenges within video games impact learning and student engagement. Some initial test data are presented that suggest that the game might be a suitable platform for education and research.

WORK IN PROGRESS - A FRAMEWORK FOR ASSESSING THE IMPACT OF INSTRUCTIONAL TECHNOLOGY ON THE NATURE OF TEACHING AND LEARNING

Catherine T. Amelink and Glenda Scales

If innovative approaches in educational environments are going to be considered for more widespread adoption, assessment methods need to be employed that demonstrate the efficacy of those approaches related to student learning. Various forms of instructional technology have been utilized within the undergraduate curriculum to enhance educational environments and as that technology rapidly advances, it is necessary to consider in what ways that technology brings about desired changes in the pedagogy employed and student engagement with course content. This paper describes the assessment methods currently being employed at a Research I university that are designed to examine the effectiveness of an undergraduate Tablet PC laptop requirement as it relates to systematic change in the nature of undergraduate teaching and learning.

Session T2F: Approaches to Involving Students at All Levels in Research

Chair: Amar Khoukhi, King Fahd University of Petroleum and Minerals

Time: Thursday, October 13, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room 201/202

UTILIZING TOPIC MODELING TECHNIQUES TO IDENTIFY THE EMERGENCE AND GROWTH OF RESEARCH TOPICS IN ENGINEERING EDUCATION

Aditya Johri, Alan Wang, Xiaomo Liu and Krishna Madhavan

In this paper we present findings from a project that used topic modeling and associated techniques to chart the emergence and growth of research topics in engineering education research over 9 years, from 2000-2008. As a field engineering education research has undergone significant changes over the past decade. There has been an increase in the number of scholars and practitioners involved in the field, particularly those that are applying rigorous research principles to advance understanding of engineering education. In such a circumstance, it is important to understand the topics, approaches, and ideas that have caught the imagination of people in the community. Since this nature of work has not been done in relation to engineering education research, a significant part of the effort described here is innovative and exploratory in nature where different techniques were tested with the goal to collect a diversity of topics that are of interest to the community. We identify major categories of topics and primary topics of interest to the community. We also identify a lack of engagement with theoretical and analytical ideas as an area of concern.

A SYSTEM FOR FORECASTING STUDENT PERFORMANCE BASED ON COURSE EVALUATION

Rodrigo Maia and Selma Shin Shimizu Melnikoff

The current work presents software capable of simulating the results obtained by students enrolled in an undergraduate course through the results obtained previously in other subjects of the course. The students and subjects were modeled as nodes and links in a graph and the growing models used in complex networks simulations were applied. The created graph represents similarity indexes between the students. The growing models were capable of predicting the evolution of the graph and, consequently, the grades obtained by the students to some precision. The current work presents four graph models based on Barabási-Albert and small world models as a way to represent relationships between students and subjects. Each presented graph model identifies clusters of students and subjects in different clustering indexes, and in this current work is discussed the benefits, limitation and growing characteristics of each model. The results obtained brought a good precision in the simulated grades, and they also made a discussion about the students and the course characteristics possible.

ON PROVIDING SUCCESSFUL RESEARCH EXPERIENCES FOR UNDERGRADUATES

Reynold J. Bailey, Hans-Peter Bischof, Minseok Kwon, Tracy Miller and Rajendra K. Raj

This paper presents strategies for providing successful Research Experiences for Undergraduates (REU). The authors have advised several undergraduates on research for the past few years, and have jointly supervised around twenty-five students, over two summers, on a project funded by an NSF-funded REU program in areas relating to the visualization of astrophysical data using high performance file systems. Several of these student projects have led to research publications. The paper briefly motivates the need for research in modern computing and engineering education. It then presents specific details about the development of summer REU programs including how to: secure funding and institutional support; plan a summer program including the design of scalable research projects; develop strategies to advertise and recruit students, especially from underrepresented groups; create a dynamic research and social environment through one-on-one mentoring; develop appropriate assessment and evaluation processes; and track student participants after they graduate from the program.

DESIGN-BASED RESEARCH: A FRAMEWORK FOR DESIGNING NOVEL TEACHING AND LEARNING EXPERIENCES IN MIDDLE SCHOOL ENGINEERING EDUCATION

Tirupalavanam G. Ganesh

This paper describes the use of design-based research methods in a National Science Foundation sponsored middle-school engineering education effort aimed at creating novel teaching and learning experiences. University experts and middle school teachers designed and implemented an engineering education program. The experiences were offered over a two-year period to 116 students organized into two cohorts in four middle schools as a year-round extracurricular program. The research question addressed is: "What are the characteristics of successful novel teaching and learning experiences for middle school students that use engineering-based project challenges?" The characteristics of the program were: multiple hands-on learning experiences so students discovered for themselves the means to solve the posed project challenge; deliberate use of the engineering-design process in meeting each project challenge; use of learning cycle (engage, explore, explain, expand, evaluate) method for instructional planning; cognitive apprenticeships for learners with professional engineers and undergraduate engineering students; access to high quality technologies and tools necessary to meet the project challenge; the use of

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questioning strategies and learning facilitation techniques that promoted student centered learning experiences; and systematic refinement of learning experience facilitation through an iterative process. Using design-based research methods in the form of a cyclic process of theoretical reflections, conceptual analysis, small-scale curriculum development, and classroom research of the interaction of the novel teaching-learning processes, the project team arrived at a final set of characteristics for engineering-design based project challenges for middle school students.

WORK IN PROGRESS – EXPLORING THE EVOLUTION OF THE MENTORING RELATIONSHIP IN A SUMMER UNDERGRADUATE RESEARCH PROGRAM

Renata A. Revelo Alonso and Michael C. Loui

The mentoring relationship is an important and crucial aspect in the academic and professional development of both mentor and protégé. Although the characteristics of positive mentoring relationships have been identified, there is little prior research in assessing the relationship between undergraduate researchers and their graduate student mentors. We present a document analysis of the reflective journals and mentoring philosophy statements of four graduate student mentors of undergraduate researchers in a summer research program. The preliminary results show that mentors and students can have mismatched expectations, and that as the mentoring relationship evolves, the roles of the mentor and student also evolve. We also present a mentoring model grounded in the data.

Session T2G: Transforming Engineering Laboratories through Information Technologies

Chair: Mary Kasarda, Virginia Polytechnic Institute and State University

Time: Thursday, October 13, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room 205

WORK IN PROGRESS - ENHANCING STUDENTS LEARNING THROUGH INSTRUCTIONAL VIDEOS DURING HANDS-ON LABORATORIES ON RENEWABLE ENERGY SOURCES

Oxana Pantchenko, Shehba Shahab, Daniel Tate, Philippe Matteini, Michael Isaacson and Ali Shakouri

At the University of California Santa Cruz, a renewable energy sources course is a theory based course that includes six hands-on laboratory experiments. The course is designed for engineering and non-engineering undergraduate students and does not require any advanced mathematics or physics background. Each laboratory experiment introduces a miniature version of an energy conversion device that mimics the insights and workings of a real scale device. The hands-on laboratory experiments illustrate principles of the; solar pathfinder, flywheel, hydroelectricity, wind turbine, thermoelectricity and a fuel cell. In the past, each laboratory consisted of paper based instructions, pre and post questionnaires and a laboratory kit. Since many students in the class were non-science majors and had difficulty following the paper based instructions, we substituted the paper based instructions with instructional videos to ease the kit assembly and enhance student learning by providing more time to focus on the data gathering and analysis processes by minimizing the assembly time. The instructional videos demonstrate the experimental set-up and a method for collecting the data during each hands-on experiment. This work in progress paper presents description of our methods.

SERIOUS GAMING FOR EXPERIENTIAL LEARNING

David Gouveia, Duarte Lopes and Carlos Vaz de Carvalho

In Engineering Education, the traditional process of knowledge building was based on one-way (teacher->student) delivery of information, in classrooms. Students were passive receptors of the teacher's messages. In the past few years, the tendency is to implement active learning paradigms where students are the focus of the educational process. The interaction between teacher and students is more dynamic, enhanced by technological tools and includes rich content and flexible activities. The integration of Virtual Environments in Engineering Education allows new and innovative learning methods and is, therefore, a contribution to these new paradigms. This article presents the instantiation of these learning methods with first year engineering students. In our study, students were involved in simulation/gaming environments related to fundamental physics learning. Afterwards their knowledge was tested and their perception of the relevance of the system was evaluated. Results show that knowledge construction was greatly enhanced and that student's motivation for learning was increased.

A PIC18 ROBOT-CENTERED MICROCONTROLLER SYSTEMS LABORATORY

Kathleen A. Kramer and Michael Anderson

A required junior-level introductory course in microcomputer systems for electrical engineering majors was the basis of a three-year project to enhance student abilities to design microcontroller-based systems. A new PIC18-based circuit board was developed by the authors to serve both as an evaluation board and as a robot controller. A series of five laboratories were developed using the new circuit board, named Trogdor, as an evaluation or test board. The initial series of laboratories had microcontroller interfacing and programming learning objectives related to developing student abilities in assembly language programming, higher-level language embedded systems

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programming, sensor interfacing, analog-to-digital conversion, and motor control. Following the lab series, this same board was plugged into a low-cost commercially available robot, and served as the robot's controller for a project to design a robot that would autonomously solve an unknown maze. Students were provided with a robot that had working sensors of two different types, and were encouraged to independently add new sensors and adapt the kit while developing their own solutions.

MODULES AND LABORATORIES FOR A PATHWAYS COURSE IN SIGNALS AND SYSTEMS

Konstantinos Tsakalis, Jayaraman J. Thiagarajan, Tolga Duman, Martin Reisslein, G. Tong Zhou, XiaoLi Ma and Photini Spanias

A gap between theory and practice in signals and systems courses is often reported at many universities as a key problem in recruiting signals and systems students. On the other hand, instructors often cite a lack of fundamental understanding in mathematics as an issue in this course. Students seem to be discontent with some of the abstraction of the signals and systems courses. In this work-in-progress paper, we describe a new pathways concept we introduced to address these problems by introducing in-depth discussions, several applications and hands-on exercises.

CONTROL SYSTEM EXPERIMENTS AT HOME

Musa K. Jouaneh and William J. Palm, III.

Most mechanical engineering curricula include courses in system dynamics, controls, mechatronics, and vibrations, but these courses often do not have a laboratory component. Even if there is such a component, laboratory access is often limited, and thus there is a need to increase students' laboratory experience. This paper addresses the development and testing of instructional material in the form of take-home hardware kits and software that can be used to perform control system experiments at home. The students are given a compact, low-cost hardware kit and software with which they can perform an experiment at home using only their PC/laptop. The kit consists of three components. These are: a hardware interface board which interfaces with the student's PC and with the experiment hardware, a Windows-based user interface program that the students download to their computer, and the experimental setup. Five experiments have been developed. Here we report on two of these experiments that involve control systems: a DC motor/tachometer system and a heater/temperature sensor system. Administration of the kits in several mechanical engineering courses has shown that the kits were effective in improving student understanding of key concepts.

Session T2H: New Directions Influencing Participation of Women in Engineering

Chair: Catherine Didion, National Academy of Engineering

Time: Thursday, October 13, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room 206

INSPIRING FUTURE FEMALE SCIENTISTS

Marsha Zaidman

This paper will briefly summarize the current state of women in the sciences (especially computer science and engineering), examine current trends, and explore the needs of potential female scientists. One recognized need for academic achievement is the availability of mentors. Female mentors serve as role models and offer tangible proof that a woman can succeed in the field. This paper will explore one approach to inspiring and providing role models for women interested in the sciences. At the University of Mary Washington (UMW), a member of the Department of Computer Science introduced an innovative and novel freshman seminar: "Beauty and Brains—Women in the Sciences". This course is designed to expose students to the achievements and lives of many female scientists. Details about teaching methods, successful assignments, and outcomes are included in the paper. Feedback has been very positive.

THE CO-OPERATIVE EDUCATION WORK TERM: A COMPARISON OF EXPECTATIONS AND OUTCOMES FOR INTERNATIONAL ENGINEERING GRADUATES IN CANADA

Sandra Ingram and Anita H. Ens

The completion of a co-operative education work term allows students to reflect on how their work experience aligned with their initial expectations. Such an opportunity presented itself within a larger, exploratory study examining the perceptions of international engineering graduates (immigrant engineers) on their participation in a university co-op education program as part of an alternative pathway for professional engineering licensing. The pathway combines an eight-month academic term with a four-month, paid work term. Previous research has indicated the potential for co-op education programs to support the integration of women and other underrepresented groups into the engineering profession by developing soft skills largely through positive mentoring and networking experiences. The potential for the co-op placement to offer similar advantages for international engineering graduates

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was explored in this study. Qualitative data were collected through focus group sessions with students and employers, co-op work term reports, and program documents. Findings indicate the value to international engineering graduates of the co-operative work term in simultaneously developing technical and cultural competencies including mentoring and networking. This study highlights the potential of the co-op work term to contribute human, cultural and social capital essential to the integration of international engineering graduates into the Canadian engineering profession.

WOMEN AND HIGHER ENGINEERING EDUCATION – CHOOSING ONE'S DEGREE PROGRAM

Aura Paloheimo, Kaisa Pohjonen and Pirjo Putila

In this study we investigate women's pathways to a selection of degree programs in the oldest and largest institution of higher engineering education in Finland. We concentrate on eight degree programs in two categories: four degree programs with a relatively high concentration (over 43 %) of female first-year students and four degree programs with a relatively low concentration (below 15 %) of female first-year students. Our study focuses on an analysis of 48 free-form narratives written by first-year female students. The narratives cover the sequence of events from their earliest reflections on engineering as a career choice to the present state as well as the students' thoughts and views of their future in engineering. The most dominant factor for choosing an engineering career was relatives or acquaintances in technical fields. The second-most dominant factor was the difficulties in the process of choosing one's degree program. In degree programs with a low concentration of female students, the next dominating factor was an inherent interest in mathematics and natural sciences. In study programs with a relatively high concentration of female students, many women expressed interest in socially oriented studies, multidisciplinary studies and "healing the world".

IMPACT OF INTRODUCING SINGLE-GENDER CLASSROOMS IN HIGHER EDUCATION ON STUDENT ACHIEVEMENT LEVELS A CASE STUDY IN SOFTWARE ENGINEERING COURSES IN THE GCC REGION

Amir Zeid and Rehab Elbahey

Changing from a co-education to a single-gender learning environment could be an opportunity and a challenge to any institute. Software engineering is one of the fields that could be affected by gender-segregation policies. Teaching the subject involves group and individual activities which could be dramatically affected in single-gender settings. In this paper, we present our experience in teaching software engineering in gender segregated classes. We will compare the performance of students before and after gender segregation. We will show samples of the activities and the findings. We will have a discussion about the impact of gender segregation on the overall course performance. Our findings could be useful in providing strategies to enhance the higher education learning experience and to eliminate future gender divide issues in the workplace.

RESULTS FROM REPEATED EVALUATION OF AN ONLINE TUTOR ON INTRODUCTORY COMPUTER SCIENCE

Amruth N. Kumar

We analyzed the data collected over 7 semesters by a single Computer Science software tutor to study the differences between the sexes and races on their prior self-confidence, prior preparedness and their assessment of the tutor. We found that when there was a statistically significant difference in the prior self-confidence of male and female students, female students had lower prior self-confidence than male students, in spite of the fact that there was no significant difference in the prior preparedness of male and female students. The prior self-confidence of female students in Computer Science may be improving with increasing enrollment. Whenever there was a statistically significant difference among racial groups, positively stereotyped racial groups were better prepared and had higher prior self-confidence than the traditionally under-represented racial groups. Whenever there was a statistically significant difference between the sexes in the assessment of the tutor, female students assessed the tutor more favorably than male students. When there was a statistically significant difference between racial groups, under-represented racial groups assessed the tutor more favorably than positively stereotyped racial groups. When there was a statistically significant difference in how developer's students assessed the tutor versus how other adopters' students assessed it, assessment by developer's students was more positive than that by students of other adopters.

Session T2J: Graduate Students, Graduate Programs, and Preparing Engineering Graduates

Chair: Craig G. Downing, Rose-Hulman Institute of Technology

Time: Thursday, October 13, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Ponderosa Room

WORK IN PROGRESS - DESIGN AND DELIVERY OF THE GRADUATE COURSE ON ELECTRONIC SYSTEMS INTEGRATION

Qing Zheng, Ramakrishnan Sundaram and Fong Mak

This paper discusses the approach to improve the preparation of graduate students in Electrical Engineering for projects in the electronics industry by introducing the graduate course: Electronic Systems Design and Integration. The course emphasizes the understanding and skills necessary for students to achieve competencies at the system and sub-system level of electronic project design, test, and validation. Basic and advanced electronic circuits are studied and modeled in terms of their input-output characteristics. In this course, the circuit simulation software, the printed circuit board design software, printed circuit board maker and its related software are introduced to students. Students are required to complete several sub-system level and system level projects by employing the above software and hardware to design, build, test, and validate the final products. Through this procedure, students learn the required software and hardware for the electronic systems design and become familiar with the process to manufacture printed circuit board based electronic circuits. The purpose of offering this course is to (a) enable graduate students to apply what they learn in electronics courses during undergraduate studies to design complex circuits for electronic systems integration, and (b) to prepare students for electronic systems design and integration projects in industry.

WORK IN PROGRESS - IDENTIFICATION OF BEHAVIOR PATTERNS WITHIN GRADUATED STUDENTS AT THE TECHNICAL UNIVERSITY OF CARTAGENA, SPAIN

Alvaro Botia, Mathieu Kessler and Angel Molina-Garcia

As a consequence of the governmental decision to adapt the Spanish graduate and post-graduate studies to converge to the 'European Higher Education Area', the goal of the so-called Bologna Process, committees of experts were set up at the Technical University of Cartagena, located south of Spain, to design the new curricula that would build up the restructured offer of courses. It was decided to provide as supporting material to these committees statistical information about the academic behavior and results of the students in modules of the existing courses. In this work, pattern identification among modules and among students using cluster procedure and principal component analysis is carried out. The influence of relevant factors like gender, course and marks obtained at the School Leaving certificate on the resulting groups composition is explored as well.

THE CHALLENGE OF EMBEDDING INFORMATION LITERACY AS A GRADUATE ATTRIBUTE INTO ENGINEERING AND TECHNOLOGY COURSES

Patrick Keleher, Joanne Keleher and Karin Simon

Universities and professional bodies require graduates to be skilled practitioners educated to a high standard of competency with proficiency in a diversity of graduate attributes. Some attributes are discipline based while others are of a more generic nature. Proficiency in the generic attribute of Information Literacy can provide the necessary scaffolding to enable practitioners to engage in the digital landscape to identify, locate, evaluate, manage and apply information and acknowledge information sources in their chosen field or profession. Non-technical courses have always been considered better suited to addressing Information Literacy skills. Commonly, assessment in these types of programs consists of written essays, analysing case studies, and report writing; assessment which is generally more applicable to the implicit embedding of Information Literacy skills. Technical courses, generally, rely more heavily on mathematical computations and technical descriptions and drawings to demonstrate knowledge and information and are proving to be more challenging to effectively embed Information Literacy as a learning outcome. The Information Literacy framework consists of six competency levels; essentially identify, find, evaluate, manage, apply, and acknowledge. This paper explores the preliminary process of including Information Literacy implicitly, into assessment items in an undergraduate engineering technical course; Control Systems Analysis and Design.

WORK IN PROGRESS - EFFECT OF DEPARTMENTAL CULTURE ON EPORTFOLIOS FOR GRADUATE ENGINEERING PROGRAMMATIC ASSESSMENT

Mahnas Mohammadi-Aragh and Lisa McNair

This "Work In Progress" is part of a larger study investigating ePortfolio use for graduate assessment in engineering programs. ePortfolios have been used in a variety of applications ranging from undergraduate assessment to graduate student work showcases and most recently for graduate program assessment. Little work to date has been done that specifically addresses graduate assessment in engineering. Our study helps fill this gap by examining the results of ePortfolio implementations in three separate engineering graduate programs at a large research institution located in the southeast United States. The ePortfolios studied were designed in Fall 2010 and implemented in Spring 2011.

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During the design phase, anecdotal evidence of distinct departmental cultures emerged. The cultures appeared to have an effect on the final ePortfolio designs. This work formally examines departmental culture from an “insider” perspective and determines the relationship, if any, between departmental culture and perceptions of ePortfolios.

WORK IN PROGRESS – DEVELOPING A GRADUATE CONSORTIUM IN ENGINEERING EDUCATION

Lauren D. Thomas, Brook Sattler and Adam R. Carberry

Graduate students engaged in engineering education research have always informally networked in small clusters at engineering education themed conferences. As the graduate student population has grown, so too has a widespread desire to develop a larger, more formalized student network. An effort supported by engineering education faculty and interested graduate students is currently underway to create a formal consortium to network and support students. This paper provides a brief overview of the tentatively planned programs and events that demonstrate the progress to date of the Graduate Engineering Education Consortium for Students (GEECS). Presenting our early development is intended to provide a basis for our decisions to date. Exhibition of the consortium through this media also intends to raise awareness and attract other students who may not be aware of the planned consortium and the benefits and resources that it may provide to enhance their experience.

Session T3A: Mini Workshop - A Strategy for Assessing Student Work on Open-Ended Problems

Chair: Heidi A. Diefes-Dux, Purdue University

Time: Thursday, October 13, 2011, 1:30 p.m. - 3:00 p.m.

Civic Center Room LaCroix C

MINI WORKSHOP - A STRATEGY FOR ASSESSING STUDENT WORK ON OPEN-ENDED PROBLEMS

Heidi A Diefes-Dux and Monica E Cardella

Assessing student work on realistic, open-ended problems is challenging when multiple solutions of varying quality can be expected. A balance needs to be sought between school-like and engineering-practice-like feedback and assessment of student work if an instructor wishes to capitalize on the authenticity of a problem. This workshop will work with the ideas of authentic assessment for open-ended engineering problems – the idea that not only the problem but also the feedback and assessment strategy can reflect engineering practice. Participants will learn about a four dimensional feedback and assessment model being used with Model-Eliciting Activities, a special form of open-ended problem. They will learn to apply the feedback and assessment model to sample student work and how the model can be more generally applied to open-ended problems.

Session T3B: Mini Workshop - Designing Project-Based Courses for Learning and Cost-Effective Teaching

Chair: Kristina Edstrom, Royal Institute of Technology

Time: Thursday, October 13, 2011, 1:30 p.m. - 3:00 p.m.

Civic Center Room LaCroix D

MINI WORKSHOP - DESIGNING PROJECT-BASED COURSES FOR LEARNING AND COST-EFFECTIVE TEACHING

Kristina Edstrom, Stefan Hallstrom and Jakob Kutteneuler

This workshop draws on experience in the international collaboration for engineering education reform, called the CDIO Initiative, where project-based learning is a key part of the concept. The purpose of project-based courses in engineering education is to provide environments where students can develop a deeper working knowledge of technical fundamentals together with the complex skills necessary for engineering practice, or in short: where students can become engineers. In this workshop, the learning perspective is emphasized, by identifying trade-offs where there are inherent tensions between learning outcomes and other factors in project-based courses (such as project goal, product performance, technical sophistication, teacher popularity, student satisfaction). A set of principles are derived for enhancing learning and teaching in project-based courses, using concrete examples to illustrate thought-provoking implications. Each principle aims to improve both student learning outcomes and cost-effectiveness of teaching. Together the principles constitute a framework for learning-driven course design. The aim is to challenge assumptions and common practices in project-based courses, and provoke fruitful discussion among participants.

Session T3C: Development of Critical Thinking, Lifelong Learning, Leadership, and Values: Integration within Engineering Curricula

Chair: Jim Morgan, Texas A&M University

Time: Thursday, October 13, 2011, 1:30 p.m. - 3:00 p.m.

Civic Center Room LaCroix B

A BEHAVIORAL APPROACH TO BUILDING COGNITIVE FOUNDATIONS FOR EFFECTIVE THOUGHT AND ACTION IN A FRESHMAN CRITICAL THINKING COURSE

Eric C. Pappas

Problem Solving Approaches in Science and Technology is a James Madison University three-credit freshman-level General Education course in psychological dispositional skills and metacognitive processes that includes instruction, practice, and maintenance in a variety of dispositional skills, intentional behavior, and lifestyle modification that support effective thought and action in academia, the workplace, and students' personal lives. Mean values of survey results of freshman students (n=118) of 1) perceived dispositional project and course value, 2) likelihood of continued use of acquired skills, and 3) perceived importance of these skills were positive and indicate the necessity of continued research into behavioral methodologies for teaching metacognitive skills.

WORK IN PROGRESS – DEVELOPING AN INDIVIDUALIZED LIFE-LONG LEARNING PLAN FOR JUNIOR ELECTRICAL AND COMPUTER ENGINEERING MAJORS

Michael Elmore and James Constable

The Accreditation Board for Engineering and Technology (ABET), now ABET Inc., adopted Engineering Criteria 2000 (EC2000) in 1997. At the time this was considered a revolutionary approach to accreditation criteria, because of its focus on what is learned in the classroom rather than what is taught. In the spring of 2003 the faculty of the Electrical Engineering and Computer Engineering department at Binghamton University approved a new course - EECE 382 - Electrical and Computer Engineering Seminar II. The intent was to consolidate topics that were being taught across several courses within one focused seminar to better ensure that Criteria 3 of General Criteria for Basic Level Programs - Program Outcomes and Objectives - was consistently addressed. EECE 382 was to provide an overview of the professional aspects of the fields of Electrical Engineering and Computer Engineering. This paper reports on how one of the objectives of Criteria 3: 'a recognition of the need for and an ability to engage in life-long learning' is addressed in EECE 382.

WORK IN PROGRESS - ASSESSMENT OF A LEADERSHIP CURRICULUM

Andrew L. Gerhart, Donald D. Carpenter and Melissa L. Grunow

Lawrence Technological University has implemented a required four year leadership curriculum for all undergraduate students based on the University's Leadership Education Goals and the Relational Model of Leadership. This investigation is assessing individual components of the curriculum, which include courses and co-curricular elements, as well as the impact of the curriculum as a whole. The primary tool for assessment is the author developed Leadership Self-Perception Assessment Instrument. Through pilot testing, the instrument has been proven to be temporally stable and internally consistent. The instrument will aid in answering many research questions which cover how students perceive their own leadership traits and skills, whether students are demonstrating growth in confidence in those skills through each component of the curriculum, the impact of the entire four-year leadership curriculum, and the modifications necessary to the curriculum to adequately address the student learning outcomes. Therefore, the instrument will be used for both formative and summative assessment and facilitate a longitudinal study of the leadership growth of the students. A pilot test of the instrument revealed that the students perceived an improvement in some leadership skills upon completion of one component of the curriculum. This paper will focus on pilot test results as well as set the stage for the longitudinal investigation.

KNOWLEDGE AND INFORMATION SHARING IMPROVED BY SIMULATION TECHNOLOGY: A QUANTITATIVE STUDY

Adrienne Colbert, Angelica Guzman, Martha McQueen and Ray Luechtefeld

While research continues to grow in the area of facilitation, engineers continue to focus on enhancing their technical knowledge base. Training is seldom directed at increasing non-technical skills. We investigate the use of virtual facilitation based on the facilitation framework of Chris Argyris to determine if its use leads to acceptable solutions and increased trust. Simulation technology is widely used by the military. Instead of using multi-million dollar pieces of equipment to practice flight maneuvering, simulation technology is used as a substitute. Whether internal or external to the engineering arena, simulation technology can be an innovative educational tool. If simulation technology can be used to enhance the quality of decision-making in human beings, there also exists the ability to process information quickly, utilize comparable and visual processing techniques, and improve data organization, critical thinking, and problem solving skills. This study furthers research into virtual facilitation as an aid in

enhancing knowledge and information sharing by improving participants' openness and interdependence.

STUDENT DEVELOPMENT IN THE CO-CURRICULUM THROUGH VALUES-BASED TEAMING

Dan Dolan, Michael Batchelder, James McReynolds, Kimberly Osberg, Ryan Koontz, Patricia Mahon, Michael Keegan and John Weiss

A co-curricular multidisciplinary teaming and design center was started in 1997 to augment classical classroom engineering education with active and collaborative project-centered experiential learning. Design, creativity, inventiveness, hands-on learning, project management, teaming, and leadership become the value-added education in the center which now has thirteen teams. Projects such as Formula SAE, Baja SAE, Aero Design etc. are all based on regional, national, and international competitions developed by the engineering societies. The importance of the values of respect, trust, integrity, and responsibility is well known for good teaming and leadership. Values of affection, well-being, skill, understanding, proper use of goods and services and proper use of power and influence are also extremely important. Rucker's continuum of values provides a scale for measurement of these values. Qualitative values assessment as a formative assessment, and placement in the competitions as a summative assessment have been used to measure quality of the teaming, leadership, and general level of the quality of the engineering done by the team. Teams with high values assessments were considered successful and often placed high in their competitions. Teams with low values assessments did not fare well in competitions.

Session T3D: Understanding How K-12 Learners Think about Engineering and How Technologies Might Influence their Beliefs

Chair: Carlos Vaz de Carvalho, Instituto Superior de Engenharia Porto

Time: Thursday, October 13, 2011, 1:30 p.m. - 3:00 p.m.

Civic Center Room 101

MOBILE LABORATORY PROGRAMS AS VEHICLES TO PROMOTE STEM EDUCATION IN K-12 AND BEYOND

Carl Franzblau, Carla A. Romney, Russell Faux and Donald DeRosa

Mobile laboratories refer to self-contained, traveling laboratories that accommodate student participation in hands-on laboratory science aboard the mobile laboratory unit. Most of the mobile laboratory programs that are now in operation focus on providing middle and high school students and teachers with access to science equipment and supplies that are difficult for them to acquire and maintain. In addition, many of the mobile laboratory programs provide inquiry-based curricular materials that are engaging, substantive, and thought provoking. Further, since mobile laboratories are completely self-sustained and can travel to urban and rural locations that are often educationally and economically disadvantaged, they provide equal access to state-of-the-art learning opportunities. The use of mobile laboratories is an innovative way to transform science teaching and learning, particularly in the pre-college setting. While many of the mobile laboratory programs now in operation focus on the biological sciences, we believe that these programs can be adapted to broader applications in STEM education. Mobile laboratories have the potential to offer powerful and unique ways to engage and inspire future scientists and engineers. These "vehicles" may pique the curiosity of students and motivate them to continue their study of science in high school and beyond. As such, mobile science laboratories may contribute to increasing the number of students who become science-literate citizens and members of the science workforce.

WORK IN PROGRESS - EXERCISES IN SQUEAK SMALLTALK FOR PRE-COLLEGE EDUCATION

Steve E. Watkins, Nicolette Kowalewski, Kathryn N. Rodhouse and Benjamin Cooper

Computer programming education helps to prepare pre-college students to function in a technology-based society and to promote technical careers. However, opportunities are limited for pre-college students to learn computer programming and effective programming instruction can be difficult. A set of introductory, self-paced tutorials in Squeak Smalltalk has been developed for students in high school and middle school. This work describes two supplementary exercises that address the needs of new learners, especially those at younger ages. Students are given tools for drawing and image manipulation. The optional exercises integrate basic concepts while allowing more interactivity and customization through creative "play."

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

Rajesh Ganesan, Donna Sterling and Philip Henning

This WIP report is a continuation of the 1st and 2nd year work presented at the previous FIE conferences in 2008 and 2009 respectively. The WIP documents 4th year development, implementation efforts, and results of SUNRISE, a unique graduate Fellowship program at George Mason University (GMU) that targets graduate students working in the grade 4-6 school environment. SUNRISE is a new GK-12 project aimed at partnering STEM (Science,

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Technology, Engineering, and Mathematics) graduate students (Fellows) with school teachers from three different school divisions in Northern Virginia. The innovative practice aspect of the project is the construction of a framework that provides training, exchange of information, and integration of scientific research from diverse disciplines with teaching to make science exciting for students. A feature of SUNRISE that makes this project different from other GK-12 projects in the nation is that the project is housed in the School of Information Technology and Engineering which is unique in the nation. One of the contributions of the project is that it is focused on infusing Information Technology (IT) rich STEM concepts into K-12 education, which is also another unique feature. This WIP presents a summary of the project's impact on its key participants.

WORK IN PROGRESS - DEVELOPMENTAL ENGINEERING: USING OBSERVATION FOR UNDERSTANDING CHILD BEHAVIORS AS PRECURSORS TO ENGINEERING THINKING

Diana Bairaktarova, Demetra Evangelou and Christina Citta

Children's experiences in early childhood have significant lasting effects in their overall development and in the United States today the majority of young children spend considerable amounts of time in early childhood education settings. At the national level, there is an expressed concern about the low levels of student interest and success in science, technology, engineering, and mathematics (STEM). Bringing these two conversations together our research focuses on how young children of preschool age exhibit behaviors that we consider relevant in engineering. There is much to be explored in STEM education at such an early age, and in order to proceed we created an experimental observation protocol in which we identified various pre-engineering behaviors based on pilot observations, related literature and expert knowledge. This protocol is intended for use by preschool teachers and other professionals interested in studying engineering in the preschool classroom.

FIRST EXPERIENCES WITH EBLOCKS AS AN ASSISTIVE TECHNOLOGY FOR INDIVIDUALS WITH AUTISTIC SPECTRUM CONDITION

Jennifer Drain, Mario Riojas, Susan Lysecky and Jerzy Rozenblit

The integration of technology into autistic classrooms has shown promising results, including an increase in attention span, creativity, and social skills. We have introduced a low-cost learning technology composed by electronic modules called eBlocks to an autistic middle-school classroom. The participants of this study had the opportunity to learn concepts in the design and implementation of electronic systems by using the eBlocks. Our initial findings show that the integration of hands-on real world based projects, centered on the design of systems for a Smart House stimulated peer-to-peer interaction and teamwork, while promoting spontaneous creative thinking. We present our experiences with six students, including summaries of our overall experiences, teacher's pre- and post-surveys, and the examination of students' work.

Session T3E: Faculty Development: Perspectives from Peers and Students

Chair: Jim Borgford-Parnell, University of Washington

Time: Thursday, October 13, 2011, 1:30 p.m. - 3:00 p.m.

Civic Center Room 102

A REVIEW OF AN ENGINEERING TEACHING APPRENTICESHIP PROGRAM

Kerry Meyers and Jay B. Brockman

A teaching apprentice program was implemented for senior-level engineering graduate students at the University of Notre Dame during the spring of 2009. The goal of the program was to offer a mentored teaching experience to graduate students that would soon be taking on roles as faculty members at institutions across the country. Responsibilities included: (1) teaching two sections of the first-year engineering course (as the instructor of record, receiving formal teaching evaluations), (2) helping to develop course materials (with feedback from engineering faculty and the Center for Teaching and Learning), and (3) leading two undergraduate teaching assistants (graders for their class). Finally, regular box lunch meetings were held for purpose of exposure to engineering education research and practice, through discussion of engineering education literature or meeting with outside guests from the engineering educational community. Program participants were required to document their goals at the start of the semester and to follow up with reflections at the end of each semester they participate; excerpts from participant reflections are presented. After completing the First-Year Engineering Teaching Apprentice Program (FYETAP), several participants have accepted post-docs or faculty positions and were able to use this experience in their interview process.

WORK IN PROGRESS - IMPLEMENTING PEER OBSERVATION OF TEACHING

Byron Garry, Li Qian and Teresa Hall

This paper describes how the Department of Engineering Technology & Management (ETM) at South Dakota State University (SDSU) is implementing a Peer Observation of Teaching process to improve teaching and as a result

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improve student learning. A robust definition of what constitutes good teaching that will address a variety of contexts and student cohorts has yet to be developed. There is general agreement that good teaching should lead to increased student learning. The teaching process is complex and difficult, however external feedback can be a useful tool to help faculty improve effectiveness. Based on a seminar provided to the entire SDSU campus, the ETM Department has developed and is beta-testing a seven-step process to implement peer observation and evaluation to provide feedback to teachers from their fellow faculty. Yet to be fully developed is how to choose from among several possible ways to assess the results of the peer review of teaching process and to improve effective teaching. At the time of this paper's presentation in Fall 2011, we will report on the status of the process, some assessment outcomes, and recommendations for future implementation.

DEVELOPING IT EDUCATION IN TANZANIA: EMPOWERING STUDENTS

Matti Tedre, Mikko Apiola and Josephat O. Oroma

Due to an urgent national need for more IT professionals, developing countries spawn academic IT programs at an increasing rate. Those programs are often replicated from similar programs in Europe and America. Students' preferences concerning their education are, however, rarely inquired. This research study explored and analyzed Tanzanian IT students' views of challenges in their studies, as well as their views of the most important factors for their learning. A longitudinal perspective was introduced, as changes in results between 2008 and 2011 were analyzed. The findings suggest that there is a need for increased practical training, development of facilities, improvement of course design, and increased feeling of ownership and empowerment.

COOPERATIVE LEARNING: LESSONS AND INSIGHTS FROM THIRTY YEARS OF CHAMPIONING A RESEARCH-BASED INNOVATIVE PRACTICE

Karl A Smith

Innovation according to Denning and Dunham (2010) is "the adoption of a new practice in a community." I argue that our innovations need to be based on good learning theory and good instructional practice. The Johnson and Johnson conceptual model of cooperative learning is an excellent example of a widely adopted evidence-based practice. I identified cooperative learning as important for engineering education in about 1974, tried it in my classes and did some systematic research on it with David and Roger Johnson, introduced it to the engineering education community in 1981 (FIE conference and JEE paper), and it took over 25 years for it to become widespread practice. My point in presenting this story is I don't think we can afford to wait 25 or more years for the current innovations to make it into practice. This paper summarizes the history of the emergence of cooperative learning in engineering education; documents the development of the theoretical, empirical, and practical support; maps the milestones and lessons learned; and provides insights and guidance for engineering education researchers and innovators especially concerning increasing the rate of adoption of evidence-based promising practices.

WORK IN PROGRESS - HOW TO PROVOKE CREATIVITY AND INNOVATION WITHIN THE CLASSROOM BY MODIFYING THE ROLE OF FACULTY

Lluís Vicent, Xavier Gumara and Malinda Fitzgerald

The normal role of teachers in a classroom is based on the didactic method of teaching involving lectures and writing on the board, or assisting students in their exercises in a consultant manner. This is a passive method of learning. This classical approach to teaching has been evolving in the last few years with more innovative practices being proposed and implemented. Particularly, the Socratic method of teaching, which is a more open, non-lecture style and has less teacher directed activities, in an effort to approximate the work place with teams and more real world scenarios. In the course entitled "Teaching Innovation", a new role for teachers was conceived and implemented. This innovative teaching philosophy provides a dual role for teachers. In this class the innovative, thought provoking teacher initiates the discussion and gives the appearance of providing disruptive ideas, while the insightful, facilitative teacher is steering the students into formulating those ideas into reality. At the end of this course there were 11 innovative educational programs that were proposed to potentially modify the study of technology in the secondary level of the Spanish System of Education.

Session T3F: Project-anchored and Team-based Approaches to Teaching Engineering Design

Chair: Michael Isaacson, University of California at Santa Cruz

Time: Thursday, October 13, 2011, 1:30 p.m. - 3:00 p.m.

Civic Center Room 201/202

WORK IN PROGRESS - A NOVEL APPROACH TO CARRYING OUT MINI PROJECT IN COMPUTER SCIENCE & ENGINEERING

Padmashree Desai, Gopalkrishna H. Joshi, M Vijayalakshmi and Karuna Gull

The student projects done in Computer Science and Engineering suffer from the following problems: poorly managed

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requirements, poor or no design and poor or no testing. Students generally tend to focus more on coding phase of the project, since the misconception is that a large code constitutes good software. Unlike other branches of engineering, the engineering processes are not visible here. Further, management of large number of student projects poses a challenge in terms of guidance, progress monitoring and assessment. The student projects are observed to be ending up incomplete and are rarely deployed. The feedback from industry side also speaks about the gaps in terms of these skills. A mini project course for fifth semester is designed in the undergraduate programme in Computer Science and Engineering to address the lacunae observed above by tightly integrating it with the theory course on Software engineering. The focus of the mini project is not on what the problem definition is, instead it is on how it is done. The implementation plan addressed the issues and challenges listed above faced by the faculty. Assessment rubrics are written to guarantee proper understanding of the expectations among the stake holders resulting in fair assessment. This approach improved students understandability in Software engineering concepts and also the quality of their capstone projects. The paper discusses the design, implementation and assessment details of mini project along with the experience gained.

A TWO-CHANNEL BIOAMPLIFIER DESIGN AS A CROSS-COURSE EXPERIENCE

Steve Warren, James DeVault and Kejia Li

A cross-course design experience is an efficient way to stitch together two concurrent, single-semester courses to obtain a meaningful number of design credits without unduly increasing a student's overall load. This paper addresses a project that joined the design credits from two Kansas State University (KSU) courses: ECE 773 – Bioinstrumentation Design Laboratory and ECE 502 – Electronics Laboratory. The goal of each project team was to design, build, and demonstrate a two-channel bioamplifier that is functionally similar to a commercial bioamplifier used in the KSU AP 773 – Bioinstrumentation Laboratory course taken by some of these students. Assessment of the experience was provided via a post-project survey that addressed eight learning objectives, learning in 23 technical areas, project administration, and the overall experience. Survey results were positive across the board. Though the time commitment was significant, the students appreciated the opportunity to work on a complex system that required their collective expertise.

WORK IN PROGRESS - AN INNOVATIVE DESIGN OF A MASTER IN COMPUTER SCIENCE PROGRAM

Lixin Tao, Constantine Coutras, Narayan Murthy and Richard Kline

Master in Computer Science programs (MS-CS) are critically important in producing competitive IT professionals and preparing students for doctorate research. A major challenge is how to integrate the latest computing technologies into MS-CS programs without compromising the computer science foundation education. This paper shares Pace University's study and experience in renovating its MS-CS program to address this challenge. The study started with the identification of the most important progress in computing over the past decade and its relationship with the fundamental computer science concepts and theory. In particular Internet and web technologies, cloud computing, mobile computing, and Internet/web security are analyzed. Based on this theoretical analysis Pace University's MS-CS program was revised into a 30-credit program with a 12-credit program core for comprehensive theoretical foundation, 12-credit concentrations for in-depth study in selected technology areas, and three 6-credit capstone options for knowledge integration and application as well as life-long learning.

STUDENT PERSPECTIVES ON LEARNING THROUGH DEVELOPING SOFTWARE FOR THE REAL WORLD

Christopher Dean, Thomas D. Lynch and Rajiv Ramnath

From a student's perspective, the standard computer science curriculum can effectively develop fundamental software design principles and techniques, but may struggle to fully prepare students for professional practice. Real-world projects require many skills that are challenging to foster in the classroom, including the ability to implement large applications, interact professionally with others, and independently learn new concepts. Undergraduate programs have attempted to develop these abilities through capstone classes and by encouraging participation in co-ops and internships. At Ohio State University, nearly a dozen students have attempted to foster these abilities by doing long-term, real-world, large-scale, commercial-grade software development projects. The first such project recently released an iPhone-based, stadium-centric infotainment application to end-users in time for the 2010 football season. This paper, whose first author is an undergraduate computer science student, captures, from a student's perspective, the educational benefits of ongoing and real-world projects over the more traditional approaches. Following an examination of the educational impacts of these projects relative to the impacts of co-ops, internships and capstone classes, results suggest that long-term, real world projects are a valuable and synergistic component of an undergraduate education in computer science.

TEAM-BASED SOFTWARE/SYSTEM DEVELOPMENT IN A VERTICALLY-INTEGRATED PROJECT-BASED COURSE

Randal Abler, Ed Coyle, Agrita Kiopa and Julia Melkers

We use per-student virtual machines to allow new students to configure servers, thus enabling them to develop an understanding of the complex eStadium system. The outcomes include: student learning as the per-student virtual machines progress into software development and production machines supporting the eStadium game-day environment; the teamwork and leadership skills that evolve as students progress from initial learning to leadership roles in the creation of sophisticated applications; guidelines for instructors mentoring students through the process of building and maintaining a working production system; and, parallels with best-practice software and system development in industry. The use of peer-evaluations and social-network studies enable us to determine how the students interact with and learn from each other across years (sophomores through seniors). This cross year, cross experience-level learning process is essential for maintaining the technical and team continuity of the project. It also prepares students in a very realistic way for the software-development process in industry.

Session T3G: Are there new Approaches to Designing Engineering Laboratory Experiences?

Chair: Michael E. Auer, Carinthia Tech Institute Villach, Austria

Time: Thursday, October 13, 2011, 1:30 p.m. - 3:00 p.m.

Civic Center Room 205

HIGH TECH GARBAGE CAN HELP ENGINEERING COLLEGES TO IMPROVE HANDS-ON EDUCATION

Samuel E. de Lucena

This paper presents a discussion on the potential use of high tech garbage, including electronic waste (e-waste), as a source of mechanisms, sensors and actuators, that can be adapted to improve the reality of microprocessor systems labs, at low cost. By means of some examples, it is shown that entire subsystems withdrawn of high tech equipments can be easily integrated into existing laboratory infrastructure. As examples, first a precision positioning mechanism is presented, which was taken from a discarded commercial ink jet printer and interfaced with a microprocessor board used in the laboratory classes. Secondly, a read/write head and its positioning mechanism has been withdrawn of a retired CD/DVD drive and again interfaced with the microprocessor board. Students who have been using these new experiments strongly approve their inclusion in the lab schedules.

'GREEN' REMOTE LABORATORY FOR CHEMICAL ENGINEERING DEGREE: A NEW PARADIGM FOR TRAINING

Yolanda Bolea and Antoni Grau

This paper presents an innovative web-based 'green' remote process control laboratory focused on the necessity of chemical control education community. The usefulness of the remote laboratory proposed in this paper is justified by two relevant factors: the opportunity of organizing remote experiments, saving students time and money; and the integration of the 'Sustainability' (transversal competence) in the curricula. A new innovative pedagogical methodology for laboratories is carried out. Furthermore, a set of practices that constitutes the remote lab will be presented covering all the subject of "Chemical Processes Control" in the Chemical Engineering Degree at the Technical University of Catalonia (UPC). Students should achieve chemical control systems (modeling and control design) basic knowledge and skills as well as the necessary concepts, real world situation vision and awareness in order to take decisions in their professional live taking into account the Sustainability, economy and efficiency.

WORK IN PROGRESS - HANDS-ON LEARNING OF FUNDAMENTAL CONCEPTS IN ELECTROMAGNETIC FIELDS

Yong Xu, Kathleen Meehan, Xiangyu Wei, Alan B. Overby and Courtney Martin

A pedagogical approach of hands-on learning that has formed the foundation of the nontraditional circuits and electronics laboratory courses at Virginia Tech (VT) is now being applied to enhance the learning in what has been a series of highly mathematical courses on abstract theory on electromagnetic fields. A set of experiments that demonstrate basic concepts in electromagnetic (EM) fields has been developed for a two-semester course sequence that is offered in the junior year of the Bachelor's degree in Electrical Engineering at VT. The experiments are designed to reinforce concepts on electric and magnetic fields and propagation of electromagnetic waves to promote student comprehension, depth of learning, and application of the fundamental concepts in electromagnetic fields. The experiments were introduced into the curriculum during the 2010/2011 academic year. An initial assessment of the experiments has been conducted, which indicates that students value the learning opportunity to translate the abstract concepts into practice.

A PRELIMINARY MOTIVATIONAL EVALUATION OF MILESTONE-BASED LABORATORY ASSESSMENT

Ken Stanton and Euan Lindsay

Milestone based marking is an asynchronous assessment approach used for semester-long projects. By providing students with a fine-grained marking scheme – the milestones – at the start of semester, and allowing students to claim these marks at any point in the semester, students can better plan and self-manage their learning. The milestone-based assessment approach is intended to motivate the students by making the assessment process transparent and accessible. To determine whether or not this has occurred, it is necessary to evaluate the initiative through the lens of motivation theories. Since the connection between motivation and learning is well understood, looking specifically at motivation should shed light on how deeply students are learning in this new approach. In this paper, student data from three semesters of implementation is reviewed and explained using various motivation theories: Self-Determination Theory, Flow Theory, Self-Efficacy Theory, Goal Theory, and Expectancy-Value Theory. Results show that many of these theories have opportunity to explain the students' engagement and learning and provide insight into how better to examine student motivation in upcoming semesters.

WORK IN PROGRESS - CREATING A COLLABORATIVE LEARNING ENVIRONMENT FOR ENGINEERS AND TECHNOLOGISTS

Craig Downing, Anneliese Watt, Julia Williams and Rick Stamper

There is widespread agreement on the important role higher education plays in preparing students to enter the workplace as positive contributors able to work in multidisciplinary teams. This is especially true in Engineering and Technology education where many pundits have estimated there will be a shortfall of qualified STEM (Science, Technology, Engineering, and Mathematics) graduates equal to the ever-changing demands of the private sector. As such, many institutions of higher education have responded to these concerns by developing programs and projects to facilitate workplace simulations where students can demonstrate their technical competence while working as a team. Furthermore, students participating in these activities are afforded an opportunity to develop a strong combination of technical and non-technical competencies necessary to be effective leaders while working in the diverse population of today's business environments. This paper reports on a workplace simulation project experience that requires collaboration of technology students from a community college with undergraduate engineering students in bachelor's degree programs to develop a new product.

Session T3H: How Might Technological Developments Make Differences In the Lives of Engineering Students and People in General?

Chair: Rachel A. Louis, Virginia Polytechnic Institute and State University

Time: Thursday, October 13, 2011, 1:30 p.m. - 3:00 p.m.

Civic Center Room 206

ULTRA-LOW POWER AND THE MILLENNIUM GENERATION

Antonio Mondragon and Adriana Becker-Gomez

Millennials are a generation of young people currently in training at universities and colleges, and entering the workforce. They have several characteristics that could potentially make them one of the most productive generations ever. On the other hand the concepts of sustainability and energy awareness are part of their vocabulary and most of the jobs will be related to these terms. This work relates an attempt to tailor a microcomputers course to appeal to this generation of students. What we have found is that the traditional teaching formulas have to be adapted to make them usable by millennials who do not know a world without internet, wireless communications and social networking.

WORK IN PROGRESS - DEVELOPMENT OF AN INTEGRATED CIRCUITS COURSE THAT INCLUDES THE FULL EXPERIENCE OF DESIGNING AN ASIC IN A CMOS PROCESS

Jose Lipovetzky, Alejandro De La Plaza, Mariano Garcia Inza, Ariel Lutenberg, Martin Carra, Pablo Barbeito, Federico Dangiolo, Nicolas Rigoni and Luis Lopez

This work presents the development and first experiences in a course of design of digital and analog integrated circuits using a CMOS process in a country and university which do not have strong traditions on microelectronics. During the first two months of the course, lectures are given on specific topics, leaving the last months to work on a design project proposed by the students themselves, which is fabricated. The course ends when students characterize the functionality of their circuits.

A NOVEL INTERDISCIPLINARY COURSE IN GERONTECHNOLOGY FOR DISSEMINATING COMPUTATIONAL THINKING

Hen-I Yang, Peter Martin, Debra Satterfield, Ryan Babbitt, Johnny Wong, Mack Shelley and Carl K Chang

While specialized knowledge and skills are the hallmark of modern society, the size and complexity of contemporary problems often require cooperative effort to analyze and solve. Therefore, experiences with skills, methodologies, and tools for effective interdisciplinary collaboration and structured problem solving are vital for preparing students for future academic and professional success. Meanwhile, computational systems have permeated much of modern professional and personal life, making computational thinking an essential skill for members of modern society. However, formal training in these techniques is primarily limited to students within computer science, mathematics, management of information systems, and engineering. At Iowa State University, we have designed and offered an experimental course to develop undergraduate students' abilities for interdisciplinary teamwork and to disseminate computational thinking skills to a broader range of students. This novel course was jointly designed and instructed by faculty from the Computer Science Department, Gerontology Program, and Graphic Design Program to incorporate diverse faculty expertise and pedagogical approaches. Students were required to interview real users to identify real-life problems, gather requirements, and assess candidate solutions, which necessitated communication both within the group and with technologically-disinclined users. In-class presentations and wiki-based project websites provided regular practice at disseminating domain expertise to larger interdisciplinary audiences. Workshops, group-based mentoring, peer learning, and guided discovery allowed non-CS majors to learn much more about computer programs and tools, and grading criteria held students individually accountable within their disciplines but also emphasized group collaboration.

EFFECTIVENESS OF TECHNOLOGY EDUCATION LEARNING ACTIVITIES ON THE IMPROVEMENT OF SPATIAL SKILLS

Susan K. Donohue

A skill set important to student success in engineering studies is spatial skills. It is important, therefore, to provide opportunities to improve these skills in the curriculum. Research has demonstrated that spatial skills are trainable, and the subsequent literature on initiatives and interventions is robust. We are interested in validating earlier research on the efficacy of traditional technology education learning activities, such as technical drawing, on the improvement of spatial skills. The results indicate that technical and perspective drawing and projects involving the manipulation of 3D objects contribute to improvements in spatial skill levels. These findings do validate previous work. The re-investigation of "old school" interventions may be of particular interest to P-12 engineering educators working with constrained resources.

WORK IN PROGRESS - PROGRAMMING IN A CONFINED SPACE – A CASE STUDY IN PORTING MODERN ROBOT SOFTWARE TO AN ANTIQUE PLATFORM

Stacey L. Montresor, Jennifer S. Kay, Michel Tokic and Jonathan M. Summerton

In a typical introductory AI class, the topic of reinforcement learning may be allocated only a few hours of class time. One engaging example of reinforcement learning uses a crawling robot that learns to use its two-degree-of-freedom arm to drag itself forward. Unfortunately, the cost of the required hardware is prohibitively expensive for many departments for what is typically a once-a-semester demonstration. So we decided to port the algorithm to a platform that many departments may already have on hand: the LEGO Mindstorms RCX 2.0. Initially the task seemed relatively straightforward: build a robot base out of LEGO parts and implement the algorithm in the Not Quite C language. However the challenges of designing a robot arm without servos and attempting to trim code down to a size that would fit on the RCX has proven to be as educational to the undergraduates working on the project as we hope the final product will be to students in AI classes. This paper describes the challenges we have faced and the solutions we have implemented, as well as the work that remains to be completed.

Session T3J: Assessment: Changing Practice of Engineering Faculty and Behaviors Among Engineering Students

Chair: Arnold Pears, University of Uppsala, Sweden

Time: Thursday, October 13, 2011, 1:30 p.m. - 3:00 p.m.

Civic Center Ponderosa Room

THE EFFECT OF ASSESSMENTS ON A TELEMATICS COURSE FOR TELECOMMUNICATION ENGINEERS

Maria-Dolores Cano

This paper studies the effect of including continuous assessments in the methodology of an introductory Telematics course for Telecommunication Engineers. Seven academic years were evaluated, corresponding to a total number of

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364 students. Whereas the methodology of the first three years was based only on lectures and lab activities, the last four years included assessments (e.g., problem resolution, information searching, reports, tests, etc.) as an integral part of the students' final scores. Through statistical analysis, results reveal that there is no significant difference in the pass rate between years with assessments and years without assessments, taking into account all students enrolled in the course. However, there is a significant (statistical) difference in the fail and dropout rates. On the other hand, if only students who did not dropout the course are taken into account, then there is a significant (statistical) difference in the pass rate comparing both methodologies: including the assessments increased the pass rate from 53% to 72%. Nevertheless, no differences were found in the average final grades obtained by the students with either methodology. Regarding the students' gender, the effect of the assessments was higher for male students than for female students.

LEGITIMIZATION OF SUBJECT MATTER IN A DESIGN INTENSIVE DEGREE PROGRAM

Charles D. Cox

This is a descriptive study at the departmental level of a university. It provides a glimpse into the ways that this department, as an academic community implementing a design intensive degree program, deals with the conflicts between accreditation as a system of program assessment and the processes that distinguish them as a culture. The process under primary investigation was modification of curriculum to introduce subject matter into the degree program (one possible terminus of subject matter's progress toward legitimization: recognition of being both integral to the required portion of the curriculum and well defined by cultural agreement and system records). Employing ethnomethodological strategies, the researcher maintained prolonged contact with members of this culture, interrogating legitimization and curriculum modification (regarding sustainability subject matter) that they attempted despite ongoing disturbances to these processes. The disturbances and reactions made cultural processes observable to an extent not likely under ordinary circumstances.

FIVE YEARS WITH KATTIS – USING AN AUTOMATED ASSESSMENT SYSTEM IN TEACHING

Emma Enstrom, Gunnar Kreitz, Fredrik Niemela, Pehr Soderman and Viggo Kann

Automated assessment systems have been employed in computer science (CS) courses at a number of different universities. Such systems are especially applicable in teaching algorithmic problem solving since they can automatically test if an algorithm has been correctly implemented, i.e., that it performs its specified function on a set of inputs. Being able to implement algorithms that work correctly is a crucial skill for CS students in their professional role, but it can be difficult to convey the importance of this in a classroom situation. Programming and problem solving education supported by automated grading has been used since 2002 at our department. We study, using action research methodology, different strategies for deploying automated assessment systems in CS courses. Towards this end, we have developed an automated assessment system and both introduced it into existing courses and constructed new courses structured around it. Our primary data sources for evaluation consists of course evaluations, statistics on students' submitted solutions, and experience teaching the courses. Authors of this paper have been participating in teaching all of the courses mentioned here.

DEFINING, INTEGRATING, AND ASSESSING A PURPOSEFUL PROGRESSION OF CROSS-CURRICULAR INITIATIVES INTO A COMPUTER SCIENCE PROGRAM

Steve Hadfield, Dino Schweitzer, David Gibson, Barry Fagin, Martin Carlisle, Jeff Boleng and David Bibighaus

ABET-based program outcomes are the skills and knowledge that a student successfully completing the program has obtained at the time of graduation. For a Computer Science program, many of these outcomes require a developmental progression of learning experiences that are best provided incrementally across courses. Achievement of such a progression is predicated on a cooperative effort by faculty to define effective approaches to realizing the outcomes. However, the progression must also minimize demands on individual courses and eliminate unnecessary restrictions on faculty discretion in course design and implementation. In addition, a time-phased assessment plan should be overlaid upon the progression to measure and track the developmental process. This work documents our effort to define a developmental progression in our computer science program to better achieve ABET-based outcomes, integrate the progression into an existing curriculum in a minimally invasive manner, and incrementally assess the effectiveness of the approach.

INTERACTIONS AMONG UNDERGRADUATE ENGINEERS: HOW CARE AND RESPECT ARE DEMONSTRATED AMONG PEERS

Janice E. Austin and Elizabeth G. Creamer

The Accreditation Board for Engineering and Technology requires all accredited engineering programs demonstrate that their students can function on multidisciplinary teams and communicate effectively. Previous research has shown

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that engineering faculty members remain uncertain on how to teach students to effectively work in groups and that care and respect from peers is a key factor related to both short- and long-term student interest in engineering. The purpose of this qualitative study was to obtain verbal descriptions of how care and respect or the lack thereof is experienced in engineering peer interactions. Eighteen participant interviews were conducted. The results of this study provided a list of actions that demonstrate care and respect and a lack thereof among engineering peers. Five conceptual categories of actions were identified. Study participants indicated that a lack of care and respect had been repeatedly experienced and/or observed during group work. Participants described a lack of guidance from faculty on how to effectively work in groups. While there are many educational advantages to group work, it also introduces some troubling peer dynamics. The findings further highlight a need for engineering faculty to teach their students how to communicate with peers and work effectively in groups.

Session T4A: Special Session - Assessing Student Learning of Engineering Design

Chair: Monica E. Cardella, Purdue University

Time: Thursday, October 13, 2011, 3:30 p.m. - 5:00 p.m.

Civic Center Room LaCroix C

SPECIAL SESSION - ASSESSING STUDENT LEARNING OF ENGINEERING DESIGN

Monica E Cardella, William C Oakes, Carla B Zoltowski, Robin S Adams, Senay Purzer, Jim Borgford-Parnell, Reid Bailey and Denny Davis

Design is a central aspect of engineering and engineering education, but is challenging to teach and even more challenging to assess. In this special session participants co-construct an understanding of design and what aspects of design should be (and can be) assessed. Additionally, the special session will review the instrument development process (including the process of validating instruments) and will provide examples of existing instruments for assessing learners' understanding of design. These instruments measure a variety of topics and concepts related to design, have been designed for many different audiences and have been developed for different purposes. This session will equip educators with tools that are useful for assessing and promoting students' understanding of design. Additionally, this session may benefit educators and researchers interested in adopting or adapting design assessments for use with K-12 populations.

Session T4B: Special Session - Attracting and Supporting Military Veterans in Engineering Programs

Chair: Susan M. Lord, University of San Diego

Time: Thursday, October 13, 2011, 3:30 p.m. - 5:00 p.m.

Civic Center Room LaCroix D

SPECIAL SESSION - ATTRACTING AND SUPPORTING MILITARY VETERANS IN ENGINEERING PROGRAMS

Susan M. Lord, Kathleen A. Kramer, Rick T. Olson, Mary Kasarda, David Hayhurst, Sarah Rajala, Robert Green and David Soldan

The Post-9/11 GI Bill overhauled the educational benefits available to military veterans. Additionally, the Yellow Ribbon Program makes private institutions more affordable to veterans. Consequently, more veterans are seeking undergraduate degrees, and many schools are seeing significant numbers of veterans for the first time. The National Science Foundation (NSF) has recognized that veteran engineers may address shortages in the engineering workforce and has funded projects to develop models for helping veterans make the transition from active duty to successful student. This special session provides a forum for several awardees to describe their work and to engage a larger audience in discussions about engineering education for veterans. The goals for this session are to raise awareness in the engineering education community about the issues facing veteran engineering students, identify issues commonly encountered as veterans transition from service to the classroom, promote the dissemination of results from NSF-supported efforts to support veterans in engineering programs, provide a forum for sharing best practices related to the successful transition of a veteran from the military to engineering programs, and establish relationships between schools with the shared interest of serving military veteran students.

Session T4C: Informing Practice in Design and Implementation of Online Courses

Chair: Antonio Vieira de Castro, Instituto Superior de Engenharia do Porto

Time: Thursday, October 13, 2011, 3:30 p.m. - 5:00 p.m.

Civic Center Room LaCroix B

TEAM FORMATION BY REGION TO IMPROVE OUTCOMES FOR DISTANCE-EDUCATION STUDENTS IN A PBL COURSE

Andrew P. Wandel

Because they are not able to meet face-to-face, distance education students find it more difficult to develop

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team-working skills: an important graduate attribute. In an effort to improve the development of this skill, (where possible) teams in a Problem-Based Learning (PBL) course were formed so that students were located in the same city or region. The expectation was that by being close together, the students would be able to communicate with each other more easily, thereby overcoming a barrier to performance. The results of a student survey show that they thought that their team's cohesion and performance were improved by being close together. All those whose team's performance was perceived to be improved wished to have the same opportunity to be close together in the future; many whose team's performance was not improved similarly wanted to work close together in the future. Analysis of the students' grades shows strong statistical significance that those students who were not geographically close to their teammates had lower grades on average. Efforts should be made to form teams relatively close geographically so that the ease of interaction leads to stronger interpersonal bonds, thereby improving the performance levels of the teams.

IMPROVING EFFICIENCY IN ENGINEERING EDUCATION THROUGH ASYNCHRONOUS COMPUTER-BASED INSTRUCTION

Ronald D. Williams and Joanne Dugan

The GOAL (Guided On-Demand Adaptive Learning) project produced three computer-based instruction modules for use in a course on Digital Logic Design. GOAL modules teach concepts interactively, provide exploratory interactive activities, and present material in a style that best matches the student's preferences. In addition, GOAL allows the student to set the pace, providing more detail and explanation when needed, moving quickly when possible. GOAL also can evaluate knowledge through assessment activities, allowing a student to earn validated credits for demonstrated mastery of material. Evaluation of the data collected during three semesters of student trials suggest that students using GOAL can achieve comparable learning in significantly less time. than traditional classroom lectures.

WORK IN PROGRESS - DESIGN OF INTERACTIVE LEARNING OBJECTS FOR IMPROVEMENT OF DIGITAL ELECTRONICS TEACHING AND LEARNING IN HIGH SCHOOL AND DISTANCE LEARNING UNIVERSITIES

Sergio Martin, Jose Joaquin Fabuel, Elio Sancristobal, Manuel Castro and Juan Peire

This paper introduces the use of interactive animations in a blended learning approach for a digital electronics course. These interactive animations help students in the concepts acquisition, thanks to their visual and interactive features. The designed animations include all kind of logic gates (e.g., OR, AND, NOR; NAND, EXOR), Boole's algebra, many combinational and sequential circuits (e.g., coders, decoders, multiplexors, demultiplexors, comparators, synchronous and asynchronous flip-flops, chronograms, synchronous and asynchronous counters, and shift registries). These interactive animations have been embedded in many examples, exercises and auto-evaluation exams, which facilitate the understanding of the different concepts. Besides, these interactive animations have been encapsulated as learning objects and included in a learning object repository. Thus, anyone in the Web can search, find and use these digital resources. Finally, these interactive animations have been used in two different environments: high school and distance learning university. A different methodology has been used in each one of these environments to fit its requirements.

WORK IN PROGRESS - DEVELOPMENT AND PRACTICE OF NATIONAL COLLEGES OF TECHNOLOGY VERSION EMBEDDED TECHNOLOGY SKILL STANDARDS

Kazuhide Sugimoto, Kentarou Noguchi, Chikatoshi Yamada and Takahiro Yonamine

Recently, demands for skillful engineers for developing higher application of embedded systems increase in the industry. In both universities and national colleges of technology, the higher education for embedded technology skill has been practiced in Japan. However, the systematization of the curriculum for embedded skill training is an item to be solved. Now, we are working on a project and developing skill standards with both educational contents and the new curriculum in cooperation with 10 national colleges of technology. Main objective of this project is to clarify what kinds of embedded skills should be learned and mastered in national colleges of technology. Here, skill standards have to be defined as a 'skill sheet', and based on the standards, mastered skills by each student have to be visualized to encourage their learning motivation. In this paper, two parts are mainly outlined. One is how to design embedded technology skill standards. And the other is how to construct the skill management system to guarantee student's skill level for embedded technology.

WORK IN PROGRESS - ALTERNATIVE INTERFACES FOR E-LEARNING PLATFORMS USED IN REMOTE AREAS

Lilian Simao Oliveira, Didier Vega Oliveros, Maria Graca Pimentel and Jose Pinheiro Queiroz-Neto

Several studies show that distance learning is a viable way to provide quality education in areas of difficult access. In

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the Amazon state, in Brazil, a region where most towns have no roads and transport is primarily via rivers, some projects have gained notoriety for providing effective results in education. These initiatives provide inclusion of people who live in geographically isolated cities. This article discusses the use of a web-based e-learning platform in a region with no high speed internet available and uses Digital TV as an alternative. The software developed using the Brazilian Digital TV pattern and its middleware called GINGA. This paper reports a study on how the extensions can be used. The software developed is an alternative to help these students that lived in isolated areas. The study case was applied to the Federal Institute College from Amazon (IFAM) that offers technician courses as environment and tourism. This Project observed the internet quality and proposes the use of Digital TV as a good option to local with restrictions from the Internet. To prove the viability of the software developed, we made an experimental test with real users. We conducted usability evaluations using the think aloud protocol and used a control group to compare the learning level of two groups. The first students group use the Digital TV software and the second group the web-based tool, after watching the class they answer five questions about the class content.

Session T4D: Novel Initiatives to Learn about and Educate K-12 Teachers and Students – can you do better?

Chair: Carla A. Romney, Boston University

Time: Thursday, October 13, 2011, 3:30 p.m. - 5:00 p.m.

Civic Center Room 101

WORK IN PROGRESS - STEM COLLABORATION CUBED

Stephen J. Zilora

For many years educators have operated in “silo mode” providing the benefits of depth and rigor, but often short-changing context and applicability. This is particularly important when addressing the current Reality TV Generation that demands immediate relevance. In stark contrast to the silo approach, Informatics brings together technology, information, and people. Scientific principles of analysis, hypothesis, and evaluation are at the heart of informatics, but they are not sterile notions. Informatics makes these principles relevant by working with specific domain information. In the case of high school teenagers, examples of relevant domains include movies, music, and college selection. This paper describes a high school course in informatics that is currently under development. In addition to the natural interdisciplinary nature of informatics, our 3-way partnership and 3-strategy approach to adoption makes this project special. The goal of the project is that by working together and utilizing these diffusion strategies, this team can not only develop and deliver a successful course, but also lay the groundwork for widespread adoption. We believe that successful completion of such a course would empower both college-bound and career-oriented students by helping them work comfortably and effectively with digital information in the 21st century.

PUBLIC SCHOOL STUDENTS LEFT BEHIND: CONTRASTING THE TRENDS IN PUBLIC AND PRIVATE SCHOOL COMPUTER SCIENCE ADVANCED PLACEMENT PARTICIPATION

Kevin Freisen, Tim Sanders and Jennifer S. Kay

Across the United States, interest in computer science as a major is down, as are the number of Bachelor's degrees in computer science. While there are obvious factors like the dot com bust that may explain much of our communal enrollment crash over the last few years, anecdotal reports also suggest that the No Child Left Behind act of 2001 (NCLB), and specifically the fact that computer science is not an area that students are tested on, may be a factor in the decreased presence of computer science at the high school level. But how can we empirically separate the effect of the dot com bust from that of NCLB given the proximity in time of the two events? This paper presents a first attempt to do so: recognizing the fact that private schools are exempt from NCLB, it seems appropriate to compare public school students with their private school counterparts. We present some initial results of our investigation focusing on our home state of New Jersey. This paper discusses these results and further directions of study.

WORK IN PROGRESS – EXPLORING TEACHER AND STUDENT DIFFERENCES IN ASSESSMENT OF CONSTRUCTIVIST PRACTICES

Taylor Martin, Pat Ko and Stephanie Baker Peacock

Student and teacher versions of the Constructivist Learning Environment Survey (CLES) are used to measure whether a class environment is consistent with constructivist practices. While studying STEM classrooms, we found differences between how teachers and students score the CLES. Since different perceptions of class norms may impede student learning, we propose to investigate possible causes for the differences.

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WORK IN PROGRESS - MERGING SCIENCE INQUIRY AND ENGINEERING DESIGN: A SUMMER WORKSHOP SERIES FOR MIDDLE AND HIGH SCHOOL SCIENCE TEACHERS

Patricia Carlson, Peter Hylton, Michael Robinson, Renee Rogge, Justin Shearer, Maarij Syed and Deborah Walter

We report on a two-week professional development workshop for middle and high school science teachers offered as part of a three-year Indiana Department of Education Math-Science Partnership grant awarded to Rose-Hulman Institute of Technology (RHIT) and Vigo County School Corporation (VCSC).

REINVENTING THE ENGINEERING: AN EXTRACURRICULAR PROGRAM DESIGNED TO ATTRACT NEW ENGINEERING STUDENTS

Juliana Mesquita Vidal Martinez de Lucena, Vicente Ferreira de Lucena Jr, Claudia Magalhaes do Valle, Luiz Henrique Claro Jr. and Antonio da Fonseca de Lira

This project was developed aiming at increasing the number of student candidates for undergraduate courses in the field of Engineering. In Brazil and particularly in the Amazon region, official numbers point to a big deficit on the necessary quantity of new engineers in order to fulfill the actual demand of new job positions in the industry. This should be achieved with the use of new teaching methodologies on the basic sciences for high school students coming from public schools in Manaus, Amazon's capital. High school students are invited to attend to workshops and practical laboratory classes, in two University campuses in Manaus, on the subjects of Mathematics, Physics, Biology and Chemistry. The workshops shall develop their creativity and give them motivation to learn more complex topics related to those subjects. The lab practical classes are planned to show the students the interface between different subjects and its practical application in the engineering world. This should show the students the relevance and applicability of what they learn in the school as the basis for real problems solutions. Moreover, the chosen topics of each science are related to specific engineering topics.

Session T4E: Faculty Innovations in Teaching via Technologies

Chair: Mahnas Jean Mohammadi-Aragh, Virginia Polytechnic Institute and State University

Time: Thursday, October 13, 2011, 3:30 p.m. - 5:00 p.m.

Civic Center Room 102

WORK IN PROGRESS - A SMARTPHONE APPLICATION AS A TEACHING TOOL IN UNDERGRADUATE NURSING EDUCATION

Jesse Vivanco, Bryan C.P. Demianyk, Robert D. McLeod and Marcia R. Friesen

One in four people in a healthcare facility has a pressure ulcer (bedsore) at any given time, and bedsores are one of the leading iatrogenic causes of death reported in developed countries. Standardized documentation is identified as a critical component in the prevention and treatment of pressure ulcers, with the greatest challenges being non-compliance to protocol and inconsistency of documentation. As a result, attention is focused on electronic information systems, and the research objective in this work was to develop an interactive software application on a mobile device (Smartphone; tablet) to allow healthcare workers to electronically document patients' wounds, and to explore whether the application may promote higher consistency and compliance in wound care documentation, and higher patient and caregiver satisfaction relative to paper-based documentation. A prototype application on an Android platform is in progress with additional intelligence over paper-based forms. The prototype is being extended to a version designed as an educational tool for undergraduate nursing students learning clinical practices in wound care. The work advances the emerging area of healthcare applications and supports the increasing prevalence of e-health in nursing practice.

DEMO PROGRAM FOR TEACHING THE CHARACTERISTICS OF LOW-PASS IIR FILTERS

Gordana Jovanovic Dolecek

Demo programs that illustrate concepts with visual aids, become the important tools in the field of engineering education. They help students to learn better, remember longer, and better identify the appropriate concepts. Another benefit of the demo programs is, that they can be used as a complementary tool in the traditional classes in the classroom, to visualize and improve understanding of the presented subject. To this end here is presented the demo program for teaching the principal characteristics of digital IIR (Infinite impulse response) filters: Butterworth, Chebyshev I, Chebyshev II, and Elliptic filters. The program was implemented in MATLAB using MATLAB tool makeshow which has different favorable characteristics. First it is demonstrated how the analog filters can be converted into digital IIR filters using impulse invariance and bilinear transforms. The goal is to visualize the advantages of the bilinear transform. Next goal was to visualize the comparison of different above mentioned IIR filters in terms of complexity, magnitude and phase responses. The program can be also used as a self-study tool for the classes on the fundamentals of digital signal processing at the graduate level. The student validation of the program is also included.

WORK IN PROGRESS - HIGHER-LEVEL-LEARNING ENHANCEMENTS TO ONLINE ASSIGNMENTS IN AN ELECTRICAL ENGINEERING LINEAR SYSTEMS COURSE

Chen Jia and Steve Warren

Online assignments with mathematical analyses often replicate the handwritten problem-solving process. This paper addresses work-in-progress enhancements to online linear-systems modules that move past procedural solutions toward visualizations and exercises that promote deeper thinking. Enhancements address (1) plotting additions to zero-input response and unit-impulse response help files and (2) a new Fourier series module that targets coefficient comparisons rather than calculations. The time-domain enhancements focus on the visualization of signals that are solutions to the system equations, whereas the Fourier series additions focus on the roles that the coefficients play in determining signal shape. Upon completion of this enhanced module set, data from in-class examinations and out-of-class teaching/learning interviews will be compared to similar data from prior course offerings in an attempt to quantify the effect of these higher-level, conceptual additions on learning.

AN APPLICATION FOR THE COLLABORATIVE DEVELOPMENT OF SEMANTIC CONTENT

Miguel Rodriguez-Artacho, Celia Paola Sarango-Lapo and Dunia Ines Jara Roa

This paper shows an approach to build communities of students working collaboratively to create educational content. We present an evaluation of the usability of a customized semantic environment and show how it interacts with a semantic wiki-based approach. Additionally, a proposal for a manageable hybrid methodology for the creation of ontologies is given. The result is a tool: OntoWikiUTPL and SemanticWikiUTPL, which allows the academic community to create semantic content. Thus, it is an interesting step toward innovation in interactive educational projects and collaborative activities in the Universidad Técnica Particular de Loja (UTPL).

KNOWLEDGE SERVERS FOR THE CLASSROOM

Michael Wollowski and Kevin Ridsen

We describe a knowledge-server we developed for our data structures course. This server holds information traditionally contained in textbooks. Additionally, it houses information that is not easily contained in textbooks, such as animations and presentation slides of important concepts. It furthermore references materials from diverse sources available on the World Wide Web. In addition to course materials, the server makes available a variety of ways in which to navigate the information. In addition to searching concepts and a directory listing of concepts, it makes available a navigable graph, representing the ontology of the course materials. This enables students to more quickly find information and to better see relationships between materials introduced in the course. We see knowledge servers as taking the role of textbooks in the not so distant future.

Session T4F: Student Development Outcomes via Curricular Innovations: Creativity, Teaching Preparation, Graduate School

Chair: Eric W. Johnson, Valparaiso University

Time: Thursday, October 13, 2011, 3:30 p.m. - 5:00 p.m.

Civic Center Room 201/202

FACTORS INFLUENCING THE DECISION TO ENROLL IN AN ENGINEERING PHD PROGRAM

Hoda Baytiyeh and Mohamad K. Naja

This research investigates the contributing factors for considering enrollment in engineering doctoral programs by offering responses' analysis of two groups; the first consists of 274 graduate students enrolled in various engineering programs in Lebanon and the second consists of 187 working engineers scattered in several countries around the world working in different social and multicultural settings. Both groups of participants completed a survey investigating the factors that may impact their decision to pursue a PhD degree. Based on the Theory of Reasoned Action, the Likert-scaled items aimed to identify the attitudinal and normative factors leading to the intention of enrolling in PhD program. An Independent t-test revealed no significance between students and engineers' intention. An exploratory Factor Analysis provided four factors: professional attitude, social attitude, financial attitude, and subjective norm. Repeated measures ANOVA showed the Professional attitude as the most important for participants followed by the Financial attitude, the Subjective norm, and the Social attitude. The findings are discussed and recommendations for future studies are offered.

ASSESSING CREATIVITY IN ENGINEERING STUDENTS

Susan Amato-Henderson, Amber Kempainen and Gretchen Hein

Creativity has been studied extensively since 1956 when the NSF sponsored the first national research conference on creativity (Taylor, 1962). Within engineering education, one often hears the call for the development of creativity in engineering students. As part of the IDEAS grant (DUE-0836861), we examined the relationship between domain specific hypothetical challenges and opportunities, and engineering students' self-reported attitudes and behavioral

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intentions designed to measure creative self-efficacy in engineering. Our concept of creative self-efficacy in engineering was designed to assess one's confidence in their ability to be creative within the engineering domain. Using factors analysis procedures, we have identified four factors that appear to be novel indicators of creative self-efficacy in engineering: Cognitive Approaches, Cognitive Challenges, Cognitive Preparedness, and Impulsivity in problem solving.

WORK IN PROGRESS - PUTTING THE "E" IN STEM TEACHER PREPARATION: A NEW BACHELOR OF SCIENCE DEGREE WITH AN ENGINEERING EDUCATION MAJOR

Kenneth J. Reid and Eric T. Baumgartner

The National Academies report "Engineering in K-12 Education: Understanding the Status and Improving the Prospects" gives recommendations describing the importance of a necessary, systematic change in the incorporation of engineering within the K-12 education system. Existing efforts to introduce engineering into K-12 typically consist of in-service activities for teachers and summer camp experiences and/or single day events in classrooms. The effectiveness of reaching out to teachers and students as individuals is debatable, but these methods are certainly not sustainable. Systematic change will require a new paradigm – teachers who have a fundamental understanding of engineering will provide the most effective, sustainable solution for the implementation of K-12 engineering education. Ohio Northern University (ONU) has developed and introduced a Bachelor of Science degree with a major in Engineering Education. This degree provides the graduate with a foundation in engineering, mathematics and education, qualifying the graduate for licensure as a secondary math teacher in the state of Ohio. The degree is similar to a General Engineering degree offered by some other Universities, expanding potential career opportunities to general engineering (sales, training, etc.) and unique opportunities in venues such as Science and Technology museums. This paper describes the fundamental structure of the degree program and the vision for those graduating with this major.

WORK IN PROGRESS – DEVELOPING A CURRICULUM TO PREPARE ENGINEERS TO PARTICIPATE IN PUBLIC POLICY

Ida Ngambeki, Demetra Evangelou, Suresh Rao, Monica Cox and Lamis Behbehani

With the increasing proliferation of scientific knowledge and technological artifacts into society comes an increased need to regulate these artifacts and their use. The development and implementation of such regulations and laws in many cases requires both a technical understanding of the functioning of these artifacts and an understanding of how this technology interacts with social and natural systems, and would benefit from the involvement of a technical expert. Clearly, there is an important role to be filled by engineers in the public policy arena. However, there are very few engineers participating in public policymaking and very few engineering programs offer or encourage courses of study in policy. While there is agreement in the engineering education community that an increased focus on Engineering and Public Policy is a good idea, very little empirical evidence has been assembled to guide the establishment of these courses and programs. This paper reports on the development of an initiative at one university to develop a public policy curriculum for engineers that can easily be integrated into the existing engineering program.

A SURVEY ON COMPUTER SCIENCE K-12 OUTREACH: TEACHER TRAINING PROGRAMS

Jiangjiang Liu, Ethan Philip Hasson, Zebulun David Barnett and Peng Zhang

The decline of student enrollment in computer science (CS) is a pressing issue for computing educators. One of the solutions is to provide K-12 teachers with CS related training. K-12 teachers play an important role in preparing students for college and helping them thrive in the 21st-century global workforce. This paper presents a comprehensive study of K-12 teacher training programs that target improving CS education. These outreach programs are provided by universities, mostly by computer science faculties. The paper first describes each individual training program with highlights for its particularities and contributions. Then it provides a side-by-side comparison of the programs based on different categories such as targeted K-12 teachers, workshop durations, curriculum development information, training tools, etc. At the end, summaries of these programs are presented. The successful strategies and lessons learned from these programs could be beneficial for future K-12 teacher training program development.

Session T4G: Innovations in Teaching CSET Courses: Programming, Formal Languages, Computer Engineering, Software Engineering

Chair: Steve Hadfield, U.S. Air Force Academy

Time: Thursday, October 13, 2011, 3:30 p.m. - 5:00 p.m.

Civic Center Room 205

WORK IN PROGRESS – THE EVALUATION TOOLS DATABASE FOR ASSESSING ENGINEERING EDUCATION INNOVATIONS

Michael S. Trevisan, Denny Davis, Jennifer E. LeBeau and Mo Zhang

This paper describes a one-year project that addresses a national need to build the evaluation capacity of engineering educators to effectively evaluate engineering education programs, projects, and innovations. The project goal was to lay the foundation for the construction of an inventory of evaluation tools that could be used as part of evaluation by engineering educators. Project leaders conducted a search through ten years of archived literature to identify existing evaluation tools. An initial database was developed to document a variety of characteristics about the tools. A panel of stakeholders was assembled to assist in the review of tools and the structure of the database. Recommendations for refinement, further development, and dissemination of the inventory were offered by the panel and are documented in this paper.

ACTIVITY BASED TEACHING LEARNING IN FORMAL LANGUAGES AND AUTOMATA THEORY – AN EXPERIENCE

M Vijayalakshmi and K G Karibasappa

The course on finite automata and formal languages is important in the computer science and engineering curriculum as this course is a prerequisite for system software and compiler design courses and also the concepts learnt in this course are widely applicable in the computer science and related engineering fields. Teaching the course on finite automata and formal languages is challenging because there are difficulties in understanding the formal language and automata theory concepts as the course is mathematical in nature. In addition, the conventional approach to the course followed a sequence of machine and then the corresponding language theory. The standard textbooks also recommended the same approach. The authors observe that this approach has failed to establish the context required for the study. A new approach to teaching the course on Formal Languages and Automata Theory is attempted by the authors. The course structure is redesigned to teach formal languages and corresponding automata followed by the properties of the respective languages according to the hierarchy of the formal languages. This flow of teaching makes students to understand the concepts and relate to the real time applications easily. Activity oriented teaching learning was attempted in the course and a tutorial was introduced for this course with an objective of increasing student participation. Group activities were attempted in tutorials which enhanced peer learning. Course assessment was done in terms of regular minor exams, quizzes based on GATE format and presentations. The authors observed that this has resulted in increased participation and learning of students as evident in their performance. Students also felt that the pressure during examinations is reduced as they were comfortable with their learning through activities. The paper discusses the experience of the course teachers and the results obtained.

STUDENT REFLECTIONS AS AN INFLUENCE IN THE DYNAMICS OF AN INTRODUCTORY PROGRAMMING COURSE

Scheila Wesley Martins, Antonio Jose Mendes and António Dias Figueiredo

Learning computer programming is known to be difficult for many students. In the context of a wider study, which aims to design a pedagogical strategy for introductory programming, we decided to use some less conventional activities. This strategy was applied in the last three academic years with some success. In this paper we will discuss a component that proved very relevant, the biweekly reflections we asked the students to write during the course. They were expected to reflect on the course, the different activities, their learning, the difficulties felt, and any other aspect they considered important. The analysis of the texts written gave the teacher several hints that lead to some successful individual interventions. From a research point of view this analysis gave also some important clues to the refinement of our pedagogical strategy.

THE USE OF CONCEPT MAPS IN COMPUTER ENGINEERING EDUCATION TO PROMOTE MEANINGFUL LEARNING, CREATIVITY AND COLLABORATION

Inaki Calvo, Ana Arruarte, Jon A. Elorriaga, Mikel Larranaga and Angel Conde

Concept maps are graphical tools for organizing and representing knowledge. The fundamentals of concept mapping are in Ausubel's learning theory which is based on the assumption that meaningful learning occurs when the new concepts are linked to familiar concepts existing in the learner's cognitive structure. Creativity can be seen as a very high level of meaningful learning. Database Principles is a compulsory subject studied in the second year of the Computer Engineering degree at the University of the Basque Country UPV/EHU. The study presented in the paper

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was designed pursuing a twofold goal: (1) to introduce engineering students the Concept Mapping technique as a way to promote meaningful learning, and (2) to involve engineering students in both a creative and collaborative learning experience using concept maps. Final exam marks showed significant statistical differences among the experimental group and the control group. In addition, participants admitted that the use of the concept mapping technique to fulfill the objectives of this study is applicable to other domains, situations and problems.

CONNECTING REALITY WITH THEORY - AN APPROACH FOR CREATING INTEGRATIVE INDUSTRY CASE STUDIES IN THE SOFTWARE ENGINEERING CURRICULUM

Joseph Bolinger, Michael Herold, Rajiv Ramnath and Jayashree Ramanathan

Case studies have been successfully integrated into a wide variety of educational contexts and disciplines. Today, case studies are increasingly accepted as valuable teaching tools in science and engineering curriculums to complement the underlying theory of the field. Well-articulated cases can reinforce abstract concepts, demonstrate the nature of real client interactions, and showcase the relevance of soft skills to students that lack significant practical experience. However, assembling and delivering quality case studies to students requires a great deal of practical disciplinary knowledge, and a careful alignment of the case content and delivery style with curricular objectives, course learning outcomes, and the overarching institutional format. In this paper, we summarize our experience with an approach for constructing case study teaching materials that are integrative and deep in content, but also carefully aligned to the core principles and format of a senior-level software engineering course. Our approach ensures that the cases are complex enough to retain their realism and intrinsic appeal, while mirroring the format and objectives of the course such that the cases reinforce key points in a familiar and consistent fashion to the students.

Session T4H: Factors Influencing Decisions of Women to Select and/or Continue in Engineering

Chair: Michele Miller, Michigan Technological University

Time: Thursday, October 13, 2011, 3:30 p.m. - 5:00 p.m.

Civic Center Room 206

WORK IN PROGRESS - WHY ARE MOST UNDERREPRESENTED GROUPS EVEN MORE UNDERREPRESENTED IN A VEHICLE DESIGN PROGRAM?

Janet M. Braun

Minority groups, especially females, provide a large pool of talent which is largely underrepresented in the engineering workplace. The purpose of this study is to determine the factors that cause students to choose an engineering technology major, and more specifically, a vehicle design major in an engineering technology program, to help infer why minority groups are not choosing it. Preliminary data analysis shows that this particular program is well below the national average for nearly all underrepresented groups in engineering technology programs. The data does not indicate that a significant retention problem exists within this program; rather it is most likely an initial recruitment problem. Recognizing that some underrepresented groups are represented to an even lesser degree in engineering technology programs than in engineering programs may shed some light on this problem. Through the use of student and alumni surveys and interviews, this study will attempt to determine why students are choosing the vehicle design major and how they perceive the program in several areas to provide insight as to why underrepresented groups are not entering and finishing this major at nationally equivalent levels. It will also attempt to determine if common influencing factors exist for students choosing the vehicle design major.

ENGINEERING FUTURES: FEMALE STUDENTS, CAREERS, AND WORK/LIFE BALANCE

Jonathan C. Hilpert, Melissa L Carrion, Jenefer Husman and Laura Baughman

The purpose of this research project was to examine the content of engineering students imagined futures. We asked 347 students from a large undergraduate engineering program to list ten salient events they imagined in their future, as well as to list the ages at which they wanted to realize those milestones. We also surveyed them about their learning strategies and motivation for engineering coursework. We developed a coding procedure to examine the types of events participants in the sample reported, and utilized a number of statistical techniques to examine the relationship between event type and classroom motivation and learning strategies, as well as to compare differences in event type between males and females. Our correlational results suggested that students who listed more professional engineering events were more likely to self-report adaptive learning strategies and motivation for their coursework. Further exploration of the data uncovered that women were more focused on short term academic events than males, and that their long term vision of the future was split between domestic events and professional events, which may have decreased how far their events extend into the future.

IMPLICATIONS OF BLACK GREEK LETTER MEMBERSHIP ON THE DEVELOPMENT OF THE ENGINEER OF 2020

Denise R Simmons and Julie P Martin

Higher education and student affairs literature have detailed the impact of Black Greek Organizations (BGOs) on African American students' educational experiences. However, our work is the first examination of BGO membership in terms of impact on engineering students' educational experiences, and specifically skills deemed valuable by the National Academy of Engineering's (NAE) The Engineer of 2020: Visions of Engineering in the New Century. In our earlier study, results pointed to the many advantages of African American student participation in BGOs on their engineering educational experiences. Further, the data suggested that BGO membership has the potential to provide unique contributions to African American engineering students' persistence, academic achievement, and career paths. This paper builds on our previous work by examining how students' BGO experiences influence the development of specific skills described by the Engineer of 2020. Results of this qualitative study point to the potential advantages of African American engineering students participating in BGOs, particularly equipping them to succeed in the engineering workforce by instilling qualities of The Engineer of 2020. The significance of the work is also highlighted by the focus on BGOs, which have been a staple of the African-American culture and educational community for over 100 years.

WORK IN PROGRESS - THE BRIDGE TO THE DOCTORATE EXPERIENCE: A REFLECTION ON BEST PRACTICES AND PROJECT OUTCOMES

Tuncay Aktosun, Ariana Arciero, Benjamin C Flores, Helmut Knaust and Cristina Villalobos

Since 1992 the University of Texas System Louis Stokes Alliance for Minority Participation has promoted the participation of underrepresented minorities in STEM with funding from the National Science Foundation. In 2003 the Alliance initiated the Bridge-to-the-Doctorate project to support students during their first two years of graduate studies. The expectation was that financial support, effective mentoring, and developmental activities would significantly increase the six-year completion rate for a Ph.D. degree. Consequently the Alliance has developed effective strategies to recruit, retain, and advance these students and to ensure completion of their advanced degrees. Recruitment strategies include nationwide solicitation, faculty nominations, intensive interviews, and competitive selection. Retention activities consist of seminars, personalized advising, team building, and workshops for achieving milestones in graduate studies. Advancing efforts include personalized academic advising and semester review of research progress to keep students focused and on track. To date, the Alliance has supported 70 students at three UT System institutions. From this group, 40 have earned their MS, eight have earned their Ph.D. and 30 are currently pursuing the doctorate. Best practices will be discussed along with important outcomes seen since the inception of the Bridge-to-the-Doctorate project in the UT System.

WORK IN PROGRESS - GENDER IMPACTS OF RELEVANT ROBOTICS CURRICULA ON HIGH SCHOOL STUDENTS' ENGINEERING ATTITUDES AND INTEREST

Benjamin S. Terry, Brandi N. Briggs and Stephanie Rivale

This study compares gender differences on Likert scale pre/post assessments of engineering interest, identity, and knowledge in three "traditional" introductory function- and task-oriented robotics courses and two biomedical robotics courses. In addition, the STEM Academy at a local high school is surveyed to identify their preferences given six hypothetical robotics curricula: three traditional function- and task-oriented courses and three contextualized courses consistent with helping society and gender-friendly messaging. The students are asked to rate each hypothetical course from least to most preferred. ANOVA is used to test our hypothesis that the biomedical robotics curriculum will result in higher gains in engineering interest and identity for all students, especially for the girls in the sample. This study adds to the literature base by empirically testing the role that the design problems and contexts we choose as engineering educators plays in the gender inclusiveness of K-12 engineering education efforts.

Session T4J: How Learners Understand CSET Concepts and Careers

Chair: James Wolfer, Indiana University South Bend

Time: Thursday, October 13, 2011, 3:30 p.m. - 5:00 p.m.

Civic Center Ponderosa Room

DOES AN AVATAR MOTIVATE?

Mohammad Nur Azhar Mazlan and Liz Burd

The purpose of this study is to investigate students' perceptions of their motivation to learn while possessing an avatar alongside the learning activities. The activities include attendance and accessing the course module's eLearning portal. 47 students participated in the study and were divided into two groups: an avatar group and a non-avatar group. Additionally, two research instruments were used in the study. Firstly, an avatar environment named Avatar Hall was developed to allow the students from the avatar group to view their avatars. The second

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instrument was a motivation inventory, which was used to identify the students' perceptions of the extent to which the presence of an avatar motivated them to learn. The results for both groups show a moderate percentage distribution of the students' perceptions of their motivation to learn and further statistical test reveal no significant difference between the two groups of students in terms of their motivation to learn.

WORK IN PROGRESS - ANALYSIS OF MISCONCEPTIONS OF ENGINEERING TECHNOLOGY STUDENTS ABOUT ELECTRICAL TECHNOLOGY CONCEPTS. A MIXED METHODS STUDY

Tatiana V. Goris and Michael J Dyrenfurth

Leading policy makers and researchers of the National Academy of Engineering agreed that the teaching of STEM disciplines in the U.S. schools must be improved. "The focus on STEM education is closely related to concerns about U.S. competitiveness in the global economy and about the development of a workforce with the knowledge and skills to address technical and technological issues" [1]. Analyzing the academic success of engineering students, previous research [2] shows that even high-performance students after four years of college instruction still continue to hold significant misconceptions about scientific concepts and have incorrect interpretations of phenomena (like electricity, force, light). This paper is based on the dissertation research that focuses on the analysis of students' misconceptions about electricity. It represents a unique synthesis of methods from educational research and cognitive psychology applied to the population of Electrical Engineering Technology students. Misconceptions about electrical concepts of freshmen will be analyzed and compared to the misconceptions of seniors. The goals of this research target: (1) understanding how student mental models and misconceptions change with increasing levels of competency and expertise during their progression from freshmen to senior levels and (2) investigating the correlation between student academic success and their misconceptions.

INFORMAL LEARNING IN ENGINEERING EDUCATION: WHERE WE ARE - WHERE WE NEED TO GO

Daria Kotys-Schwartz, Mary Besterfield-Sacre and Larry Shuman

This paper investigates the state of programmed informal learning (e.g., team competitions, internships) in engineering education, the relevant research and available assessment instruments. Our purpose is to synthesize the existing informal learning research in engineering education for the engineering community, which should subsequently lead to the development of improved programs and learning experiences for engineering students. We also draw on the research performed in science education to identify potential outcomes for engineering education, including: improved student attitudes towards engineering, development of an engineering identity, knowledge of engineering practices, and broadened participation in engineering. Last, we provide future direction for informal learning research in engineering education.

WORK IN PROGRESS - DOES THE MARKETING OF ENGINEERING COURSES THROUGH PEDAGOGICAL DIFFERENTIATION MATTER?

Josef Rojter

The lack of attractiveness of engineering as a course of study has been a major concern at Victoria University (VU). Students enrolling in undergraduate courses at VU lower cut-off entry scores than students enrolling in engineering at other Melbourne universities. This impacted course standards, attrition rates and perceptions of engineering education at VU. The decision in 2005 to introduce problem-based learning (PBL) pedagogy was to differentiate engineering education at VU from that of other universities. This new pedagogical paradigm was followed by an extensive publicity and marketing at secondary schools in Melbourne. The number of preferences for engineering studies at VU has increased without affecting the entry cut-off scores. The objective of this study is to examine whether marketing engineering courses through distinct pedagogy had any effect in attracting and retaining students. Surveys of second year engineering students have shown that the proportion of students at VU who chose engineering in high schools as their first choice of study has increased and the number of students who were considering transferring to other courses or universities has decreased. It is envisaged that at a 7 year study would produce the results required to differentiate between the marketing of engineering and pedagogical influences.

WORK IN PROGRESS - DOES MAINTENANCE FIRST IMPROVE STUDENT'S UNDERSTANDING AND APPRECIATION OF CLEAN CODE AND DOCUMENTATION

Maureen Doyle, Brooke Buckley, Wei Hao and James Walden

The ACM's "Computer Science Curriculum 2008: An Interim Revision of CS 2001" suggests 31 core hours of Software Engineering covering the standard phases of software development. At many universities, including ours, Software Engineering is a capstone course with a semester-long team project. While the course covers the software development lifecycle there is not enough time in a single semester for students to gain an appreciation for all phases, especially the importance of testing and documentation to the maintenance phase which is the longest phase in successful software projects. To address this, a new course, Software Maintenance and Testing, was added as a

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pre-requisite to Software Engineering. The course will be implemented in fall, 2011. Students will be surveyed to determine if their appreciation for different development models, documentation, recording of design decisions, and clean code are improved by maintaining code prior to developing a brand-new or greenfield project. A Likert scale instrument will be developed to evaluate students' attitudes. The research instrument will be tuned until validity and reliability are achieved. Preliminary and baseline results will be presented.

FRIDAY SESSIONS

Session F1A: Mini Workshop - How to Organize a Professional Development Workshop for High School CS Teachers

Chair: Joanne McGrath Cohoon, University of Virginia

Time: Friday, October 14, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room LaCroix C

MINI WORKSHOP - HOW TO ORGANIZE A PROFESSIONAL DEVELOPMENT WORKSHOP FOR HIGH SCHOOL CS TEACHERS

Joanne McGrath Cohoon and James P. Cohoon

This mini-workshop will follow a “train-the-trainer” model. Experts will provide guidance and resources for college computing faculty who wish to organize workshops for high school computer science teachers. These workshops will enable the teachers to attract more and diverse students to their computer science classes, which will add to the college-bound population of students prepared for and interested in a computing major.

Session F1B: Mini Workshop - The CS2013 Computer Science Curriculum Guidelines Project

Chair: Joseph G. Tront, Virginia Polytechnic Institute and State University

Time: Friday, October 14, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room LaCroix D

MINI WORKSHOP - HOW TO IMPROVE TEACHING AND LEARNING: SELECTING, IMPLEMENTING AND EVALUATING DIGITAL RESOURCES IN THE ENGINEERING PATHWAY

Joseph G. Tront, Flora P. McMartin and Alice M. Agogino

Are you trying to integrate interactive simulations, applets, case studies, courseware or other web-accessible materials into your classes? Where do you go to find these digital learning materials? How do you evaluate the quality of the materials you do find? Are there digital learning materials available that are aligned with the ABET criteria? Are there related resources for assessing student outcome assessments that you can use? How can you customize your course website with supplemental materials for students? How can you find a collection of self-studies that can be used to guide a department as they prepare for the ABET review process? This workshop introduces faculty who are interested in integrating digital learning materials in their courses to a set of criteria and methods useful in selecting and evaluating the quality of these materials to help achieve their course goals. The workshop focuses on the 10,000 educational resources cataloged in the Engineering Pathway digital library (www.engineeringpathway.org) and goes through the resources and tools available for faculty to use to locate, evaluate and select helpful digital learning materials to achieve their teaching and learning goals. Participants will be introduced to a general intellectual framework for integrating digital learning materials that stresses identifying the particular learning objectives and pedagogies for the use of particular materials. Participants will be introduced to two sets of evaluation criteria, those used in the Premier Award for Excellence in Engineering Education Courseware and another set that is used to guide catalogers as they register materials in a digital library. They will have a hands-on opportunity to apply these criteria to better understand the metrics for quality in digital learning materials, and how to apply these metrics to materials they are considering using to help achieve their course goals. The workshop also helps faculty locate courseware that can help satisfy the ABET criteria for evaluation. For those preparing for the ABET review process, the Engineering Pathway identifies a number of self-study that can be used to guide departments in the development of measurement instruments and processes. Lastly, the workshop will introduce new tools for student engagement with history of technology and well as current news in each discipline. Annotated textbooks with links to context-sensitive links to Engineering Pathway resources will also be explored.

Session F1C: Developing and Assessing Professional Skills: Teamwork, Sketching, Communication

Chair: Holly M. Matusovich, Virginia Polytechnic Institute and State University

Time: Friday, October 14, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room LaCroix B

WORK IN PROGRESS - EFFECTIVE TEACHING OF TECHNICAL TEAMWORK TO LARGE COHORTS OF ENGINEERING STUDENTS IN CHINA

Dan Zhang, Laurie Cuthbert and Steve Ketteridge

Teamwork skills have been acknowledged as the key skills of potential engineers by industries internationally, including Chinese enterprises. This paper reports research in a joint Sino-UK programme in China on how teamwork can best be taught. Literature shows that little work has been done to find effective ways to teach teamwork to engineering students in China. This work attempts to implement successful cooperative learning practices of the West

to a module that takes teamwork skills as one of its key teaching objectives and tries to design a new model for instructors to follow to teach teamwork effectively to Chinese engineering students. Preliminary results show that Chinese engineering students need training and practices in teamwork skills, and the situation is not exactly the same as previous research in other Confucius Heritage Culture countries.

WORK IN PROGRESS - TECHNICAL FREEHAND SKETCHING

Kenneth S. Manning and John Hampshire

In the past all engineering students took a drafting class. This involved the use of T-squares, triangles, architectural scales, pounce, eraser shields, bow compasses, pencils, and patience. It gave students a sense of how drawings and diagrams are made and used. As new subjects have come into the curriculum most engineering programs have dropped the drafting requirement, or at least replaced it with a computer-based CAD course. Also dropped, as a consequence, is the ability of engineering students to visually express the ideas they see in class and those that form in their heads. This paper describes the effort to address this change. This project is the result of a joint effort between an engineering and an art professor to empower students with the simple skills of producing reliable hand drawings for their notes and when expressing their design ideas. The result is a one-hour, lunch-time seminar open to engineering and science students to improve their technical freehand sketching techniques. They were coached by both professors in the techniques of hand sketching, including drawing straight and orthogonal lines, circles and ellipses, 2- and 3-D diagrams, graphs and charts, and labeling and lettering. Specific activities were used to gauge the improvement by the students as they progressed through the one-semester mini-course. This paper shares the best and the worst of this endeavor. This work was supported in part by a grant from the Professional Development Committee of SUNY Adirondack.

A TAKE-HOME EXAM TO ASSESS PROFESSIONAL SKILLS

David Lopez, Josep Llorenc Cruz, Fermin Sanchez and Agustin Fernandez

Professional Skills, such as the ability to communicate effectively or the ability to gather and integrate information, are not easy to teach or to assess. A traditional exam is not the best way of assessing these skills because it is limited both by time and by the resources students are able to consult. Moreover, in a traditional exam it is difficult to assess if professional skills have been acquired in depth. In this paper we propose to substitute the traditional exam by a take-home exam in which students have more time to solve the questions and are not restricted by the sources they can consult, thereby providing a highly educational task in which students experience a deep learning process. We also analyze what kind of questions should be asked to evaluate professional skills, as well as analyzing the potential drawbacks of these kind of exams (such as inappropriate student behavior). Finally, we show the results of one subject at the Barcelona School of Informatics, in which the take-home exam replaced the traditional exam. This course has been taught over 11 terms with good results.

WORK IN PROGRESS - COGNITIVE SCAFFOLDING IN CONTEMPORARY COMPUTER DOCUMENTATION

Kenneth R. Price

This work in progress examines cognitive scaffolding in the instructional design of contemporary computer documentation. It illustrates how the cognitive theories of advance organizers, load theory, and normal ordering may be applied to educational technology and classroom instruction to create more effective computer documentation. I will research the macrostructures common in contemporary computer documentation; note how electronic instructional materials—in particular, electronic instructional materials such as online help systems, software demonstrations, and interactive simulations—have changed discourse processing; and explore how most effectively to present instructional information with the advent of electronic instructional materials using rich media technology.

TEACHING TEAMWORK IN ENGINEERING AND COMPUTER SCIENCE

Robert Lingard and Shan Barkataki

Teamwork is recognized as an important skill for engineering and computer science professionals. Both potential employers and accrediting agencies, such as ABET, expect students to gain proficiency in teamwork skills through experiential learning. Teamwork based projects challenge the student to apply the technical knowledge they gain in school to solve meaningful and complex problems. However, to be truly proficient in teamwork, a student must also learn and practice a large number of peripheral skills. These include planning, estimating, tracking progress, taking corrective actions, managing change, controlling and managing risks, maintaining ethical and professional conduct, communicating complex ideas clearly and concisely, using design automation tools, leveraging web-based tools for team collaboration, and most importantly participating effectively as team members. It is essential that students should be taught these important skills. It is unlikely that without adequate faculty guidance students can pick up these skills through ad-hoc project experience. Yet, many engineering and computer science programs expect the

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students to do just that. We feel strongly that we need to employ a more pragmatic approach in teaching students the skills necessary to function as effective and productive team members. Additionally, we need to develop criteria for assessing the effectiveness of teaching teamwork and the tools to measure learning outcomes. Among the problems contributing to this situation are the following: engineering and computer science instructors themselves often have had little or no experience operating in teams; training or guidance in effective ways to teach teamwork is seldom provided; and tools and effective approaches to assist in the teaching and assessment of teamwork are lacking. Another problem is that, it takes a great deal of faculty time, effort and energy to guide groups of students in doing effective teamwork. We will describe an approach that we have used to teach team collaboration skills using free and freely available web-based tools. Students learn to use tools for design automation, metrics collection, project management, and web-based collaboration. Our approach encourages students to learn teamwork skills and improves levels of collaboration among team members while reducing demands on faculty time and effort. Use of web-based collaboration tools allows students to participate without the need for frequent face-to-face meetings; this our students love. In an effort to maximize the use of techniques like the ones described in this paper, we hold regular informal sessions of interested faculty to share ideas on improving teaching teamwork and to develop methods and tools for assessment. The paper and the conference presentation will describe both our approach and the results we have obtained.

Session F1D: Innovations in Teaching Students Fundamental Ideas and Skills

Chair: Russ Meier, Milwaukee School of Engineering

Time: Friday, October 14, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room 101

CONDUCTING SUCCESSFUL STUDIES IN MATERIALS SCIENCE AND ENGINEERING WITH CONSIDERATION TO A MULTIPLICITY OF STUDENT COHORTS AND DELIVERY MODES

Patrick Keleher, Arun Patil and Kai Duan

Second year students undertaking their studies in Materials Science and Engineering within the Bachelor of Engineering at CQUniversity, Australia, are a diverse group requiring a variety of approaches to enable them to undertake their studies. The university, whilst having a strong regional focused approach, conducts its Engineering degree offerings over three campuses, at Mackay, Rockhampton and Gladstone, in Queensland, Australia and by flexible mode throughout Australia and internationally. Lecturers are located on each of the campuses and it is their role to oversee the cohort of on-campus students on that particular campus. On-campus, full-time students are traditionally secondary students who have continued with their studies into tertiary education or mature learners who have been in the workforce for some time and return to study to re-skill, up-skill or update their knowledge and skill base. While students who study by a part-time, external (ie. flexible or distance) study mode are practitioners who have a trade qualification or are university graduates wishing to re-skill, up-skill or update their knowledge and skill base and continue working throughout their study. All students have access to course materials, video-streams of lectures, student-student and student-lecturer communication channels via a dedicated course Moodle™ website.

AN AUTOMATIC CORRECTION TOOL THAT CAN LEARN

Ferran Prados, Josep Soler, Imma Boada and Jordi Poch

The majority of Computer Based Assessment (CBA) environments have been designed for fixed-response questions. This feature is not enough for the university context since not all the skills can be reduced to this typology of questions and free response exercises are required. In this paper, we present a web-based tool designed to automatically correct exercises that require a diagram or a graph to be solved. The main novelty of this tool is the strategy used for the correction. The tool starts without the knowledge about correct and incorrect solutions and then learns about the solutions provided by teachers and students. It automatically records the information of all entered solutions, the teacher correction and the corresponding feedback in a system database. When a new student solution is entered the information of the database is used for correction. The main components of the tool are the graph editor module, designed to support diagram drawing, and the correction module, which corrects the solutions entered by the students. These modules are integrated in a more general e-learning platform denoted ACME. ACME provides teachers all functionalities required for student work tracking, assessment, personalized attention, etc. The proposed tool has been evaluated on experimental group.

WORK IN PROGRESS – STUDENT LEARNING AS A FUNCTION OF ATTENDANCE IN LARGE ENGINEERING CLASSES

Michael Elmore and Koenraad Gieskes

This study documents an alternative for freshman engineering students to attending a large lecture in their introductory engineering course. In the fall semester students are required to be physically present in lecture. In the spring semester students are given the option of either being physically present, when the lecture is given, or viewing

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the recorded lecture. Attendance is recorded in the lecture with an iClicker™. Students, who choose to not attend lecture can access the recording on Blackboard™ during the same week the lecture is given. The study compares student performance on first semester midterm exam grades with student performance on second semester midterm exam grades. It is seen that students, as a group, tend to achieve the same midterm grade whether they attend the lecture, when it is given, or not. Lecture assignment completion rates are also compared to lecture attendance. Suggestions for further study are given.

WORK IN PROGRESS - PROMOTING METACOGNITIVE KNOWLEDGE AND SHARED NOTE-TAKING TO LEARN ELEC-TRIC CIRCUIT CONCEPTS THROUGH ENHANCED GUIDED NOTES

Oenardi Lawanto, Paul Schreuders, Doug Holton and James Dorward

This work in progress involves a design-based research process to develop new instructional materials and strategies for use in an electric circuit course by students who are not electrical engineering majors. These materials and strategies are designed to replace traditional note-taking practices or standard guided notes used in most engineering courses and stimulate students to actively engage in meaningful learning activities. The enhanced guided notes (EGN) developed by this study include two additional components that are not present in the standard guided notes. First, the EGN will include questions that prompt students to assess their metacognitive knowledge. Second, the EGN will be further enhanced through the inclusion of outside class activities. This requires students to share notes made during lectures with their friends by using a tablet format computer and an online uploading document mechanism. Six research questions were constructed to guide this study. The impact of the treatments will be assessed using a combination of quantitative and qualitative methods.

AN ANALYSIS OF DC CIRCUIT THEORY CONTENT IN AN ENGINEERING TEXTBOOK: PRESENTATION FEATURES, CONCEPTUAL CONTENT, AND USE OF ANALOGIES

Deepika Sangam, Brent K. Jesiek and Julia Thompson

Textbooks play an integral role in teaching and learning across disciplines and levels of undergraduate engineering education. In this paper we present an empirically derived framework for evaluating engineering textbooks, based on prior findings from the field of engineering education research. Our more specific focus is content related to DC resistive circuits. We begin with a review of prior literature on textbook analysis in engineering education and other fields, and then provide a detailed description of our analytic framework, which includes three different categories of analysis: presentation features, conceptual content, and use of analogies. To demonstrate the utility of the proposed framework, we apply it to the content of a first-year engineering textbook. Our analysis reveals significant gaps between the textbook's coverage of electric circuit theory and recent advances in engineering education research, which provide many insights about effective teaching and learning techniques based on a conceptual understanding approach. Our analysis is relevant for textbook authors, who can use the framework presented in this paper to guide textbook development and revision. Instructors can also benefit by using our criteria to evaluate and select textbooks, and incorporating supplemental materials to address common conceptual gaps.

Session F1E: Service Learning

Chair: Ramakrishnan Sundaram, Gannon University

Time: Friday, October 14, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room 102

LORSE: INTELLIGENT META-SEARCHER OF LEARNING OBJECTS OVER DISTRIBUTED EDUCATIONAL REPOSITORIES BASED ON INTELLIGENT AGENTS

Silvia Margarita Baldiris Navarro, Jorge Luis Bacca Acosta, Adriana Noguera Rojas, Juan Carlos Guevara Bolanos and Ramon Fabregat

This paper introduce LORSE, a multiagent system based on JADE (Java Agents Development Framework) to support teachers and students in the time consuming task of searching for distributed learning objects in several learning objects repositories such as MERLOT, Connexions and Fedora Commons Repositories, It offers them the possibility of developing this task in the context of a learning management system. LORSE consist of a set of intelligent agents, whose responsibility it is to deliver to users different learning objects in response to specific searches requested by the users. The agents connect with the repositories by means of RESTful web services clients developed as one of its behaviors and then they develop the searches over the learning objects metadata to provide a suitable response to users. The integration process of LORSE with the dotLRN platform is presented and some implementations results are introduced.

TEACHING A SERVICE LEARNING INTRODUCTORY ENGINEERING COURSE - LESSONS LEARNED AND IMPROVEMENTS MADE

Tanja Karp

This paper describes the format of an introductory engineering course that applies service learning teaching pedagogy. The semester-long service learning project consists of mentoring elementary and middle school students during an eight week long LEGO robotics competition that is annually held at Texas Tech University in Lubbock, Texas. The service learning section is currently being offered for the second time by the same instructor and this paper describes adjustments that were made resulting out of the experiences during the first year.

WORK IN PROGRESS - INTERDISCIPLINARY INTERNATIONAL PREPROFESSIONAL SERVICE WITHIN THE FIRST-YEAR ENGINEERING CURRICULUM

Kenneth J. Reid, Robin M. White and Christine L. North

The first-year engineering curriculum of Ohio Northern University culminates in a capstone design experience where students design a device to help alleviate some effects of poverty. Student teams research an assigned population to find a suitable device that could improve the lives of those living in poverty, develop a proposal, work through a complete design process and build and demonstrate a prototype. While student groups have been very proud of their excellent designs and assessment results show the experience is valuable, the devices have yet to make it past the demonstration phase. At the same time, Ohio Northern University established a program involving pharmacy, nursing and preprofessional students who travel to the Dominican Republic on medical mission trips. One engineering faculty member attended an informational meeting of a newly established student organization called "Northern Without Borders" and then accompanied the group on a trip to investigate potential projects and opportunities to implement first-year capstone designs. An international program for first-year engineering students was born: "Freshmen Without Borders". This paper describes the creation of an international engineering service opportunity specifically for first-year engineering students, tied to the first-year engineering curriculum. This paper will describe the first year capstone project and the changes made to integrate specific device(s) which will not only be prototyped, but implemented in an impoverished population. The integration of the mission trip into the first-year engineering curriculum, including students who did and did not participate in the group, especially in consideration of ABET engineering accreditation criteria, will be discussed. Important details of teaming with an existing international service program will be demonstrated, including integrating engineering projects and engineering student teams into existing programs. Building the program, promoting it within the engineering student body and faculty, and assessing student interest will be included. While many schools have existing "without borders" programs available for their engineering students, this paper will be of particular interest to faculty members who are ready to explore the implementation of an international, interdisciplinary service component into their curriculum.

SECURITY PLANNING FOR SMALL BUSINESSES: A SERVICE-LEARNING COURSE

Todd Burri and Susan J. Lincke

Experiential, real-world problems results in higher impact learning. However, security planning is a complex process to learn. The Small Business Security Workbook was developed as part of an NSF CCLI grant to enable students to help small businesses in planning for security. The Workbook leads students and small business management through the security planning process, via a top-down (or bottom-up) approach and step-by-step procedures. Students learn concepts in lecture, which are just-in-time reviewed in the Workbook. The students practice with a case study, and then do actual security planning with a community partner. The Workbook is rated highly by both community partners and students in improving security in cooperating organizations. This paper describes the experience that a student team had with the Workbook and their community partner, as well as summarizing the overall perspective of the class.

FROM THE MANAGER'S PERSPECTIVE: CLASSROOM CONTRIBUTIONS TO OPEN-SOURCE PROJECTS

Edward F. Gehringer

For the past several years, students in computer-science courses have been assigned work on open-source project development. The literature is replete with examples. Yet an instructor desiring to incorporate OSS into a course often has difficulty finding a suitable project and developing a fruitful interaction with its personnel. This paper reports on a survey of managers of OSS projects on how they have interacted with classes and students, and on what faculty can do to work with them effectively. Our findings indicate that instructors need to seek out projects weeks or months in advance, and need to be personally involved in OSS development themselves, and that they need to give their students a good background in design and testing. As a help for instructors looking for a project, we describe several OSS projects that have benefited from student contributions.

Session F1F: Lenses for Understanding Design Education: Hands-on, Cognition, Lifelong Learning, Complexity, Project-based

Chair: Charlie D. Cox, University of Pittsburgh

Time: Friday, October 14, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room 201/202

JUMP-STARTING A SENIOR-LEVEL CAPSTONE PROJECT THROUGH HANDS-ON LABORATORY EXERCISES**James Bluman and J. Ledlie Klosky**

Many universities incorporate either a senior-level thesis research requirement or a senior-level capstone design experience for their engineering majors. One of the biggest challenges in advising such projects is providing a means for students to make meaningful progress early in the project timeline, very often due to the steep learning curve associated with the technical details of the projects. This paper reports on a technique that requires students to complete a series of laboratory exercises designed to give them an operational awareness of the technical issues associated with small wind turbines. The three main efforts required of students were characterizing the efficiency of small generators, characterizing the efficiency of different wind turbine designs, and determining the charging characteristics of lead-acid batteries. This technique has been found to be much more effective than classroom-style instruction or pure literature review, most likely because it appeals to active, visual, and sequential learning styles. This technique, which is based on earlier work in this area, is broadly applicable to many engineering capstone design efforts. Survey data and project performance data will be presented and the effectiveness of the method is evaluated.

EFFECTS OF DESIGN EDUCATION ON DESIGN COGNITION: A PRELIMINARY STUDY OF A SOPHOMORE DESIGN COURSE**Christopher B. Williams, Yoon Suk Lee, Marie C. Parette and John S. Gero**

This paper presents first year results of a longitudinal study of how engineering students develop design competencies over time, and how these competencies are affected by design education. Using a task-independent approach to verbal protocol analysis based on the function-behavior-structure ontology, the authors are able to evaluate students' cognitive processes as they work in pairs to respond to a design scenario. In this paper, the authors analyze data from experiments that occurred before and after the participants completed a sophomore-level design course. The percent occurrences of design issues and syntactic design processes from the first and second halves of each of the two experimental design sessions are analyzed and compared in order to identify differences in students' design behaviors. These results provide an opportunity to investigate and understand how sophomore students' design ability is affected by a design course.

FOSTERING LIFELONG LEARNING IN A CAPSTONE DESIGN ENVIRONMENT: AN IMPLEMENTATION ASSESSMENT**Gonca Altuger-Genc and Constantin Chassapis**

The Accreditation Board for Engineering Education and Technology (ABET) criteria require that engineering programs demonstrate that students attain "a recognition of the need for, and an ability to engage in lifelong learning". To meet this requirement, the Department of Mechanical Engineering at Stevens Institute of Technology has implemented a program to foster self-directed lifelong learning during the senior year. Several of the modules developed by the American Society of Mechanical Engineers (ASME), as a part of Professional Practice Curriculum (PPC), are implemented to the capstone senior design course in an effort to provide students the desired self-directed learning skills. This paper presents the implementation and administration of the ASME-PPC self-directed learning modules into the capstone senior design course environment. Program outcomes assessment and student feedback are examined to develop the program further while proposing future improvements on which modules to include in which order, and how to improve the effectiveness of the homework assignments. A discussion on whether to implement some of the modules on different undergraduate courses during the junior year and thereby introduce students to self-directed learning early in the curriculum is also presented.

TEACHING CAPSTONE DESIGN: THE INFLUENCE OF PROBLEM COMPLEXITY**Julie Linsey, Cheryl Osterman and Vimal Viswanathan**

Many capstone courses include design methodology but the characteristics of design problems that provide the best learning opportunities need to be defined and the effect on student perceptions measured. In an industrial setting, it is generally up to the engineer to decide which design methods should be applied in order to obtain the desired outcome. Thus if students do not believe the design methods to be effective, they will not choose to use them in the future. Functional modeling is a technique for systematically breaking down a design problem into its sub-functions. Groups were given either a simple or complex problem to solve for their senior design project. At the end of the

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semester, a quiz over the functional modeling concepts was administered, and a questionnaire was answered by the students to measure their perceptions of the design methods. An ANOVA shows an interaction between student opinions and the complexity of the design problem on the students' functional modeling ability. Results indicate the complexity of the problem and perceptions of the design methods are significant factors when determining the students' functional modeling abilities. Additionally, the complexity of the design problem likely affects other design skills.

WORK IN PROGRESS – IMPLEMENTATION OF A PROJECT-BASED LEARNING CURRICULUM

Ronald Ulseth, Dan Ewert and Bart Johnson

A new project-based learning (PBL) curriculum has begun in northeastern Minnesota as a collaboration between a community college, Itasca Community College, and a state university, Minnesota State University, Mankato. The Iron Range Engineering (IRE) model is a unique, undergraduate problem-based learning engineering program. Students at IRE, who are mostly graduates of Minnesota's community colleges, are upper-division engineering students, enrolled at Minnesota State University, Mankato. IRE students do not take classes. Rather than studying about engineering in the context of 15-week engineering courses, IRE students work in mining, milling, and manufacturing industries solving complex and ill-structured industry problems. All of their learning activities are organized and indexed by those industry projects. At the completion of their two-year program, they receive a B.S. in Engineering with emphases in mechanical engineering and/or electrical engineering. True to the intent of ABET and the attributes of the "The Engineer of 2020", graduates emerge from the IRE program with integrated technical/professional knowledge and competencies.

Session F1G: Directions for Innovation in Engineering Laboratories: Fun, Personal, Virtual, Remote, Online

Chair: Elio Sancristobal, Spanish University for Distance Education - UNED

Time: Friday, October 14, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Room 205

WORK IN PROGRESS - INTEGRATING EDUCATIONAL ONLINE LAB PLATFORMS AROUND THE ILAB SHARED ARCHITECTURE

Danilo Garbi Zutin and Michael E. Auer

This work in progress focuses describing the work being carried out at the Carinthia University of Applied Sciences (CUAS) as a collaborative work around online electronics laboratories together with BHT, Sweden and MIT, USA to integrate two different and well known online lab architectures so that users are not limited to the availability of one or the other. These platforms are VISIR (Virtual Systems in Reality) and the iLab Shared Architecture (ISA). While VISIR delivers, among others, electronics experiments in a highly flexible online workbench where circuits can be built and tested in a similar way as in traditional hands on laboratories, ISA focuses in providing mechanisms for sharing online laboratories in a distributed Web services based architecture by managing lab session scheduling and maintenance while a experiment is executed. Opening VISIR based labs to use the standard online lab support services provided by the ISA brings several advantages to both sides.

CLASSROOM MEDIATED BY TECHNOLOGY MODEL: A NEW PROPOSAL FOR EDUCATION TO REMOTE REGIONS OF THE AMAZON

William Roberto Malvezzi, Katia Cilene Neles Silva and Graca Bressan

This article presents a new model of education that is not categorized as classroom teaching or distance learning either - the Classroom mediated by technology (CMT). In the CMT system teachers do not stand a direct contact with students in the classroom, to perform direct questions, or even be able to do facial observation of the student submitting questions. The need for an education system that could be suitable to the peculiarities of the Amazon region was the main motivation for developing this new system. In the Amazonas state the majority of the population is distributed almost entirely by distant and remote places where access is possible only through the rivers. The education is a catalyst for development and natural promoter of citizens' social inclusion who see it as a guarantee to the sustainable development of their communities. Geographical distance is one of the biggest challenges in this region which make a huge difference between Manaus - the main city in the Amazonas and the other cities in this state. Although Manaus has a reasonable level of development and many universities, the human resources in education are not enough to all of the state especially in remote areas around the rivers of the Amazon.

WORK IN PROGRESS - TOOLS AND TECHNOLOGY TO IMPLEMENT A STUDENTS PERSONAL LABORATORY

Mark Walters

Today's students want to solve problems and experience engineering regardless of where they are – in lecture, in the

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laboratory, or the dorm room. Professors want to provide a hands-on learning experience to empower students who want to tinker, experiment, and explore concepts while improving the comprehension through reinforcement. Student access to affordable, low-cost technology enables educators to address limitations in the laboratory, including access to equipment, time on task, and cost. With a portable laboratory, a student can learn concepts in their preferred environments and provides a supplement to the traditional lecture and laboratory based courses.

DESCRIPTION AN ON-LINE VIRTUAL OBSERVATORY FOR UNDERGRADUATE MODULES BASED ON OPEN SOURCE APPLICATIONS

Alvaro Botia, Mathieu Kessler, Angel Molina-Garcia, Manuel Jimenez-Buendia and Josefina Garcia-Leon

As a consequence of the governmental decision to adapt the Spanish graduate and post-graduate studies to converge to the 'European Higher Education Area', a complete restructuring of the offer of undergraduate studies at the Technical University of Cartagena, located south of Spain, was carried out. As part of a multi-perspective plan to ensure the global quality of teaching, an online virtual observatory was set up to monitor academic indicators associated to the undergraduate modules. Concretely for each module considered in the on-line observatory, the evolution of six indicators is represented graphically, allowing us to assess the global behavior of the students related to this module and to identify and anticipate possible problems. This observatory was developed using the open source business intelligence suite Pentaho. It includes a system of authentication and different levels of access to the results. Typically, a teacher has access to the data related to the module he teaches, the head of department has access to the data related to all modules taught by his department... The idea is to provide all the partners involved in the teaching process a multidimensional tool to monitor, through data, the way that the students react to the teaching, enabling possible actions to be taken, and ensuring the global quality.

WOW! LINEAR SYSTEMS AND SIGNAL PROCESSING IS FUN!

Maurice Felix Aburdene and Kundan Nepal

We describe a recent offering of a linear systems and signal processing course for third-year electrical and computer engineering students. This course is a pre-requisite for our first digital signal processing course. Students have traditionally viewed linear systems courses as mathematical and extremely difficult. Without compromising the rigor of the required concepts, we strived to make the course fun, with application-based hands-on laboratory projects. These projects can be modified easily to meet specific instructors' preferences.

Session F1H: Using Games to Teach CSET

Chair: Stephen Jacobs, Rochester Institute of Technology

Time: Friday, October 14, 2011, 8:00 a.m. - 9:30 a.m..

Civic Center Room 206

GAME TEL: AN APPROACH TO MULTI-FORMAT AND MULTI-DEVICE ACCESSIBLE ENGINEERING EDUCATION

Luis Anido-Rifon, Daniel Burgos, Manuel Caeiro, Javier Torrente, Manuel Fernandez, Javier Gonzalez, Mario Manso, Manuel Ortega, Daniel Rodriguez and Baltasar Fernandez-Majon

Game Tel is an open source software system that supports personalized learning, focusing on serious games and simulations, making these and traditional content accessible and adaptive to the student and educational context. In this paper we discuss about its design and functionalities, its modular architecture and the multi-environment approach.

AN AGILE BOOT CAMP: USING A LEGO®-BASED ACTIVE GAME TO GROUND AGILE DEVELOPMENT PRINCIPLES

Thomas D. Lynch, Michael Herold, Joe Bolinger, Shweta Deshpande, Thomas Bihari, Jayashree Ramanathan and Rajiv Ramnath

Industry-practiced agile methods must become an integral part of a software engineering curriculum. It is essential that graduates of such programs seeking careers in industry understand and have positive attitudes toward agile principles. With this knowledge they can participate in agile teams and apply these methods with minimal additional training. However, learning these methods takes experience and practice, both of which are difficult to achieve in a direct manner within the constraints of an academic program. This paper presents a novel, immersive boot camp approach to learning agile software engineering concepts with LEGO® bricks as the medium. Students construct a physical product while inductively learning the basic principles of agile methods. The LEGO®-based approach allows for multiple iterations in an active learning environment. In each iteration, students inductively learn agile concepts through their experiences and mistakes. Subsequent iterations then ground these concepts, visibly leading to an effective process. We assessed this approach using a combination of quantitative and qualitative methods. Our assessment shows that the students demonstrated positive attitudes toward the boot-camp approach compared to

lecture-based instruction. However, the agile boot camp did not have an effect on the students' recall on class tests when compared to their recall of concepts taught in lecture-based instruction.

INTRODUCING OBJECT ORIENTED DESIGN PATTERNS THROUGH A PUZZLE-BASED SERIOUS COMPUTER GAME

Adrian Rusu, Robert Russell, Remo Cocco and Spence DiNicolantonio

In this paper we confront the stereotype which depicts a software engineer as an individual who is programming all day in his or her cubicle. We present an interactive, puzzle-based game, which is similar to Lemmings, to help students ranging from middle school to college juniors learn high-level concepts about the design phase of the software engineering life cycle. Object oriented design patterns are represented in our game in the form of actions that can be assigned to lemmings. The actions are metaphors for object oriented design patterns in software development, which means the student is not actually developing a design for a real software system. This could be an abstract and intimidating process. Instead, the student plays a puzzle-based game which is appealing especially to a younger audience. The key is the student is still using the same strategies that would be used in a real software project to develop a design to beat our game.

WORK IN PROGRESS - A SURVEY OF POPULAR GAME CREATION PLATFORMS USED FOR COMPUTING EDUCATION

Kathlyn Doss, Valerie Juarez, Daniel Vincent, Peggy Doerschuk and Jane Liu

Because of the large appeal of video games, many educators are introducing computing concepts through video game development. By teaching students through video game development, teachers have the opportunity to continuously engage students, and students have fun while learning. In this paper, we present a review of game development platforms that have been used as teaching tools. We survey the attributes of different game development environments as well as their pros and cons. We investigate each platform to determine the following metrics: the type of interface the platform uses (graphical, textual or both), the language used to program the game (if applicable), the level of the intended user, whether the platform provides a debugging mechanism, and whether it provides a sharing mechanism. This literature review can be used to assist future development of teaching materials that engage students in computing via game development.

WORK IN PROGRESS - GAMES FOR LIFE WORKSHOP: OUTREACH TO MIDDLE AND HIGH SCHOOL AGE GIRL SCOUTS

Stephen Jacobs

In spring 2008 the author, a professor teaching game design at the Rochester Institute of Technology (RIT), offered a lecture on the game design process and video game industry to a local Girl Scouts of America (GSA) troop to help them meet the requirements for the "Games for Life Interest Project." (GFL) In fall 2009, RIT faculty and students offered their first full-day GFL workshop, designed to allow the scouts to meet the majority of the requirements for the insignia. The workshop has since been offered, in various forms, twice in Rochester, New York and once in Los Angeles, California. The workshop has now been refined to the point where the author plans to release the course materials openly via the web so that others across the country can offer the workshop in their home communities. This Work In Progress paper will discuss the evolution of the workshop and its materials, the creation of teacher/presenter training materials, the plans for distribution of the materials and follow-up with troop leaders who have offered the workshop in their own communities.

Session F1J: Mathematical and Science Foundations for Engineering Education

Chair: Chuck Stone, Colorado School of Mines

Time: Friday, October 14, 2011, 8:00 a.m. - 9:30 a.m.

Civic Center Ponderosa Room

DEVELOPING INSTRUMENTS TO ASSESS FIRST-YEAR CALCULUS AND PHYSICS MECHANICS SKILLS NEEDED FOR A SOPHOMORE STATICS AND DYNAMICS COURSE

Kristi J Shryock, Arun R Srinivasa and Jeffrey E Froyd

Anecdotally, engineering faculty members complain students taking sophomore engineering science courses are not prepared with respect to mathematics and mechanics-based physics. However, evidence has rarely been systematically collected and analyzed to determine the veracity of these assertions. Therefore, the paper intends to address two questions: • With respect to first-year mathematics and first-year physics mechanics knowledge, what do engineering faculty members expect students to know and be able to do when they begin a sophomore statics and dynamics course? • To what extent do students satisfy these expectations? To address these questions, the following steps were taken. First, engineering faculty members who taught a sophomore statics and dynamics course at Texas A&M University were asked for problems involving first-year mathematics and physics mechanics they thought

students should be able to solve entering the course. Learning outcomes were abstracted, and two instruments were developed and administered near the beginning of the statics and dynamics course. After administering the instruments and analyzing results, faculty members have a better idea of the background of their students. Furthermore, there is evidence to examine the extent to which students are prepared in first-year mathematics and physics mechanics to begin a core engineering science course.

TABLET PC USE IN FRESHMAN MATHEMATICS CLASSES PROMOTES STEM RETENTION

Carla A. Romney

Tablet PCs are standalone personal computers with touch-sensitive screens that serve as the primary input device. The interface between the user and the computer depends on contact between the surface of the screen and a finger or stylus, a pen-like instrument designed to enable users to write directly on the screen. Tablet PCs are fully functional laptop computers that have conventional PC operating systems and applications. The use of Tablet PCs and other tablet technologies in educational settings has increased tremendously over the past decade and now many reports describing classroom applications of Tablet PCs appear in the literature. While some studies have described implementations of Tablet PCs in undergraduate education, few have specifically examined the impact of Tablet PCs on student performance and retention in the sciences and engineering. To address the paucity of data about the effects of Tablet PC use in undergraduate education, we have implemented a longitudinal student tracking study to better understand the impact of this technology on students. The most important finding is that students who began their undergraduate mathematics education in Tablet PC classes were more likely to continue their science and engineering studies than were their peers who took non-Tablet PC courses during their first semester of college.

MOBILE LEARNING EXPERIENCE IN THE CALCULUS CLASSROOM

Travis Kowalski, Kevin Israel, Ambu Sreedharan and Ziliang L. Zong

Mobile technologies are ubiquitous in modern society, and college students find themselves increasingly immersed in their use. Is it possible to integrate this hand-held universe of mobile technology into the STEM classroom so that it becomes an organic, integral part of the 21st-century learning experience? Can mobile technology be used to enhance and improve the learning experience of students, one that develops both their technical and psycho-social skills? This paper discusses our attempt to do so at the South Dakota School of Mines and Technology, by developing a “mobile portal” through which instructors and students can access mobile content to supplement and expand the in-class learning environment.

WORK IN PROGRESS - CALCULUS PLACEMENT MODELING FOR ENGINEERING STUDENT POTENTIALLY CONTRIBUTES TO APPROPRIATE ADVISING

Qu Jin, Lorie Groll, P. K. Imbrie and Teri Reed-Rhoads

The appropriate placement for mathematics courses for first-year engineering students is an important factor in ensuring the success of engineering students in terms of retention and graduation rates. However, often the advisors only are able to look at the cutoffs of a few factors when making their recommendations. We propose that modeling offers advisors a more effective method to integrate multiple factors in order to make the most appropriate recommendation for first year math courses to entering students and help ensure student success. Results to be reported in this study are effectiveness of predicting engineering students’ success in Calculus I courses using regression models, significant predictors to Calculus I grades, the actual recommendations that students received from advisors for appropriate calculus placement, whether students took the advisors recommendations in choosing a calculus placement, and the relationship between the model and what advisors are actually advising. The results of this study will provide information that helps to find the most effective means of advising to help ensure student success.

WORK IN PROGRESS - ENGINEERING MATH WITH EARLY BIRD

Sabina Jeschke, Olivier Pfeiffer and Erhard Zorn

Mathematics is the most important discipline for engineering students besides their own subject – and it is constantly required in engineering freshmen lectures. Sometimes, mathematical content is needed in engineering lectures before it has been taught in the mathematics classroom. Thus, the engineering teachers often have to do mathematical excurses that are ineffective and unsatisfying, both for the students and the teachers. A propaedeutic dedicated to mathematical studies only, cannot be implemented within the current study regulations. Moreover, it would contradict the engineers’ wish for a rapid identification with the “real” engineering subject to increase the students’ motivation. Therefore, we introduced EARLY BIRD to overcome this deficiency. In EARLY BIRD I freshmen can benefit of their time between high school graduation and their enrollment at the university to attend Calculus I and Linear Algebra classes. In EARLY BIRD II Calculus II classes are offered during the winter semester break.

Session F2A: Mini Workshop - P - 12 Engineering Education: Using Engineering Teaching Kits to Address Student Misconceptions in Science

Chair: Susan K. Donohue, University of Virginia

Time: Friday, October 14, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room LaCroix C

MINI WORKSHOP - P - 12 ENGINEERING EDUCATION: USING ENGINEERING TEACHING KITS TO ADDRESS STUDENT MISCONCEPTIONS IN SCIENCE

Susan K. Donohue and Larry G. Richards

The primary goal of this mini-workshop is to introduce participants to practical, validated methods of identifying and remediating student misconceptions concerning scientific concepts through the use of Engineering Teaching Kits (ETKs). ETKs are self-contained standards-based units grounded in the constructivist philosophy of education and the principles of guided inquiry and active learning. They were originally developed for use in middle schools, but the activities have proven scalable throughout P-12. By the end of the workshop, participants will be introduced to the literature on misconceptions; be able to identify appropriate methods for assessing misconceptions; and gain experience in using ETK activities to remediate misconceptions. Participants will have the opportunity to work with popular ETKs, HoverHoos and Save the Penguins, to accomplish these learning objectives. The instructors will provide discussion notes, appropriate references, and materials. Attendees will be registered with the ETK Collaborative web site for access to additional ETKs and supporting materials. This mini-workshop will be of interest to faculty and program staff involved in P-12 outreach activities, and to P-12 educators interested in developing integrated STEM curricula.

Session F2B: Special Session - How to Improve Teaching and Learning: Selecting, Implementing and Evaluating Digital Resources in the Engineering Pathway

Chair: Richard LeBlanc, Seattle University

Time: Friday, October 14, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room LaCroix D

SPECIAL SESSION - THE CS2013 COMPUTER SCIENCE CURRICULUM GUIDELINES PROJECT

Mehran Sahami, Steve Roach and Richard LeBlanc

Work began in late 2010 on a project to revise the ACM/IEEE-Computer Society Computer Science volume of Computing Curricula 2001 and the interim review CS 2008. The new guidelines for computer science are scheduled for release in 2013. This interactive session will give the computing education community an opportunity to review current working documents created by the CS2013 Steering Committee and thus influence a draft of the CS 2013 volume scheduled for release in December 2011. In early 2011, the Steering Committee began an extensive review of the Body of Knowledge and Characteristics of Graduates sections that are key parts of this series of curriculum volumes. New Knowledge Areas are being defined (Parallel and Distributed Computing, Security and Information Assurance, and Systems Fundamentals) and existing areas are being reorganized and updated. The Steering Committee will present a draft of the new Body of Knowledge as part of this session and will engage attendees in guided discussions of sections for which community input is particularly relevant. Similarly, a draft of the new Characteristics of Graduates description will be presented and discussed as part of the session.

Session F2C: Developing Engineering Professional Skills: Ethics, Write, Teamwork, Lifelong Learning

Chair: Mike Elmore, Binghamton University

Time: Friday, October 14, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room LaCroix B

READING STRATEGIES AND STUDENT COMPREHENSION IN AN INTERNET ETHICS COURSE

Mark A. Holliday

Our students' reading comprehension skills underpin their ability to learn the concepts and competencies in computer science. However, there has been little attention given to evaluating how well our students comprehend what they read and the effectiveness of strategies to improve their reading comprehension. In this paper we focus on the case of a non-major course on internet ethics and the reading of the original writings of key figures in ethical theory. Due to the observed weakness of the reading comprehension skills of the students, we have been teaching our students strategies to improve their skills in reading comprehension and meta-comprehension within the framework of an in-class group reading. The reading strategies we have been using are described, evaluated, and placed in the context of the reading comprehension literature. Increased awareness of the limitations of the reading comprehension skills of our students and of ways to teach the students strategies to improve those skills should prove useful in helping instructors ensure that our students have the foundation they need to be successful in their computer science studies.

WORK IN PROGRESS - EARLY IMPROVEMENT IN REPORT WRITING SKILLS USING CRITIQUES

Jeffrey R. Mountain

Developing the written communication skills of engineering students has become a higher priority learning outcome since the advent of the ABET EC2000 criteria. Increased numbers of writing intensive courses, refinements to document requirements and proliferation of rubric development indicate the effort used to address the elevated priority. The sharing of rubrics and standards for the formatting and content of various report styles is intended to help students understand the writing assessment process. While sharing reduces the “we can’t read your mind” comments associated with qualitatively assessed assignments, it does not always improve the outcome, since it does not provide a “learn by example” experience. Consequently, the first two or three reports submitted are typically of low quality, and many receive failing grades. In an effort to significantly improve student performance on early semester reports, a critique-based exercise has been inserted early in a junior level laboratory class. Students are randomly assigned previously graded student reports which have been stripped of identifying information to protect the original authors. The reports were previously evaluated using a rubric which included both qualitative assessment information and guidelines for assigning point deductions. The students were instructed to evaluate the sample reports guided by the rubrics and standards for formatting and content. The deliverable for the critique assignment included assessing a numerical “grade” for their report sample, along with justifications for the assessments. Initial results indicated an average increase in the quality of the initial report submissions when compared to initial reports from three previous years. The technique is being expanded into a multidisciplinary design methodology course, where different standards and rubrics apply, to see if the critique exercise can produce notable improvements in the quality of early course writing skills among a more discipline diverse set of students.

A QUANTITATIVE STUDY OF THE IMPACT OF AUTOMATED FACILITATION ON ENGINEERING STUDENT DYADIC TASK COMPLETION

Ricardo Romero, Richard Savage, Paul Figueroa and Ray Luechtefeld

Engineering students are very well versed in the fields of science and mathematics; however, the successful engineering student must also build their communication skills to prepare for their work on collaborative projects. Study is needed to determine if exposure to communication intervention strategies will enhance these professional skills of engineers over time. This project evaluates the effects of a structured approach to facilitation through the use of an automated Virtual Facilitator. Dyads will be asked to solve a widely used scenario entitled the “Candle Problem.” The scenario involves overcoming a common bias called “functional fixedness” that prevents subjects from seeing alternatives to their preconceived notions for the specific use of objects. This study aims to analyze the impact of automated interventions on the completion of a shared task between dyads by measuring the amount of time it takes the dyad to develop the solution, the number of inquiries inspired by the Virtual Facilitator, and whether or not the dyad was successful in completing the task. The Virtual Facilitator, using intervention techniques adapted from the work of Chris Argyris, will monitor the dyadic interactions using text matching / Boolean logic and intervene in the conversation as needed.

DECISION-MAKING AND CONFLICT RESOLUTIONS SKILLS ENHANCED BY VIRTUAL FACILITATION: A QUALITATIVE STUDY

Adrienne Colbert, Angelica Guzman, Martha McQueen and Ray Luechtefeld

Facilitation among engineers continues to focus on the enhancement of technical knowledge. Very little effort addresses non-technical skills. This research explores the phenomenon behind the use of the facilitation framework of Chris Argyris and Marshall Rosenberg in a virtual facilitation simulation tool. Currently, the military uses simulation technology to practice various exercises such as flight maneuvering. The engineering arenas use of technology whether internally or externally can be an innovative educational tool. The focus of such a tool would enhance the quality of decision-making and conflict resolution. This study investigates whether the use of virtual facilitation during a simulation leads to enhanced decision-making and conflict resolution skills. This research focuses on the use of the “Ugly Orange”, a commonly used negotiation simulation, with interventions based on the framework of Argyris and/or Rosenberg interjected into the communication process. This research extends existing knowledge on the effects of virtual facilitator to enhance decision-making and conflict resolution skills, as well as conditions to enhance participants’ openness and interdependence.

FRONTIERS OF ENGINEERING: OPPORTUNITY AND CHALLENGES

Claudio da Rocha Brito and Melany M. Ciampi

Western world is presently immersed in a spiral of challenging economical environment where globalization allied with technological achievements are shaping completely new work relations as well as personal. The era after the Bologna Process in Europe is now about to graduate a global engineer, and not only the European engineer. Motivated teachers inspire students to pursue the success in the profession. The teacher is a key element in the

formation of any professional. The quality of an engineering program depends not only on good labs, libraries and etc but also the teachers qualification as educators too and not only as engineers. No matter the field of expertise civil, electronic, chemical, environmental it is more and more evident the importance of engineering sciences applications in the global world. This paper has the objective to discuss and propose issues for reflections on the formation of engineering teachers in present challenging academic community.

Session F2D: Entrepreneurial Skills to Promote Innovation

Chair: Susan Burkett, The University of Alabama

Time: Friday, October 14, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room 101

WORK IN PROGRESS - ENHANCING THE ENTREPRENEURIAL MINDSET OF FRESHMAN ENGINEERS

Kenneth J. Reid and Daniel M. Ferguson

Our research reports on an ongoing study of the impact of entrepreneurial interventions within first-year engineering courses on changes in the mindsets of engineering students. Entrepreneurial mindset in our study is operationally defined as a more growth oriented mindset versus a fixed oriented mindset. This operational definition and an accompanying mindset measurement instrument was developed and validated by Carol Dweck of Stanford University. Based on Dweck's research results we assume a growth mindset is a reasonable surrogate for a student engineer's creative and innovative or entrepreneurial skills. Mindsets of student engineers are benchmarked at the beginning of the freshman year and again at the end of the freshman year, soon after completion of a team based poverty alleviation freshman capstone project. Pre- and post- control samples of freshman engineer mindsets are being collected from similar sized engineering programs at comparable colleges in our geographic vicinity. A pilot study indicated a statistically significant tilt toward a fixed mindset in freshman engineering students compared to a growth mindset observed in an opportunity sample of freshman business students. We are currently tracking engineering students both at the group and at the individual level. Our long-term research goal is to determine how and why engineering course assignments affect a student engineer's entrepreneurial skill set. We hypothesize that a student engineer's creative and innovation skills are in part a learned behavior that is influenced by the student engineer's learning experiences and course assignments. In order to study this phenomenon we are establishing a baseline of the change in engineering student mindset over time. Once we have established this baseline of mindset data, we will then alter interventions to evaluate their differentiated impact on engineer mindset changes.

PATENTS AND INTELLECTUAL PROPERTY IN ENTREPRENEURSHIP EDUCATION IN COMPUTING AT HOFSTRA UNIVERSITY

Gerda L. Kamberova, Andrea Pacelli, John Impagliazzo, Edward Currie and Simona Doboli

Entrepreneurship is an integral part of the computing education at Hofstra University and consists of: (i) two optional, specialization-type programs as part of undergraduate degrees that target students with strong entrepreneurial interests, and (ii) open seminars and enrichment modules, exposing all majors to entrepreneurial ideas and activities while attempting to spark their creativity and drive for innovation. To educate students and help them understand the purpose, procedures, cost and legal implications of patenting and intellectual property issues and to give them first-hand experience in these subjects, we have included "patents and intellectual property" as one of the facets of the new programs and activities. In this paper, we present the implementation details and we summarize the experiences and practices and draw conclusions. Adoption of modules at Qatar University illustrates the generality and transferability of the approach.

WORK IN PROGRESS - ENGINEERING CREATIVITY AND PROPENSITY FOR INNOVATIVE THINKING AND DESIGN IN ENGINEERING STUDENTS

Gisele Ragusa

Over the past two decades, various research studies across education and business fields have attempted to measure individuals' creativity and innovative behavior. The research on creativity has most often been accomplished in K-12 education while research in innovation has focused on workplace measurement. Business research has attempted to link metrics of innovation to entrepreneurship. Educational research has not broached this connection. Research is somewhat split as to whether creativity and innovation are domain or disciplinary characteristics or traits or whether they can be measured in general form. Such research has not been focused on engineering or the sciences. Interestingly, both engineering and scientifically focused industries are expecting both innovative and entrepreneurial skills in their degreed employees. To meet the need of measuring whether engineering programs are inspiring and cultivating creativity and innovation (a recognized precursor of entrepreneurship,) I designed an engineering creativity and innovation index. This paper reports on the development, theoretical grounding and reliability and validity testing and piloting of this new instrument.

WORK IN PROGRESS - PRODUCT EVOLUTION FROM AN ENGINEERING PERSPECTIVE

David Benson

In entrepreneurship and innovation circles, “painstorming” is a process by which a person examines either a particular product or the world around them with the goal of identifying negative customer/user issues to serve as focal points for development efforts or research. In business education, the concept of product evolution is used to both chart the stages in the product development and to examine changes in a product over time from a product characteristics and market-needs perspective. To promote the transfer of classroom knowledge into practice through the context of entrepreneurship, a classroom tool termed a “product evolution study” has been developed to help students identify and describe the growth and transformation of a product within the context of the energy relations, material properties and engineering involved in the products as they relate to class learning objectives. This tool is intended for insertion within a content-oriented engineering class, such as Fluid Mechanics, to provide context for the subject matter and to model the everyday application of entrepreneurial thinking. Student experiences with this type of analysis are being used to develop a formal, graphical procedure for describing the evolution of a product from the standpoint of the underlying physics involved in the product’s development.

WORK IN PROGRESS - ENTREPRENEURSHIP LITERACY FOR ENGINEERING STUDENTS

Nathalie Duval-Couetil, Teri Reed-Rhoads and Shiva Haghghi

Through entrepreneurship education, engineering students are increasingly being prepared to work for startup companies or launch their own ventures. Understanding and utilizing the language relevant to entrepreneurship is essential to establish legitimacy and participate fully in the entrepreneurial community. Identifying the entrepreneurship-related lexicon in which engineers should be fluent is a component of defining the body of knowledge for engineering entrepreneurs. This paper describes methods and instruments that have been used to arrive at terms and concepts that reflect entrepreneurship literacy. This work can provide a foundation for curriculum development, assessment, and the development of new instruments that measure knowledge or self-efficacy.

Session F2E: Lifelong Learning for Engineering Faculty: Teaching, Leadership, Disciplinary Content

Chair: Gonca Altuger-Genc, University of Massachusetts Lowell

Time: Friday, October 14, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room 102

PERSPECTIVES ON LEADERSHIP CONCEPTS BY ENGINEERING ACADEMICS

Steven Goh, Todd Hartle and Megan Brodie

This paper presents the analysis of structured interviews with engineering academics on the perception of leadership based on an action-based participatory research at the frontline of academic activities as part of a USQ Senior Fellowship. There were eight participants who volunteered to be part of a faculty team to initiate and liaise with the peak professional body, Engineers Australia, to conceive and develop a new postgraduate program for graduate engineers as a pathway to professional (chartered) status. The interviews were coded and analyzed using NVivo software based on grounded theory. The analysis provided a wide spectrum of perspectives on leadership however there were strong themes that suggest there is a linkage between authority and leadership. There is a belief that the type and the degree of leadership required are different for professional practice versus academia. There are also strong themes that leadership is heavily influenced by natural traits (nature), but interestingly, by learnable skills and behaviors (nurture), and very much dependent on the actual environment (context). The perspectives presented in this paper are useful in providing an understanding why academics do or do not pursue opportunities for leadership professional development and opportunities to exhibit leadership in their frontline (non-supervisory/executive) academic activities.

IN-SERVICE TEACHING ASSISTANT TRAINING (INSTAT) FOR ENGINEERING AND COMPUTER SCIENCE GRADUATE STUDENTS IN HONG KONG: A BLENDED-LEARNING APPROACH

Kai-Pan Mark, Dimple Ramesh Thadani, David Santandreu Calonge, Cecilia F. K. Pun and P.H. Patrio Chiu

In-service teaching assistant (TA) training often receives relatively limited attention from university decision makers when compared to the plethora of courses designed for junior faculty (i.e., peer-to-peer mentoring or 'buddy' system) in tertiary institutions around the world. In Hong Kong, as in many other parts of the world, TAs serve in different capacities to provide front-line teaching and learning support in the university, despite their insufficient experience in using active learning strategies or grading students' assignments. Major challenges faced by new TAs, especially non-local graduates (as many of City University of Hong Kong's (CityU) graduate research students are originally from the Chinese Mainland), include the relative absence of teaching experience, the difficulty to switch from a teacher-centered approach to a student-centered approach, the adoption of English as the medium of instruction

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(EMI), and role transformation. This paper presents an innovative approach in providing a compulsory In-service Teaching Assistant Training (InsTAT) course for all graduate research students at CityU before undertaking any teaching-related duties: it includes an unconventional but effective multi-directional engagement team teaching approach with the extensive support of e-learning technologies throughout the course. Comments and feedback data show that students found the course very engaging, useful, and innovative.

WORK IN PROGRESS - THE ORGANIZATION OF A SYMPOSIUM THAT SUPPORTS FACULTY DEVELOPMENT IN THE EMBEDDED-SYSTEMS FIELD

Ariel Lutenberg, Julian Bruno, Juan Manuel Cruz, Ignacio Zaradnik and Diego Brengi

With the aim of stimulating an interest in embedded systems among engineering students and young professionals, spreading the latest advances in embedded systems, and encouraging collaboration between industry and academia, the second edition of the Simposio Argentino de Sistemas Embebidos, SASE, (i.e. Argentinean Symposium of Embedded Systems) was organized in Buenos Aires, Argentina. SASE is one of the biggest South American meetings on embedded systems, having about four hundred attendees, the sponsorship of fifty universities, fifteen institutions and thirty companies, and offering 120 ninety-minute tutorials, 17 three-hour hands-on workshops, a scientific meeting with paper and poster presentations, six plenary sessions, a student-projects contest, an entrepreneurship contest, a university-equipment donation program, and a travel and accommodation grant program; all under the scope of a low fee event. In this paper we present a brief summary on how SASE was conceived, how professors from different universities and people from industry worked together to organize this event, and the obtained results.

WORK IN PROGRESS - CULTIVATING AN ENGINEERING EDUCATION COMMUNITY OF PRACTICE FOR K-12 TEACHERS

Linda L. Mellish, Wei Liu and Johannes Strobel

A Community of Practice is not a new concept; however, our exploration of looking at how learning occurs in a social-cultural context may be. An online community space has been designed for a group of practicing teachers sharing a passion for Engineering Education at the primary and secondary levels. We learn by constructing meaning from experience. To that end, this community has been designed with interaction. As humans we also interpret the world largely through our social process; thus, the addition of social interaction forums and the designed encouragement for sharing has been built in. This is a focused attempt to provide engineering educators a dedicated space in which they can come together to share knowledge; the very definition of a Community of Practice. The population has driven the design through their participation in needs assessments enabling the expression of their specific desires. This community is embedded in a larger website associated with a Summer Academy for the INSPIRE, Institute for P-12 Engineering Research and Learning at Purdue University. It is this connection that the researchers hope will also contribute to the cultivation and subsequent life of this community.

INTRODUCING CATS TO STEM FACULTY THROUGH GRADUATE STUDENTS

Maria Gabriela Garcia, Rebecca Bates, Jeremy Pincosy and Gregg Asher

The success of any instructional style in promoting meaningful learning, whether novel or traditional, active or passive, is critically dependent on the engagement of students in the course of instruction. Improving engagement, whether explicitly or implicitly, is a central goal of effective pedagogy. Social learning strategies, such as active or collaborative learning, are one way of improving engagement. A specific type of these is classroom assessment techniques (CATs) as described by Angelo & Cross. This project examines both the impact of including CATs in courses on student engagement as measured through a brief questionnaire and the experience of faculty implementing the methods in their courses. Faculty are supported in their implementation through condensed literature and one-on-one mentoring. Results show that measures of student affect related to the course increase post-intervention and that faculty will continue to implement CATs in their courses.

Session F2F: Factors in Student Success: Choosing Engineering, Identity, Transfer, Career Development

Chair: Alan Cheville, Oklahoma State University

Time: Friday, October 14, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room 201/202

SUCCESS FACTORS FOR STUDENTS TRANSFERRING INTO UNDERGRADUATE ENGINEERING DEGREE PROGRAMS

Michael F. Anderson, Lance C. Perez, David Jones and Carmen Zafft

A qualitative pilot study designed to ask transfer students about their transfer experiences and develop practices that will increase transfer student success and retention is being conducted. When completed, this qualitative study will

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include a series of three interviews occurring at three major epochs during a transfer student's first year of study in an undergraduate engineering degree program. The study includes students transferring from community colleges, students transferring from two partner universities in China, and nontraditional students pursuing second careers. The goal of the study is to identify those key factors that lead to a student successfully transferring to undergraduate engineering degree programs.

WORK IN PROGRESS - IDENTITY DEVELOPMENT OF FIRST-YEAR ENGINEERING STUDENTS THROUGH A SUMMER COLLEGE PREP PROGRAM

Rachel A. Louis and Holly M. Matusovich

Research shows life experiences, specifically community-based shared experiences before the freshman year, are a key factor in professional identity growth, but few studies explore exactly what it is about these experiences that contribute to students' identity development. Our study aims to further understand exactly how this identification happens to assist faculty and program administrators in understanding what ways they can help students identify with their profession in a stronger way. Through a mixed methods research design, we will answer the following research question: How do summer preparatory programs contribute to students' development of an engineering identity? We started with a series of focus groups with participants from a summer engineering transition program which is covered in this paper and will continue in the future with additional focus group data and a quantitative survey at a large research institution and at a military academy. Ultimately, our goal is to uncover how students' develop their professional identities.

WORK IN PROGRESS - WHAT ATTRACTS STUDENTS TO THE STUDY OF ENGINEERING? PERCEPTIONS AND MOTIVATIONS

Josef Rojter

This enquiry was held between 2009 and 2011, of second year engineering students enrolled in architectural, civil and mechanical engineering at Victoria University (VU). The basis for this study was to ascertain student perceptions of engineering profession and their motivation for undertaking the study of engineering. It is a part of a pilot program which, hopefully, with a research grant support will expand to a broader nation-wide program encompassing engineering faculties and disciplines at other Australian Universities to determine socio-economic comparisons and students' perceptions and motivations for studying engineering. Victoria University was selected for this study not only because of its accessibility but also because of its uniqueness among other metropolitan engineering education providers. A high proportions of the student body enrolled in engineering programs at VU comes from a low socio-economic background and with relatively low entrance score. The preliminary study indicated that though there were some disciplinary deviations, students have exhibited positive, if sometimes inaccurate, perceptions of engineering profession and to be highly motivated and hard-nosed in studying engineering.

WORK IN PROGRESS - ENGINEERING'S GRAND CHALLENGES: AN ANALYSIS OF STUDENT VIEWPOINTS

James R Rowland

As the next generation of engineers, engineering students at the local level have specific views on what key issues should be addressed in the coming decades. Results of a University of Kansas survey completed by over 220 engineering students from sophomores to graduate students in seven engineering majors from five departments are reported, analyzed, and compared with the 14 Grand Challenges for Engineering presented by the National Academy of Engineering in 2008. While some areas follow from the NAE list, other suggestions are innovative beyond that list and yet support the goals and spirit of the subsequent NAE Grand Challenge Scholars Program. The contributions of this study are: (1) a report of survey findings from six classes of students, (2) an analysis of student responses according to levels and majors, and (3) a comparison of these viewpoints with the NAE Grand Challenges for Engineering.

EVALUATION OF A TEN YEAR LIFE PLANNING ASSIGNMENT FOR AN ACADEMIC SCHOLARSHIP SUCCESS CLASS

Mary R. Anderson-Rowland

In Fall 2010, 98 students in a one-credit Academic Scholarship Success Class were given an assignment to write a life plan for the ten years after their Bachelor of Science or Bachelor of Science in Engineering degree. The students in this class were either NSF S-STEM Scholarship students (engineering or computer science majors), transfer students who would receive a \$300 scholarship after successful completion of the class, or other upper division students who had heard that the course was very helpful. The programs supporting the class have an emphasis on women and underrepresented minority students. The students were to address a summary of goals and professional objectives, current status in education and personal life, education goals and planned coursework, research

importance, industrial importance, community service importance, personal mentoring plan, graduate school, professional goals, lifelong learning, family planning, travel plans, contingency plans, and their philosophy of life. The purpose of this paper is to analyze the reaction of the students to this assignment. The students were asked at a later time for their evaluation: was the assignment helpful, what did they learn doing the assignment, was the assignment thorough enough, and what changes would they make in the assignment. A summary of these findings is presented. Some students were surprised at how much their goals and plans in some areas changed in just a semester. The conclusion of the study is that this is a very helpful, important, and interesting assignment that should be given in mentoring situations and academic success classes.

Session F2G: Hands-on, Cooperative, and Remote Approaches for Engineering Laboratories

Chair: Ladimer S. Nagurney, University of Hartford

Time: Friday, October 14, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room 205

MULTI-CORE SYSTEM EDUCATION THROUGH A HANDS-ON PROJECT ON FPGAS

Xiaofang Wang

Multi-core system education for Computer Engineering students is quite challenging since it involves a wide range of complex topics, especially when hardware design is the focus. In contrast to simulation-based approaches, FPGA-based configurable processors offer exciting opportunities for students to develop and implement both hardware and software of multi-core processor systems on real hardware. This paper presents a hands-on and comprehensive multi-core processor project that utilizes configurable processors and is designed for an introductory embedded systems design course. In addition to designing and implementing a quad-core processor system on the Altera DE2 FPGA development board, students are also required to propose a parallel technique to map and manage matrix multiplication on their own multi-core processor system running on the DE2 board. Students are exposed to many aspects of multiprocessing during the process and build hardware/software codesign skills for embedded systems.

WORK IN PROGRESS - DEVELOPING A HANDS-ON COURSE ON NETWORK SCIENCE

Janne Riihijarvi and Petri Mahonen

In this paper we discuss our ongoing work towards developing a hands-on course on network science. Unlike most of the existing courses on this emerging topic, our focus is on data analysis and modeling, with strong emphasis on model validation. Our objective is to develop a course that will not only give students a broad outlook on this emerging new field, but also equips them with practical skills useful in later professional and research careers. We discuss the planned structure for the course, especially focusing on the topics and methodologies covered. We also outline the structure of the proposed hands-on components, including tools used as foundation for these sessions.

WORK IN PROGRESS - VIRTUALIZATION AND REMOTE COMPUTING ENVIRONMENT (VRCE) TO IMPROVE LABORATORY EXPERIENCE IN AN ONLINE COMPUTER NETWORKING PROGRAM

Kuldeep Rawat, Chun P Lau and Vernon T Brown

This work in progress (WIP) paper reports the implementation of a virtualized and remote computing environment (VRCE) to provide remote access to laboratory equipment and software tools in the computer networking program offered in the Department of Technology at Elizabeth City State University. This funded project is being implemented as part of wider initiative to offer web-enhanced and online courses in the area of computer networking. Most of these courses are laboratory intensive and require a mechanism in place that supports remote laboratory accessibility in these courses to be delivered as fully online. The VRCE lab is currently in its testing phase and will start offering remote laboratory experience beginning Fall 2011 semester. The VRCE lab will also provide a reliable and standardized laboratory management and assessment platform for instructors. Using web-based communication tools, instructors will be able to create and edit class profiles, design and host custom lab exercises, and administer laboratory activities through a graphical user interface. Motivation for VRCE lab, remote lab requirements, and remote lab implementation details are discussed in the WIP paper.

WORK IN PROGRESS - COOPERATIVE AND COMPETITIVE PROJECTS FOR ENGAGING STUDENTS IN ADVANCED ICT SUBJECTS

Montse Pardas and Antonio Bonafonte

In this paper we present a specific kind of projects that can be used for project-based learning in engineering subjects. The subjects must combine lectures with projects, in order to provide the technical competences together with additional skills such as teamwork learning, oral and written communication skills and application of theory to practice. The projects proposed consist on improving an elemental baseline system. The system is decomposed in modules that correspond to the topics that have been learnt during the lectures. For improving the system, the class is

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divided in groups and each group has to propose, implement, assess and report a better system. In order to be able to improve the system with a limited amount of time and effort the students need to make a coherent proposal and split the project in several tasks that are usually developed by one or two students. The students within a group cooperate to achieve a better system, but groups compete for the best results. We have already implemented this kind of project in a Speech Processing course and we plan to apply it in a Video Coding course.

WORK IN PROGRESS - INTERACTIVE SIGNAL-PROCESSING LABS AND SIMULATIONS ON IOS DEVICES

Jinru Liu, Andreas Spanias, Mahesh K Banavar, Jayaraman J Thiagarajan, Karthikeyan N Ramamurthy, Shuang Hu and Xue Zhang

Handheld devices are increasingly finding more applications in STEM education. In this paper, we present the design of an interactive signal processing simulation software operating on both the iPhone OS (iOS) and Android platforms. This object-oriented application is called i-JDSP and is conceptually based on the award-winning Java-DSP (J-DSP) simulation environment. The i-JDSP app offers a user-friendly visual programming interface and provides users with a compelling multi-touch programming experience. It supports basic signal processing simulation functions such as the FFT, filtering, frequency response, pole-zero plots, and sound recording and playback. Initial assessments have been promising and we believe that this new attractive smartphone interface will make signal processing education among undergraduate students more appealing.

Session F2H: Factors in CSET Student Success: Choosing a Major, Identity, and Social Capital

Chair: Renata A. Revelo Alonso, University of Illinois at Urbana-Champaign

Time: Friday, October 14, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Room 206

DEVELOPING A SURVEY INSTRUMENT TO CHARACTERIZE SOCIAL CAPITAL RESOURCES IMPACTING UNDERGRADUATES' DECISIONS TO ENTER AND PERSIST IN ENGINEERING

Julie P. Martin, Kyle Gipson and Matthew K. Miller

This paper describes the theoretical basis, development, and initial results of a quantitative survey instrument that measures the engineering-related social capital resources of undergraduate engineering students. Despite significant efforts over the last few decades to increase participation of under-represented groups in engineering within the United States, progress has been disturbingly slow. Further research in this domain is needed to realize the significant advancements that are necessary for diversifying undergraduate engineering enrollment. The long-term purpose of this research is to develop a conceptual model based on Social Capital Theory to provide a deeper understanding and explanation of undergraduates' academic and career choices related to engineering, of which developing the survey instrument is the first step. Our "Name and Resource Generator" instrument has been administered to 890 students at three institutions within the United States. Supporting literature and initial results indicate that under-represented students in engineering may utilize different mechanisms for developing and activating engineering-related social capital compared to other engineering undergraduates, and that an approach utilizing social capital theory shows promise as a model with which to improve the diversity of the engineering field.

ENCOURAGING PARTICIPATION IN COMPUTER SCIENCE WITH CONNECT

Brandon Vargo, Cyndi Rader and Tracy Camp

Although professional networking is vital to career building, college-age students may not have acquired sufficient skills to network effectively. Several conferences, such as the Grace Hopper Celebration (GHC) of Women in Computing and the Richard Tapia Celebration of Diversity in Computing, now exist to counteract feelings of isolation and encourage participation of women and minorities in computer science. To enable conference attendees to take full advantage of the potential for mentoring at these events, we have developed CONNECT (Creating Open Networks aNd Expanding Connections with Technology), a technology-based system that helps conference attendees meet and exchange information. This paper reports the results of deploying the CONNECT system at the GHC conference on two different years. Although the results were generally positive, with about 75% of the survey respondents indicating they were either satisfied or very satisfied with the support provided by CONNECT, there were also a number of suggestions for improvement. We review these results and provide a list of guidelines for creating an effective tool to encourage conference attendees, especially college students, to network and form communities.

EXAMINING THE IMPACT OF MATHEMATICS IDENTITY ON THE CHOICE OF ENGINEERING CAREERS FOR MALE AND FEMALE STUDENTS

Cheryl A.P. Cass, Zahra Hazari, Jennifer Cribbs, Philip M. Sadler and Gerhard Sonnert

Previous research suggests strong connections between mathematics background and persistence in engineering

career aspirations. This study expands on this research by examining how mathematics identity impacts the choice of engineering careers for male and female students. Our framework encompasses interest, recognition, performance, and competence as central factors that contribute to the development of mathematics identity. The data used in this study were drawn from the Factors Influencing College Success in Mathematics (FICS-Math) project; the survey included questions on students' demographics, mathematics background/experiences, interest in mathematics, and career aspirations. Results indicate that factors of mathematics interest, mathematics competence and performance, and mathematics recognition are significant predictors of the choice of an engineering career, even after controlling for SAT/ACT math scores and demographics such as parental education. Moreover, the interaction between mathematics recognition and gender is also significant with the estimate indicating that females who are recognized in mathematics are more likely to choose engineering careers. This work reaffirms the importance of mathematics to engineering career choices and furthers the discussion by looking beyond mathematics grades to ascertaining the importance of mathematics identity.

COMPARING ATTRIBUTES OF ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND NON-ENGINEERING STUDENTS

Michele Miller, Leonard Bohmann, Chris Van Arsdale and Benjamin Mitchell

Relative to other countries, the number of students in the US studying engineering is low. The numbers of women studying electrical and mechanical engineering have been persistently low relative to other engineering majors. For several years we have been measuring the electrical and mechanical aptitudes of electrical and mechanical engineers as part of a project to better understand hands-on ability. We have also examined connections between these aptitudes and academic performance indicators, spatial visualization ability, prior experiences, and engineering attitude. In fall 2010 we administered the same questionnaires and instruments to a group of non-engineering majors. The results provide some insight into the role that three factors--aptitudes, experiences, and attitude--play in a students' selection of academic major. This paper summarizes our findings.

FOCUSING HIGH SCHOOL TEACHERS ON ATTRACTING DIVERSE STUDENTS TO COMPUTER SCIENCE AND ENGINEERING

James P. Cohoon, Joanne M Cohoon and Mary Lou Soffa

An effective workshop has been developed for promoting a positive impact on high school teachers' recruitment of students, particularly women and minority students, into their CS classes. All past workshop attendees indicate they now are actively try to recruit girls and minority students into their computing classes and are successful in doing so.

Session F2J: Teaching Engineering: Current Issues and Classroom Approaches

Chair: Sarah Grigg, Clemson University

Time: Friday, October 14, 2011, 10:00 a.m. - 11:30 a.m.

Civic Center Ponderosa Room

TRAGEDY IN THE GULF: A CALL FOR A NEW ENGINEERING ETHIC

George D. Catalano

The question that the present work addresses is how might we move the engineering profession towards a more encompassing engineering ethic and do it in a way which the practitioners might be receptive to such new ideas? Put another way, how might we develop a new engineering ethic, which focuses more upon the results as evidence by its adoption across the myriad of disciplines rather than the purity or elegance of the argument? The present work seeks to offer one approach that might work borrowing from our developing view of complex systems theory. One important characteristic of a complex system – and we shall consider others -- is that a system is composed of interconnected parts that as a whole exhibit one or more properties. Stated another way, the behavior among the possible properties may not be obvious from the properties of the individual parts. The proposed new ethic also integrates new ideas from quantum mechanics as well as eco-philosophy.

NEW PEDAGOGIC CHALLENGES IN ENGINEERING EDUCATION AND THE ANSWER OF IGIP

Michael E. Auer, Dana Dobrovska and Arthur Edwards

Never has the speed of development in the area of engineering been as accelerated as it is today, as we observe the enormous and driven growth of the area of engineering. Today's tendencies require concerted new efforts in engineering education- or in other words: The importance of pedagogy in the field of engineering is growing enormously. These changes strongly demand new didactic and pedagogical paradigms. The International Society of Engineering Education (IGIP) offers seeks to contribute to the relevance and pedagogical aspects related to developing educational concepts in engineering education. The IGIP Recommendations for Engineering Pedagogy Studies (in short IGIP Curriculum) are briefly described in this work.

DEMONSTRATING THE IMPACT OF MULTITASKING IN THE CLASSROOM

Steven Fulton, Dino Schweitzer, Lauren Scharff and Jeff Boleng

The advent of laptops, mobile devices, and ubiquitous connectivity in the classroom has created both opportunities and challenges for the learning environment. Students, often feeling that they are good multitaskers, will use their laptops to read e-mail or browse the web during classes. Telling students the results of multitasking research may convince some students not to become distracted, but experiencing it first-hand provides a more active learning approach to the lesson. The goal of this project was to design a meaningful demonstration of the negative effects of multitasking so that students would internalize the message and, hopefully, change their behavior, if necessary. In this demonstration students were assigned to three groups, one which had no computing distraction (students were asked to take notes on paper), one which had a single on-line distraction, and one group which had dual on-line distractions. All groups were told that distractions should not be allowed to interfere with their class work. At the end of the lecture, students completed a quiz on the material just presented to test their level of understanding. There was a significant effect on quiz performance. The group without distractions obtained higher quiz scores than either distraction group. End-of-semester feedback showed that 63.5% of the students reported modifying their behavior in class based on the demonstration.

AN EFFECTIVE APPROACH TO TEACHING MAGNETICALLY COUPLED ELECTRIC CIRCUITS INCLUDING IRON SATURATION IN A POWER ENGINEERING COURSE

Rene Wamkeue

This paper describes the use of an effective approach to teaching magnetically coupled electric circuits as an introduction chapter to the electric machine modeling and simulation course for power engineering students. The teaching methodology focuses on some common notions and fundamentals of electrical machine theory such as machine inductances (self, leakage and mutual), equivalent circuits, magnetic circuits, iron saturation, etc., so that the electrical equivalent circuit of each type of classical machine can easily be deduced from the general theory established by the chapter on magnetically coupled electric circuits. Numerical simulation examples using a state space model are performed to assess the effectiveness of the tutorial approach developed and to provide students with applications.

INCREASING INSTRUMENTALITY WITHOUT DECREASING INSTRUCTIONAL TIME: AN INTERVENTION FOR ENGINEERING STUDENTS

Krista Puruhito, Jenefer Husman, Jonathan C. Hilpert, Tirupalavanam Ganesh and Glenda Stump

Calculus is essential to the engineering curriculum, though its value is not necessarily apparent when the topics are first introduced to students. Our goal was to develop a series of interventions that credibly presented students with information about the utility of calculus topics through a 5-minute video segment. If successful, this intervention would provide instructors with a way to increase the perceived utility of the curriculum without significantly decreasing their instructional time. We recruited 463 students enrolled in Calculus II for engineers. All instructors teaching this course consented to participation in this study and classes were randomly assigned to video and no-video groups. The video group received three interventions during the weeks they were being exposed to the content. The no-video group did not receive any intervention of any kind but were measured at the same points in time as the video group. Results indicate that perceived instrumentality (PI) increased after the first intervention and remained high throughout the semester in the video group. The results suggest that the intervention influenced students' perceptions of instrumentality. Theoretically, this provides additional evidence that PI, value, and orientation are constructs distinct from self-efficacy (SE); practically, it provides instructors with a way to improve student motivation without making extensive changes to their courses.

Session F3A: Special Session - Engineering Ethics: Toward a Definition

Chair: Craig Titus, Purdue University

Time: Friday, October 14, 2011, 2:30 p.m. - 4:00 p.m.

Civic Center Room LaCroix C

SPECIAL SESSION - ENGINEERING ETHICS: TOWARD A DEFINITION

Craig P. Titus, Carla B. Zoltowski and William C. Oakes

This special session addresses a challenge posed by engineering ethics: What does it mean? Review of the literature shows many competing definitions, each with their own understandings of the term ethics and the role it plays in engineering. Our aim is to review the different uses of the term "engineering ethics," along with several other common terms, such as "professional ethics" and "professional responsibility," and consider what might constitute clearer and more meaningful ways of understanding engineering ethics. As an interdisciplinary field, engineering ethics must represent both of its major parts: engineering and ethics. Examples of engineering ethics in the literature do not always make clear what aspects of ethics—a very large and complex field of philosophy—is being employed

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in an engineering context. Group activity and discussion will instigate a debate on how we should understand these terms and how we can be better about clarifying the key features of engineering ethics and its role in engineering education.

Session F3B: Special Session - Connecting and Expanding the Emerging Engineering Education Research (EER) and Engineering Education Innovation (EEI) Communities

Chair: Karl A. Smith, Purdue University

Time: Friday, October 14, 2011, 2:30 p.m. - 4:00 p.m.

Civic Center Room LaCroix D

SPECIAL SESSION - CONNECTING AND EXPANDING THE EMERGING ENGINEERING EDUCATION RESEARCH (EER) AND ENGINEERING EDUCATION INNOVATION (EEI) COMMUNITIES

Karl A. Smith and Ruth A. Streveler

Currently there is a lot of emphasis on engineering education research (EER) and engineering education innovation (EEI). In the EER domain, several universities have established or are considering establishing engineering education research centers and PhD programs. In the EEI domain, the National Academy of Engineering launched the Frontiers of Engineering Education (FOEE) symposium and NSF recast CCLI as TUES. The growth of interest in the scholarship of teaching and learning (SoTL) has great potential to contribute to EER and EEI. A recent NSF Webinar series is featuring SoTL. The aim of this special session is to provide an opportunity for representatives of these three communities to network with one another, to welcome representatives from emerging programs, and to provide guidance to colleagues who are considering establishing initiatives in these areas. We will set up a space on the Collaboratory for Engineering Education Research (CLEERhub.org) where we will post the program descriptions (and links). We will encourage participants to use CLEERhub.org as a means for following up after the session.

Session F3C: Applying Accepted CSET Education Practices in Distance Education Contexts

Chair: Venkat N Gudivada, Marshall University

Time: Friday, October 14, 2011, 2:30 p.m. - 4:00 p.m.

Civic Center Room LaCroix B

ENABLING REMOTE ACCESS TO COMPUTER NETWORKING LABORATORIES FOR DISTANCE EDUCATION

Carlos E. Caicedo Bastidas

Academic organizations that provide students with the facilities for experimenting and learning basic and advanced concepts in networking rely on computer networking laboratories. These facilities can be implemented in many ways with varying degrees of cost, management complexity and capabilities. The benefits of these facilities can be extended by enabling remote access to them for distance education purposes. Providing remote access capabilities to these facilities with the objective of offering the learning experience of a computer networking laboratory to distance education students of Information and Communication Technology (ICT) programs is a challenging task. This paper provides a description and a comparative analysis of the implementation of three different computer network laboratory setups for which remote access was enabled and discusses lessons learned and good practices for similar setups.

USING VIRTUAL WORLDS IN DISTANCE LEARNING ENVIRONMENTS

Itana Stiubiener, Waleska Barbosa, Christiane Schweitzer and Carlos Alberto Kamienski

This paper presents two tools developed to facilitate the use and automate the process of using Virtual Worlds for educational purposes. The first tool has been developed to automatically create the classroom space, usually called region in the virtual world, which means, a region in the virtual world used to develop educational activities between professors, students and interactive objects. The second tool helps the process of creating 3D interactive objects in a virtual world. With these tools educators will be able to produce 3D interactive learning objects and use them in virtual classrooms improving the quality and appeal, for students, of their classes.

WORK IN PROGRESS - ITEM RETRIEVAL SYSTEM IN DISTRIBUTED REPOSITORIES TO GENERATE ADAPTIVE ASSESSMENTS SUPPORTED IN ITEMS RESPONSE THEORY (.IRTT)

Yehiry Lucely Pulido Vega, Gloria Milena Fernandez Nieto, Silvia Margarita Baldiris Navarro and Juan Carlos Guevara Bolanos

The assessment process is one of the most important issues in the learning process and in many case it is the process that defines the instruction sequence because it measures the performance of the student in the educational process. During recent decades the inclusion of TICs in the teaching-learning process have facilitated addressing the diversity of student and teacher features. Technologies to enhance learning have allowed the different ways of learning and teaching that coexist in the educational context to be adapted through user modeling and adaptation processes. Our

purpose in this paper is to introduce “. IRTT” (item response theory tool), an adaptive tool based on item response theory to generate assessment according to the student competence level, in the context of a learning management system (LMS), in particular .LRN

A VIDEO-MESSAGE EVALUATION TOOL INTEGRATED IN THE UNED E-LEARNING PLATFORM

Rafael Pastor Vargas, Roberto Hernandez, Salvador Ros, Antonio Robles-Gomez, Agustín Caminero, Manuel Castro and Rocael Hernandez

Use of multimedia services has become very important in learning process. This is due to the traditional approach of document based assignments not provide any feature which allows to evaluate some basic competences (oral communications skill, for example). In this paper, the UNED (Spanish University for Distance Education) solution will be presented focusing on user’s interaction: lecturers and students. In the first case, the lecturer has to define a task and propose a solution (available only at the end of task availability). This solution is also video/audio based, so the student can learn about it and compare it with his/her solution. The student has several attempts, in order to try better responses and decides which of these attempts will be selected as final response. The whole interaction schema will be presented and how is integrated in the e-learning platform as a usual task (like document based tasks). This integration permits the use of all features of the platform evaluation tool, simplifying the evaluation process and tasks grading (no special procedures are required).

VIRTUAL COLLABORATIVE SPACE TO SUPPORT ACTIVE LEARNING

Gerardo J Alanis-Funes, Luis Neri and Julieta Noguez

Active learning is an educational strategy that promotes the development of the students’ critical and creative thinking through carefully designed activities. Collaborative learning techniques such as Problem-Based Learning (PBL) and Project- Oriented Learning (POL) are useful tools to achieve effective active learning. However, teachers often face important challenges promoting, monitoring and ensuring a well-balanced collaboration so both - workload and learning are significant and also as equitable as possible among team members. With the advent of new social software, virtual collaborative environments have become an important part of our lives. Nevertheless file sharing and e-mail communication alone do not necessarily promote learning. It is necessary to combine the learning methodologies with the appropriate software tools to create a virtual collaborative space that promotes active learning. The paper reviews related work on active learning, problem based learning (PBL), project oriented learning (POL), social software tools, and collaborative virtual environments. Hence, a virtual collaborative space that integrates distributed web interactivity tools with learning methodologies is the focus of this paper. A virtual collaborative space using the collaborative elements in Blackboard 9.1 applied to PBL and POL is also presented.

Session F3D: Advances in Introductory Engineering Courses: Topic Modules, Rubrics, Student Career Perceptions, Diversity, Self Assessment

Chair: David Benson, Kettering University

Time: Friday, October 14, 2011, 2:30 p.m. - 4:00 p.m.

Civic Center Room 101

WORK IN PROGRESS: INTEGRATION OF TOPIC MODULES AND ORGANIZATION OF SESSION FLOW FOR THE FIRST-YEAR SEMINAR COURSE IN ENGINEERING TO MOTIVATE AND SUSTAIN STUDENT LEARNING

Ramakrishnan Sundaram

This paper presents the overview of course instructional material in modules and the organization of these modules for presentation in sessions of the critical entry-level course, First-Year Seminar in Engineering, for undergraduate engineering majors at ABET-accredited institutions of higher education. The First-Year Seminar in Engineering at our University is offered once each year during the fall term. The enrollment can be between 45 and 50 first-year students. In recent years, the course, which is coordinated by one engineering faculty member and taught by up to fifteen different instructors, comprises a loosely organized collection of engineering and non-engineering topics delivered in twenty eight 55-minute sessions of the semester (14 weeks of instruction). The summative assessment of the student learning outcomes has revealed glaring weaknesses in content and delivery. For the incoming engineering student to receive both the holistic university experience and the ability to learn and retain fundamental engineering principles and practices, the course is being revised through central and integrative engineering design projects with service learning components. The revised structure places emphasis on the continuity across modules and sessions to ensure (a) the sustained engagement, and (b) the highest levels of student learning and retention of concepts throughout the semester.

A FIRST COURSE IN OPERATING SYSTEMS WITH AND WITHOUT RUBRICS

Oswaldo Clua and Maria Feldgen

We are in charge of the Introduction to Operating Systems course at the school of Engineering of the University of Buenos Aires (FIUBA) and in a sister institution. Both courses are developed in parallel and placed in the same semester of the program. Each course has a different set of teaching assistants. To overcome overcrowded classes and lack of interaction time, at FIUBA we decided to use a rubric in the grading of the programming assistant. Teaching assistants at the other institution do not lack interaction time and courses are a lot less crowded, so they discarded the rubric idea regarding it as bureaucratic burden. We assumed that the exposure to the rubrics experience will make some sort of difference. We decided to use the same programming assignments and the same final exams in both institutions in order to make the experiences comparable. Our findings are presented and discussed in this paper.

WORK IN PROGRESS - DIVERSITY HARNESSING IN A GENERAL EDUCATION COURSE ON DIGITAL INFORMATION TECHNOLOGY

Christopher D Schmitz, Renata A. Revelo Alonso and Michael C. Loui

Our general education course in digital information technology draws many students from academic disciplines outside science and mathematics. These students often struggle with the relevance of the course topics. To promote student motivation, we are modifying the course to better engage the students in the course topics via a method we term diversity harnessing. Diversity harnessing refers to the diversity in the students' personal interests and chosen academic disciplines. From the students' interests, we intend to gather applications and ideas and to quickly integrate this diverse student-driven subject matter back into the lectures, homework assignments, and examinations. Through diversity harnessing, we expect to find that students are more engaged in the course and that they apply the course content more effectively to their lives and careers beyond the end of the semester. We are assessing the effectiveness of diversity harnessing using both individual interviews and a standard course engagement questionnaire.

USING LOW-STAKES QUIZZING FOR STUDENT SELF-EVALUATION OF READINESS FOR EXAMS

Kirsten A Davis

Introductory level courses in many Science, Technology, Engineering, and Math (STEM) disciplines require students to acquire an enormous new discipline-specific vocabulary in preparation for future courses. Students are often not prepared for the amount of self-directed studying they must do to be successful in these types of courses, particularly in their first year of college. To assist students in more accurately gauging their readiness for an exam, online low-stakes quizzes were implemented in a freshman level course, giving students an opportunity to practice their new language with minimal grade-related consequences. This quizzing strategy provides students an opportunity to self-assess their current level of knowledge. The quizzes also provide feedback, helping students determine how to adjust their behavior to ensure that acquisition of the missing knowledge is successful. This paper presents preliminary results of the research effort and illustrates the effects of this low-stakes quizzing. Specifically, this paper evaluates (1) whether the quizzing helps students to better prepare for medium and high stakes exams; (2) whether the quizzing increases the mean exam scores compared to previous semesters with no quizzing; and (3) whether the quizzing must be required (low-stakes) to be effective, or whether it can be optional (no-stakes) and still benefit students.

STUDENTS' PERCEPTIONS OF THE ENGINEERING PROFESSION AND IMPLICATIONS FOR INTEREST IN THE FIELD

Emily Towers, Jennifer A. Simonovich and Yevgeniya V. Zastavker

Understanding personal learning goals and perceptions of engineering is critical in encouraging students' interest in the field. This work defines engineering in terms of the students' course-related learning outcomes (e.g., skills and knowledge) described in the latest version of the Accreditation Board of Engineering and Technology (ABET) Engineering Criteria 2000 (EC2000). We argue that aligning students' perceptions of course task value with the EC2000 should enhance students' perceptions of the engineering profession and increase their interest in the field overall. Using student interviews from a larger study of instructor and student experiences in three undergraduate engineering programs, this study is guided by the following questions: 1) What are students' perceptions of the skills required by the engineering profession? 2) How do these perceptions compare to the skill set defined by ABET EC2000? 3) How do these perceptions affect students' assessment of course value and interest in the relevant coursework? Two required introductory engineering courses, Physics Laboratory and Engineering Design, are investigated. The ensuing theoretical framework is placed in the broader context of Eccles and Wigfield's expectancy-value model, specifically focusing on utility value. Our findings indicate that students' perceptions of the skills and knowledge required in professional engineering diverge from those defined by ABET. This disparity is negatively correlated to the students' assessment of the required coursework utility value. The absence of perceived utility then contributes to the students' lack of interest in their courses.

Session F3E: Trends in Instructional Technologies: Visualization, Learning Objects, Open Source

Chair: Arnold Pears, University of Uppsala, Sweden

Time: Friday, October 14, 2011, 2:30 p.m. - 4:00 p.m.

Civic Center Room 102

VISUALIZING CONDUCTIVE AND CONVECTIVE HEAT TRANSFER USING THERMOGRAPHIC TECHNIQUES**Masoud Naghedolfeizi, Sanjeev Arora and James E. Glover**

This work explores the educational applications of thermography in teaching conductive and convective heat transfer concepts to undergraduate students. Thermography helps students effectively visualize heat transfer phenomena particularly in two and three dimensions. Experiments were designed to demonstrate one-dimensional heat transfer in metal rods, two dimensional heat transfer in a metal plate subject to given boundary conditions and convective heat transfer in fluid. The data obtained through these experiments, including thermal imaging video clips, was made available to students enrolled in instrumentation and physics courses. Using these thermographic data, students could physically observe heat transfer phenomena that otherwise would have been difficult to visualize.

WORK IN PROGRESS - ENHANCING ON-LINE INTERACTION WITH GRAPHICAL TOOLS**William Schleter and Richard Bennett**

A limitation in many on-line interaction systems (discussion boards, wikis, chat rooms, etc.) is the lack of graphical tools. When using these types of systems to provide asynchronous help for engineering classes, the lack of integrated graphical tools ignores the need to communicate with sketches and equations. Due to the nature of the material and the limitations of current technologies, students tend to work in a mixed-mode environment. That is, they will work out their solutions to problems on paper, and then they have to duplicate or describe their work in a text only mode when they go on-line for assistance. The requirements, design, and implementation of a prototype system for allowing students to seamlessly integrate images, sketches, and equations along with text in on-line discussion board environment is described.

WORK IN PROGRESS - LIVE PROGRAMMING LEARNING OBJECTS REPOSITORY**Kai Qian, Lixin Tao, Wanjun Hu and Richard Kline**

The technique of learning objects has been identified in the past decade as an effective methodology to modularize concepts and skills in a subject area. In this preliminary research we focus on “live” learning objects using Java programming languages to support students’ customized and personalized learning experiences.

WORK IN PROGRESS - ENHANCING INTERACTIVE GEOMETRY SYSTEMS WITH INTELLIGENT TUTORING FEATURES**Danilo Leite Dalmon, Seiji Isotani, Anarosa Alves Franco Brandao and Leonidas de Oliveira Brandao**

There are different approaches that drive the development and use of educational software, such as Interactive Geometry Systems – IGS and Intelligent Tutoring Systems – ITS. Considering their benefits to teachers and students, these systems may be used to complement each other. The ongoing development of ITS features in an existing IGS called iGeom is presented. First, the limitations of both approaches are listed, describing possible benefits of using them together. Then, the resulting component architecture of the conducted analysis and software design is outlined. The ITS paradigm chosen was Example-tracing Tutors. The current state of research is the tutoring features implementation and planning for testing in classrooms and in distance learning courses.

BUILDING A MEDICAL LEARNING METHODOLOGY BASED ON OPEN SOURCE TECHNOLOGIES**Antonio Vieira de Castro, Carlos Vaz Carvalho and Eurico Manuel Carrapatoso**

This article aims to present the steps for creating a learning methodology to the health area based on open source software and digital health learning contents. We intend to apply some common practices of engineering to the health area in order to enhance the preservation, sharing, production and re-use of contents. For this purpose, we created a thematic repository named MELOR (Medical Learning Objects Repository), an e-learning platform named MEDUCA (Medical Education), a social network, a ip-TV channel and several learning resources and learning objects in order to investigate new mechanisms to increase health education and enhance the sharing overall. We also created a main portal where other researchers can participate.

Session F3F: Improving Professional Skills through Undergraduate Research Experiences

Chair: Teresa Larkin, American University

Time: Friday, October 14, 2011, 2:30 p.m. - 4:00 p.m.

Civic Center Room 201/202

WORK IN PROGRESS - UNDERGRADUATE RESEARCH COURSE DESIGN AT KFUPM, A BASIC STARTING EXPERIENCE**Amar Khoukhi**

In this paper we share our approach into the design of undergraduate research course at King Fahd University of Petroleum and Minerals (KFUPM). The course design process, description and instruction delivery are discussed. The lessons learnt will be highlighted along with experiences and challenges from a first offering of the course during winter term of 2011. As a first assessment, major benefits of the course include for both students and faculty through providing increased interaction, increasing student intellectual maturity, and furthering faculty research projects.

WORK IN PROGRESS - INTERVENING TO IMPROVE THE DISSERTATION OF FINAL YEAR ENGINEERING RESEARCH PROJECTS**Steven Goh and Harry Ku**

This paper presents preliminary results of an investigative study into the final-year engineering research project. Final year students completing engineering research projects were surveyed pre- and post-intervention regarding their perception and ability to undertake a literature review in their research project. The pre-intervention survey provided an insight into the students' initial disorientation in starting the projects but also acted as an awareness mechanism for the student participants to consolidate or improve their literature review skills. A series of intervention workshops were devised based on the pre-intervention survey. A post-intervention survey was then conducted along with a focus group. The paper discusses the results of these two surveys and then compares them with the 'actual' literature review skills demonstrated in progress reports (contain the literature review section). From the pre and post intervention surveys, it can be seen that the intervention workshops were successful in increasing awareness and understanding of the literature reviews. However, the intervention was regarded as not so successful if the knowledge of literature reviews was based on the progress report artifacts. This is somewhat a contradiction. The literature review skills demonstrated in their final dissertations were compared with those in their progress reports. It was evidenced that their literature review skills have improved significantly in their final dissertations but were not displayed in the progress report artifacts submitted earlier in the project.

WORK IN PROGRESS - THE J-DSP/ESE SOFTWARE FOR ANALYZING EARTH SYSTEMS SIGNALS**Linda Hinnov, Karthikeyan Natesan Ramamurthy and Andreas Spanias**

Java-DSP (J-DSP) is a free online Java applet that has been extensively used in signal processing education and research. We present the functionalities of J-DSP Earth Systems Edition (J-DSP/ESE) that uses the basic architecture of J-DSP, but has functions tailor-made for Earth systems signals. No text-based programming is required, so that users can focus on understanding signal processing concepts. Here, we describe the functionalities in the current version of J-DSP/ESE. A coherency analysis of Earth time series is presented. In order to overcome the inherent limitations of J-DSP/ESE in terms of memory and computations, a standalone Java application is proposed. This will greatly enhance the functionalities of the existing J-DSP/ESE applet. The standalone application will be platform independent and available for free. These additional functionalities of the application make it suitable for use in research as well as education.

A NOVEL REU PROGRAM TO DEVELOP THE SKILLS OF THE ENGINEER OF 2020**Michael West, William Cross, Stuart Kellogg and Alfred Boysen**

Since 2009, the South Dakota School of Mines and Technology (SDSM&T) has hosted a new Research Experience for Undergraduates (REU) Site entitled Back to the Future. The focus of the REU site is metallurgical engineering research with an emphasis in art and history. This latter aspect is embedded within the site as there is significant evidence that a richer learning environment can be created in engineering by establishing a context within the liberal arts, as described in the recent National Academy of Engineering's Educating the Engineer of 2020 report. In addition to being involved in research projects to develop specific technical skills in engineering, students in this program are engaged in unique supplemental activities that support learning the societal context and potential impact of their research. Specific program activities for a "holistic" approach to an engineering REU experience are described in the paper. A combination of professional development activities, societal context and diversity activities, and library activities are performed to investigate the broader impacts of student research. These activities lead to substantial opportunities for student self-reflection. Finally, assessment activities and results are also described in the paper with a focus on the development of students with different learning-styles and implications for recruiting from underrepresented groups in the STEM disciplines.

WORK IN PROGRESS - A HEALTH INFORMATION TECHNOLOGY CENTRALIZED WEB APPLICATION

Ronald J. Glotzbach, Laura A Kocur, James L Mohler and Carlos R Morales

Healthcare is not about seeing patients anymore; the focus has shifted. Patients are concerned with the cost associated with the care and the amount of time they will spend at the doctor's office and away from work. Doctors are concerned with administration, management, business development, cost, review boards, lawyers, insurance companies, government, specialists, continuing education, and patient education. The focus is seldom on the doctor-patient relationship anymore. Improving the effectiveness of the patient data management system can help alleviate some of these issues so that more time can be spent focusing on that relationship. This study centers on faculty-led undergraduate students developing, implementing, and researching the use of a web-based, touch-screen, self-service computer kiosk or tablet to (a) provide adequate history to the provider, (b) provide feedback and information to the patient, and (c) enable the sharing of patient record (in a future expansion to the project). Doctors and patients will be surveyed to assess the system's impact on doctor-patient interactions. Staff surveys will investigate the impact of the system on human error, paperwork reduction, and administrative costs. Data from the surveys will be statistically analyzed to determine the effect of the system on the listed outcomes.

Session F3G: Improving Student Learning in Introductory Programming Courses

Chair: John C. Luth, University of Alabama

Time: Friday, October 14, 2011, 2:30 p.m. - 4:00 p.m.

Civic Center Room 205

IMPROVING PROGRAMMING EDUCATION IN TANZANIA: TEACHERS' AND STUDENTS' PERCEPTIONS

Mikko Apiola, Matti Tedre and Josephat O. Oroma

Contextualization of curriculum and course contents has been central to development of IT education at Tumaini University in rural Tanzania. However, as the development of the IT program has progressed, pedagogical challenges have become increasingly evident. The pedagogical difficulties materialize most markedly in programming courses. This paper reports an empirical study of students' and teachers' perceptions of challenges of programming education in Tanzania. The results support the anecdotal evidence from various developing countries that programming education is hindered by shallow learning strategies, unfamiliar pedagogical approaches, language problems, extrinsic motivations, free riding in group assignments, and cultural differences.

COMPARING THE COLLABORATIVE AND INDEPENDENT VIEWING OF PROGRAM VISUALIZATIONS

Teemu Rajala, Erkki Kaila, Johannes Holvitie, Riku Haavisto, Mikko-Jussi Laakso and Tapio Salakoski

In this paper, we report a study on the differences of using a program visualization tool collaboratively or independently. We conducted a study, where students were divided randomly into two groups: the treatment group used a visualization tool called ViLLE in collaboration with another student, while the control group used the tool alone. During the study, we recorded screen captures and students' conversations. Our previous results confirmed that the treatment group outperformed the control group in the post-test in questions related to functions and in total score. Thus, we now annotated and tagged students' actions in answering the exercises, trying to find out an explanation for the difference in learning results. The results show, that the students working in collaboration spent more time answering the difficult exercises than the students working alone, and moreover, spent more time in higher level of engagement, both relatively and absolutely measured. Furthermore, we found out that the students working in pairs discussed the most when in the higher level of engagement and that almost all discussion was related to the exercise they were doing.

IDENTIFYING COGNITIVE ABILITIES TO IMPROVE CS1 OUTCOME

Ana Paula Ambrosio, Fabio Moreira Costa, Leandro Almeida, Amanda Franco and Joaquim Macedo

Introductory programming courses entail students' high failure and dropout rates. In an effort to tackle this problem, we carried out a qualitative study aiming to shed some light on the programming phase that is most challenging for students, in order to elicit the specific difficulties they experience while learning to program. In doing so, distinctive cognitive abilities, differentiating subjects in terms of the way they handle programming tasks, were detected. Such aptitudes are represented in three groups of students: those who learn easily, those who never seem to fully grasp what programming requires despite true effort, and those who experience a sudden insight, making them leap from a point where they had difficulties to another where they overcome them. By interviewing teachers and students, abstraction and sequencing elaboration were found to be the two core skills for programming. These results impelled us to consider the mental models' approach, concluding that there are very specific cognitive functions that are more favorable to learn programming and that are fostered by more adequate schemas of representing reality. Some conclusions involving Problem-based learning as a fit teaching methodology to overcome students' difficulties are also presented.

WORK IN PROGRESS - COURSES DEDICATED TO THE DEVELOPMENT OF LOGICAL AND ALGORITHMIC THINKING

Orna Muller and Amir Rubinstein

Undergraduate students often start their academic course of studies with inadequate learning and thinking skills. Our college has a policy of setting high standards, while supporting students' learning in a variety of ways. In this paper we present two distinctive courses designed to aid students develop logical and algorithmic thinking, essential for coping with software engineering studies. The courses are taught independently from but in parallel to Introduction to Computer Science and Math courses of first semester. Courses elaborate on algorithmic thinking, logical reasoning and argumentation while explicating abstract ideas which are often hidden in a loaded curriculum of the disciplinary courses. At the same time, connections are made to the application of the abstract ideas in the disciplinary courses. Feedback from participants in the two courses demonstrates an increased awareness and appreciation of abstract ideas beyond mathematical and programming knowledge, improved problem-solving skills and deeper understanding of concepts and principles.

WORK IN PROGRESS - WEB PENETRATION TESTING: EFFECTIVENESS OF STUDENT LEARNING IN WEB APPLICATION SECURITY

Hwee-Joo Kam and Joshua J. Pauli

Web penetration testing embodies both the understanding of attack and defense philosophies. By learning malicious hacking activities, students will understand the perspectives of attackers and realize how to defend a Web application system. To foster information security education, it is important to introduce the attack understanding philosophy. Using student group projects, this study aims to measure student learning effectiveness in Web application security and to discover how students perceive learning given the attack understanding philosophy. In support of triangulation, this research will employ pre-test and post-test study along with the grounded theory approach. The future research findings will propose a framework to improve student learning effectiveness and student learning perception in Web application security.

Session F3H: Themes in Improving Engineering Courses: Collaboration, Frequent Assessment, Studio Environments, Deep Insight

Chair: Robert O'Connell, University of Missouri

Time: Friday, October 14, 2011, 2:30 p.m. - 4:00 p.m.

Civic Center Room 206

RESULTS OF THE COOPERATIVE LEARNING PROGRAM AT TELEMAR UNIVERSITY COLLEGE, NORWAY

Trond Clausen and Svein Thore Hagen

In 1982, the forerunner of the engineering school of Telemark University College adapted a version of project based learning program of the Aalborg University as their sole pedagogical method, the Telemark Model. Based on 20 years of positive experience with the Telemark Model, a pioneering project was launched in 2002 on recruitment with graduates from classes at vocational schools. In 2004, a program for student enterprise was added with astounding results. In 2008, the engineering school of Telemark University College was awarded the First Prize for Quality in Education by the Ministry for Education and Research for the development and quality assurance of this project. In addition, their student enterprises have been awarded 30 prizes, including 5 prizes in the European championship contests. After a brief historical presentation, the paper will describe, discuss, and relate the results of the Telemark Model. These results include better recruitment, student retention, improved college finances, and most important - a good academic standard of graduates nationally as well as internationally. Finally, it will be discussed if the sum of these experiences can pave the way from interdisciplinary into transdisciplinary thinking and methods.

DEVELOPING AN INTERMEDIATE EMBEDDED-SYSTEMS COURSE WITH AN EMPHASIS ON COLLABORATION

Andres Djordjalian, Ariel Lutenberg, Juan Manuel Cruz, Sebastian Garcia, Pedro Martos and Pablo Gomez

Embedded systems are computing devices designed to perform specific tasks as part of larger systems such as digital cameras, measuring instruments, cars, etc. Technological advances have added complexity to embedded-systems development, which needs to be reflected in academic curricula. This paper presents the design and delivery of an intermediate embedded-systems course that follows up on a typical introduction to microcontrollers and, while doing so, it offers an example of engineering-course development that makes use of collaborative learning, outbound ties and learning modes of a community of practice. The paper explains planning, learning objectives, activities and other aspects of the course, including hardware and software tools used as well as lessons learned. A section is dedicated to student projects and current results.

UNDERSTANDING A STUDIO ENVIRONMENT: A COMPLEX SYSTEM APPROACH TO A COMMUNITY OF PRACTICE

Ashley Thompson, Brook Sattler and Jennifer Turns

This paper looks at characteristics of a studio environment and the ways in which engineering pedagogies can begin to incorporate them. Using inductive coding, student reflection forms, in which students described their experiences with a studio environment as they developed professional portfolios, are analyzed. Based on our findings and using communities of practice and complexity theory as a theoretical lens, we describe how portfolio studios engage students in key elements of learning. In particular, the analysis of students' reflection forms demonstrates that students validate each other's experiences through peer interaction, engage in the negotiation of meaning, and make sense of their own identity. The paper provides insights into studio environments and their role in engineering education, an explanation of our research methodology, the results, a discussion of the results and the ways in which they relate to communities of practice and complexity theory, and a conclusion focused on possible implications.

THAYER QUIZ METHOD: REPLACING HOMEWORK WITH FREQUENT QUIZZES IN ENGINEERING CLASSES

Kenneth Viall, Christopher Lowrance and Scott Bronikowski

This paper investigates the consequences of eliminating graded homework assignments in engineering courses and replacing them with ungraded study problems and short periodic in-class quizzes. The authors of this paper have taught electrical engineering courses under both course models over four semesters, and this paper outlines the benefits realized by switching to a course structured around study problems and quizzes in lieu of assigned homework problems in an environment where students have little discretionary time. Test and comprehensive final exam performance were similar under the quiz models. Surveys of students also indicated that students believe they had sufficient time to achieve course objectives.

TEACHING DEFLECTION OF STEPPED SHAFTS: CASTIGLIANO'S THEOREM, DUMMY LOADS, HEAVISIDE STEP FUNCTIONS AND NUMERICAL INTEGRATION

E. M. Odom and C. J. Egelhoff

The need for finding the deflections of shafts, many of which are stepped or varying cross-sectional areas is timeless. Each generation of engineers has used that part of mechanics of materials theory that fit the calculating capability available to them. The method presented here is offered in that vein. The method uses an engineer's ability to construct free body diagrams, derive moment equations, and knowledge of energy methods. The problem solution is kept general until the last step which is a digital numerical integration. The digital numerical integration can be performed on a wide variety of software to include TKSolver[®], MatLab[®], MathCad[®], EES[®]; and spread sheets. This method keeps the section properties independent of the moment equations making it straightforward to include scaling and shape factors on the cross-sectional dimensions. This allows an engineer to run any number of "what if" scenarios during a design process. Additionally, this method provides intermediate opportunities to validate the solution path by a) plotting the moment equation and comparing it against shear and moment diagram developed by hand, or b) plotting the cross section and comparing it against the drawings. Thus far, this approach to solving for the deflection of stepped shafts has been presented to nearly 300 junior Mechanical Engineering students.

Session F3J: Reaching Beyond Traditional Boundaries and Characterizations of CSET Students

Chair: Steven P Fulton, U.S. Air Force Academy

Time: Friday, October 14, 2011, 2:30 p.m. - 4:00 p.m.

Civic Center Ponderosa Room

WORK IN PROGRESS - STREAMLINING PATHWAYS TO ENGINEERING DEGREES FOR MILITARY VETERANS

David L. Soldan, Noel N. Schulz, Don M. Gruenbacher, Blythe Marlow Vogt and Rekha Natarajan

This paper will focus on the accelerated track for military veterans into bachelor's degrees in engineering. It is important to have contact with the military veteran prior to their arriving on campus to begin their schooling. An initial thorough evaluation of the veterans' training, experiences, and expertise will be conducted with the option of granting academic credit where appropriate. Current policies give little credit for military experience or training. The development of on-line pre and post assessments and subject based tutorials will be used to accelerate the veteran's entry into the traditional math sequence. The creation of accelerated courses specifically for veterans enrolled in the program will be another aspect used to accelerate degree completion. Veterans may have a base of technical knowledge acquired through the technical nature of their service posts. Assigning them to introductory level courses with traditional freshman and sophomore students does not respect their technical expertise nor challenge their

capabilities and accustomed pace. Another aspect of this project is the inclusion of summer internships for participants.

WORK IN PROGRESS - TEACHING ENGINEERING CONCEPTS TO LIBERAL ARTS STUDENTS

Polly R. Piergiovanni

Lafayette College, with strong programs in engineering and the liberal arts, requires sophomore students to enroll in a "VaST" (Values and Science/Technology) course. These courses incorporate approaches from the engineering viewpoint and ideas from the social sciences and humanities. As a result of taking a VaST course, students should be better able to see and understand engineering and science as a functioning part of their daily social world. However, in practice, the courses are difficult to develop and populate. This paper describes a course that uses experiential learning to involve liberal arts students in all aspects of the course. The liberal arts students learned basic engineering concepts by using hands-on activities, side-by-side with engineering students.

TEACHING COMPUTATIONAL THINKING TO NON-COMPUTING MAJORS USING SPREADSHEET FUNCTIONS

Kuo-Chuan (Martin) Yeh, Ying Xie and Fengfeng Ke

Recently, higher education has seen an increasing emphasis on the prominent role of computational thinking in all disciplines. Computational thinking is advocated as not only a fundamental skill or concept in computer science but also a core competency for all disciplines. Teaching students in non-computer science majors computing thinking is challenging because students do not have experts' mental models. This study investigates the knowledge gap that non-computing major college students (n=126) possess about computational thinking in an introductory MS Excel course by measuring their performance using spreadsheet functions in three categories: recall, application, and problem solving. The empirical result, analyzed using ANOVA, shows that students can recall the meaning of those functions but seem to have trouble using them correctly and precisely (cued or uncued). Students' test results suggest the following issues: (1) problems with understanding the data type, (2) failure in translating problems to productive representations using spreadsheet functions, and (3) inadequate stipulation of the computational representations in precise forms. Addressing these problems early and explicitly in future classes could improve the education of computational thinking and alleviate difficulties students may experience in using computational thinking in learning and problem solving.

WORK IN PROGRESS - INTERPRETING ELEMENTARY STUDENTS' ADVANCED CONCEPTIONS OF ENGINEERING FROM THE DRAW-AN-ENGINEER TEST

Heidi A. Diefes-Dux and Brenda M. Capobianco

The Draw-an-Engineer Test (DAET) is an age-appropriate instrument for collecting elementary students' conceptions of engineers and engineering. However, analysis of drawings can be challenging. To make using the instrument more manageable for measuring the impact of engineering integration into classrooms, it is desirable to code each drawing with one of a limited set of defined conceptions. Four conceptions were identified in prior work with students with little to no engineering instruction: laborer, mechanic, technician, and designer. In this prior work, few students demonstrated the conception of designer. As engineering has been integrated into classrooms, more drawings could be coded designer but the drawings also represent a wider variety of ideas about engineering. This Work in Progress (WIP) will look at representative samples of student drawings coded with the designer conception to highlight the emergent engineering ideas.

WORK IN PROGRESS - A NEW LABORATORY PROJECT IN A REQUIRED ELECTRICAL ENGINEERING COURSE FOR NON-MAJORS: DESIGN, SURVEY, AND ANALYSIS OF STUDENT FEEDBACK

Hongwei Liao and Alexander Ganago

We investigate the student learning in a new lab project of a large introductory course in Electrical Engineering for non-majors. This lab project was developed in the Fall 2010 and offered to about 209 engineering students. In this lab project, students gain hands-on experience with two temperature controllers, Analog/Digital and Programmable, and learn the skills applicable to their major fields of study. We have implemented a survey study of student learning in this lab, embracing three metrics: Feasibility of lab design, Interest of students, and Transferability of knowledge (FIT). Our results indicate that this lab project evokes student interest and helps students to apply the knowledge gained in this course to their future learning and to engineering practice. This lab also fosters the development of students' communication skills in a multidisciplinary environment.

Session F4A: Mini Workshop - Exploration of the Ethical Development of Engineering Undergraduates

Chair: Donald D. Carpenter, Lawrence Tech University

Time: Friday, October 14, 2011, 4:30 p.m. - 6:00 p.m.

Civic Center Room LaCroix C

MINI WORKSHOP - EXPLORATION OF THE ETHICAL DEVELOPMENT OF ENGINEERING UNDERGRADUATES

Donald D. Carpenter, Janel Sutkus, Cynthia Finelli and Trevor Harding

This workshop will be conducted by members of the Exploring Ethical Decision-making in Engineering (E3) Team. The workshop will be an interactive exploration of the meaning of “ethical development” for engineering students. We will introduce participants to a variety of teaching strategies and co-curricular activities that may enhance a students’ ethical development as identified through the Survey of Engineering Ethical Development (SEED) project. The SEED project was a multi-year national holistic assessment of ethics education in engineering that included measurements of a students’ ethical knowledge, ethical reasoning, and ethical behavior. The investigation included 19 diverse partner institutions and over 4000 engineering undergraduates. In addition to the presentation of research results and analysis, the audience will be asked to share personal experiences and discuss strategies for adapting identified best practices in different institutional settings. Finally, breakout groups will identify challenges and opportunities for improving ethical decision-making on a national scale.

Session F4B: Panel - Tales from the Field - Cross-College Curriculum Development

Chair: Ruth A. Streveler, Purdue University

Time: Friday, October 14, 2011, 4:30 p.m. - 6:00 p.m.

Civic Center Room LaCroix D

PANEL - TALES FROM THE FIELD - CROSS-COLLEGE CURRICULUM DEVELOPMENT

Ruth A. Streveler, Tim Riordan, Odsema Dalrymple, Eric Johnson and Stuart Kellog

Funded by grants from the National Science (DUE 0817461 and 0817498), the first cohort of engineering and engineering technology colleges gathered in the summer of 2010 to work with Purdue University and Alverno College faculty on curriculum development for student learning outcomes, including Engineer of 2020 attributes. The overarching goals of this panel are to (1) present the progress of the first cohort of cross-college curriculum development projects and (2) provide an environment where audience members can engage with the panelists about the challenges and successes of their project implementation. This project has received multi-year funding, thus audience members will also discover how to become a member of the third cohort.

Session F4C: Virtual Learning Environments: Assessment, Collaboration, Community

Chair: Raghu Raman, Amrita University

Time: Friday, October 14, 2011, 4:30 p.m. - 6:00 p.m.

Civic Center Room LaCroix B

WORK IN PROGRESS - THE IMPACT OF TIME ON BUILDING COMMUNITY IN AN ALN

Timothy J. Ellis

The importance of establishing a sense of community is accepted as a central element in establishing an effective learning environment, impacting student persistence, satisfaction, and achievement. Although there is a body of research on building learning communities within an asynchronous learning network (ALN), that research is rather one-dimensional in that it is based upon a sample taken at a point in time and does not adequately address the dynamic characteristics of interpersonal relationships. The impact of shared experiences over time on feelings of community within an ALN is not clearly understood. This baseline information is necessary for providing context for an analysis of how to build community. This work in progress addresses that lack of context through a causal-comparative study that addresses the research question, “How does the sense of community change throughout the semester in a course offered in an ALN?” In deriving an answer to the research question, students in twelve graduate-level courses offered as part of the curriculum in a school of computer and information sciences completed the Classroom Community Scale twice during their 12-week terms: once at the midterm point, and again at the end of the term. A MANOVA analysis of the data did not suggest a change in community over the course of the semester.

AUTOMATIC ASSESSMENT FOR THE E-LEARNING OF THE NETWORK SERVICES IN THE CONTEXT OF THE EHEA

Antonio Robles-Gomez, Llanos Tobarra, Salvador Ros, Roberto Hernandez, Agustin C. Caminero and Rafael Pastor

This work presents a new system for the automatic assessment of practical activities in the context of the EHEA. A

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subject focused on the configuration of network services has been chosen to implement the new automatic evaluation platform. Unlike traditional platforms based on theoretical contents to evaluate the students' knowledge, the proposed system is able to immediately evaluate students' practical skills and, additionally, provide them with feedback about the correctness of their activities. Therefore, faculty can dynamically follow the students' progress in order to adjust the learning process to their needs. Since the UNED University serves a large number of students via a distance-learning methodology, the use of scalable assessment platforms within the students' learning process is crucial to keep it working efficiently. Automatic assessment systems are also of particular interest when practical activities are performed within higher engineering courses.

STUDENT EMPOWERMENT IN HIGHER EDUCATION THROUGH PARTICIPATORY EVALUATION

Dina Soeiro, Antonio Dias Figueiredo and Joaquim Armando Ferreira

This paper is concerned with sharing between students and teacher the power to manage a course that engages heterogeneous student populations in a blended learning environment in higher education. Our aim is not just to see how the students can be empowered to act autonomously, but rather to understand how they can fare as full partners of the course management experience. To this end, we engage them in a cultural transformation based on strategies that promote their participation in their own learning and evaluation. This is done with the help of the evaluation star, an ideogram we have developed to support these strategies. Our study draws on principles proposed by Dewey, Freire, Knowles, Mezirow, and Fetterman, and follows a research approach based on two action research cycles that involve different courses, subjects, and students. Our study, which can be seen as a proof of concept, shows that the students have learned to evaluate and accept evaluation, share critical reflections, and take responsibility for their contributions. They have also participated democratically in their learning process and have built change, quality, and competent collective learning.

APPLYING A ASSESSMENT TOOL IN DISTANCE LEARNING EDUCATION

Elio Sancristobal, Nuria Oliva, Juan J. Aguado, Juan V. Miguez, Sergio Martín, Gabriel Diaz, Jose Carpio and Manuel Castro

Spanish National University for Distance Education (UNED) has a great number of students located in different places from Spain, Europe and South America. By this reason, it is necessary to use e-learning tools that make easier learning process of our students. Nowadays, there are many e-learning tools in the World Wide Web, for instance: Learning management systems (LMS), courseware or online laboratories. In this paper we are going to describe the design, implementation and use of an assessment tool developed by Electrical and Computer Engineering Department that is able to work along with other learning systems (for instance a LMS, online laboratories, etc.) with the objective of improving learning processes.

IMPROVING COOPERATION IN VIRTUAL LEARNING ENVIRONMENTS USING MULTI-AGENT SYSTEMS AND AIML

Marcio Alencar and Jose Magalhaes Netto

The large number of messages posted on the forum, a key element in Distance Education Courses based on Virtual Learning Environment, which does not receive adequate feedback from the tutor in sufficient time is a typical problem faced by students in these environments. The tutors, in turn, feel a lack of tools to monitor activities carried out by the student. This article proposes an approach for solving these problems based on the concept of perception, using the multiagent system paradigm. The system is composed by intelligent agents, which act in a Moodle discussion forum using an AIML knowledge base. Agents solve questions about matters discussed at the forum, and they use perception to recommend the implementation of activities that the student has not done. The results from simulations based on real courses already completed show that there is a decrease in the workload of tutors. Students are reminded the deadline for the tasks automatically. It was necessary to create hundreds of AIML rules to get answers to good level. The partial results indicate that the approach of combining AIML and MAS is promising to improve the feedback from tutors and motivate students to conclude their work on time.

Session F4D: Pre-College Outreach through Projects, and Multi-Institution Collaborations

Chair: Jack Mottley, University of Rochester

Time: Friday, October 14, 2011, 4:30 p.m. - 6:00 p.m.

Civic Center Room 101

MULTI-UNIVERSITY PRECOLLEGE OUTREACH FROM A RENEWABLE ENERGY FOCUSED ENGINEERING RESEARCH CENTER

Keith E. Holbert, Kristen Molyneaux, Lisa L. Grable and Patricia Dixon

The precollege program in the NSF-supported Future Renewable Electric Energy Delivery and Management (FREEDM) Systems Center is in its third year with over 100 participants in the first two years at three university

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campuses. The precollege programs consist of (1) a Research Experience for Teachers, (2) a Young Scholars commuter program for high school students, and (3) summer science camps for middle school students. An Each One Mentor One approach is implemented which links mentorship between faculty, graduate and undergraduate students, teachers, and high school and middle school students. Program assessment results show that teachers now have an increased interest in research on how math and science can be applied, and the teachers feel more confident in talking to their students about future careers in the field of engineering. The precollege program has motivated both the high school and middle school students to study harder, and while high school students are more confident they will enroll in an engineering degree program, they are not as confident that they will complete an engineering degree.

IMPLEMENTING NANOTECHNOLOGY EDUCATION IN THE HIGH SCHOOL CLASSROOM

Ben Pelleg, Manuel Figueroa, Matthew VanKouwenberg, Adam Fontecchio and Eli Fromm

In this work, we report on a program that aimed to expose high school students to nanotechnology. The program involved two NSF GK-12 engineering graduate fellows who developed a series of nanotechnology modules for an introductory engineering elective course in an urban public magnet high school. The fellows implemented the unit in two classrooms during the 2009-2010 school year. The unit was composed of multiple lessons that introduced students to some of the key concepts of nanotechnology, such as the relative magnitude of a nanometer, surface area to volume ratio, and nanoscale characterization. The effectiveness of the nanotechnology unit was measured by implementing a word association survey for each student. The responses from the students were categorized and tabulated by frequency. The results revealed that before the nanotechnology unit, students had perceptions about nanotechnology that were shaped by popular culture, movies, and video games. The survey given after the unit indicated a shift in the students' conceptions of nanotechnology. The unit presented here can be used as a model for inserting a nanotechnology focused unit into a high school classroom while still meeting core curriculum standards required by state governments.

WORK IN PROGRESS - USING A "CIGAR BOX" GUITAR TO TEACH WAVES AND SOUND IN A HIGH SCHOOL PHYSICS PROGRAM

Kelly Crittenden, Heath E Tims, Krystal Corbett, David Hall and Michael Swanbom

NASA-Threads is a full length high school physics program developed by Louisiana Tech University faculty with support from NASA. NASA-Threads is a partnership between K-12 schools and Louisiana Tech University that aims to improve high school student achievement in mathematics and science. This partnership will result in better prepared students entering science, technology, engineering, and mathematics (STEM) programs at the university level. Our previous experiences with K-12 program development have shown that long-term impact on students comes through close collaborative relationships between their teachers and university faculty. This paper presents how mathematics and science fundamentals are shown through the construction of a cigar box guitar. Tuning the guitar further develops the physics concepts of sounds, frequency, and waves.

SET UP AND DELIVERY OF ELECTRICAL AND COMPUTER ENGINEERING PROJECTS AT UNDERGRADUATE ENGINEERING UNIVERSITIES FOR OUTREACH AND PARTNERSHIP WITH K-12 STEM SCHOOLS

Ramakrishnan Sundaram

This paper discusses the set up and delivery of Electrical and Computer Engineering (ECE) projects with critical Science, Technology, Engineering, and Mathematics (STEM) components as part of "Engage K-12 students in ECE", the outreach and partnership program to (a) inspire K-12 students to pursue careers in ECE disciplines, and (b) integrate K-12 STEM learning with the ECE disciplines at institutes of higher education. In this form of outreach, called direct outreach, the K-12 students are invited to the University on ECE day to participate in hands-on ECE project activities in the ECE laboratories. The projects relate engineering principles to design specifications with real-world constraints. The project overview and the steps required to build and validate the design are presented by the ECE faculty member in charge of the project activities. The faculty member and currently enrolled ECE undergraduate students assist the K-12 STEM students. The K-12 students complete a survey at the end of the project as part of the summative evaluation. The survey comprised two sections (a) quantitative (b) qualitative. Despite the limited duration of each project, the students rated the projects to be very effective (greater than 3.8 on 5) in the application of STEM to real-world problems.

WORK IN PROGRESS - STUDENT TASK INTERPRETATION, DESIGN PLANNING, AND COGNITIVE STRATEGIES IN ENGINEERING DESIGN PROJECT: AN EXPLORATORY STUDY FOR GRADES 9-12

Oenardi Lawanto

This work in progress evaluates Grades 9-12 students' self-regulated learning (SRL) strategies during an engineering design project. The specific focus of this study is on student task interpretation and its relation to planning and

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cognitive strategies in engineering design activity. The two research questions guiding this study are: (1) to what degree does students' interpretation of the design task is reflected on their working plans and selected cognitive strategies? and (2) how those strategies relate to students' design performance? The subjects for this study are selected from students enrolled in the Architectural and Robotic design classes at a high school in Colorado this spring 2011 semester. Thirty students are expected to participate in the study. Survey questionnaire and Web-based engineering design journal writing will be used to capture students' metacognition. Students' perception about task interpretation, planning, cognitive, and self-regulating strategies, and performance criteria will be collected through the questionnaire. Except for the performance criteria, data for these metacognitive variables will also be collected through students' engineering design journal. A rubric will be used for the teacher to grade the students' design performance. Descriptive statistics and graphical views will be used to analyze the survey. Scoring rubric will be used to analyze journal entries.

Session F4E: Issues Using Instructional Technologies to Facilitate Learning: Usability, Feedback, Context, Personalization, Development Time

Chair: Asad Azemi, Penn State University

Time: Friday, October 14, 2011, 4:30 p.m. - 6:00 p.m.

Civic Center Room 102

WORK IN PROGRESS - OPEN SOURCE USABILITY EVALUATION: THE CASE OF MOODLE

Hoda Baytiyeh

The open source course management system, Moodle, is designed to help instructors deliver course materials to their students from a social constructivist perspective. This study evaluates the usability of Moodle based on the perceptions of 189 professors and 1867 students at the American University of Beirut. Participants were invited to participate in an online survey reflecting the performance of the system in teaching and learning by rating a set of 30 items related to five usability attributes: Learnability, Efficiency, Memorability, Error Prevention, and Satisfaction. Besides testing the usability attributes and evaluating the course management system, the study aims to attest the open source software quality at academic institutions in the Middle East region.

WORK IN PROGRESS - EVALUATION AND FEEDBACK FOR WEB PROGRAMMING CURRICULUM

Ronald J. Glotzbach and Laura A Kocur

Leading any curriculum development is always difficult and challenging. A survey of former students and industry professionals is being performed that will help guide the changes necessary to keep our students gainfully employed. Too often, improvements to courses come not through industry experts, but instead through what faculty feel is the best approach, which may or may not be correct. This paper looks at evaluation of curriculum contents, down to project assignments and tools used, and the implementation of new content and objectives. In addition to gathering some demographic information such as job title and location, the 72 questions in the survey ranged from "How frequently do you or others in your company/organization commonly use the following web technologies/languages?" to "How important is teaching Search Engine Optimization (SEO) so that students understand how to obtain better page listings?" to "With the purpose of HTML5 being to reduce the amount of reliance on RIAs and browser plug-ins like Flash, how important do you see Flash development being in the future?" The feedback garnered thus far has been useful in guiding changes in the web programming curriculum and has shown that industry professionals are generally interested in helping guide student learning.

MODEL-DRIVEN DEVELOPMENT OF LEARNING OBJECTS

Marco Aurelio Graciotto Silva, Ellen Francine Barbosa and Jose Carlos Maldonado

The development of effective learning objects that explores blended learning, collaborative, and open development requires a laborious process. Information created and used at each phase of the process must be manually translated and augmented until achieving a proper product. The issue of systematic development of learning objects can be addressed using model-driven development. In fact, each phase in the development of learning objects requires a specific type of user/developer profile and generates different models. This article defines a model-driven approach for the open and collaborative development of learning objects. The approach herein described uses concept maps, represented as CXL documents, and statechart-based models, which are represented as UML models in XMI documents. Finally, the later model is used to generate learning objects, given a specific platform description. The current implementation supports the generation of slides in LaTeX/Beamer format. The feasibility of the approach is demonstrated using a course on software testing for undergraduate students, with learning objects generated for a context that comprises both traditional classroom and blended learning.

CONTEXT-AWARE RECOMMENDATION ALGORITHMS FOR THE PERCEPOLIS PERSONALIZED EDUCATION PLATFORM

Amir Bahmani, Sahra Sedigh and Ali R. Hurson

This paper describes Pervasive Cyberinfrastructure for Personalized Learning and Instructional Support (PERCEPOLIS), where context-aware recommendation algorithms facilitate personalized learning and instruction. Fundamental to PERCEPOLIS are (a) modular course development and offering, which increase the resolution of the curriculum and allow for finer-grained personalization of learning artifacts and associated data collection; (b) blended learning, which allows class time to be used for active learning, interactive problem solving and reflective instructional tasks; and (c) networked curricula, in which the components form a cohesive and strongly interconnected whole where learning in one area reinforces and supports learning in other areas. Intelligent software agents customize the content of a course for each learner, based on his or her academic profile and interests, aided by context-based recommendation algorithms. This paper provides an introduction to the PERCEPOLIS platform, with focus on these algorithms; and describes the educational research that underpins its design.

WORK IN PROGRESS - VIRTUAL FACILITATION AND PROCEDURAL KNOWLEDGE EDUCATION

Ray Luechtefeld and Steve E. Watkins

Engineering students acquire both conceptual and procedural knowledge as part of their education. While conceptual knowledge, such as understanding why certain design practices are required or having knowledge of the general principles of engineering development, is essential, procedural knowledge to enact specific engineering practices is also needed. This kind of knowledge, such as balancing chemical equations, solving calculus problems, or finding Thevenin-Norton equivalents, is usually taught through rote problem solving, sometimes with the guidance of teaching assistants or aid from the instructor if students find themselves “stuck”. However, a Virtual Facilitator, designed to help students develop team skills, can also be used to guide students through the solution of specific problems. This Work In Process paper describes the process for developing the needed procedural rules using an example problem from electrical engineering – finding a Thevenin equivalent circuit.

Session F4F: Facilitating Development of Engineering Design Knowledge and Skills

Chair: Trond Clausen, Telemark University College

Time: Friday, October 14, 2011, 4:30 p.m. - 6:00 p.m.

Civic Center Room 201/202

WORK IN PROGRESS - AN INNOVATIVE APPROACH TO PROBLEM IDENTIFICATION AND DESIGN FOR CAPSTONE PROJECTS

M Vijayalakshmi, Padmashree D Desai, Gopalkrishna H Joshi and Karuna C Gull

Capstone project forms an important part of engineering degree programme as it has a bearing on both employability and admission to higher education. Choice of problem is very crucial decision in the first stage of the project. Problem definition is normally given by the faculty or chosen by the students. Inadequate efforts and thinking at this stage has negative impact on the performance of the student teams. Poorly managed requirements resulting in poorly defined scope extend the project time and efforts or mostly leave the projects half done. Sometimes, problem definitions themselves are changed in the middle. Yet another phenomenon observed is gross injustice done to design phase. Students tackle the project with the mindset of one problem and a unique solution. Further traceability is rarely achieved among the various stages of development. A new approach to problem identification is attempted by the authors in the capstone project wherein every project team puts in adequate efforts while finalizing the problem definition for the capstone project. An innovative approach to alternate designs is tried resulting in the choice of the right design through discussions and deliberations. In the entire process, peer review and feedback is made part of assessment which has improved learning. Assessment rubrics are developed and communicated to stakeholders resulting in uniform assessment which was otherwise a challenge. This has resulted in improved learning by students and enhanced participation of both faculty and students right from the beginning of the project phase. The paper discusses the experiences of the authors and the innovative practices adopted to address the issues related to handling of large number of student projects.

COMPARING DESIGN COGNITION OF UNDERGRADUATE ENGINEERING STUDENTS AND HIGH SCHOOL PRE-ENGINEERING STUDENTS

Matthew D Lammi and John S. Gero

This paper presents the results of design cognition studies of two groups of students: high school juniors and seniors who have taken pre-engineering courses and sophomore university students in a mechanical engineering department. Both groups carried out design sessions designing for the same design challenge. Data were collected using the protocol analysis technique through video and audio recordings of design sessions. The students' design cognition was measured by segmenting and coding the transcribed videos using the Function-Behavior-Structure (FBS)

ontologically-based design issues and design processes coding scheme that provides a uniform basis for analyzing design protocols. Differences in design cognition were found and tentative explanations provided to account for them.

WORK IN PROGRESS - AN AGILE EMBEDDED SYSTEMS DESIGN CAPSTONE COURSE

Antonio F. Mondragon-Torres, Alexander Kozitsky, Clifford Bundick, Edward Mc Kenna Jr, Eric Alley, Matthew Lloyd, Peter Stanley and Roger Lane

Embedded systems design has been characterized by the combination of two basic design methodologies: Hardware and Software. In this work in progress we incorporated Agile Project Management methodologies to a Computer Engineering Technology senior capstone course on product ideation, prototyping, demonstration and final presentation. As students were going through the course, they were; imprinting their stories on a wiki; creating, self assigning, working and closing tasks; following an Agile like methodology; and behaving like an entrepreneurial start-up company that wants to launch an innovative product.

WORK IN PROGRESS - COMPUTER SCIENCE PERSPECTIVES ON INTEGRATION WITH HUMAN-CENTERED DESIGN

Michael Herold, Aaron Ganci, Bruno Ribeiro, Rajiv Ramnath and R. Brian Stone

Capstone courses in many disciplines often fall into a single paradigm: they allow students to practice the skills they should have gathered through their progress in the department curriculum in a real-world or near-real venue. However, these courses often fail the real-world test by one important factor: they are not interdisciplinary projects, which is not indicative of industry experiences. We are attempting to create an interdisciplinary environment for capstone courses, involving both design and computer science students, to more adequately prepare students for industry work. This work-in-progress paper describes our experiences and plans for bettering the interdisciplinary capstone experience. The experiences show that there is a fundamental miscommunication between students of different disciplines that hinders their ability to collaborate. By analyzing qualitative questionnaires from thirty-three computer science students, we have affirmed the existence of this rift in inter-departmental understanding. This realization has formed our basis for creating educational modules to ease the collaboration between computer science and design students.

WORK IN PROGRESS – DEVELOPMENT OF A LINEAR INTEGRATED CIRCUITS COURSE FOCUSED ON DESIGN UNDER REALISTIC TRADE-OFF CONDITIONS

Ariel Lutenberg, Mariano Garcia Inza, Sebastian Carbonetto, Jose Lipovetzky, Gabriel Gabian, Hernan Romero and Daniel Musciano

At the Electronics Department of the University of Buenos Aires it is being developed a new introductory course on linear electronic circuits where the students will not only learn how to analyze these circuits, but will also synthesize an Operational Amplifier (OPAMP) under the scope of realistic trade-off conditions. The outcome circuits will be fabricated through MOSIS university program. At the proposed course the whole OPAMP is gradually designed through three laboratory assignments, in which different circuit stages of the OPAMP are designed and simulated. The last step of the learning process is a final project where the students have to compare the performance of the OPAMP they designed with that of similar commercial OPAMPs. This new approach is only possible thanks to a strong collaboration with the Allegro Microsystems Design Center at Buenos Aires, which has many years of experience on the field of analog microelectronics design. This paper presents a brief summary on how this idea was conceived, how the University teaching staff is in tight collaboration with Allegro's engineers, the organization of the proposed course and the expected results.

Session F4G: Learning Programming Language Concepts and Methodologies: Consistent Challenges, New Approaches

Chair: Inmaculada Plaza, University of Zaragoza

Time: Friday, October 14, 2011, 4:30 p.m. - 6:00 p.m.

Civic Center Room 205

FACING COMPUTER SCIENCE MISCONCEPTIONS: AN INTRODUCTORY COURSE BASED ON HISTORICAL STRANDS AND CAREER PATHS AT A GLANCE

Siegfried Rouvrais and Ioannis Kanellos

Incoming students in post-secondary education often perceive Computer Science (CS) under a series of stereotypes. While it is certainly difficult to define CS, it seems still possible to grasp its scope through comprehensive points of view, addressing for example its foundations, technologies, and uses. This paper proposes a retrospective analysis of a 21-hour course trial realized in a French engineering school for six consecutive years; its aim was to help recent K12 graded students to have a more objective vision of CS. We start by discussing freshmen's CS dominant

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conceptions, and the role they think it plays for their future career. We then give some statistical elements concerning student perception of such a course; in particular, we analyze the obtained feedbacks and the limits of intended learning outcomes. In the light of this analysis, it is possible to state that, although initially reluctant to CS due to misconceptions, some students can develop interest and expectancy for this discipline as applied to engineering. A clarified vision of CS seems moreover to contribute to better adjusting choices of minors and majors and facilitate reasoned career plans. We finally conclude on some possible future issues in this subject for our society.

NEW TOOLS AND METHODOLOGIES FOR PROGRAMMING LANGUAGES LEARNING USING THE SCRIBBLER ROBOT AND ALICE

Sebastian Londono and Ana Maria Orozco_Idrobo

Today is often raised the question, what happened to engineering? Each day are less aspiring to such programs, and we need to find innovative ways to motivate students, encouraging learning fun, and that his time, guaranteeing a solid covering topics that are usually evaluated in the first programming courses, some of the tools that were used during the experience at the University Icesi for teaching programming and Alice were Scribble robot, the which allowed students to interact with the fast world of programming. The teaching methodology had proven that through it the student can interact with a friendly interface that let users explore and use the concepts seen in the programming courses, encouraging students to improve their capacity through algorithmic understanding. Working with new strategies in the teaching of computer courses, is a fundamental pillar in the education of future engineers, given that capacity building fosters algorithmic analysis and problem solving skills as required by engineers. This paper will present the progress and results obtained using different programming interfaces and robots, as a complement to the basic algorithms and programming languages. It also will review the differences between traditional teachings vs. new tools for learning.

EXPERIENCES WITH CS2 AND DATA STRUCTURES IN THE 100 PROBLEMS FORMAT

Nicholas Kraft, Xiaoyan Hong, John C. Lusth and Debra McCallum

A dissatisfaction appears to permeate the process of educating computer science students. Both students and instructors seem uninspired in the classroom, resulting in many attempts to enliven, freshen, and improve the experience. These attempts show efficacy, but the pace of improvement is slow. 100 Problems (100P) is an innovative guided discovery curriculum in which students are freed from the classroom and instead work on 100 concept- and research-related problems throughout their undergraduate careers. The 100 problems guide the students to discover the fundamental knowledge and skills required of a graduate of the degree program. Each student is free to create an individualized mode of learning and discovery. As such, the curriculum fosters deep learning among students and challenges students' intellectual growth. In this paper we introduce the 100P curriculum, describe the 100P course format and our experiences offering courses in this format, and report our early findings.

A CLASS RECORD AND REVIEWING SYSTEM DESIGNED TO PROMOTE PROGRAMMING LEARNING

Alvaro Santos, Anabela Gomes and Antonio Jose Mendes

Many students feel difficulties in programming learning and, consequently, the failure rates in introductory programming courses are frequently high. Some students do not have the necessary commitment, while others do not show a natural ability for programming, which means they need more time to master the necessary knowledge and develop appropriate problem solving skills. Often, class pace is very intensive and many students are simply not able to follow all contents and activities. In order to help students with their studies it would be helpful if they could review classes so that they could clear doubts or take additional notes. Students that miss class for some reason could also take advantage of such possibility. In this paper we present a new system that we developed to record and replay lessons. The system is able to record the voice of the teacher, but also the main visual points of a class: the computer in focus in the class, the blackboard and the classroom environment. This system gives students the opportunity to review any part of a particular class, clear doubts that may have remained, review examples or exercises that may contribute to their programming learning.

WORK IN PROGRESS - USING GRAPHICAL PROGRAMMING TO CONTEXTUALIZE A CONVENTIONAL PROGRAMMING COURSE

Ali Jalal-Kamali and Eric Freudenthal

"Computer Programming for Science/ Engineering" (CPSE) is an introductory programming course for STEM students other than Computer Science (CS) major. Typical attendees are required to attend either CPSE or the Java-based first programming course of the CS majors' sequence (CS1). The previous curriculum for CPSE was a traditional introductory programming course with chronically low enrollment despite less its substantially relaxed learning outcomes. Post-reform, CPSE has become a popular alternative to CS1. Pass rates in CPSE are substantially higher than both local and national pass rates for CS1 and equivalent courses, and in-class tests of CPSE students

indicate that 70% satisfy the majority of CS1 outcomes, which exceeds the pass rate for most CS1 sections at our institution. While both CPSE and CS1 teach the Java language, CPSE integrates inductive teaching strategies developed by the second author's iMPaCT program that exploit the relaxed syntax of the Jython language. Like immersive foreign language programs, lessons during the first half of the course exploit the relaxed grammatical requirements of a simpler programming language (Jython) to introduce programming concepts (semantics) incrementally in a conversational manner. These early lessons are motivated by accessible graphical problems that incidentally review foundational math concepts.

Session F4H: Broadening Participation in STEM: Perceptions, Recruitment, Retention, Success

Chair: Ingrid St. Omer, University of Kentucky

Time: Friday, October 14, 2011, 4:30 p.m. - 6:00 p.m.

Civic Center Room 206

REPRESENTATION OF WOMEN AND PERCEPTIONS OF SUPPORT IN ENGINEERING

Elizabeth G. Creamer

A deductive coding scheme developed during a previous stage of a multi-institutional research project was used with interview data to gain a more nuanced understanding of the types of gender specific supports identified by female participants and how these might be related to the numeric representation of women. Findings confirm that gender ratios in a field affect perceptions of the gender appropriateness of a field. The numeric representation of women is a type of contextual support that is important because it communicates, not that women need special treatment, but that women belong and can succeed in a field. Within the context of a culture that communicates values that are consistent with it, extracurricular clubs like SWE and positive female role models, send the message that obstacles, while present, are surmountable and that the benefits associated with the outcome make the effort worthwhile.

STAIRSTEP: AN INTERDISCIPLINARY PROGRAM FOR RETENTION AND OUTREACH IN STEM

Peggy Doerschuk, Cristian Bahrim, Jennifer Daniel, Joseph Kruger, Judith Mann and Christopher Martin

Lamar University's Students Advancing through Involvement in Research Student Talent Expansion Program (STAIRSTEP) is designed to increase the number of United States students receiving undergraduate degrees in science, technology, engineering and mathematics (STEM). The program's goals are to attract students to STEM, retain them through to graduation, and help them transition to careers or advanced study in STEM. The STAIRSTEP program targets talented "at risk" students who face social and economic barriers that can make it difficult for them to complete degrees in STEM. This includes women and minorities who are underrepresented in STEM, low income and first generation students. It uses recognized strategies from the literature for increasing participation in STEM and implements them in an innovative way. The program has been very successful in its first two years. This paper describes the program's strategies, activities and results achieved during this time. Benefits and challenges of the interdisciplinary approach are discussed, and key elements essential to the program's success are identified.

ROBOTS, RECRUITMENT, AND RETENTION: BROADENING PARTICIPATION THROUGH CS0

Laura M. Grabowski and Pearl Brazier

Despite increasing demands for computing professionals in the global economy, interest in computing careers and their related university majors has declined steadily over the past decade, leading to challenges in recruiting undergraduate majors in computing programs. These problems are exacerbated when the university serves traditionally underrepresented groups and students who come from economically depressed communities. We present an innovative approach for a "CS0" course, designed to recruit and retain computer science and computer engineering majors at a Hispanic-serving university in the lower Rio Grande Valley of Texas. We use Lego® Mindstorms® NXT robots as the primary tool for learning algorithmic problem solving and fundamental programming concepts, in a supportive, social learning environment. We delivered the course during two semesters. One semester focused on increasing awareness about career possibilities in computing fields among female students, while the second semester's class targeted retaining early computer science and computer engineering majors. Early assessments indicate that our approach is successful for our student population. Student interest in the course increased dramatically from the first semester to the next, and student engagement remained high during the semester. To date, the retention rate of the computer science and engineering majors who completed the course is 100%.

A GENDER ANALYSIS OF STUDENT LEARNING IN PHYSICS

Teresa L. Larkin

Assessment of student learning is an important vehicle for understanding the effectiveness of various pedagogical approaches. There are a number of assessment tools currently available within the domain of STEM education.

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Perhaps most notable are those that are a direct result of Physics Education Research (PER). One assessment tool that is widely used in PER is the Force Concept Inventory (FCI). This paper reports on a research study that involved the assessment of student learning of basic concepts in mechanics within an introductory physics course. Both qualitative and quantitative assessment strategies were employed. To qualitatively assess student learning, a variety of free-writing activities were used at a number of stages throughout the learning process. To quantitatively address the question of whether deeper student understanding was achieved, numerical results from the FCI will be presented. Data analysis will include a presentation of pre- and post-test FCI gains. Results of this study reveal that the FCI gains are significantly lower for the female students as compared to their male counterparts. Other studies in PER have noted similar results when a gender analysis of the data is considered. A discussion of the significance of these results will be presented and issues related to this apparent gender discrepancy as they relate to student learning in physics will be provided.

PROBLEMATIZATIONS OF WOMEN'S UNDERREPRESENTATION: COMPARING EDUCATOR INTERVIEWS WITH THE LITERATURE

Kacey Beddoes

Various arguments for increasing diversity and the presence of underrepresented groups in engineering have been put forth. However, little attention has been paid to those arguments themselves or their implications. The goal of this paper is to call attention to the need for further reflection upon and analysis of how engineering educators understand and discuss underrepresentation and diversity. Specifically, it examines the motivations of a diverse group of engineering educators to undertake work on feminist engineering education initiatives. It builds on prior scholarship from the field of Science and Technology Studies (STS) of the ways in which underrepresentation has been framed as a problem. Participants' responses to the question of why underrepresentation is a problem are quoted at length and discussed. They are compared with prior findings from an analysis of the framings found in engineering education publications. Several differences between the publications and interview data are identified and the implications of these findings for engineering education, engineering education research, underrepresentation, and diversity more broadly, are then discussed.

Session F4J: Sustainability

Chair: Jenefer Husman, Arizona State University

Time: Friday, October 14, 2011, 4:30 p.m. - 6:00 p.m.

Civic Center Ponderosa Room

INTEGRATING SUSTAINABILITY TECHNOLOGIES INTO CONSTRUCTION EDUCATION CURRICULUM

Daniel Davis

At the University of Hartford, we have established an architectural program founded on integration. Architecture by its very nature is connected to other disciplines, yet architectural education is often criticized for a lack of integration in the curriculum. By increasing the awareness of the interrelationship between different areas of study, we are attempting to strike a new and more effective balance. Considering our mission of integration, we set out to incorporate sustainability into our curriculum. This paper will attempt to provide an overview of the need for, benefit of and cost of sustainable design and how it relates to architecture and engineering education at the University of Hartford. We have embarked on a 3 step process to bring sustainable design into the design studio curriculum.

ACTIVITIES TO INFUSE SUSTAINABILITY AND RENEWABLE ENERGY CONCEPTS IN ELECTRICAL AND COMPUTER ENGINEERING

Anil Pahwa, William B. Kuhn, Ruth Douglas Miller, Andrew Rys, Chris Eldridge, Scott Geier, Jeff Schuler, Matt Morley, Ian Sobering and Jonathan Stacks

Several engineering programs have introduced courses related to sustainability following the Brundtland Commission report in 1987. Available literature suggests that environmental engineering programs have initiated most of such activity, but only a few activities are reported in electrical and computer engineering programs. To fill this gap, a project to infuse sustainability into the electrical and computer engineering curriculum was initiated in 2009 in the Electrical and Computer Engineering department at Kansas State University with support from the National Science Foundation. The goal of the project is to prepare engineers, who are equipped to meet the growing needs of society, as well as to bolster enrollment by aligning the curriculum with needs of the current generation of students, who wish to involve themselves in work that benefits society. The paper describes activities related to sustainability including hands-on experiments in renewable energy, development of a rooftop solar and wind generation system, and associated outreach activities. Finally, results of assessments conducted in freshman classes provide a view of student knowledge related to sustainability and renewable energy as they enter their college experience.

WORK IN PROGRESS - SUSTAINABILITY AND SENIOR DESIGN AT THE UNIVERSITY OF SAN DIEGO

Susan M. Lord and Charles N. Pateros

Engineering senior design courses fill a critically important role in the curriculum forming a bridge between school and the workplace. Although sustainability is one of ABET's considerations for design, it is often overlooked in student projects. In 2010-2011, the instructors for the senior design sequence in electrical engineering (EE) at the University of San Diego (USD) chose sustainability as a theme. The USD Director of Sustainability worked with the instructors to suggest some projects, students suggested others, and industry input was obtained. Mechanical engineering (ME) students were invited to participate on projects where their skills were beneficial. Projects included Carpool Companion (EE only), Smart Shower (EE only), Engineering a Brighter Sudan (EE/ME), Cycle to Sustain (EE/ME), and TOCOM: An Energy Management Laboratory (EE/ME). Sustainability also became a theme for the instructors as they considered logistics of peer review, evaluation of reports, and distribution of class materials. As students better understood the concept of sustainability, they suggested that more should be done electronically. This work-in-progress discusses the logistics and experiences of incorporating sustainability into a senior design course. This information should be helpful to other engineering instructors aiming to incorporate sustainability into their senior design courses.

WORK IN PROGRESS - WEAVING THREADS OF SUSTAINABILITY INTO THE FABRIC OF THE MECHANICAL ENGINEERING CURRICULUM

Michele Miller, John Gershenson, Chuck Margraves, Ibrahim Miskioglu and Gordon Parker

This paper discusses progress in producing problem-based learning curricular materials on sustainability that are incorporated into three mechanical engineering science courses: mechanics of materials, thermodynamics, and dynamic systems and controls. Student learning outcomes for the project are: (1) knowledge of sustainability principles; (2) skill at solving design problems with realistic constraints; (3) attitudes about mechanical engineering as a profession and the importance of sustainability considerations. To assess design skills, we evaluate design project reports using a four-item rubric, and analyze the design objectives and constraints from these reports. To assess attitude, we administer a 28-item attitude survey to senior level students.

INTRODUCING SUSTAINABILITY CONCEPTS IN LOWER DIVISION ENGINEERING CORE COURSES

Juneseok Lee, Nicole Okamoto, Richard Chung and Thalia Anagnos

Engineers will play a significant role in designing, building and implementing creative solutions to major global challenges that we face. To prepare the 21st century engineer, sustainability concepts needs to be covered systematically throughout the curriculum and in all majors of the engineering departments. This NSF-funded project is integrating fundamental concepts of sustainability into two core lower division engineering courses (Introduction to Engineering and Introduction to Materials). The outcome of the project is three learning modules covering the topics of renewable and non-renewable energy sources, energy conversion and efficiency, water and energy, and product life cycle analysis. The modules include lectures, hands-on laboratories, and interactive Excel spreadsheets. The modules, along with the accompanying equipment and software, are currently being piloted in SJSU courses and will be disseminated to local the community colleges through a hands-on workshop for community college teachers. Preliminary assessment materials have been collected for the past year to determine effectiveness of the modules.

Saturday Sessions

SATURDAY SESSIONS

Session S1A: Mini Workshop - Real World Engineering Projects: Discovery-Based Curriculum Modules for First-Year Students

Chair: Stephen Williams, Milwaukee School of Engineering

Time: Saturday, October 15, 2011, 8:00 a.m. - 9:30 a.m.

Holiday Inn Room Salon D

MINI WORKSHOP - REAL WORLD ENGINEERING PROJECTS: DISCOVERY-BASED CURRICULUM MODULES FOR FIRST-YEAR STUDENTS

Stephen Williams, Masoud Agah, Luiz DaSilva, Kamyar Dezhgoshia, Allen MacKenzie, Nicky

Mostert-Phipps, Sanjay Raman and Javier Resano

This mini workshop is organized to provide an interactive forum for the introduction of a set of five new curriculum modules developed under IEEE's Real World Engineering Projects (RWEP) program. The modules, which are representative of a larger collection of curriculum modules available to the public via an open-access RWEP web portal, are designed for use in the first-year engineering and computer science classroom, and are hands-on, team-based projects that emphasize the societal impact of the work that engineers do. After a brief introduction to the RWEP program and the five showcased curriculum modules, the authors of the modules will work one-on-one with the audience providing tutorials on the laboratory activities associated with their modules in a highly interactive, simultaneous mode.

Session S1B: Satisfying Accreditation Expectations

Chair: Chuck Stone, Colorado School of Mines

Time: Saturday, October 15, 2011, 8:00 a.m. - 9:30 a.m.

Holiday Inn Room Salon E

EVOLUTION OF THE UNIVERSITY OF DENVER ENGINEERING PROGRAMS DUE TO ABET ACCREDITATION CRITERIA

Ronald R. DeLyser

Radical changes in the engineering programs at the University of Denver came in 1996 with the advent of ABET EC2000. Prior to EC2000, the engineering programs were developed based on the experience of faculty, the numbers of students and faculty, laboratory resources necessary to deliver the programs, and the accreditation requirements. As disciplinary programs evolved from a general engineering program and the number of students was low, this was a difficult process under the old ABET Criteria; the new ABET Criteria gave opportunities to design unique programs. New curricula were developed in 1996 along with an assessment process that took into account the needs of constituencies. Since then, the programs, assessment processes, as well as the process of determining the needs of constituencies have evolved substantially. Ethics has evolved from half of a course shared with engineering economic to ethics throughout the curricula; engineering economics has evolved into a full course for the BSME program, and an engineering entrepreneurship course for the BSEE and BSCpE programs; a legal studies course is required in the BSEE and BSCpE curricula; an option in Mechatronics Systems Engineering has been added to the BSEE program; and 5 year dual degree programs have been created that combine BS and MS degrees.

EFFECTIVE EVALUATION STRATEGIES TO MEET GLOBAL ACCREDITATION REQUIREMENTS

Lyn Brodie, Frank Bullen and Lesley Jolly

With the ongoing internationalisation of the engineering profession there is an ever increasing need for universities to provide robust evaluation of the quality of their undergraduate degree programs and to benchmark that quality internationally. It is important that the claims made of course evaluation and renewal, during the evaluation-accreditation process, can be substantiated and the tenuous connection between course evaluation and international acceptance as a professional engineer, be strengthened. There are a variety of methods used to evaluate courses and programs including student questionnaires, final grades, progression-retention data, and graduate attribute and competency mapping. The authors compared typical examples of such approaches to study the robustness of the link between the data collected and the evaluative judgments. It was found that there is a great deal of inference involved in the process and that the causative link between curriculum design and pedagogy, and skills and attributes, is often tenuous. Some of these approaches should not be taken as final evaluation outcomes, but rather inputs to a larger overarching evaluation strategy. It was concluded that a "program logic" approach such as that used by the University of Wisconsin, Extension, Program Development and Evaluation Model offers a superior approach for capturing and assessing the causal connections between local evaluation and international accreditation.

UNIFYING PROGRAM-LEVEL ABET ASSESSMENT DATA COLLECTION, ANALYSIS, AND PRESENTATION

Ken Christensen, Rafael Perez, Purushottam Panta and Pummy Bedarahally

Assessment of engineering and computer science programs involves a significant effort in data collection, analysis, and formatting of results for presentation to an ABET evaluation team. At the University of South Florida, we have developed a web-based system to unify program-level data collection, evaluation, and presentation for all programs in the College of Engineering. The goal of our web-based Accreditation Portal is to both improve the efficacy of assessment activities in the College and provide a clearer view of continuous improvement results to constituents and ABET evaluation teams. For each defined program educational objective and student outcome there are links to pages for Performance Indicators, Methods of Assessment, Assessment Data, Evaluation, Changes, and Closing the Loop. For each of these assessment steps Word, Excel, PDF, text, and/or image files can be uploaded. The portal also includes survey tools to enable data collection. We describe the development and deployment of the portal. We show a full sample assessment loop for a mock objective. Our evaluation of the portal is based on a trade study with comparison to several existing web-based assessment systems. Faculty members in the College are using the portal.

ENABLING SCALABILITY, RICHER EXPERIENCES AND ABET-ACCREDITABLE LEARNING OUTCOMES IN COMPUTER SCIENCE CAPSTONE COURSES THROUGH INVERSION OF CONTROL

Thomas Bihari, Igor Malkiman, Moez Chaabouni, Joe Bolinger, Jayashree Ramanathan, Rajiv Ramnath and Michael Herold

Capstone courses are expected to prepare students for the “real world” by putting them into a microcosm of the real world. In these courses, students are given a problem of some complexity, and are expected to exercise and develop problem-solving skills as they address the problem. Within our Computer Science and Engineering program we have, over the past eight years, successfully scaled up the Capstone courses. Doing so has required innovative thinking about the roles of the students, faculty, and project sponsors. In this paper, we discuss issues with scaling up the components that have made this program successful. These include housing the courses in an NSF IUCRC that enable the cultivation of highly-committed industry partners, the creation of strong pre-requisite courses, careful development of faculty resources through the selective hiring and mentoring of clinical faculty, a commitment of the faculty to give up close management and control, strong partnerships with other organizations within the university to provide students greater access to resources, an emphasis on cross-team knowledge sharing and learning, and the development of unique assessment and evaluation tools so as to be able to monitor, measure and fairly assess a wide-spectrum of projects.

THE ARTICULATION OF MILITARY TRAINING ONTO ENGINEERING DEGREE PLANS

Dave Lighthart, David T. Hayhurst and Patricia Reily

The expected US military draw-downs (reductions in force) combined with a strong GI-Bill will create challenges for engineering programs and colleges nationwide as they work to serve a large influx of veterans who wish to pursue engineering degrees. We have conducted a comparative analysis of Marine Corps engineering training curriculum to determine if military training may be used as a substitute for courses within engineering degrees. SDSU's degree plans are used as a model for ABET-accredited degree program and the Marine Corps training was chosen as the model for generalized military training. The disciplines of civil and construction engineering have the largest amount of relevant training, with possible direct articulation of two courses, Surveying and Project Management. Beyond these two courses, no direct (complete) substitutions were noted, suggesting future analysis might need to consider combinations of military training courses as substitutes for additional technical courses. Analysis through the framework of military profession was necessary to determine course sequencing.

Session S1C: Successful Careers After Graduation: What is Needed? How are programs evolving to develop expected competencies?

Chair: Hamid Khan, Our Lady of The Lake University

Time: Saturday, October 15, 2011, 8:00 a.m. - 9:30 a.m.

Holiday Inn Room Salon A

PRACTITIONER ENGINEERS PERCEPTIONS FOR A SUCCESSFUL EARLY EMPLOYMENT CAREER

Hoda Baytiyeh and Mohamad K. Naja

The aim of this research is to examine the transition of Lebanese engineering students from collegiate life to working professional as a case study in the Middle East region. Practicing engineers (n=217) graduated from universities in Lebanon and working domestically and abroad in different social and multicultural settings were surveyed. The survey identified their current employment and their attitudes toward their academic preparation level. The results showed that locating a job is not a major concern for graduates due to the high demand of engineers in the prosperous Arabic Gulf States. However, novice engineers confront critical issues during the transition process. While

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Internships and graduation projects appear to be essentially helpful for participants, it was observed the lacking role of career centers in such critical stage. An Exploratory Factor Analysis revealed three main challenges facing engineering graduates: communication, responsibility, and self-confidence. Participants' answers to open-ended questions suggest a strong need for collaboration between the engineering industries and the academic institutions to facilitate a smoother transition.

A COMPREHENSIVE PROJECT UTILIZING SPATIAL VISUALIZATION SKILLS

Amber Kempainen and Brett Hamlin

It has been shown that spatial visualization skills are a critical part of engineering education. Methods to improve these skills are varied, but in general contain activities that have students attempt to visualize objects when translated or rotated from their original orientation. At Michigan Technological University, students take a two-semester engineering course sequence (ENG1101 and ENG1102) during their first year. Both courses have activities that help develop spatial visualization skills through hand sketching and 3D modeling. This paper describes two culminating spatial visualization activities that combine all the skills learned by the students in their engineering coursework. In one case, students are provided with an object that has four or more distinct parts. Students measure, sketch, dimension, and model a single component and then combine their object with their team member's objects into a completed assembly in NX. A more advanced boot dryer project allows students flexibility in their final design. Students are provided with several components to the dryer, but not all. Based on their measurements and models of the given parts, they can design and model unique boot dryer systems.

ACQUIRING PROFESSIONAL SKILLS: VIRTUAL FACILITATOR AS MODEL FOR TEAM COMMUNICATION

Tracey Wiggins, Daniel Swift, Uyen Mai and Ray Luechtefeld

This paper aims to explore some of the professional skills engineering students require, namely leadership, communication, and teamwork. An important tool that may aid in developing those skills is facilitation, a process that encourages information sharing and clear communication, which provides more opportunities for team members to better collaborate. A virtual facilitator was developed to aid in online communication. It provides prompts and interventions designed by using Chris Argyris's Model II communication techniques to guide the user to communicate in more open ways. This quasi-experimental study explores whether students exposed to virtual facilitator software are more likely to model communication techniques displayed by the virtual facilitator. Teams of students worked online on a time-sensitive project. The virtual facilitator intervened in the conversations of teams in a treatment group, while it remained idle in the Control group. Pre-tests and post-tests were administered to measure whether exposure to the virtual facilitator increased students' capacity to enact interventions. Based on Albert Bandura's observational learning theory, researchers expected that students exposed to the virtual facilitator would report the use of more facilitative behaviors.

WORK IN PROGRESS - DEVELOPING INDUSTRY ORIENTED COURSES

Mihaela Radu

This paper presents the development of two industry oriented graduate courses at Rose Hulman Institute of Technology, Terre Haute, IN and preliminary assessment of the courses.

DEVELOPMENT OF PROFESSIONAL COMPETENCIES IN ENGINEERING EDUCATION

Asa Cajander, Mats Daniels and Brian R von Kinsky

This paper reports on a study conducted at a Swedish university in which engineering students reflect on their attainment of professional competencies using generic graduate attributes as a guiding framework. In this study, the nine graduate attributes from Curtin University in Perth, Australia were used as this framework. The Swedish students were asked to reflect on their understanding of the competencies, and to select three on which to focus over the course of the semester. Students predominantly selected professional skills, thinking skills, information skills, communication skills, and intercultural understanding. In a subsequent reflection, students were asked to self-assess improvement of their chosen attributes. Results showed that while the teaching staff judged that the students had further developed the competencies, students lacked a framework to see this for themselves and reported difficulty in reflecting on progress in professional competency attainment. This suggests that a more holistic approach should be taken earlier in the degree to focus student attention on professional competencies, and provide ongoing experience reflecting on progressive achievement.

Session S1D: What engineering interests and engineering skills can be nurtured through outreach programs?

Chair: Bernardo Leon de la Barra, University of Tasmania

Time: Saturday, October 15, 2011, 8:00 a.m. - 9:30 a.m.

Holiday Inn Room Salon F

WORK IN PROGRESS - UNITED STATES COAST GUARD ACADEMY ROBOTICS ON WATER COMPETITION AS RECRUITING TOOL – PROGRAM ENHANCEMENT FOR STEM & DIVERSITY OUTREACH

Brian Maggi, Hudson Jackson, Kassim Tarhini and Jonathan Russell

Over the past two years, the United States Coast Guard Academy developed and implemented a one-day hands-on Coast Guard Academy Robotics On Water program (CGAROW). The program is gaining national attention because of its success in recruiting a diverse group of students interested in pursuing Science, Technology, Engineering and Math (STEM) careers in the Coast Guard. In order to meet the growing interest from high schools to host the program, USCGA is standardizing the materials and equipment used in order to make them readily available. Furthermore, to advance CGAROW's role as a STEM outreach program, educational materials are being developed to reinforce STEM concepts within the current middle and high school curricula. The authors discuss the ongoing enhancement of the CGAROW program, its standardization and curriculum development.

WORK IN PROGRESS - INTRODUCING SOLAR ENERGY ENGINEERING IN AN AUSTRALIAN MIDDLE ELEMENTARY SCHOOL

Bernardo Leon de la Barra and Karen L. Wilson

This paper describes preliminary results in the development and implementation of a new inquiry- and standards-based solar energy unit for a grade 3/4 composite class at an elementary school in Hobart, the capital city of the state of Tasmania, Australia. This new unit is being developed in close cooperation between an experienced elementary classroom teacher and an engineering lecturer who is actively involved in a number of K-12 collaborative partnerships that seek to excite students about their learning experiences in the STEM (Science, Technology, Engineering, and Mathematics) fields. As part of the 2011 delivery of the new solar energy unit, the research team has explored elementary students' perceptions of science, scientists and technology by using the Draw-a-Scientist-Test (DAST). Later this year, the Draw-an-Engineer-Test (DAET) will also be administered. The conference presentation will include the results of applying the DAST before and after the delivery of the new solar energy unit. It will also describe the hands-on activities and teaching resources developed through this partnership, and provide a reflective account on how such a partnership provided students with rewarding learning experiences in Solar Energy Engineering. The work to be presented at the conference will not only appeal to those with an interest in how some key central ideas in Solar Energy Engineering can be introduced at mid-elementary level but to anyone who is interested in productively engaging with schools and teachers with a focus on the STEM fields.

WORK IN PROGRESS - THE ROD-SPRING APPROXIMATION: AN INTUITIVE APPROACH TO THE BEST-FIT LEAST-SQUARES LINEAR APPROXIMATION

Steven Gutstein, Eric Freudenthal, Ali Jamal-Kamali, Vladik Kreinovich and David Morgenthaler

Best Fit Least-Squares (BFLS) is a required technique for many STEM subjects. It is a method to compute a linear model for a set of data points. Due to its utility, BFLS is frequently taught to STEM students before they have sufficient mathematical experience to follow the mechanics of a derivation. Not only does this fail to produce procedural and conceptual understandings, but also it encourages students to view formulae and algorithms as things to be looked up, rather than derived. This discourages students from developing productive dispositions. In this paper, we describe the "Close Fit Rod-Spring" (CFRS) approach to the problem. This approach computes the resting position of a rigid rod, which is connected by vertically oriented springs to a set of data points. This method of derivation results in two linear equations that may be solved for the slope and intercept of the best fit line. The result is equivalent to BFLS. However, it is achieved in an intuitively understandable and mathematically accessible way for high school students.

WORK IN PROGRESS - COMPUTING FOR MIDDLE-SCHOOL STUDENTS: THE EXPERIENCE OF TEACHING COMPUTERS FOR 7TH GRADE STUDENTS

Simona Doboli

Number of college students in computing has declined since 2000 by more than 70%. Women and minorities are highly underrepresented. Students are exposed to computing education late in high-school or in college. At that point, the population sampling is already geared towards students already interested in computers. This approach results in the small number of students and more importantly in the low demographics diversity. Exposure to computing principles needs to start at a much younger age in order to spark interest in a larger and more diverse student body.

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This work in progress paper describes the experience of a new computing course for 7th grade students. The novel component of the course consists in the robotics projects inspired by biological or artificial characters that seem to motivate students independent of gender.

AFFORDABLE K-12 ROBOTICS PROGRAMS

George (Mangnan) Tan, Eric Levy, Richard Gale, Tanja Karp and Alan Barhorst

This paper describes the history of GEAR, BEST Robotics and FIRST Robotics in West Texas and analyzes the relative benefits of these programs. We feel that the best case scenario includes both types of programs so that widespread involvement can be achieved cost-effectively through GEAR and BEST and that a more sophisticated level of involvement is available to those with the interest and aptitude through FIRST.

Session S1E: Mobile and Authoring Instructional Technologies

Chair: Chiu Choi, University of North Florida

Time: Saturday, October 15, 2011, 8:00 a.m. - 9:30 a.m.

Holiday Inn Montana Room

SHERPA: A MOBILE APPLICATION FOR STUDENTS AND EDUCATORS IN THE CLASSROOM

Dino Schweitzer and Scott Teel

Mobile computing is becoming ubiquitous across many areas including education. Many of the education-based applications are targeted toward the student as the end-user and trying to create a more effective educational environment using mobile technology. At our institution, we are investigating such applications, but wanted to look at tools focusing on the educator as well as the student. In this regard, we have developed and are testing a mobile productivity tool, SHERPA, for use by both the student and the instructor in the classroom. It is designed to assist the instructor in a number of administrative classroom activities and facilitate instructor-to-instructor communication. Student functionality includes the ability to interact with the instructor and other students, arrange collaborative meetings, and provide feedback on lectures. SHERPA is designed with a cloud computing architecture and attempts to leverage information sharing between instructors with common students. SHERPA was initially developed and tested in Fall semester 2010 with more extensive evaluation in the Spring 2011 semester. User feedback is very positive. This paper will describe SHERPA's functionality and design, its use in the classroom, instructor experience and feedback on the tool, and future plans.

WORK IN PROGRESS - AN IMMERSION COURSE CONCENTRATION IN MOBILE WEB COMPUTING

Carol J Romanowski, Rajendra K Raj and Minseok Kwon

In the modern world of computing, diverse mobile devices connect to the internet and typically share data stored within the cloud. To live and succeed in this world, it is imperative that all majors, especially engineering majors, have an in-depth, not introductory, understanding of topics in mobile web computing. This paper explores the design and development of an immersion concentration of courses in these topics as part of general education at our institution. The concentration consists of courses that introduce hands-on programming of mobile devices; the issues in and the impact of architectural and distributed computing; and finally secure data management, privacy, and legal issues in mobile web computing. All of these courses focus on developing critical thinking, modern communication, contemporary issues, and life-long learning issues in the context of hands-on mobile computing. This work-in-progress paper motivates this effort, discusses the main features of the proposed courses, outlines some of the challenges being faced, and summarizes the current status of this ongoing effort.

TIMELINE-BASED AUTHORIZING TOOL FOR E-TEXTBOOK: BRINGING THE "MIND-MAPPED LEARNING MODEL"

HeeJeong Lee, TeongJoo Ong and Christopher Hugh Messom

This paper describes a novel and interactive tool for teaching and learning (the Time Evolution Learning Tool: TimeBook) that allows teachers and students to generate the e-Textbook or e-book. Recently, there is an increase in the usage of e-books in the pedagogical context, however not many attempts have been made to embed temporal related information into the content generation in e-books. The temporal information can be valuable for curriculum planning and learning, for readers and users may easily contrast and observe the evolution of a concept over a timeline. In this research, we used a "Time Evolution" concept in creating e-books for the school curriculum. A prototype is implemented and we performed a user study to investigate its efficiency in content creation and learning. The results show that this new tool has the potential to enhance teaching and learning approaches.

WORK IN PROGRESS - THE ICOLLABORATE MSE PROJECT

Kathleen L. Kitto and Debra Jusak

The overall objectives of the research work in the iCollaborate MSE (Materials Science and Engineering) project are to measure if improvements in student learning outcomes, student engagement, and successful course completion are

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possible if the structure in basic materials engineering courses is transformed from primarily deductive practice to an Information Communication Technology (ICT) enabled inductive teaching and learning environment. The specific innovations that are proposed in the project are the development of MSE education applications for the iPod Touch, which facilitate and support collaborative learning opportunities, by targeting specific student learning objectives that are known to be challenging for many students in basic MSE courses. We are studying whether the combination of specific learning objective targets, completed in collaborative groups, and supported by conceptually contained data, visuals, audio, and information from the iPod Touch, will lead to specific improvements in learning outcomes for students. The purpose of this work-in-progress paper is to describe the initial suite of iPod applications that have been created, the challenges faced in the development of them, and the observable differences in collaborative experiences of the students with and without the devices.

WORK IN PROGRESS - A BLENDED MOBILE LEARNING CONTEXT ORIENTED MODEL APPLIED TO AN INFORMATION SYSTEMS UNDERGRADUATE DEGREE CURRICULUM

Fernando Moreira and Maria Joao Ferreira

The increasing number of mobile devices on day-to-day of the general population and particularly among youth people, leads to the emergence of new paradigms in several areas of activity, particularly in education. As an example of a new paradigm in the teaching / learning process can be invoked the mobile learning, such as technologies did not stop and progressed to become part of the Blended Mobile Learning (BML) model. In this paper and in the context of three-year courses Bologna Process European Degree structure at school, in Portugal, following the Curriculum Guidelines for Undergraduate Degree in Information Systems from ACM/AIS, we intend to test Mobile Google Docs system in our BML Context Oriented (BML-CO) model into an Information System course.

Session S1F: Stories about Engineering Students: Interest, Success, Career Transitions

Chair: Stephanie Adams, Virginia Polytechnic Institute and State University

Time: Saturday, October 15, 2011, 8:00 a.m. - 9:30 a.m.

Holiday Inn Private Dining Room

WORK IN PROGRESS - ENGINEERING PATHWAYS STUDY: THE COLLEGE-CAREER TRANSITION

Sherri Sheppard, Holly M. Matusovich, Cindy Atman, Ruth A. Streveler and Ronald L. Miller

Research in engineering education has shown that academic programs are often designed based on a projected image of engineering practice. However, this image may be outdated or misaligned with today's actual professional work. To develop a more complete picture, we designed the Engineering Pathways Study (EPS). EPS extends findings from the NSF-funded Center for the Advancement of Engineering Education (CAEE), and in particular findings from CAEE's multi-method, multi-institutional Academic Pathways Study (APS) research project. Following-up with participants from APS, we are uniquely positioned to explore transitions to the workforce and the needs/experiences of early career professionals (ECP). Over a period of two years, our sequential mixed-methods design uses outcomes from in-depth interviews to develop a survey for a broader sampling. Currently in early phases of interviews and analysis, preliminary findings highlight connections and gaps between current career experiences and academic career preparation.

WORK IN PROGRESS - THE AGE OF APATHY: REIGNITING ENGINEERING EDUCATING

Elif Eda Miskioglu

The last several decades have seen great changes in education. Technology has altered both the way we teach and learn. Students today are cited as being no less inherently intelligent than their peers of the past but as being much less focused and much less capable of the inductive thinking required for innovation. The attitude has shifted from needing to understand the basics to relying on technological resources to provide the answers. The result is students who are able to solve problems more efficiently than 30 years ago but who lack the understanding necessary to distinguish between reasonable and unreasonable findings. While faculty are finding fault in the unfocused student, students feel neglected by the faculty. As university priorities shift from education to innovation in pursuit of research funding, students suffer from inattentive professors. Between running a quality laboratory, applying for grants, and publishing papers, faculty have little time left to devote to the other portion of their job—teaching. This lack of time results in uninteresting lectures, unattended office hours, and a growing gap between students and instructors. As learning becomes less personal, interest and motivation fade, compounding the effect of any potential technology-induced attention problems.

WORK IN PROGRESS - ASLEEP IN CLASS ARE THE SCHEDULES OF COLLEGE STUDENTS HAMPERING THEIR ABILITY TO LEARN?

Maurice Baynard and Donald McEachron

Irregular sleep schedules, circadian desynchronization and sleep loss are all known to affect human cognitive

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performance and emotional stability. In addition, a number of environmental factors, including temperature and ambient light levels, can also contribute to alertness and neurobehavioral performance. In these studies, data were collected on the sleep patterns of university students and the ambient conditions in classrooms, dormitories and other academic environments to which these students were habitually exposed. Thirty-eight engineering undergraduates were monitored using wrist actigraphy to measure sleep, waking and light exposure. Data were collected in 14-day increments and repeated three times during a college term. Preliminary analyses have been performed to characterize the habitual sleep and circadian conditions experienced by these subjects. Results suggest that college students are following sleep/wake schedules detrimental to the acquisition and retention of learned material. In effect, students may be subjected to schedules and lighting that physiologically impaired their ability to perform to high academic standards.

IT'S NOT WHAT YOU THINK: A THEORY FOR UNDERSTANDING THE LACK OF INTEREST AMONG DOMESTIC STUDENTS IN THE ENGINEERING PHD

Michelle C. Howell Smith, Amanda L. Garrett, Ellen Weissinger and Namas Chandra

We live in a fast-paced world surrounded by technological advances. Engineers with advanced skills perform important functions in our society. However we know very little about how engineers consider obtaining advanced education and skills. The purpose of this study is to understand and develop a theory explaining the process domestic engineers undergo in developing an interest in obtaining a PhD in engineering. Our research was guided by the following central research question: What is the theory that explains the process of developing interest in doctoral-level engineering education for engineers? We used qualitative, grounded theory methods, to investigate the process of advanced engineering education interest. Interview data were collected from undergraduate engineering students, doctoral engineering students, engineering faculty, and engineers in industry with PhD degrees from seven institutional sites. Our theory explains that misperceptions, personal characteristics, and environmental elements are part of engineers' interest in advanced education. Engineers must be exposed to these factors and must also actively process this information to develop interest. This theory provides a framework for understanding and promoting doctoral education for engineers. Implications for educators are offered.

WORK IN PROGRESS - PREPARATION CREATING EFFECTIVE FACULTY OF ENGINEERING: A TECHNOLOGICAL LITERACY APPROACH

Mani Mina, Diane Rover and Mack C Shelley

This paper reviews the framework and provides new result for the implementation of a new program designed to develop more effective future faculty in engineering. The core of the proposed program will be based on our efforts regarding the recently developed Minor in Engineering Studies (MES). This program will team up effective engineering faculty to train, mentor, and evaluate a select group of graduate students to teach classes in our MES program. The goal is to help the engineering graduate students (the graduate educators) become better communicator and better educators by training non-engineering students in technological literacy classes. This practice is being introduced as a possible venue to develop and enhance the effectiveness of the graduate educators as classroom instructors and that therefore this is the way to train effective future faculty in engineering. This paper will introduce new results, and describe the new findings and developments in this project. In this paper we introduce the conceptual framework of the MES and the results of the early implementation of this study

Session S1G: Technologies and Quality Assurances: Approaches to Improving Engineering Education across the World

Chair: Claudio da Rocha Brito, Science and Education Research Council

Time: Saturday, October 15, 2011, 8:00 a.m. - 9:30 a.m.

Holiday Inn Hammons Room

USE OF LMS FUNCTIONALITIES IN ENGINEERING EDUCATION

Martin Llamas-Nistal, Manuel Caeiro-Rodríguez, Manuel Castro, Inmaculada Plaza-Garcia and Edmundo Tovar-Caro

This paper shows the partial results of a survey sent to all the members of the IEEE Education Society around the world about some aspects on the use of Learning Management Systems (LMSs) in Engineering Education. The main interest of this study was to learn how e-learning functionalities were being used in the field of engineering education. The study covered the most commonly used LMSs, their main functionalities (Content Delivery, e-mail, Tasks-Exercises, Forums, Mailing lists, Exams, Self-assessment, Surveys, Groupwork, Chat, Calendar, FAQs, Wikis, Blogs, Glossaries, Videoconference, Notebook, Whiteboard, Learning Paths, Student Portfolio, Podcast, Student Tracking, and Vodcast), and aspects of their use, such as knowledge levels, training, patterns of use, perception of training proficiency, usefulness, learning curve; teachers' perceptions of the students' use of the different functionalities; institutional support; exams tools, and finally, the main advantages and disadvantages of e-learning

use. The objective of this paper is to show the main results of this survey in the use of LMSs, and therefore to contribute to a reflexive debate in the international community about e-learning functionalities.

WORK IN PROGRESS – EXPLOITING VIDEOCONFERENCING POSSIBILITIES TO PROMOTE THE EUROPEAN CONVERGENCE PROCESS

Enrique Barra, Sandra Aguirre and Juan Quemada

This paper introduces the experience of using videoconferencing and recording as a mechanism to support courses which need to be promoted or discontinued within the framework of the European convergence process. Our objective is to make these courses accessible as live streaming during the lessons as well as recorded lectures and associated documents available to the students as soon as the lesson has finished. The technology used has been developed in our university and it is all open source. Although this is a technical project the key is the human factor involved. The people managing the virtual sessions are students of the courses being recorded. However, they lack technical knowledge, so we had to train them in audiovisuals and enhance the usability of the videoconferencing tool and platform. The validation process is being carried out in five real scenarios at our university. During the whole period we are evaluating technical and pedagogical issues of this experience for both students and teachers to guide the future development of the service. Depending on the final results, the service of lectures recording will be available as educational resource for all of the teaching staff of our university.

LEADING CHANGE IN THE INTERNAL QUALITY ASSURANCE SYSTEM IMPLANTATION OF A EUROPEAN TECHNICAL UNIVERSITY

Edmundo Tovar, Gonzalo Carrillo and Jose Domingo Carrillo

The Universidad Politécnica de Madrid's School of Computer Engineering is implementing its internal quality assurance system from European directives and other sources, quality policies, and its underlying process map. One the main success critical factor implementing these processes is to obtain a real involvement of the different stakeholders. Change management is a good practice used in organizations as a way to provide a detailed road map, with caution signs pointing out the potential dangers. This paper presents the adaptation of a change management methodology to technical universities and explains the road explored implementing a key strategic process as the educational program improvement review process. We show, as an example, success results about of how a student workload study is developed and used.

GIFT YOUNG ENGINEERS: AN EXTRA-CURRICULAR INITIATIVE FOR UPDATING COMPUTER AND ELECTRICAL ENGINEERING COURSES

Vicente Ferreira de Lucena Jr, Jose Pinheiro de Queiroz Neto, Joao Edgar Chaves Filho, Waldir Sabino da Silva Junior and Lucas Carvalho Cordeiro

The curricula of engineering courses are well defined by the central government for all Brazilian universities. Indeed, there are some mandatory determinations that must be fulfilled prior to the accreditation of any engineering course in Brazil. Modifications must be submitted for evaluation beforehand, resulting in a process that sometimes takes years to be approved. That is a secure way to guarantee that the fundamentals of each engineering program will be part of the students' carrier all over the country, and at the same time a problem when you need to introduce new technological subjects. That poses a problem when you have new demands for technological curricular components that could express the actual state of the art of modern subjects. Trying to solve these issues some professors from the Federal University of Amazonas developed a flexible extra-curricular program for electrical and computer engineering courses, named Gift Young Engineers. This paper describes the philosophy of these extra-curricular programs. Some examples of successful particular partnerships are also discussed. Indeed the proposed training programs for Digital TV Systems (hardware and software) will be presented and analyzed in details. The obtained results will also be discussed in order to contribute to similar experiences worldwide.

TEACHING MOBILE SOLUTION DEVELOPMENT IN A GLOBAL CONTEXT: COMPARING SOLUTIONS PROPOSED BY STUDENTS IN THE DEVELOPED AND DEVELOPING WORLD

Christelle Scharff, Jean-Marie Preira, Roslyn Kay and Serene Hang Su

This paper presents and reflects on the different approaches of teaching mobile solution development at Pace University in the US and in different universities in Senegal in the last three years. The evolution of the objectives, contents, and targeted mobile technologies of the different courses are described based on our lessons learned and the state-of-the-art technologies and practices used in the industry. Students developed mobile solutions aimed at improving life on campus in the US and in Senegal, sometimes collaboratively. These initiatives permitted us to do a cross-cultural exploration of what students saw themselves as needing and how mobile technology can meet these needs given the nature of the specific and local constraints of their institutions, infrastructures, and cultures. This paper summarizes the findings of this exploration and presents recommendations for faculty interested in teaching

mobile solution development in a global context.

Session S1H: Promoting Female and Minority Engineering Students

Chair: Jim Borgford-Parnell, University of Washington

Time: Saturday, October 15, 2011, 8:00 a.m. - 9:30 a.m.

Holiday Inn Room Salon BC

CONFLICTED IDENTITIES AND SEXISM IN COMPUTING GRADUATE PROGRAMS

Joanne McGrath Cohoon, Monica Nable and Paul Boucher

Stereotypes about women's place among creators of technology still exist. As a result, women engineers and computer scientists must find ways to manage the conflict between their identities as women and as creators of technology. Many women manage the conflict by hiding or denying their feminine identity. We found that this strategy becomes particularly evident when discussing experiences of sexism. Focus groups with women graduate students identified many instances of sexism, but found that women tended to deny or ignore the sexism. Because sexism communicates the view that women do not fit in the culture of computing, it increases the difficulty of combining a feminine gender identity with a technical identity. Many women try to meet this challenge by minimizing their femininity, or acting like one of the guys. These coping strategies may be effective for enabling individual persistence, but they permit persistence of an inhospitable environment. Adopting practices known to reduce the incidence of sexism and mitigate its negative impact could help retain women graduate students in computing.

ENGINEERING SELF-EFFICACY OF WOMEN ENGINEERING STUDENTS AT URBAN VS. RURAL UNIVERSITIES

K.L. Jordan, Sheryl Sorby, Susan Amato-Henderson and Tammy Haut Donahue

For more than two decades researchers have addressed gender issues in engineering. Efforts such as Engineer Girl (www.engineergirl.org), a website dedicated to increasing young girls' interest in pursuing an engineering degree, address the engineering "diversity gap". Potential improvements exist for increasing the number of women pursuing engineering careers, such as increasing their engineering self-efficacy. Engineering self-efficacy refers to a person's belief that he or she can successfully navigate the engineering curriculum and eventually become a practicing engineer. It encompasses self-efficacy, feeling of inclusion, and outcome expectations. A longitudinal multi-institutional study conducted by Marra and Bogue indicated statistically significant differences for female engineering students with respect to the coping, mathematics, and self-efficacy subscales. The authors wish to explore whether institutional setting (urban vs. rural) accounts for differences in female students' engineering self-efficacy.

WORK IN PROGRESS - ASSESSING AND EVALUATING MENTORSHIP PROGRAMS AFFECTING STUDENTS RETENTION AT THE UNIVERSITY OF MARYLAND BALTIMORE COUNTY IN MECHANICAL ENGINEERING

Jamie Gurganus and Anne Spence

Two well-known mentoring/scholar programs at the University of Maryland Baltimore County, demonstrate themselves to be observably effective in retaining STEM students. These programs include the Center of Women and Information Technology and the Meyerhoff Scholars program. Recent data from the Office of Institutional Research and Advancement at the University comparing males and females in the department of mechanical engineering showed females are retained at higher rates than males. A short term qualitative and quantitative analysis is being used in this study to assess and evaluate the underlying facets that motivate women and men to continue in mechanical engineering. Utilizing researched driven existing evaluative tools, a well-defined themed survey will be created to assess each of these programs in their mentoring ability based on the mentees of the program. The goal is to administer the survey to undergraduate men and women (freshman – senior) mechanical engineers, affiliated and non-affiliated with the programs. Interviews are currently being conducted giving profound understanding to identify the facets that make these mentorship programs successful or ascertain the external influences. Each of these programs has, to include mentoring in the department, small significant variations in mentorship.

WORK IN PROGRESS - MODELING ACADEMIC SUCCESS OF FEMALE AND MINORITY ENGINEERING STUDENTS USING THE STUDENT ATTITUDINAL SUCCESS INSTRUMENT AND PRE-COLLEGE FACTORS

Joe J. Lin, P.K. Imbrie, Kenneth J. Reid and Junqiu Wang

Female enrollment in engineering in the United States has remained at or below 20% for decades. Enrollment of students from traditionally underrepresented groups has also remained below desired level for years. A systematic understanding of important factors leading to persistence and success in undergraduate engineering programs for

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female and underrepresented minority students would be very valuable for recruiting, retaining and educating young engineers with diverse perspectives. This paper discusses the significant predictors for retention and academic performance of female engineering students, and reports the difference in comparison with male engineering students. Similar results on the important predictors for retention and performance of underrepresented minority engineering students will also be reported and compared with the ethnic majority students. The findings from this study suggest it is potentially advantageous to develop student success models specific for female or minority engineering student populations, rather than using the same model developed for the whole population. New knowledge obtained through this study will lead to the development of necessary strategies, interventions or programs to help improve retention and academic success of our engineering students.

WORK IN PROGRESS - REPORTING S-STEM RETENTION: NEW DIVERSITY VS. SUPPORTING EXISTING DIVERSITY

Mary Virnoche and Elizabeth A. Eschenbach

The Scientific Leadership Scholars (SLS) Program is an NSF S-STEM sponsored scholarship for financially and academically eligible students in Computer Science, Environmental Resources Engineering and Mathematics at Humboldt State University. The scholarship has sponsored 57 students in these majors over the past 4 years. Of these students, 54% were underrepresented minorities and 70% were underrepresented in STEM. The first group (Group 1) of students recruited to the program brought additional diversity to the three academic programs. To fill the spots vacated by SLS students who no longer met the requirements of the SLS program after their first or second years, additional SLS students were recruited from existing CS, ERE and Math majors. This second group (Group 2) drew from existing diversity in the three SLS programs. The retention outcomes of these two groups are quite different due to the nature of the populations. As far as the authors know, no other work has operationalized the concept of supporting existing diversity in this way.

Session S2A: Mini Workshop - Aligning Content, Assessment, and Pedagogy in the Design of Engineering Courses

Chair: Karl A. Smith, Purdue University

Time: Saturday, October 15, 2011, 10:00 a.m. - 11:30 a.m.

Holiday Inn Room Salon D

MINI WORKSHOP - ALIGNING CONTENT, ASSESSMENT, AND PEDAGOGY IN THE DESIGN OF ENGINEERING COURSES

Ruth A Streveler, Karl A Smith and Mary K Pilotte

The purpose of this workshop is to introduce participants to the integration and alignment of content (or curriculum), assessment, and pedagogy (or instruction) for learning module, course, and program design and provide some essential methods for designing courses and curricula in this way. Rather than treat each of these areas separately, this workshop strives to help participants consider all three elements together in a systematic way. The workshop framing is an engineering design approach, that is to say, it begins with requirements or specifications, emphasizes metrics, and then evolves into preparation of prototypes that meet the requirements. Participants interested in developing rationale, and learning and practicing a model of how to align course content with assessment and pedagogy that they can use to inform the design or re-design of engineering courses are encouraged to attend.

Session S2B: Creativity in the Classroom

Chair: Gisele Ragusa, University of Southern California

Time: Saturday, October 15, 2011, 10:00 a.m. - 11:30 a.m.

Holiday Inn Room Salon E

WORK IN PROGRESS - STRUCTURAL ART: ENCOURAGING STUDENT CREATIVITY AND ARTISTIC EXPRESSION

Andrew T. Rose

A series of assignments were incorporated into a structural analysis course to encourage student creativity and help develop an appreciation for aesthetics and artistic expression in engineering design. Selected reading assignments and web research were combined with a culminating exercise to create and display a piece of artwork influenced by or related to structural design. Student feedback on the activity provided data on the various aspects of the assignment as well as suggestions for improvement.

A SOCIAL-BASED META-MULTIDISCIPLINARY FRAMEWORK TO MOTIVATE THE CREATION OF A NEW GENERATION OF ELECTRONICS 2.0 SYSTEMS

Cesar Cardenas

In a previous work, we published multidisciplinary experiences on teaching the design of electronics 2.0 systems for

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social change. In this paper we present the latest changes done in our framework. The most important change currently is the inclusion of a new course from the business creation and development academic program. Previous experiences have been considered only computer-related engineering and industrial design students. This new step presents improvements in our previous process. Since the new included academic program has the objective to graduate students with an enterprise, the integration of our previous experience and this new academic program is a win-win junction to achieve that goal. The main objective is to create a new generation of electronics products that adds social capital to the society through its use. This approach to promote the entrepreneurship spirit in our undergraduate students can be considered as pragmatic since students from electronic engineering and industrial design are not following a formal entrepreneur education. We will present the results of surveys that take into account several institutional criteria.

DEVELOPING THE NEXT GENERATION OF ENTREPRENEURS

Edward H Currie, Simona Doboli and Gerda L Kamberova

It is clear that much of the world's technological innovation originates from the domain of the startup, an arena in which the United States has historically played a major role. However, while business and other schools have traditionally offered courses in entrepreneurship, only about one third of all new businesses ever reach profitability and less than half of all new startups survive more than five years. Much of the attrition of small businesses is a result of poor preparation of the founders and the failure of academia to treat entrepreneurship as something more than a purely academic subject. A new program at Hofstra University focuses on a fresh approach to preparing Computer Science and Engineering students in entrepreneurship by providing a curriculum specifically designed to meet the myriad challenges encountered by entrepreneurs in the "real" world.

ASSESSING CREATIVITY PRACTICES IN DESIGN

Guy-Alain Amoussou, Michael Porter and Steve J. Steinberg

As part of a National Science Foundation initiative involving the Science of Design (SoD) and specifically the grant CNS-0614003, a survey was developed to measure the current level of the incorporation of creativity-promoting factors in computer science and engineering curricula in California institutions of higher learning. In some areas such as interdisciplinarity, evaluation of creative work goal setting or model creative behavior, faculty seem to be doing adequately in training the computer scientists and engineers of the future to be creative professionals. However, in other areas such as training in social-psychological processes that affect group creativity they are not. Several recommendations to faculty are provided and discussed.

WORK IN PROGRESS – UNDERGRADUATES AND INTELLECTUAL PROPERTY: TRENDS, POLICIES, AND PRACTICES

Nathalie Duval-Couetil and Brandon Barrett

Undergraduate students are increasingly engaged in developing products, technologies, and services that are commercially viable through their involvement in courses and experiential programs focused on entrepreneurship and product design. Little is known about the degree to which these activities are creating protectable intellectual property (IP) or the degree to which student involvement in these activities is aligned with university policies and practices. This work in progress describes the rationale behind a survey that will be administered to university technology transfer offices to understand trends in the level of undergraduate involvement in IP protection, common institutional policies and practices, suggestions on how policies can be improved, and to what extent this differs based on institutional characteristics. Ultimately, the purpose is to understand the degree to which IP policy, and an institution's implementation and communication of it, hinders or fosters entrepreneurial activity among undergraduate students.

Session S2C: Professional Skills Beyond Teamwork and Communication

Chair: Odesma Dalrymple, Arizona State University at the Polytechnic campus

Time: Saturday, October 15, 2011, 10:00 a.m. - 11:30 a.m.

Holiday Inn Room Salon A

ENGINEERING POSITIVE ORGANIZATIONAL BEHAVIOR AND MANAGING THE PSYCHOLOGICAL CAPITAL FOR LEARNING EFFECTIVENESS

Hamid Khan

Social Intelligence has been a living concept for quite some time as an offshoot of Emotional Intelligence and has been used in engineering. Its usefulness in individual context has found several applications in developing individual effectiveness. Several researchers have expanded the concept to organizational development, and organizational effectiveness using modern concepts of Positive Organizational Behavior (POB). The POB has been derived from Psychological Capital and Psychological Ownership. These have been useful for implementing organizational

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development. POB and Social Intelligence studies in engineering classroom setting are important to today's engineering leadership development. This paper examines the intended outcomes of an Organizational Behavior (OB) course in shaping Positive Organizational Behavior (POB) using different tools-- Authentic Leadership Questionnaire (ALQ), Psychological Capital Questionnaire (PCQ), Psychological Ownership Questionnaire (POQ), which were administered as pre and post semester basis. An analysis of result has been provided that can be directly attributed to the effects of carefully designed interventions in the course.

WORK IN PROGRESS - ASSESSING INFORMATION LITERACY IN CIVIL ENGINEERING

Hudson Jackson, Nathan Rumsey, Patricia Daragan and Sharon Zelmanowitz

Although information literacy is not specifically mentioned in the ABET outcomes, the development of these skills is essential to the achievement of several outcomes. Civil Engineering faculty at the United States Coast Guard Academy (USCGA) have developed performance indicators and assessment tools under existing ABET outcomes designed to develop and improve student information literacy skills. The link to ABET specific outcomes enables students to see the connection between information literacy and their ability to engage in lifelong learning, to follow contemporary issues, and to use modern information technology tools in their engineering work. The authors discuss steps taken at the USCGA to evaluate aspects of information literacy within the current assessment process in the Department of Civil Engineering.

INTRODUCING "SUSTAINABILITY AND SOCIAL COMMITMENT" SKILLS IN AN ENGINEERING DEGREE

David Lopez, Fermin Sanchez, Jordi Garcia, Marc Alier, Jordi Piguillem and Martha Velasco

This paper presents a proposal to develop "Sustainability and Social Commitment" skills (SSC) in engineering degree curricula. The proposal is based on providing general education in SSC to teachers (in particular, the relationship between SSC and their field of knowledge) and SSC-related material for each subject, as well as developing learning and assessment methods for these skills. Unlike other proposals advocating the existence of a few specific subjects that include SSC, the authors propose to integrate these skills into different subjects throughout the curriculum. The existence of a global mechanism for the coordination and assessment of SSC skills is also proposed. Finally, the paper explains the introduction of SSC into the Barcelona School of Informatics Computing Engineering Degree at the Technical University of Catalonia (UPC-BarcelonaTECH), providing examples of how to deal with SSC within the subjects of the degree. While the experience is based on a Computing Degree, the ideas and methodology can be extended to other technical studies.

WORK IN PROGRESS - A GRAND CHALLENGE LEADERSHIP COURSE FOR ENGINEERING STUDENTS

J. Elaine Seat, Christopher D. Pionke and J. Roger Parsons

At the University of Tennessee, The Grand Challenge Scholar program operates in conjunction with the Honors Engineering Leadership minor (HELM) and emphasizes leadership training as part of interdisciplinary coursework preparing engineering students to work at the boundaries of their profession with business, entrepreneurship, ethics, and human behavior. We have formed a partnership with the Department of Management, College of Business Administration, to assist in developing this interdisciplinary leadership training for engineering students. In response to the question of how Leadership Development could be customized based on student differences by major, a brief analysis of leadership skills was conducted. This analysis includes comparison of the overall reported Master and Needs Work skills between UT-CBA and UT-COE students. Observable differences and similarities in Management and Engineering student leadership skills are discussed as well as implications for designing leadership activities for engineering students.

SYNERGIES AND OPPORTUNITIES BETWEEN ENGINEERING AND LAW

Ladimer S. Nagurney

The Engineering and Legal professions are regularly portrayed as diametrically opposite. This portrayal is based upon the perception that attorneys deal mostly with words and engineers with numbers. However, the skills necessary for success in either profession are actually quite similar. Both professions require the ability to synthesize information and make decisions among multiple feasible outcomes with uncertain information. The Briggs-Myers Type Indicator, INTJ, is the same for Engineers and Lawyers. This paper is to look at the synergies and opportunities between the professions, their preparation, accreditation and outcomes. It will compare the American Bar Association Core Skills and Values to the ABET Program Outcomes. It will identify of legal topics that might be included in an engineering curriculum and suggest an implementation.

Session S2D: Assessing and Developing Engineering Attitudes and Skills in K-12

Chair: Larry G. Richards, University of Virginia

Time: Saturday, October 15, 2011, 10:00 a.m. - 11:30 a.m.

Holiday Inn Room Salon F

AN EXPLORATORY EVALUATION OF AN ELEMENTARY MATHEMATICS AND SCIENCE ATTITUDE SURVEY

Tonya Lauriski-Karriker, Anna Forssen and Barbara M. Moskal

Researchers have found that students in the United States display little interest in mathematics and science as early as the sixth grade. Multiple studies have established that elementary students' interest in these subjects is not only low but also decreases further throughout middle school and high school. Few studies have investigated students' interest in mathematics and science during the elementary years. Mathematics and science are essential subjects for future engineers and scientists, and the U.S. is experiencing a shortage in college students who are majoring in these fields. Understanding the attitudes of elementary students toward mathematics and science is essential to understanding the lack of interest students have in these subjects later in their education. This paper describes the development and the on-going validation of an assessment instrument that is designed to measure elementary student attitudes with respect to mathematics and science. Expert review and a factor analysis have been used in the development of the instrument, and subsequent results are reported. Additionally, this paper examines differences among elementary students' attitudes toward mathematics and science with respect to grade level and gender.

WORK IN PROGRESS - SOIL WATERING SYSTEMS AS TEACHING MATERIALS FOR TECHNOLOGY EDUCATION IN JUNIOR HIGH SCHOOLS

Yasumasa Oomori, Kan Nagai, Naoya Kawasaki and Hideo Nagumo

In March 2008, the Japanese government announced the revision of the teaching guidelines for junior high schools, which are to be fully enacted in April 2012. According to the new guideline for the subject of Technology Education, "measurement and control by programming", "growth of living things", and "energy transformation", which had previously been elective topics, are to become mandatory. Therefore, it will be necessary to develop compound teaching materials that can be used to teach these topics. In this research, we developed practical teaching material synthesizing these topics. The developed teaching material is an automatic watering system in which soil water is measured and used as feedback to control the watering mechanism. As a preliminary test before introducing this teaching material in junior high schools, we administered mock lessons to university students five times. The average scores for all the question items improved after the lesson, and the improvement was particularly remarkable for the questions about acquiring knowledge.

WORK IN PROGRESS - APPLICATION OF THE BOE-BOT IN TEACHING K12 ELECTRICITY FUNDAMENTALS

Heath E. Tims, Krystal Corbett, Galen Turner, David Hall and Davis Harbour

Louisiana Tech University has recently developed a curriculum (NASA-Threads) that integrates engineering, mathematics, and physics. The curriculum, which targets junior and senior high school students, uses hands-on projects that develop student ability to solve realistic multiple-step problems and bring excitement into the classroom. NASA-Threads integrates NASA applications, fundamentals, technology, and communication through hands-on projects that are enabled by an inexpensive micro-controller/robotic platform, the Parallax Boe-Bot. The Boe-Bot provides the enabling technology for projects throughout the course. The course is developed so that a natural progression of fundamental topics is presented. This paper provides clear examples of K12 projects that utilize the Boe-Bot for teaching electricity fundamentals.

MIDDLE SCHOOL GIRLS' PERCEPTIONS OF ENGINEERS BEFORE AND AFTER A FEMALE ONLY SUMMER ENRICHMENT PROGRAM

Linda S. Hirsch, Suzanne Berliner-Heyman, Rosa Cano, Howard Kimmel and John Carpinelli

The Center for Pre-College Programs at New Jersey Institute of Technology sponsors a series of summer programs designed to increase academically talented students' interest in the fields of science, technology, engineering and mathematics. One of the programs, Woman in Engineering and Technology, called FEMME, has been designed specifically for young women in an effort to increase the number of women interested in engineering and other technological careers. The programs span grades four to eight because middle school is not only an important time for all students to begin thinking about future careers, but because boys and girls do not differ much in technical abilities until the later high school years but rather in their attitudes toward technological careers including engineering. Single-gender programs like FEMME can be particularly effective in reaching young girls, influencing their attitudes before they reach high school. The Middle School Students' Attitude to Engineering, Science and Mathematics Survey and the Draw an Engineer Test have been used to more fully assess young women's perceptions

of engineers and what they believe engineers actually do, and how their perceptions may change as a result of attending the FEMME program.

Session S2E: Visualizing Future Instructional Technologies

Chair: Kenneth S. Manning, SUNY Adirondack

Time: Saturday, October 15, 2011, 10:00 a.m. - 11:30 a.m.

Holiday Inn Montana Room

WEB EDITING MODULE FOR TAGGING METADATA OF THE FEDORA COMMONS REPOSITORY LEARNING OBJECTS UNDER DRD AND LOM STANDARDS

Silvia Margarita Baldiris Navarro, Cecilia Avila Garzon, Paola Andrea Rivera Gonzalez, Juan Carlos Guevara Bolanos and Ramon Fabregat

Nowadays there is a large and increasing body of learning objects stored on the Web. Some of them reside in different learning repositories, such as the MERLOT repository [1], the Education Network Australia (EDNA) [2], and the Connexions repository [3]. Fedora is an acronym for Flexible Extensible Digital Object Repository Architecture [4]. Fedora's flexibility makes it capable of serving as a digital repository for a variety of use cases, including digital asset management, institutional repositories, digital archives, content management systems, scholarly publishing enterprises and digital libraries [5]. Many universities and companies around the world are using Fedora as a valid approach to manage their increasing knowledge. This document proposes an extension of the Fedora Commons repository which is composed by: A web editing module based on the ISO/IEC 24751-3 Digital Resource Description (DRD) [6] standard in order to label learning objects from the Fedora repository to provide them with accessible characteristics and on the other hand a web editing module to label learning objects from the Fedora Repository based on the IEEE Learning Object Metadata (LOM) [7] standard. Our approach offers institutions the possibility of labelling their learning objects in an accessible way, in order to facilitate the process of delivering the educational resources and the adaptive instructional design adjusted to the special needs of users. Our approach offers institutions the possibility of labelling their learning objects in an accessible way, in order to facilitate the process of delivering an adaptive instructional design adjusted to the special needs of users.

PREPARING FOR FUTURE DATA CENTER PROFESSIONALS: INTEGRATING STORAGE TECHNOLOGY INTO THE COMPUTER INFORMATION TECHNOLOGY CURRICULUM

Wei Hao, Hetal Jasani and Traian Marius Truta

Information brings economic value to the customers and data is the "soul" of the enterprise. Data centers are playing more and more important roles in the enterprises. Storage technology is one of the fundamental technologies behind data centers. The storage knowledge and skills are needed for data center professionals. Thus, we have developed a new course, Storage Administration, for Computer Information Technology (CIT) major students at Northern Kentucky University (NKU). Since our CIT program emphasizes hands-on learning, we have developed the course based on hands-on laboratory components. The laboratory components are developed based on open source software and simulator software. In this paper, we describe the hands-on laboratory components in details.

EVALUATION OF A NATURAL SKETCH INTERFACE FOR TRUSS FBDS AND ANALYSIS

Olufunmilola Atilola, Martin Field, Erin McTigue, Tracy Hammond and Julie Linsey

Mechanix is a sketch recognition tool that provides an efficient means for engineering students to learn how to draw truss free-body diagrams (FBDs) and solve truss problems. The system allows students to sketch these FBDs into a tablet computer or by using a mouse just as they would by hand, a mouse can also be used to draw the sketch using a regular computer and monitor. Mechanix is then able to provide immediate feedback to the students and tell them if they are missing any components of the FBD, without providing answers. The program is also able to tell them whether their solved reaction or member forces are correct or not. This paper presents a study to evaluate the effectiveness and advantages of using Mechanix in the classroom, as a supplement to traditional teaching and learning methods. Current results demonstrate that students believe Mechanix enhances their learning and are highly engaged when using it. Future work on the refinement of the program is also discussed.

WORK IN PROGRESS - COLLABORATIVE AND REFLECTIVE LEARNING IN ENGINEERING PROGRAMS

Neelam Soundarajan

Learning objects (LOs) were proposed as a way to build reusable chunks of educational content. But in spite of considerable effort by various groups, the approach has had relatively little impact on education. We argue that this is because of a fundamental weakness in the way LOs have been conceived of. We show how the problem can be addressed by borrowing key ideas from object-oriented (OO) programming. We show that the resulting approach will not only help students in learning particular concepts but also help develop their reflective and team-working skills.

The approach is also consistent with the ideas of the how people learn (HPL) framework.

AN EXPERIMENTAL NEXOS LABORATORY USING VIRTUAL XINU

Paul Ruth and Dennis Brylow

The Nexos Project is a joint effort between Marquette University, the University of Buffalo, and the University of Mississippi to build curriculum materials and a supporting experimental laboratory for hands-on projects in computer systems courses. The approach focuses on inexpensive, flexible, commodity embedded hardware, freely available development and debugging tools, and a fresh implementation of a classic operating system, Embedded Xinu, that is ideal for student exploration. This paper describes an extension to the Nexos laboratory that includes a new target platform composed of Qemu virtual machines. Virtual Xinu addresses two challenges that limit the effectiveness of Nexos. First, potential faculty adopters have clearly indicated that even with the current minimal monetary cost of installation, the hardware modifications, and time investment remain troublesome factors that scare off interested educators. Second, overcoming the inherent complications that arise due to the shared subnet that result in students' projects interfering with each other in ways that are difficult to recreate, debug, and understand. Specifically, this paper discusses porting the Xinu operating systems to Qemu virtual hardware, developing the virtual networking platform, and results showing success using Virtual Xinu in the classroom during one semester of Operating Systems at the University of Mississippi.

Session S2F: Novel Contexts for Developing Engineering Design Competencies

Chair: Amalia Rusu, Fairfield University

Time: Saturday, October 15, 2011, 10:00 a.m. - 11:30 a.m. Holiday Inn Private Dining Room

INTEGRATING DEVELOPMENTAL INSTRUCTION IN SUSTAINABILITY CONTEXTS INTO AN UNDERGRADUATE ENGINEERING DESIGN CURRICULUM: LEVEL TWO

Eric C. Pappas and Olga Pierrakos

Developmental instruction in four sustainability contexts (environmental, social, economic, technical) in an engineering design curriculum offers a strong foundation and framework upon which to build an engineering program that teaches students the necessary methodologies for designing for sustainability. Instruction in sustainability contexts described in the current paper employs a developmental approach using Bloom's Taxonomy of Educational Objectives, which is a way to classify instructional activities or questions as they progress in cognitive difficulty. Our objective in this paper and presentation is to detail an instructional methodology (and results of a case study and focus group assessment) that integrates sustainability instruction in four contexts into the third and fourth classes in our six-course design curriculum using a developmental approach.

REFERENCE DESIGNS FOR EMBEDDED CONTROLS

Chiu H. Choi

A set of reference designs suitable for our student design projects was developed and tested. The purpose is to make them available for students to choose the ones suitable for integration into their projects with confidence. All the reference designs are available on our website. Some of those that are intended for embedded control applications are described in this paper. They are reference designs for DC motor driver, stepper motor driver, and GPS module. These reference designs were adopted into our embedded control projects before. Other reference designs were also developed but due to limited space are not included into this paper but the hyperlinks to them are provided. Some of the interesting projects and their evaluations are also described in this paper. Another aspect of this paper is the description of the structure of the reference designs and the various issues encountered. The information should be useful to those intend to develop reference designs for their own design courses.

UTILIZING UNIVERSITY RESEARCH AND UPPER-DIVISION COURSE MATERIAL FOR AN ENHANCED FIRST-YEAR DESIGN EXPERIENCE

Amber Kempainen, Gretchen Hein and Amy Hamlin

Design projects give instructors a chance to integrate lecture material into an engaging engineering experience. Students working on "real-world" design projects can see how their projects apply to life outside the classroom. There has been much talk about implementing a "cornerstone" design experience into first-year classes, but how "real-world" can a design project be for first-year engineering students without the technical background of their upper-division counterparts? Can students see the applications of their designs when their models and simulations are limited due to their skill set? At Michigan Technological University, we are investigating what happens when first-year students learn about future research opportunities and coursework from upper-division students, and how this material is related to their design project. It is hoped that students will have a greater enthusiasm for their project when they know that their knowledge will be useful in the future or when they see where their design project work

could lead. In addition, it is hoped that students will have a greater understanding of the application of their own work.

DISTRIBUTED SYSTEMS DESIGN SUPPORTED BY REFLECTIVE WRITING AND CATS

Maria Feldgen and Osvaldo Clua

Reflective writing in the form of three reflective writing tasks has been used in our Distributed Systems Design course to develop and assess students' thinking and learning. Case studies with real-life scenarios are developed in a Problem based Learning approach where students work in teams to identify learning needs and develop a viable solution in an iterative approach. The same case study was applied in two sister institutions with similar curricula and different policies. In the control group institution, it was mandatory to follow a teacher-centered approach. In the experimental group institution, students followed the CAT set "assessing skills in problem solving" to solve the case, write their arguments and the collected evidence for their positions in argumentative essays. Essays were debated in class to reach consensus and reflections were documented for reciprocal peer review. The outcomes of the essays and peer reviews were used as formative measures of student learning and as a vehicle for providing critical feedback to the students. In this paper, we will describe the experience, present and analyze our data comparing the students' outcomes from the two institutions over three terms. We will also describe the conducted classroom research and students' attitudes and difficulties.

WORK IN PROGRESS - DIRECT ASSESSMENT OF COURSE OUTCOMES IN A COMPUTER MODELING AND SIMULATION CLASS

Keith Garfield

This paper presents experiences with implementing a grading technique to closely couple student performance on specific course outcomes with student grades. The course selected for this technique is an undergraduate computer modeling and simulation course, which required an individual research component in addition to assignments and in-class tests. This class tested a technique whereby assignment of aggregated numerical scores for homework or tests was replaced by pass/fail feedback on individual course outcomes. Each assignment or test enumerated which specific course outcomes potentially satisfied within the assignment. Outcomes loosely correlate to Bloom's taxonomy levels of recognition, understanding, application, and creation. Student feedback reported that the technique enhanced learning, though an increased tendency towards procrastination was also reported. Instructor experiences were positive, with the assessment technique integrating easily with course design and delivery.

Session S2G: Introductory Computer Science Courses

Chair: Melany M. Ciampi, Safety, Health and Environment Research Organization

Time: Saturday, October 15, 2011, 10:00 a.m. - 11:30 a.m.

Holiday Inn Hammons Room

TEACHING COMPUTER SYSTEMS THROUGH COMMON PRINCIPLES

Mark A. Holliday

Computer system subjects ranging from computer organization and operating systems to computer networking and database systems form an integral part of a computer science or computer engineering major. Because the subjects are usually taught as separate courses, students may not recognize that they share many design principles. We identify a set of these principles and demonstrate how they apply to all these aspects of a computer system. In our experience, students' understanding of these subjects and how they are inter-related improves when we identify and illustrate these common principles.

WORK IN PROGRESS - INTEGRATING MATHEMATICAL MODELING WITH COMPUTER VISUALIZATION TO IMPROVE STUDENTS' PROBLEM SOLVING IN AN INTRODUCTORY ENGINEERING COURSE

Ning Fang

This paper reports ongoing efforts of integrating mathematical modeling with computer visualization to improve students' problem solving in an introductory Engineering Dynamics course. A special set of computer simulation and animation (CSA) learning modules was developed, implemented, and assessed in an Engineering Dynamics course taught by the author of this paper in multiple semesters. Qualitative and quantitative assessments were conducted, including pre-post tests to assess students' learning gains from the CSA learning modules, and questionnaire surveys and interviews to assess students' attitudes towards and experiences with the modules. The results showed that students made at least 48% learning gains with the CSA learning modules, and that 70%-80% of the students who responded to the survey agreed that the modules helped them build a connection between mathematics and Dynamics concepts.

NEW APPROACH TO TEACHING AN INTRODUCTORY COMPUTER SCIENCE COURSE

Asad Azemi and Nannette D'Imperio

In this work, we report our results based on an innovative approach that we started three years ago for delivering an introductory computer science course. The teaching approach consisted of team teaching, hybrid delivery, recorded lecture retrieval capability, readiness assessment activities, post assessment activities, objective assessment of student progress, and cooperative learning through team work. The new aspects of this approach were team teaching, objective assessment to provide additional feedback to students, and the combination of the aforementioned tools. Details of this work, including its advantages, disadvantages, student feedback, and lessons learned, are included.

WORK IN PROGRESS – THE IMPACT OF INTEGRATING FIRST-YEAR STUDENTS INTO THE BROADER CURRICULUM

Robert Elliott and Nancy Evans

Faculty working directly with first-year students in the Computer & Information Technology department at IUPUI wished to improve first-year student retention within the program. Initially the team focused on adjusting the flow of content in the program's foundational courses to ensure their relevance. One course in particular, an introduction to Problem Solving and Qualitative Analysis, was frequently criticized by students as they struggled with fairly abstract topics for which they did not see an immediate need. In addition to updating the course content, the faculty co-investigators designed two projects that integrated these first-year students into a sophomore-level course where problem-solving skills and systems analysis techniques were actively applied. These experimental projects were integrated into one section of the first-year course, as well as one section of the sophomore-level follow-up course. From a qualitative perspective, the project was well received by students. First-year students were actively engaged sophomore-level coursework, and higher-level students eagerly included them in projects. Buoyed by the initial success of the experiment, the investigators wish to apply similar techniques to all sections of the first-year course and quantitatively measure its impact on student outcomes in subsequent courses.

USING THE MATLAB-BASED IROBOT CREATE SIMULATOR TO ENGAGE INTRODUCTORY COMPUTER PROGRAMMING STUDENTS IN PROGRAM DEVELOPMENT AND OBSERVING COMPUTATIONAL ERRORS

K.-Y. Daisy Fan and Kathryn Conway Dimiduk

The excitement and appeal of robotics is leveraged in an introductory computer programming course by making use of the iRobot Create simulator written in Matlab. The simulator allows students to visualize their code in action which provides motivation for addressing errors in the code. Students are introduced to approximations in computation and learn how errors can build up. In the Fall 2010 semester, students completed four programming assignments of increasing complexity using the simulator. Students liked "seeing" their robot follow their code and more than 40% reported an increased motivation to learn computing skills. Students reported no change (42%) or a gain (33%) in their ability to understand and interpret code, which was confirmed by comparing their programming performance in the final exam to that of students in previous semesters (that didn't use the simulator). A strong correlation between a high exam score and a student's choice to discuss computational errors through the simulation exercises was observed. On the survey a majority of students reported that the simulator helped them better understand the concept of approximation and error.

Session S2H: How can expected Scientific Foundations for Student Learning be Nurtured?

Chair: Gul Afshan, Milwaukee School of Engineering

Time: Saturday, October 15, 2011, 10:00 a.m. - 11:30 a.m.

Holiday Inn Room Salon BC

STUDENT DIFFICULTIES WITH BASIC CONCEPTS IN INTRODUCTORY MATERIALS SCIENCE ENGINEERING

Andrew Frank Heckler and Rebecca Rosenblatt

We report on findings of a project to identify specific student difficulties in a university-level introductory materials science course for engineers. This is the first part of a larger project to design and assess evidence-based curricular materials for this course. Through interviews, testing, and classroom observation of over 1000 students, we examined in detail student understanding of basic topics in materials science including topics such as atomic structure, mechanical properties, defects, diffusion, phase diagrams, failure, and the processing of metals. We identified four general areas in which students have difficulties: Student confusion of similar concepts, student difficulties with reasoning about concepts with more than one variable, student use of inappropriate models or analogies, and student difficulties with common graphs and diagrams used in materials science. We provide a number of specific examples of each category, focusing on the materials science of metals. While these student difficulties are interesting in their own right, a careful examination of these difficulties can also provide useful information for the design of

instructional materials.

GROUP-WORK TUTORIALS FOR AN INTRODUCTORY MATERIALS ENGINEERING COURSE

Rebecca Rosenblatt, Andrew F. Heckler and Katharine Flores

We report on findings of a project to improve student learning in a university-level introductory materials science course for engineers. In a related preparatory project, we identified student difficulties with basic topics in materials science through interviews and/or testing of over 1000 students at The Ohio State University. Here, we report on the implementation of concept oriented group-work lessons or “tutorials” designed to address student difficulties identified in our prior work and improve student understanding of core concepts in materials science. The lessons were designed for weekly 48 minute recitations in which students work together in small groups on the tutorials in the presence of teaching assistants who assess and facilitate student progress. To determine the learning outcome, we analyzed scores on the final exam and found that even accounting for the fact that slightly “better” students tended to attend recitations more often, there was a valued-added effect of the recitations on final exam performance. These results suggest that these recitation methods and materials are effective in teaching students the difficult and important conceptual materials which they were designed to address.

PREDICTIVE ASSESSMENT OF STUDENT PERFORMANCE FOR EARLY STRATEGIC GUIDANCE

Patrick D. Schalk, David P. Wick, Peter R. Turner and Michael W. Ramsdell

In this study, we use well-accepted conceptual assessment instruments, initial state data such as the SAT, and our own recently developed instruments designed to measure aptitude in mathematics to develop a machine learning-based predictive model for student performance. Previous analysis found the expected strong correlation between performance in the mathematics and physics courses. The mathematics assessment instruments were designed to provide a means for suggesting corrective measures for students to take to improve performance in mathematics, and it was demonstrated that these measures also have an impact on performance in physics. With the predictive nature of the collected data and the impact of the various corrective measures on final grade established, we use these data to form a predictive model for student performance. By adaptively imputing missing data from previous years, and forming a random forest model, we are able to predict those students who are most at-risk of failing the introductory mathematics and physics courses with acceptable accuracy. This analysis contributes to an integrated evaluation of the current programs, which has led to an assessment-based initiative to offer strategic guidance to incoming students, better placing them for academic and career success in their selected STEM disciplines.

RENEWABLE ENERGY EDUCATION AT THE COLORADO SCHOOL OF MINES: A SURVEY OF DEVELOPMENT

Chuck Stone

Energy in general and renewable energy in particular are popular topics in engineering, physical science, and social science courses. K-12 students might play with roller coasters, solar cells, or toy windmills to learn about energy transformations; undergraduate students might take an environmental studies course that promotes energy conservation and the use of alternative energy resources; and graduate students might be charged with developing novel composite materials that enhance the performance of fuel cells. Renewable energy is a vast field quickly garnering public attention. Faculty, staff, and researchers within the Renewable Energy Materials Research Science and Engineering Center at the Colorado School of Mines have taken a number of steps to enhance the appreciation and understanding of this emerging area by developing a comprehensive educational program that focuses on preparing students for careers in renewable energy. This survey describes Center initiatives to (A) develop an energy minor curriculum with a track dedicated to renewable energy, (B) develop an upper division undergraduate engineering course on renewable energy, (C) form a student energy club, and (D) deliver a ten-week summer research program that engages undergraduate students in renewable energy. These provide a model program for incorporating renewable energy education into engineering curricula.

PROBING A DEEPER UNDERSTANDING OF MODERN PHYSICS CONCEPTS

Jessica Uscinski and Teresa L. Larkin

A variety of assessment tools have become more prevalent in introductory physics courses as a way to enhance and assess conceptual learning. At the interface of modern physics and quantum mechanics, these tools are not presently as widely used. The Modern Physics course at American University presents an ideal opportunity for conceptual assessment given its somewhat atypical student composition. In this study both qualitative and quantitative measures of student understanding of a key concept in modern physics, the photoelectric effect are utilized. As a quantitative overall baseline for gain, the Quantum Physics Conceptual Survey (QPCS) was implemented [1]. A set of questions on the photoelectric effect that required both a quantitative and qualitative understanding of the photoelectric effect

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were then given on both the midterm and final exams. The results of the QPCS, and a subset of QPCS questions solely on the photoelectric effect, are statistically compared to the more focused approach for assessing the photoelectric effect. Additionally, correlations between subsets of the student population and their gains on the various assessments were investigated. The results from these assessment methods will be discussed in the larger context of how assessment measures can be maximized to enhance student understanding in a modern physics course. In particular this study shows how there may be a correlation between a student's background preparation, and their gain on different types of assessments.

Session S3A: Mini Workshop - Exploration of a Direct Method for Measuring ABET Professional Skills

Chair: Steve Beyerlein, University of Idaho

Time: Saturday, October 15, 2011, 1:00 p.m. - 2:30 p.m.

Holiday Inn Room Salon D

MINI WORKSHOP - EXPLORATION OF A DIRECT METHOD FOR MEASURING ABET PROFESSIONAL SKILLS

Steven Beyerlein, Ashley Ater Kranov, Jay McCormack, Pat Pedrow, Edwin Schmeckpeper and Mo Zhang
Proficiency in professional skills related to teamwork, ethical responsibility, oral communication, impact of engineering solutions, life-long learning, and contemporary issues is critical for success in the multi-disciplinary, intercultural team interactions that characterize 21st century engineering careers. Yet, programs across the nation have struggled to define, teach, and measure professional skills since their introduction as ABET criteria for engineering programs in 2000. The Engineering Professional Skills Assessment (EPSA) is a direct assessment method centered on one of several inter-disciplinary scenarios that frame a contemporary societal problem, a generalized set of discussion questions intended to guide a meaningful, 45 minute discussion of multiple scenarios among 4-6 students, and the Engineering Professional Skills rubric that is broadly applicable for all scenarios. In this mini-workshop, participants will examine one scenario in detail along with self-scoring and peer-scoring of a scenario discussion among workshop participants. This experience will be structured to produce small-group and large-group insights about administering and scoring the EPSA in classroom situations. The intended audience for this workshop includes faculty who teach courses identified for collecting data on ABET professional skills, ABET coordinators from the entire spectrum of engineering programs, and ABET engineering program evaluators.

Session S3B: Problem and Project Based Learning

Chair: Jack Mottley, University of Rochester

Time: Saturday, October 15, 2011, 1:00 p.m. - 2:30 p.m.

Holiday Inn Room Salon E

ON IMPLEMENTATION OF PROBLEM-BASED LEARNING IN ENGINEERING EDUCATION: THOUGHTS, STRATEGIES AND WORKING MODELS

Waddah Akili

This paper focuses on problem-based learning (PBL) in engineering programs, and argues that implementation of problem-based learning needs to be placed in a context and developed with careful consideration of the social, economic, and ethnic diversity of the student population and the university academic culture and prevailing norms. It includes a brief history, selected PBL models, strategies to infuse PBL in an engineering program, and suggestions for redesigning classes and courses to catalyze change in the classroom through student engagement. The paper examines and selects most suitable versions of PBL for potential adoption at the start, identifies essential elements of a well-structured learning strategy, and illustrates faculty role in implementing PBL. Proven methodologies and knowledge generated elsewhere, if and when properly adapted, should make it possible for institutions to devise their own PBL models that meet their classroom setting, objectives, and aspirations. The paper also addresses the potential difficulties that could arise during implementation of PBL, particularly when instructors are new to this instructional method.

PROBLEM-BASED LEARNING AND ADAPTIVE EXPERTISE

Jeffrey E. Froyd

In problem-based learning and related approaches, a faculty member organizes course content around posing several situations to students and presenting them questions, challenges, problems, or projects drawn from the situation. A faculty member presents the problem and asks for student solution fragments before lecturing on relevant course content. Then, the faculty member facilitates student teams as they work through a process to answer the question. Content is selected, organized, and presented to help students address each posed challenge. Many studies have offered results that faculty members can use to evaluate the efficacy of a problem-based learning approach to teaching and decide whether to apply the approach for their courses. However, the proposed manuscript offers a

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different line of reasoning to advocate problem-based learning. Reasoning begins with a two-by-two, process-content matrix, which is very similar to the two-by-two, innovation-efficiency matrix used to characterize adaptive expertise. If student development were characterized as a trajectory in a two-dimensional, innovation-efficiency space, then questions such as the following could be raised: What characterizes more time-efficient trajectories to reach adaptive expertise? The proposed manuscript will use this line of reasoning to explore how problem-based learning may offer a time-efficient approach to developing adaptive expertise.

WORK IN PROGRESS - PROJECT-BASED SERVICE LEARNING IN ENGINEERING: INVESTIGATING PARTNER RELATIONSHIPS

Julia D. Thompson and Brent K Jesiek

Project-Based Service Learning (PBSL) is increasingly popular in engineering programs as a way to develop key student skills and address community needs. Since most PBSL projects have the intention of providing a service to a community, it is critical that partner voices are heard. However, there has been little research examining the roles and motivations of project clients. To address the community perspective, the authors have identified six organizations with long-standing (over five years) partnerships with Purdue University's Engineering Projects In Community Service (EPICS) program, and will interview 1-3 individuals associated with each. These partners have been involved with numerous EPICS projects over multiple years. Our major objectives are to investigate why organizations maintain long-term partnerships with EPICS, and develop recommendations for enhancing benefits to all stakeholders. Here we present a background literature review and description of the project scope and methods.

CAPSTONE EXPERIENCES: EFFECTS OF ADAPTED PHYSICAL ACTIVITY DESIGN PROJECTS ON ATTITUDES AND LEARNING

David W. Hey, Bridie Jean McCarey, Lynne A. Slivovsky, J. Kevin Taylor, Brian Self and James Widmann

Eight innovative senior level capstone engineering projects were completed at California Polytechnic State University (2008-present) involving (n=28) students (23 male/5 female). All projects involved the design of equipment to facilitate physical activity for people with disabilities. The effects on: i) learning design, ii) attitude towards people with disabilities, and iii) motivation to complete team design projects were analyzed through eight one-hour focus groups. This paper presents focus group findings using a constructivist approach and grounded theory to explore the overall student "learn by doing" experience. Results: (1) Approximately 19 (70%) of the students claimed the adapted physical activity project was their "first choice" given 60+ projects to rank; (2) Prior to the project only ten (35%) had experience working with people with disabilities and of those students the majority were women; (3) Twenty-six (92.8%) of the students were able to define 'inclusion' when asked and viewed the field of engineering as a 'natural fit' with project design for adapted physical activity. Students reported high levels of motivation for learning design as evidenced by the majority of engineers getting their "top" choice of projects; (4) Twenty-three (82%) of the engineers would 'definitely' consider a future engineering job in this sector and (5) Project challenges included: budget constraints, group communication, fabrication delays, detachment from client, and a desire for increased product testing time. Although students reported high levels of learning and motivation to complete their project; attitudes toward people with disabilities did not change significantly.

WORK IN PROGRESS - A PROBLEM-BASED LEARNING APPROACH FOR SYSTEMS UNDERSTANDING IN THE MSU AES PROGRAM

Jon Sticklen and Ronald Rosenberg

Applied Engineering Sciences is a long-standing engineering undergraduate degree program in the College of Engineering, Michigan State University. It is at root an interdisciplinary program integrating core engineering studies, core business/management studies, and a depth-oriented "finishing area." Over the last two years, an evolved program has been designed and implemented that retains the traditional strengths of the program while providing a strong underlying theme of systems thinking. In this WIP report we describe the new AES program, and our plans to leverage problem based learning as the core pedagogy for supporting student introduction and applications of systems thinking.

Session S3C: eLearning: Approaches and Tools

Time: Saturday, October 15, 2011, 1:00 p.m. - 2:30 p.m.

Holiday Inn Room Salon A

CLOUD-BASED E-LEARNING INFRASTRUCTURES WITH LOAD FORECASTING MECHANISM BASED ON EXPONENTIAL SMOOTHING: A USE CASE

Agustin C. Caminero, Salvador Ros, Roberto Hernandez, Antonio Robles-Gomez and Rafael Pastor

The development of cloud technologies allows the implementation of scalable, versatile, and customized systems, constructed on-demand. This allows more efficient use of computing resources, improving the revenue of the system and enhancing the Quality of Service (QoS) received by users while minimizing the power consumption of the

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machines. Several research works conclude that in order to efficiently manage a cloud-based infrastructure (meaning, deploy computing resources when needed without affecting negatively to the QoS perceived by users), accurate predictions on the load of machines should be made. Thanks to this, resources can be ready to use when users need them, and shutdown when they are not needed – thus reducing the power consumption and enhancing the revenue of the system. This paper presents algorithms to perform forecasts of the load of machines based on Exponential Smoothing (ES), so that the machines of the technological infrastructure of our University can be efficiently managed. Furthermore, algorithms to perform monitoring and provision of resources based on load forecasts are presented. The usefulness of these algorithms is illustrated by means of a use case based on the e-learning facilities of our University. This use case shows that thanks to the use of cloud technologies, enhanced with the developed algorithms for load forecasting and provision of resources, better use of resources and lower power consumption can be achieved, without affecting the QoS received by user.

WORK IN PROGRESS - PI2E, TOWARDS A GOOGLE HOME PAGE FOR E-LEARNING

Manuel Caeiro Rodriguez, Martín Llamas-Nistal, Juan Gonzalez-Tato and Javier Alvarez Osuna

The idea of this project is to translate the principles of Web 2.0 to e-learning, enabling social participation and dynamic data exchange between users. We are working in the development of an i-Google Gadget, called Edu-GAL (Educational-Gadget Activity List), with e-learning services and its integration with other existing tools and gadgets on the i-Google platform. Edu-GAL will take advantage of a set of existing Web services that provide main e-learning functionalities. The project is located in the context of so-called Personal Learning Environments (PLE). Compared to traditional e-learning systems, in especially Learning Management Systems (LMS), PLE are more learner-centered as it is the user who defines and decides the environment at which he/she will learn.

WORK IN PROGRESS - ENHANCEMENT OF DISTANCE LEARNING THROUGH HYBRID E-LEARNING APPROACH

Asad Azemi, Gary Chinn and Thomas Litzinger

The usefulness of hybrid delivery in education has long been realized. With the advancement of computer and communication technologies and the introduction of Web-based authoring tools, its effectiveness has been further extended. In this regard, it has affected traditional distance-learning by transforming it from a static videotape delivery to a more dynamic format by adding/substituting the web as the delivery media. Our focus in this paper is the use of hybrid e-learning with a virtual face-to-face component for distance course delivery. We believe that hybrid e-learning, in conjunction with a synchronous online delivery, can minimize the negatives that are sometimes associated with more traditional, primarily asynchronous distance learning offerings. Details of this work, including design and delivery issues, student and course assessment, and required technology, as applied to a computer programming course, are included in the paper.

WORK IN PROGRESS - INTEGRATING COMPUTATIONAL AND ENGINEERING THINKING THROUGH ONLINE DESIGN AND SIMULATION OF MULTIDISCIPLINARY SYSTEMS

Alejandra J. Magana, Prabhakar Marepalli and Jason V. Clark

Computation is an increasingly essential tool for doing scientific research. It is expected that future engineers will need to engage and understand computing in order to work effectively with computational systems, technologies, and methodologies. Toward this goal, we leverage our previous work with SugarAid v0.2 to allow learners to test their knowledge of computing by applying engineering concepts. Applied concepts include designing multidisciplinary systems including electrical, mechanical, fluidic, and thermal components. Through this method, we expect learners to enhance their computing knowledge by applying their engineering knowledge.

FACILITATING THE DESIGN OF PHYSICS ACTIVE LEARNING PROBLEMS THROUGH AUTHORING SIMULATION TOOLS: AUTHORPHYSICS

Luis Jaime Neri-Vitela, Julieta Noguez, Ivan Leonardo Perez-Cabrera and Gerardo Aguilar-Sanchez

Active learning is an educational strategy that promotes the development of the student's critical and creative thinking through carefully designed activities. The teacher often faces challenges to design adequate physics problems because it demands a high effort to have enough variety of exercises for several students' levels. In addition, it is important to display exercises in an attractive visual and interactive environment, but this requires deep computer knowledge. Most common simulators in the literature are visually attractive, but are often designed to solve a particular or limited problem. Authoring tools have the advantage to allow building several learning environments, involving professors without computer expertise. Therefore, teachers require less effort and time to develop simulation problems. In this work we present an on line authoring simulation tool, called AuthorPhysics, aimed to facilitate the design of physics active learning problems, reducing instructors' time and effort. An initial evaluation of the usability and benefits of the system for the instructors was carried on. The results are encouraging in the sense

that teachers are able to create a great variety of physical scenarios and problems, appropriate for introductory undergraduate and high-school physics courses. An evaluation with students is currently running.

Session S3D: Developing Interest and Skills in Engineering: Teams, Artifacts, Projects, and Decision Making

Chair: Bernardo Leon de la Barra, University of Tasmania

Time: Saturday, October 15, 2011, 1:00 p.m. - 2:30 p.m.

Holiday Inn Room Salon F

THE EFFECT OF EMOTIVE LANGUAGE IN VIRTUAL TEAMS

Nicholas Richter, Linda Williams, Obed Magny and Ray Luechtefeld

Technology continues to change and evolve in amazing ways. The use of technology is also evolving at a dizzying pace. The way virtual environments are being used continues to challenge the norm in education. The questions driving this research study centers around the use of emotive language and emoticons in the written communication in a virtual environment between two high school aged students. The more focused question is, how does the use of emotive language and emoticons affect the negotiation, and how will a virtual facilitator interact within that same virtual environment? This study will provide insight into how the use of emotive language affects the ability of students to reach a negotiated solution. Also, this study will provide an opportunity to look at the use of text language from authentic sources. The implications of this study are quite powerful. The potential of a virtual facilitator that understands modern colloquial text based language, may provide an additional level of safety for online interactions between young adults, in effect, giving a tool to combat such things as cyber bullying.

MULTIDISCIPLINE INTERACTIONS IN STEM: ANALYSIS BY ARTIFACT

Paul Schreuders, Matthew Verleger and Kimberly Otteson

Integration of the Science, Technology, Engineering and Mathematics (STEM) disciplines in K-12 education have been promoted through national education standards and a variety of curricular initiatives. This research examines the adoption of these standards through analysis of book purchasing pattern information available through amazon.com. A directed network was developed starting with four "root" books chosen to represent either key education standards (in the cases of science, technology and mathematics) or an assessment of the current K-12 educational status (in the case of engineering). The network was then built by branching out from the four core books using the amazon.com database of purchase history ("Customers Who Bought This Item Also Bought.") Two additional levels of purchases for the books were compiled resulting in approximately one hundred and twenty-five books per discipline. Network analysis techniques were then employed to investigate various properties of the compiled network. An exploration into the purchasing patterns provides insight into how these standards are being adopted and the relationships between the disciplines. The results of the analyses of the network suggest that there is significant integration of the four disciplines, though some disciplines align more closely than others.

ALGAE AS A BIOFUEL: AN INTERDISCIPLINARY HIGH SCHOOL CURRICULUM INCORPORATING ENGINEERING, BIOLOGY AND EDUCATION

Kenneth J. Reid, Debra Gallagher and Robert Verb

The College of Engineering, the College of Arts & Sciences, and the Center for Teacher Education at Ohio Northern University developed and implemented two parts of a four-module curriculum titled "Biomass as an Alternative Energy Source" for use in a Wind/Energy Academy within a local school district. The curriculum introduces students to the current topic of biomass, specifically algae, as a potential energy source. The modules are designed to present the science behind this energy source within a variety of contexts. This alternative energy curriculum is designed to encompass four modules, each six to nine weeks in length. The modules are designed to ideally be used in grades 9-12, one module per year. The two completed modules consist of the following topics: 1. Biology of Algae 2. Culturing of Algae Further modules to be developed for a complete curriculum include: 3. Harvesting and Processing Algae 4. Algae Capstone Design The first module introduces algae through discovery of naturally occurring algae, from the introduction of the use of microscopes through field collection and categorization of different algae. In the second module, students study design of experiments and the Taguchi method to optimize the number of tanks necessary to study the effect of variables on algal growth, and establish and study algal microcosms in the second module. The Ohio Academic Content Standards in Science are tied to each module. The curriculum is using the 5-E Learning Cycle which emphasizes an inquiry-based approach. Students work in collaborative groups and conduct research in each module. Each module is interdisciplinary (including content areas such as mathematics, language arts, and social studies) and is project-based or problem-based. The curriculum is designed to be engaging, challenging, motivating, and designed around real-world issues, and could be implemented within appropriate K-12 programs. This paper will detail the modules which have been developed, along with lessons learned and details necessary to implement this curriculum within a K-12 program. The modules remaining to be developed will be

described. The relationship to state educational standards will be discussed.

MATHEMATICS INSTRUCTION USING DECISION SCIENCE AND ENGINEERING TOOLS

Karen Keene, Richelle Dietz, Krista Holstein and Amy Craig

MINDSET (Mathematics INstruction using Decision Science and Engineering Tools) is a multiyear project involving collaboration between engineers, educators, and mathematicians at three universities in two states. Through a partnership with secondary teachers, the MINDSET project staff has created a ground-breaking new mathematics curriculum for fourth-year high school students using mathematical-based decision-making tools from the fields of operations research and industrial engineering. High school students are presented a series of real-world problem contexts with the purpose of making the underlying mathematics more relevant to them and allowing them to model the situations and actively do mathematics. This innovative new integration of mathematics and engineering at the high school level provides new opportunities for students, who have not been successful in the abstract world of mathematics, to learn to enjoy and to want to pursue a more applied form of mathematics. This paper reports the results of the nationwide implementation of this engineering-based mathematics course.

UNIVERSITY OUTREACH IN STEM EDUCATION THROUGH A ROLLER COASTER SCIENCE AND ENGINEERING CAMP

David P. Wick, Michael W. Ramsdell, Kathleen Fowler, Peter Turner and Patrick D. Schalk

We describe the structure, implementation, and outcomes of a Roller Coaster Science and Engineering Camp for students in grades 7-12. The framework for the camp has been developed over several years with the goal of providing a unique experience in STEM education using the theme of roller coaster science and engineering. Students form simulated "roller coaster design companies," whose goal is to design a working roller coaster. To assist with the design process, we have developed a Roller Coaster Card Game that incorporates a series of track segments depicting starting hills, vertical loops, corkscrews, cobra rolls, horseshoe turns, and brake segments which can be assembled to initiate the design process. Based on scientific analysis, students exchange cards from the original design with cards depicting similar segments and corrected dimensions. Only certain card combinations result in a working model. The final design is then programmed into a commercial roller coaster software package, where it can be simulated from a first-person rider perspective. We discuss the impact of the camp on student involvement in other research projects and enrichment opportunities. While the specific impact of any single intervention is difficult to measure, we offer some assessment of student participant performance in math/science.

Session S3E: Challenges in Designing CSET Instructional Technology Implementations

Chair: Keith Garfield, Embry-Riddle Aeronautical University

Time: Saturday, October 15, 2011, 1:00 p.m. - 2:30 p.m.

Holiday Inn Montana Room

MEASURING CS1 PERCEPTIONS OF PARALLELISM

Brian Rague

Educators in Computer Science (CS) generally agree that teaching concurrency can be difficult. CS programs typically offer parallel and distributed computing topics as advanced courses. A potential alternative approach is to provide instruction on parallelism early in the undergraduate curriculum, emphasizing conceptual design rather than implementation issues. This introduction of "parallel-thinking" to beginning CS undergraduates represents an innovation and significant extension to existing standard Computer Science curricula. The research described in this paper investigated the feasibility of integrating parallel computing concepts into a first-year CS course. To quantitatively assess student comprehension of parallel computing, an experimental two-factor mixed group design educational study was conducted to evaluate a control group and two instructional interventions: (1) lecture only, and (2) lecture with laboratory work using a software visualization Parallel Analysis Tool (PAT) specifically designed for this project. The Perceptions of Parallelism Survey (PoPS), a new evaluation instrument developed for this study and modeled after the Force Concept Inventory (FCI), was used to measure student learning. The results from this educational study show a statistically significant main effect among the repeated measures. PoPS results measured during the ninth week of the course reveal that performance levels remained high compared to pre-course performance scores.

WORK IN PROGRESS - MUSIC SYNTHESIZERS: A TOOL IN ENGINEERING EDUCATION

Steven Billis, Nada Anid and Steven Giordano

To improve the rates of retention in all academic programs NYIT created the Office of Academic Support and Retention Services (OoASRS). In spite of this initiative, the rate of freshman-related retention in the School of Engineering and Computing Sciences (SoECS) has not improved significantly. Contextual Teaching and Learning (CLT) is a concept of instruction that relates subject matter content to the real world and motivates students to make

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connections between knowledge and its applications. To improve retention rates the faculty of the SoECS requires all freshmen to take ETCS 105 "Career Discovery". The course uses the educational philosophy and strategies of CLT to enable students to find "meaningfulness" in their education and offers a place for meaning and content to merge. Last semester, we developed a new 8-week CLT module for this course which used a modular music synthesizer to introduce freshmen to an extremely wide range of engineering concepts in an engaging way. This "Work in Progress" will describe the module's lessons and provide a preliminary assessment of student engagement and retention rates.

WORK IN PROGRESS - AN INTERACTIVE, EXECUTION-SAFE SYSTEM FOR TEACHING E-COMMERCE USING REAL-TIME FEEDBACK

William Burns and Alfred C. Weaver

An e-commerce sandbox is being developed to supplement a course teaching the technology and business aspects of e-commerce at the University of Virginia. The system consists of a collection of relevant course materials and a sandbox environment for students to perform guided modules and receive useful automated feedback. The primary goal of the sandbox is to allow students to safely practice real-world e-commerce skills while promoting a self-guided learning approach. The system currently provides 22 modules covering topics in PHP and MySQL. The administrative interface provides tools to create arbitrary modules so that the sandbox can expand and evolve with the state of the practice. Based upon our first classroom experience, we found that use of the interactive modules increased student code quality while providing a beneficial adjunct to the lecture portion of the class.

WORK IN PROGRESS - A FRAMEWORK FOR BUILDING INTERACTIVE LEARNING MODULES

Danilo Leite Dalmon, Anarosa Alves Franco Brandao, Seiji Isotani and Leonidas de Oliveira Brandao

The development of good quality educational software is expensive, time-consuming and faces some underlying issues. In order to deal with such issues, many attempts were made, mainly on code reuse. Following a similar approach, the development of an application framework for implementing a family of interactivity-intense educational software called Interactive Learning Modules – iLM is presented. The framework main goal is to reduce development efforts while being part of a Software Product Line – SPL, an innovative technique regarding interactivity-intense educational software. The framework specification is presented by analyzing the common features of existing iLM. Therefore, the resulting component architecture is outlined. Currently, the design phase is finished and the implementation ongoing. Also, its instantiation is planned for an existing iLM, as a proof of concept.

WORK IN PROGRESS - AN EXAMPLE OF THE VARIATIONS OF VISUAL REPRESENTATIONS IN MECHANICAL ENGINEERING EDUCATION

Koenraad Gieskes, Charles DeRusso and Roy McGrann

In all forms of education, the method of representation of the concepts presented has a strong effect on both the learning of the students as well as the overall language and processes that the students will use when dealing with those concepts. With a focus specifically on mechanical engineering education, this paper provides a review of the role of visual representations in learning concepts in mechanical engineering. One of the main examples of such a visual representation is the free-body diagram which is used to display forces acting on a body. These representations not only influence the learning of the students, but also affect the methods used by students when they encounter similar concepts in their work. This review of the role of visual representations consists of several parts. First, an overview of such representations in mechanical engineering education is provided. Then a comparison of the different types of visual representations is presented. This paper culminates in a discussion of the effect such representations have on the language and processes used by mechanical engineering students.

Session S3F: Insights through Teaching Engineering Design: Mentoring, System Design, Physical Models, Teams, Sustainability

Chair: Adam Carberry, Arizona State University

Time: Saturday, October 15, 2011, 1:00 p.m. - 2:30 p.m. Holiday Inn Private Dining Room

AN INTERACTIVE APPROACH TO RENEWABLE ENERGY RESEARCH AND EDUCATION

Jonathan Bush, Matthew Kane, Kai Segrud, Damon Fick and Ziliang Zong

The United States is currently pursuing renewable energy research and education initiatives. To contribute to both of these objectives, an interactive environment that provides educational opportunities related to wind energy for students in K-12, college, and the community was created. The efforts are based on an 80 ft tall 20kW wind turbine that was installed at the South Dakota School of Mines and Technology (SDSMT) in 2009. This research facility is currently recording real-time wind data that is not easily accessed or understood by the public community due to the absence of an ease-of-communication environment. To increase the educational outreach of the wind turbine facility, an interactive computer kiosk in the student center at SDSMT was designed and utilized. The functionality of the

kiosk includes: 1) a 24/7 searchable real-time database; 2) a 3D visual model of the wind turbine and research facility; and 3) a user-created energy consumption “sandbox”. The results of the study will be used to provide recommendations for future research and education endeavors of renewable energy in general and wind-energy in particular.

ASSESSING THE IMPACT OF FACULTY ADVISING AND MENTORING IN A PROJECT-BASED LEARNING ENVIRONMENT ON STUDENT LEARNING OUTCOMES, PERSISTENCE IN ENGINEERING AND POST-GRADUATION PLANS

Mary Raber, Susan Amato-Henderson and Valorie Troesch

In 2000, we introduced an undergraduate engineering curricular option to serve as an alternative to the traditional two-semester senior capstone experience, and intended to better meet the needs of students and industry. Initially funded through NSF, this program offers teams of students from varied disciplines the opportunity to work for several years in a business-like setting solving real-world problems supplied by industry. This program has converted the traditional classroom into a multi-year, interdisciplinary, experiential learning environment, and the role of instructor from one who imparts knowledge to that of mentor, guiding students as they discover and apply knowledge. The program is now self-sustaining and successfully attracts and retains STEM-discipline students, making them more marketable to employers upon graduation. Under NSF’s IEECI program, we undertook a study to determine whether participation in such a project-based learning environment, together with the redefined role of faculty mentors, are positively correlated to student education outcomes. One measurement tool used to capture student perceptions was a modified form of the Academic Pathways of People Learning Engineering Survey (APPLES), to look at contributors to students’ persistence in engineering. In this paper, we will share the results of the APPLES survey component of our study as related to the faculty mentor role and project-based team learning environments.

WORK IN PROGRESS - A PROOF-OF-CONCEPT SYSTEM DESIGN USING MODEL DRIVEN ARCHITECTURE

Jojo Tan

The Model Driven Architecture approach was introduced to tackle enterprise scale systems through the use of models and model transformations. The MDA approach shifts the focus from writing code to building models. However, can MDA be applied to smaller-scale projects at the academic level? This work presents a case study of the iVote project which is a proposal to design and implement an electronic system for the nomination, balloting and election of union officers and committee members at our university. The current nominations and election process is a labor intensive, manual procedure. Proof-of-concept design and separation of concerns are goals in the design and architecture of the proposed system. By capturing requirements as independent models, platform specific technicalities can be deferred until a later time.

UNDERSTANDING PHYSICAL MODELS IN DESIGN COGNITION: A TRIANGULATION OF QUALITATIVE AND LABORATORY STUDIES

Vimal Viswanathan and Julie Linsey

Designers use various kinds of physical models throughout their design process to enhance creativity. The existing literature provides conflicting guidelines about their implementation. The effects of physical models on design cognition remains largely unknown. Prior laboratory studies show that physical models supplement designers’ erroneous mental models and thereby lead to higher quality ideas. These prior studies fail to demonstrate any design fixation associated with the use of physical models. In contrast, a few prior observational studies on practicing designers show that the use of physical models causes design fixation. Based on these conflicting results, this study investigates the role of physical models in industry-sponsored projects and in the development of award-winning products through a qualitative research approach. This study explores two hypotheses: The Mental Models Hypothesis - physical models supplement designers’ mental models and the Fixation Hypothesis - physical models cause design fixation during the idea generation process. The data are coded qualitatively and then tested quantitatively. The results are triangulated with the results from the prior controlled study. The results provide support to the hypotheses. The differences observed between current and prior studies point to the potential role of the Sunk Cost Effect in engineering idea generation with physical models.

WORK IN PROGRESS – IMPLEMENTING AND EVALUATING EFFORTS TO ENGAGE INTERDISCIPLINARY TEAMS TO SOLVE REAL-WORLD DESIGN CHALLENGES

Maria Oden, Marcia K. O'Malley, Gary L. Woods and Tracy M. Volz

Young engineers entering an industry job are likely to be immediately placed into a division or team that is comprised of people from a wide variety of educational backgrounds. This will include other engineering disciplines

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and, depending on the industry, individuals with business, marketing, public relations, policy or science backgrounds. This work in progress describes our initial efforts to implement and evaluate outcomes from collaboratively teaching capstone design and assigning interdisciplinary teams to solve real-world design challenges as part of the course. Initial data demonstrate that these teams are more successful than their single discipline counterparts in achieving outstanding success in their projects as indicated by a larger proportion of interdisciplinary teams earning design awards, both local and national.

Session S3G: Issues in Computer Science Education: Multicore Programming, Object-oriented Design, Teams, Design Science, Competencies

Time: Saturday, October 15, 2011, 1:00 p.m. - 2:30 p.m.

Holiday Inn Hammons Room

WORK IN PROGRESS - COURSE DEVELOPMENT OF PROGRAMMING FOR GENERAL-PURPOSE MULTICORE PROCESSORS

Wei Zhang

This paper presents the course development activities on multicore programming at the Electrical and Computer Engineering Department of Virginia Commonwealth University. As multicore processors have become the main stream computing platform, it becomes a necessity to teach undergraduate on programming for multicore processors. This paper gives details information about the multicore programming course developed at VCU, including the course modules and a brief introduction of the labs.

TEACHING OBJECT-ORIENTED SOFTWARE DESIGN WITHIN THE CONTEXT OF SOFTWARE FRAMEWORKS

Zoya Ali, Joseph Bolinger, Michael Herold, Thomas Lynch, Jayashree Ramanathan and Rajiv Ramnath

Object-oriented software design and programming is an essential part of a computer science curriculum. We have observed that novice software developers, such as fresh college graduates who have been taught object-oriented design, are able to apply good design principles in theory. However, this rarely extends into their professional practice, when they are asked to design software intended to run inside a software framework. In fact, we observe that even advanced software developers abandon good design practices when developing software while using a framework, and focus on simply “making it work.” This paper presents and discusses a methodology developed for designing software in the context of frameworks to overcome these issues. We show how design patterns can serve as the bridge between the paradigms imposed by the framework and the ideal, unconstrained design of the system. We also suggest an evaluation method for observing the results of using this methodology when used by the students.

WORK IN PROGRESS - VERTICALLY INTEGRATED TEAMS TO INSPIRE STUDENT INTEREST IN COMPUTING

Gregory W. Hislop, Massood Towhidnejad and William M Marcy

This WIP discusses Inspire-CT, an NSF-funded, multi-institutional project that is exploring ways to share the excitement and engagement of advanced computing courses with pre-college and introductory undergraduate students. The discussion includes examples of initial educational activities and a summary of results, issues, and future plans.

TEACHING AND ASSESSING AN INTERDISCIPLINARY SCIENCE OF DESIGN PILOT COURSE

Guy-Alain Amoussou and Steven J. Steinberg

The role of design and creativity is well established in many disciplines in science, engineering and art. However, in computing science disciplines, specifically in the development of software systems and information technology, the computing educational community is struggling to include creativity and design in their teaching and research. Existing curriculum in computing science lacks the foundation necessary to systematically include these concepts in the learning experience. At Humboldt State University (HSU), as part of the National Science Foundation Science of Design (SoD) initiative, the authors have initiated a NSF funded educational and research project CNS-0614003, to build an interdisciplinary community with interest, experience and knowledge in teaching and learning creativity and design. During the fall of 2006, fifteen faculty from thirteen disciplines explored a variety of activities to facilitate the teaching and learning of creativity and design from an interdisciplinary perspective. In this paper we share the interdisciplinary curriculum developed and the results of the independent evaluation of students self assessment of teaching the course for two consecutive years.

WORK IN PROGRESS - TRANSVERSAL COMPETENCIES CONTRIBUTIONS TO COMPUTER SCIENCE 1 COURSE

Ines Friss de Kereki

A competence may be generically defined as the capacity of doing something and is more than just skills or

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knowledge. A transversal competence is one which can be re-used when shifting to another context. Our goal is to contribute to improve Computer Science 1 (CS1) course's results by the systematic incorporation of activities based on transversal competencies. We designed a set of activities to enhance the development of transversal competencies, specially planning and time management, team work and communication skills. Hypothetically, we propose that including this kind of activities helps to obtain better results in the course. An initial experimentation was done in 2010. The preliminary results show a remarkable positive difference in student's results. In the selected group the fail rate was only 12% (3 of 25 students). In other groups, the fail rate was 32% (8 of 25 students) and 40% (8 of 20 students). In previous years, this rate was approximately 40%.

Session S3H: Gender and Diversity: Tiospaye, Social Media, Microaggression, Academic Career Trajectories, Innovation

Chair: Teri Reed-Rhoads, Purdue University

Time: Saturday, October 15, 2011, 1:00 p.m. - 2:30 p.m.

Holiday Inn Room Salon BC

TIOSPAYE IN ENGINEERING AND SCIENCE: INCULCATING A SUSTAINED CULTURE FOR RECRUITING, RETAINING, AND GRADUATING AMERICAN INDIAN STUDENTS

Jacqueline McNeil, Carter Kerk and Stuart Kellogg

While the general population of South Dakota is 10 percent American Indian, participation in higher education of this group in South Dakota universities remains relatively low, typically around 1.5 percent. Following best practices developed by American Indian educators and tribal colleges, the South Dakota School of Mines and Technology has developed a new program, Tiospaye in Engineering and Science, which offers a new paradigm for recruitment and support for American Indian students. Following the Lakota word for extended family, Tiospaye, the program provides both scholarship support and positive intervention strategies through an extended campus network of support. The program features extensive classroom support through a combination of campus and small group tutoring sessions, designed within department advisors, and a program mentor that offers one-on-one academic advising and mentoring. In this paper, we describe the recruitment process, positive intervention strategies for academic success, and social support networks. We conclude with a discussion of the current status of the program and early assessment results.

WORK IN PROGRESS - USING SOCIAL MEDIA TO TEACH ENGINEERING PROCESS

Bruce R. Maxim, Margaret Turton and Wassim M. Nahle

Due to the outsourcing of many low level computing jobs, many students have a perception that there are very few computer science related jobs in the United States. Consequently, the number of students majoring in computer science has been decreasing. This project attempts to use social media as a means of attracting more students to study computer science and software engineering by exposing 16 to 20 year old students opportunities to the soft skills associated project management without being concerned about programming implementation details. It is an expectation that using a game setting to expose potential students to the rich set of activities that make up software engineering process may attract them to the consider the field as a course of study. An explicit goal of this project is to try to attract female students to the study of STEM coursework although the game is being designed to appeal to male students as well. It is also hoped to determine which types of engineering process activities are most attractive to female students. A prototype of proposed game will be completed during the summer of 2011.

"MICROAGGRESSIONS" IN ENGINEERING EDUCATION: CLIMATE FOR ASIAN, LATINA AND WHITE WOMEN

Michelle Madsen Camacho and Susan M. Lord

How do women experience the climate of engineering undergraduate education? How is this shaped by race/ethnicity? Using a focus group methodology, we interviewed women who self-identify as Asian, Latina and White at a large public institution in the southeastern United States. Their narratives are analyzed using the interdisciplinary theoretical framework of "microaggressions" from the social sciences. Microaggressions arise from subtle and covert racist and sexist acts which occur frequently in the lives of marginalized groups. Women of all races, who remain severely underrepresented in engineering, may be considered a marginalized group. For women of color, stereotypes of the "model minority" or "affirmative action baby" also overlay their experiences. Microaggressions occur at multiple levels: at the institutional level, at the interpersonal level, and as jokes or humor that subtly deride women's place in engineering. In this paper, we provide examples of each of these types of microaggressions in the experiences of women majoring in engineering and how these are processed differently depending on race/ethnicity. Our findings provide a nuanced perspective on how these microaggressions help shape the academic and social aspects of the climate of undergraduate engineering education.

PERFORMANCE TRAJECTORY OF STUDENTS IN THE ENGINEERING DISCIPLINES

Marisa K. Orr, Ida Ngambeki, Russell A. Long and Matthew W. Ohland

The purpose of this study is to examine differences in student performance among engineering disciplines, as measured by term GPA's. Results indicate that: 1) Women outperform men in most engineering disciplines; 2) Student performance starts low at the freshman level, drops slightly at the sophomore level, and then increases over the junior and senior levels (without controlling for mortality); 3) Significant differences in GPA's remain between majors after controlling for relative SAT score, academic class level, race, and gender; 4) After controlling for major, relative SAT score, academic class level, and race, the gender gap in performance grows even larger.

DOES DIVERSITY IN NOVICE TEAMS LEAD TO GREATER INNOVATION?

Nicholas D. Fila, Ruth E. H. Wertz and Senay Purzer

Design teams are commonly formed in engineering courses with the assumption that diversity leads to more innovative solutions. However, the literature indicates that this assumption is conditional, based on factors such as team effectiveness and how diversity is defined. Additionally, prior research has focused on expert teams, rather than the novice teams typical of many engineering courses. The purpose of this study is to investigate the relationship between team diversity, as a function of gender and race, team effectiveness, and innovation within novice engineering teams. First, we examined the relationship between diversity and team effectiveness. We used an established peer evaluation system to measure the team effectiveness ratings of 275 four-person teams. Gender heterogeneous teams were more effective than gender homogenous teams, but there was no significant difference between racially homogenous and heterogeneous teams. Second, we analyzed student team project reports for innovative design solutions. There was no correlation between team effectiveness and innovativeness, nor did gender heterogeneous teams produce more innovative solutions than gender homogenous teams. These results suggest diversity, defined by gender or race alone, may not increase innovation within novice engineering teams.

Session S4A: Panel - Engineering Education in Iberian America

Chair: Melany M. Ciampi, Safety, Health and Environment Research Organization

Time: Saturday, October 15, 2011, 3:00 p.m. - 4:30 p.m.

Holiday Inn Room Salon D

PANEL - ENGINEERING EDUCATION IN IBERIAN AMERICA

Melany M. Ciampi, Claudio da Rocha Brito, Rosa Vasconcelos, Maria Feldgen and Edmundo Tovar

The large Continent of America has in its territory besides overseas regions, dependencies and colonies 35 sovereign countries, 25 in North America and 12 in South America. Among them there are two big countries Brazil, which official language is Portuguese and Argentina, which official language is Spanish. Both are of political and economical importance in South America. They both belong to the so called Iberian America, which is a term used since the second half of the 19th century to refer collectively to the countries in the Americas, which were formerly colonies of Spain or Portugal. The Iberian countries in Europe are Portugal, Spain, Andorra and Gibraltar. The objective of this paper is to present the history and the current status of engineering education in Iberian America countries Brazil and Argentina followed by the countries that originated the engineering education in these countries, Portugal and Spain.

Session S4B: Enabling and Assessing CSET Learning: Portfolios, Beliefs, Residency, Contexts, and Relationships

Time: Saturday, October 15, 2011, 3:00 p.m. - 4:30 p.m.

Holiday Inn Room Salon E

WORK IN PROGRESS - THE ROLE OF WORKING MEMORY AND EPISTEMIC BELIEFS ON OPEN-ENDED PROBLEM SOLVING

Elliot Douglas, Mirka Koro-Ljungberg, David J. Therriault, Christine Lee, Zaria Malcolm and Nathan McNeill

Open-ended problem solving is a skill that is central to engineering practice. As a consequence, developing skills in solving such problems is imperative for engineering graduates. Open-ended problems are often ill-defined and can have more than one viable solution. This paper presents preliminary results from a mixed methods study examining the specific problem solving strategies of undergraduate engineering students when dealing with the ambiguity of open-ended problems. Participants completed measures of content knowledge, epistemic beliefs, and working memory, and also solved four complex engineering problems during individual problem solving sessions. A subset of participants solved these problems during a think aloud session and participated in follow-up interviews. Preliminary analysis of quantitative data has focused on identifying correlations between problem solving solution scores and the measures of epistemic beliefs and working memory capacity. Analysis of qualitative data is examining the problem-solving processes students.

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WORK IN PROGRESS - SOFTWARE RESIDENCY: A CONTRIBUTION FOR PROFESSIONAL MATURITY

Luiz Ricardo Begosso, Luiz Carlos Begosso, Alex Sandro Romeo Souza Poletto, Fernando Cesar Lima and Douglas Sanches Cunha

Preparing and qualifying the Computer Science students to meet the software industry needs is a growing challenge for academia. This task is about maturing the future professional with good practices of software development, increasingly demanded by software industry. This work aims to present the process of implementing a software residency program for undergraduate Computer Science course, which we call “Software Residency Program”, and is being implemented since the beginning of the academic year 2010. This program provides an environment for undergraduate students to experience real software development, following standards and rules established by the software industry. We describe the methodology adopted to implement the process and some initial results we have collected from the students who are in the program. Currently, the Software Residency Program has entered its final phase, and is scheduled to be completed in the month of May 2011, finishing the process of Software Residency, when results will be evaluated by all the stakeholders.

PROVIDING END-TO-END PERSPECTIVES IN SOFTWARE ENGINEERING

Michael Herold, Joe Bolinger, Rajiv Ramnath, Thomas Bihari and Jayashree Ramanathan

In order to better prepare students for professional practice, we have created a software engineering curriculum that provides an end-to-end perspective that begins with the business context of software, and goes all the way to the ongoing management of software services after deployment. This paper examines how the theoretical aspects of this broad-based curriculum may be effectively delivered through a single course within a traditional computer science program. This curriculum is under a diverse set of constraints and requirements, such as the need for pedagogical consistency, faculty development, consideration of the learning style of computer science students, and a need for an effective continuous improvement process. Our approach uses “engineering-oriented” analysis frameworks such as Porter’s Five Forces model for the business aspects, and attribute-driven design for software architectures, an “inverted” classroom mode of teaching where lectures are delivered on line with interactions and exercises that promote active learning reserved for the classroom, case studies developed from real projects to serve as concrete examples, open discussion boards and weekly short quizzes for concept refinement and retention, and a paper-based project where students apply the concepts learned. Faculty development and replication outside the current site are also discussed.

WORK IN PROGRESS -: COMPUTER SCIENCE E-PORTFOLIOS: PERSPECTIVES FROM UPPER AND LOWER DIVISION STUDENTS

Karen Anewalt and Jennifer Polack-Wahl

An e-portfolio is an online multimedia-capable portfolio that showcases a student’s collection of academic learning, achievements, knowledge, and skills. While using e-portfolios to showcase student work has been a hot topic in the engineering education community, the topic has received less attention in the computer science education community. This paper presents a work in progress comparing the use of e-portfolios early in a computer science student’s academic career versus late. We find that there are benefits to each approach, both from a student perspective and an instructor perspective.

IDENTIFYING AND ASSESSING RELATIONAL UNDERSTANDING IN ORDINARY DIFFERENTIAL EQUATIONS

Karen Keene, Michael Glass and Jung Hee Kim

Is it possible to assess conceptual understanding of ordinary differential equations and their solutions? There is significant tension between students learning mathematics for understanding and students learning to drill a set of algorithms to solve standard ODE exercises. This paper presents the Framework for Relational Understanding of Procedures, a categorization of assessable conceptual knowledge. Example conceptual knowledge we examine in this project include relating a graphical representation of an ODE to a symbolic one, checking a result, and knowing why a particular solution method might be applicable. We applied this framework to three techniques taught in Ordinary Differential Equations: separation of variables, solving a first order linear ordinary differential equation, and Euler’s method and developed a set of assessment items. These assessment questions were then transformed into knowledge pieces and moved into an online platform and elaborated. Thus, the assessment can be administered either in traditional pencil-and-paper form or through a learn-as-you-assess online web site.

Session S4C: Challenges in Learning Engineering: Problem Solving, Collaboration, Teams, and Communication

Chair: Marisa K. Orr, Purdue University

Time: Saturday, October 15, 2011, 3:00 p.m. - 4:30 p.m.

Holiday Inn Room Salon A

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A QUALITATIVE ANALYSIS FOR THE FACILITATION OF INNOVATIVE PROBLEM COMPLETION AMONGST DYADS OF ENGINEERING STUDENTS

Paul Figueroa, Richard Savage, Ricardo Romero and Ray Luechtefeld

The rapidly changing environments of today's dynamic world demand effective problem solving. This is especially vital for people in the fields of math and science, because of rapid changes in technology and computing power. Much of the work in problem solving occurs in dyads, where two individuals come together to share information and tasks; but working through problems as a dyad can lead to conflict because of communication inefficiencies or lack of common understanding. This research tests the usage of an automated Virtual Facilitator to monitor dyads as they work to solve a problem via a synchronized text discussion. The Virtual Facilitator has been calibrated, via text matching and Boolean logic, to offer interventions based on the work of Chris Argyris, an academically distinguished facilitator and researcher in organizational learning. His interventions work to build mutual understanding and increase understanding between group members. The Virtual Facilitator was tested using 56 math and science students at a Midwestern university. The students worked through the "Candle Problem" which required them to consider alternate uses for three common household items that would lead to the correct solution.

MIXING NUMBERS AND LETTERS: COLLABORATION BETWEEN ENGINEERING AND ENGLISH TO IMPROVE GRADUATE STUDENT WORK

Craig Baltimore, Deborah Wilhelm, Mary Forte and Pamalee Brady

This paper will describe the issues and process of developing an introductory course in graduate writing and communication skills in conjunction with the industry of professional consulting engineering. The course was developed through a collaboration of English and engineering faculty and the collaboration is maintained in the teaching of the course. Innovative techniques incorporated into the course development include a four-pronged approach: 1) use of best practices for Writing in the Disciplines; 2) development of and focus on a multi-faceted collaborative model (Engineering and English, university and industry, students and faculty, industry and students); 3) team-teaching by engineering and English faculty members for the initial graduate research course; and 4) emphasis on the quality of the thesis project content in terms of the research itself, analysis and synthesis of that research, and effective communication of the results. Accountability and assessment of students' work includes development of the thesis project statement and presentation of their work to a body of their peers; presentations and evaluations by departmental faculty; and round table talks with industry. This system of accountability and assessment have shown marked improvement in the communication skill set often minimized in both undergraduate and graduate engineering education.

INVERSION OF TECHNICAL AND COMMUNICATION EMPHASIS IN AN ENGINEERING PRODUCT DESIGN CLASS

Dave Custer

In order to situate first year technical writing students in engineering practice, the Massachusetts Institute of Technology's Experimental Study Group (ESG) has piloted a section of a first year writing curriculum subject, 21W.732, Scientific Writing and New Media, in which the communication deliverables are based on mechanical engineering product design. The ESG section of the 21W.732 writing subject inverts the communication and technical emphases found in upper-level engineering design subjects: in the ESG 21W.732, the emphasis is on communication rather than product design. The ESG 21W.732 curriculum asks students to work together both individually and in teams to conceive, design, prototype, and evaluate products; the communication assignments are coupled directly to this design cycle or to the humanistic aspects of engineering. Results suggest that students are engaged in this novel subject and value the experience. This interdisciplinary, hands-on, project-based, team-based communication class offers students a number of benefits above and beyond situated communication instruction, including the opportunity for first year students to explore engineering as a major, to learn (some) technical content driven by the projects, and to engage in genuine team project work.

WORK IN PROGRESS - A FEEDBACK SYSTEM FOR PEER EVALUATION OF ENGINEERING STUDENT TEAMS TO ENHANCE TEAM EFFECTIVENESS

Junqiu Wang, P. K. Imbrie and Joe J. Lin

Developing students teaming skills has become common place in engineering education as a pedagogical tool to facilitate learning of technical content as well as to prepare students for professional practice. Engineering faculty typically determine the degree to which students have had an effective team experience by indirect methods such as homework or project grades along with self report team member peer-evaluations. Such methods tend to place a greater emphasis on the outcome (or product) of teaming rather than on the process of teaming itself. The use of standalone peer-evaluations to indirectly determine team effectiveness has also been shown to be problematic, since students are not typically taught how to properly evaluate their peers. This lack of training generally results in a

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significant amount evaluation bias. This research presents a theoretical framework to indirectly measure team effectiveness using a calibrated peer evaluation system. The system provides students feedback on their rating ability as well as quantifies (as a 1st order approximation) their evaluation bias. The system can be used by faculty for early identification of dysfunctional teams as well as to determine the degree to which students are engaged in effective team behaviors.

WORK IN PROGRESS - ROBUST ENGINEERING PROBLEMS FOR THE STUDY OF PROBLEM SOLVING STRATEGIES

Sarah J. Grigg and Lisa C. Benson

Our research group is examining how first year engineering students develop problem-solving skills. It is important to select and design problems such that they promote self-efficacy and build effective problem solving skills. However, it is a challenge for engineering educators to determine the appropriate difficulty or rigor of assignments or assessments that will accomplish this, especially in introductory courses in which students have a range of academic preparedness. We are reporting here on methodologies developed for studying characteristics of engineering problems, perceived difficulty of the problems from students' perspective, and different problem solving strategies that first year engineering students typically use.

Session S4D: Approaches to Developing Engineering Learners: Metacognition, Community Colleges, Grading, Co-curricula, Feedback

Time: Saturday, October 15, 2011, 3:00 p.m. - 4:30 p.m.

Holiday Inn Room Salon F

WORK IN PROGRESS - USING THE LEVENSHTAIN DISTANCE TO EXAMINE CHANGES TO TEAMS' MODEL-ELICITING ACTIVITY SOLUTIONS THROUGHOUT A SEMESTER

Jacob Bishop and Matthew Verleger

In the fall semester of 2008, students in a first-year engineering course at Purdue University completed three Model-Eliciting Activities (MEAs): Paper Airplane Challenge, Just-In-Time Manufacturing, and Travel Mode Selection. MEAs are realistic, open-ended, client-driven engineering problems designed to foster students' mathematical modeling abilities. The primary artifact produced by each team (N=295 teams, 1166 students) is a memo to the client describing a procedure for solving the engineering problem. Within each MEA, teams of students produced three iterations of their procedure, receiving feedback after each iteration. Between versions of student work, we compute a normalized measure of the addition, substitution and deletion of words between drafts. We found that student drafts changed an average of 105.4% from draft 1 to 2, and 43.8% from draft 2 to 3. Of this change, we can attribute all but 37.7% of the change from draft 1 to 2 to increased length, and all but 23.6% of the change from draft 2 to 3 to increased submission length. Knowing how much change is induced with each iteration of feedback, and how this change is related to the source and number of feedback iterations, has important implications for instructors planning feedback activities in the classroom.

WORK IN PROGRESS - PREDICTION OF STUDENTS' ACADEMIC PERFORMANCE IN AN INTRODUCTORY ENGINEERING COURSE

Shaobo Huang and Ning Fang

Prediction of student academic performance helps instructors develop a good understanding of how well or how poorly the students will perform, so instructors can take proactive measures to improve student learning. This paper reports our recent ongoing efforts that focus on developing a predictive model to predict students' academic performance in an introductory engineering course titled Engineering Dynamics. A total of 2,151 data points were collected from 239 undergraduate students in three semesters. Four predictive models were developed using multivariate linear regression (MLR), multilayer perceptron (MLP) neural networks, radial basis function (RBF) neural networks, and support vector machines (SVMs), respectively. The results show that in many cases, the support vector machine model generates the overall best predictions: The average prediction accuracy is 89.0%-90.9% and good predictions are 62.3%-69.0%.

WORK IN PROGRESS - DEVELOPING ENGINEERS FOR 2020 - AN INNOVATIVE CURRICULAR AND CO-CURRICULAR APPROACH

Monica J. Bruning, Diane T. Rover and Ana M. Williams

The E2020 Scholars Program is a National Science Foundation Scholarships in STEM (S-STEM) Program providing scholarships for cohorts of first-year and transfer undergraduate engineering students. The conceptual framework of the E2020 Scholars Program is designed to advance the academic and professional development of the scholar using the college's learning community infrastructure and building upon the aspirations and attributes of the National Academy of Engineering's (NAE) vision for the engineer of 2020. Programming includes a set of student

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development and learning opportunities consistent with this vision and includes curricular and co-curricular activities on the topics of leadership development, global awareness and understanding, systems thinking, and innovation.

THE ITASCA CC ENGINEERING LEARNING MODEL

Bart Johnson and Ron Ulseth

The engineering program at Itasca Community College in northern Minnesota has developed an innovative learning model that is focused on the formation of students into professional engineers through a continuum-based development process. Four key aspects of the Itasca CC Engineering Learning Model are: 1) strong K-12 relationships, 2) a two-year “across the curriculum” engineering development course sequence, 3) an active student and faculty learning community, and 4) flexible academic pathways for different student development and learning opportunities. The model continually reinforces students in developing the identity and commitment of a professional engineer through a) building and maintaining student aspiration for becoming an engineer, b) student development as a professional, c) student professional practicing of engineering, and d) learning to work and function in an organization. The model’s success is demonstrated with a diverse body of learners starting in a community college pre-engineering program and completing their engineering bachelor’s degree in an average of 8.8 semesters with graduation rates of 49% for all students who start the program and 67% for students who start with or achieve a “calculus 1” math ability during their college education.

WORK IN PROGRESS - USING MULTIPLE METHODS TO INVESTIGATE THE ROLE OF FEEDBACK IN OPEN-ENDED ACTIVITIES

Monica E Cardella, Heidi A Diefes-Dux, Matthew Verleger, Amanda Fry and Mark T Carnes

While providing opportunities for students to engage in open-ended, ambiguous problems allows students to develop skills for responding to ambiguity and applying knowledge in practical ways, it can be difficult for instructors to assess student work when students’ solutions are very different from each other. However, to promote student learning, it is essential that instructors provide feedback—particularly in the form of formative feedback that allows students to revise their work before submitting their final solution. In this study, we investigate the challenges associated with providing feedback, the challenges that students face in responding to feedback, and the impact of the feedback on student work. We do this by investigating the role of feedback through multiple data collection methods: collection of artifacts - copies of student work (and copies of instructor and peer feedback), interviews conducted with students and with teaching assistants, and video recordings of the students as they work to address the feedback and revise their solution. Through these multiple lenses, we are beginning to uncover challenges and strategies for success in both providing and responding to feedback. These findings provide opportunities to design and re-design instructional materials that equip teaching assistants and students with skills to provide feedback, and to equip student with skills to respond to feedback.

Session S4E: Institutionalizing Innovations in CSET Education

Time: Saturday, October 15, 2011, 3:00 p.m. - 4:30 p.m.

Holiday Inn Montana Room

WORK IN PROGRESS - TENSIONS WITH PBL IMPLEMENTATION IN UNDERGRADUATE ENGINEERING EDUCATION – PRELIMINARY RESULTS FROM TEACHING PRACTICE

Angela van Barneveld and Johannes Strobel

In this paper, we discussed research that focused on the tensions that engineering educators encounter with the implementation of problem-based learning (or its variants) in their undergraduate teaching practice. Preliminary findings indicated that students discomfort and content coverage (depth versus breadth) were the two predominant tensions in classroom implementations. Within the realm of engineering education as a system and culture, educators reported predominant tensions in needing to strike a balance between problem solving versus design, as well as theory versus application. Implications and future research are discussed.

WORK IN PROGRESS - IMPROVING THE DISSEMINATION OF CCLI (TUES) EDUCATIONAL INNOVATIONS

Joseph G Tront, Flora P. McMartin and Brandon Muramatsu

The National Science Foundation (NSF) Course Curriculum and Laboratory Improvement (CCLI) Program (now the TUES program – Transforming Undergraduate Education in STEM) has produced a vast number of products and processes since its inception. The CCLI Program has fostered innovation nationwide and has worked to improve “quality of science, technology, engineering, and mathematics (STEM) education for all undergraduate students.” More often than not these innovations ‘remain local,’ in that they are only developed and used by the initiating investigator(s) and are tied to the funding, once the initial funding ends the investigators move on. In recent years the CCLI Program has instituted a multi-stage program to encourage scale up of these innovations—extending the reach from small test-beds to national dissemination. However, this process typically recognizes and disseminates fairly

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large-scale innovation; the result is that most innovations developed through the CCLI Program continue to ‘stop where they started.’ Very few CCLI projects, or their results, are integrated into daily use by the larger set of teachers and learners who might benefit from these innovations, and who should take advantage of existing projects thereby eliminating the need to regularly re-invent these works. In the spring of 2010 a workshop was held in Washington, DC in an attempt to identify the best practices for dissemination of CCLI innovations. In preparation for the workshop, approximately 2,400 CCLI award winners were surveyed to determine their practices and what they thought were indicators of successful dissemination. NSF Program Directors were also surveyed. This paper reports on the preliminary findings from the survey of CCLI Principal Investigators (PIs) and NSF’s Cognizant Program Directors (PDs), and the results of panel discussions held during the meeting of invited experts in the area of STEM education and dissemination. Results indicate that the most frequently used methods of dissemination do not lead to desired outcomes. Several methods are proposed to improve access to resources and the adoption of these resources by other faculty seeking to improve teaching and learning.

CURRICULA DESIGN MODEL FOR DESIGNING AND EVALUATING SYSTEMS AND COMPUTING ENGINEERING PROGRAMS

Jorge Villalobos, Oscar Gonzalez Rojas, Claudia Jimenez and Francisco Rueda

Recently, there has been a big movement towards converging engineering education and practice by means of defining clear and complete program goals. In this context, a large scale of educational institutions face challenges on how to specify the desired educational goals for a specific discipline and on how to instantiate and evaluate their program-specific designs according to these goals. We have defined a curricula design model for designing, redesigning, and evaluating systems and computing engineering (S&C) programs. The core of this model is the orientation to projects for the definition of educational goals that facilitate the definition of courses that integrate a set of these desired goals. This paper presents the core elements of the curricula design model and the methodology to instantiate it into a new program design that satisfies a desired professional profile. The curricula design model has been validated through its instantiation for redesigning the S&C program at the University of Los Andes in Colombia.

SYSTEMATIC ANALYSIS OF PEER INTERACTION IN COOPERATIVE LEARNING

Chien-Hung Lai, Bin-Shyan Jong, Yen-Teh Hsia, Pai-Feng Lee and Te-Yi Chan

The strategies of cooperative learning have students help each other and make up for each other’s learning differences, in order to enhance personal learning achievement and achieve learning objectives. Therefore, educators use the online platform to aid teaching, students can do various learning activities and discuss with classmates on the platform. Online platform not only provide students to learn the material, but also use the system to record the learning activities of students on the platform, students can also seek the assistance of peers on the platform. However, the discussion activities of the learning issues for each student are not necessarily structured type on learning platform, how do get information from the online discussion activities of students, discussion activities of the quantitative and qualitative analysis has become an important research topic. The study is based on Liu and Tsai proposed the interactive model as the cooperative learning group interaction on the classification, the paper is a way of observing and analyzing manually to determine the interaction patterns of each group. The study design the questionnaire of interactive mode, it can used automatic classification of group interaction scale, in order to reduce the load on manual observation and analysis. To ensure the interaction questionnaire can actually classified the interactive model, the study used statistical package for social science to verify reliability and validity of the subject content of the interaction questionnaire, in order to effectively grasp the cognition of student interaction.

Session S4F: Facilitating Students in Learning CSET Design

Chair: Cesar Cardenas, Tecnologico de Monterrey - Campus Queretaro

Time: Saturday, October 15, 2011, 3:00 p.m. - 4:30 p.m. Holiday Inn Private Dining Room

LEARNING FROM AN INITIATIVE – HANDS-ON ROBOTICS WORKSHOPS BY IEEE STUDENT BRANCH

Tuhin Subhra Mukherjee and Prithwiraj Purkait

The present contribution reports initiative of a relatively new IEEE Student Branch involving students in creative activities that build motivation for their future engineering studies. The IEEE Student Branch at Haldia Institute of Technology has always attempted to put more emphasis on hands-on learning and training for fellow students through various workshops and training sessions. As a part of such activity, training sessions on basics of mobile robots are being conducted for the last 3 years. Participation has been from a wide range of backgrounds, from different streams and different undergraduate to post graduate levels. Initial aim of the workshop sessions was to motivate students in design, estimation, fabrication and testing their own ideas of basic mobile robots. During the course of events in last few years, as will be reported in the paper, several interesting findings could be identified. It

Saturday Sessions

is felt that in order to perform well in their workplace, as well as to be responsible citizens, students are required to not only develop mastery of a particular subject, but civic, social, interpersonal and workplace skills as well [1]. In addition to reinforcing concepts from earlier and concurrent courses, such workshops can serve as a platform for exposing students to inter-disciplinary topics that appear in greater depth in later courses. Also, students mature in areas such as oral and written communication, awareness of professional ethics issues, and working effectively in a team-based setting. Mixing of students from different disciplines and different grades greatly enhances sense of fellow feeling and team spirit. Such workshops, being conducted by students themselves, increases the sense of belongingness, inculcates maturity, sensibility, leadership qualities among the organizing students [2].

WORK IN PROGRESS – ANALYZING ENGINEERING STUDENT CONCEPTIONS OF MODELING IN DESIGN

Adam R. Carberry and Ann F. McKenna

Modeling is a pervasive feature in any engineering curriculum that is rarely taught as an explicit topic to engineering learners. The implicit inclusion of modeling often results in conceptions of models being primarily descriptive – visual and physical representations – that originate from everyday and coursework use. A broader understanding of modeling is achieved when students are given opportunities to learn about the predictive nature of some modeling applications. Exploratory studies have shown that significant shifts occur in the modeling conceptions of senior engineering students when taught an explicit modeling intervention. Descriptive-centric conceptions remained prevalent with an additional focus on predictive mathematical models. The following work in progress describes the next steps of our study focused on expanding earlier findings. Student, and additionally faculty conceptions, will be observed to gain a greater understanding of modeling conceptions.

COGNITIVE DISSONANCE DURING ENGINEERING DESIGN

Senay Purzer, Jonathan C. Hilpert and Ruth E.H. Wertz

We examined changes in engineering students' perceived challenges during a semester-long design project to identify the most salient challenges they experienced and when they occurred. We hypothesized that patterns in students' perceived challenges in key areas would take the form of multiple, overlapping waves reflective of the desire to stabilize the problem space. We collected longitudinal data from about 130 engineering students at five points during a semester, with some variation in sample size between time points. A series of Chi-square difference tests were conducted to examine changes in students' perceived challenges during the course of the project. The result of the study partially supports our hypothesized pattern of overlapping waves.

A COMPARATIVE STUDY OF ACADEMIC PARTNERSHIPS FROM A STUDENT PERSPECTIVE

Amalia Rusu and Spoorthy Gowda

Research shows that students who are engaged in their academic work are motivated by the need to succeed, need for self-expression, personal curiosity, and desire to fostering positive peer relationships. Engaging assignments help shape their understanding, allow them to explore their creative side, while interacting and teaming up with their peers. In this paper, we present a comparative study of various approaches and partnerships for teaching hands-on engineering classes, including the pros and cons of technology students partnering with industry, non-profit organizations, or interdisciplinary school collaborations vs. traditional in-class course assignments. The findings are based on a survey conducted among undergraduate and graduate students at Fairfield University. The focus group consisted of a mix of students who have worked with either one or more organizations as part of their academic work. The study also focuses on the issues and challenges while working with various organizations, and the results are presented from the students' perspective.

WORK IN PROGRESS - CREATING A PROFESSIONAL SOFTWARE DEVELOPMENT ENVIRONMENT TO SUPPORT CAPSTONE PROGRAMMING PROJECTS

Meg Coffin Murray

Experiential education provides valuable learning opportunities for students in the computing disciplines. Assigning students to work on real-world projects is often seen as a way for students to practice what they have learned in the classroom. While a desirable goal, logistics often make it difficult to provide these types of experiences. However, it is vitally important for students to be exposed to and experiment with tools used in commercial software development environments. This paper provides a descriptive overview of the development and implementation of a professional software development environment used to support computer science capstone programming projects. To date, the environment has been used to support work on a National Science Foundation funded database courseware project that includes over 100 interactive software modules. The environment was built using a collection of open-source applications that provide version control, task assignment and tracking, collaborative team tools, bug tracking, and project documentation management. This project has created a venue for providing consistent high

quality real-world types of experiences for students completing their capstone requirement.

Session S4G: Outposts in Engineering Laboratories: Remote Experiments, Personal Laboratories, System Performance, Simulations

Chair: Maria Cristina Costa Lobo, ISEP - Polytechnic of Porto

Time: Saturday, October 15, 2011, 3:00 p.m. - 4:30 p.m.

Holiday Inn Hammons Room

USING REMOTE EXPERIMENTATION IN A LARGE UNDERGRADUATE COURSE: INITIAL FINDINGS

M. C. Costa Lobo, Gustavo R. Alves, M. A. Marques, C. Viegas, R. G. Barral, R. J. Couto, F. L. Jacob, C. A. Ramos, G. M. Vilao, D. S. Covita, Joaquim Alves, P. S. Guimaraes and Ingvar Gustavsson

The use of remote labs in undergraduate courses has been reported in literature several times since the mid 90's. Nevertheless, very few articles present results about the correspondent learning gains obtained by students, and in what conditions those systems can be more efficient, thus suggesting a lack of data concerning their pedagogical effectiveness. This paper addresses such a gap by presenting some initial findings concerning the use of a remote lab (VISIR), in a large undergraduate course on Physics, with over 550 students enrolled.

WORK IN PROGRESS - A HARDWARE PLATFORM FOR A CONTINUOUS-TIME SIGNALS AND SYSTEMS COURSE

Mario Simoni

This paper describes a hardware platform that can provide hands-on learning experiences for introductory continuous-time signals and system courses. The signal inputs on the platform consist of a microphone, an instrumentation amplifier input with a right-leg drive for measuring ECGs, and a general voltage input, which enable the students to work with a wide variety of realistic signals. Other analog circuits perform multiplication, addition, filtering, and sampling of those input signals. The underlying hypothesis of this work is that students can improve their understanding of and interest in frequency domain concepts via manipulation of realistic continuous-time systems and observation of signals simultaneously in the time and frequency domains.

AN ADVANCED LEVEL RADIO-FREQUENCY CIRCUIT COURSE WITH LABORATORY AND DESIGN EXERCISES THAT EMPHASIZE COMPLETE SYSTEM PERFORMANCE

Taylor Barton and Mariano Alvira

A new course is presented that was designed and offered for the first time in 2010 as a special subject at the Massachusetts Institute of Technology. This course is a graduate-level advanced circuit design subject that covers the design of the circuit blocks that make up a modern communications system and is intended for graduate students who have analog circuit design experience. It uses a new integrated laboratory assignment which studies the detailed design of all critical modules and their impact on overall communications system performance.

TEACHING EXPERIENCES IN WIND ENERGY: SIMULATIONS AND LABORATORY EXPERIMENTS

Angel Molina-Garcia, Juan Alvaro Fuentes, Emilio Gomez-Lazaro and Antonio Viguera-Rodriguez

The main objective of this paper is to discuss recent teaching experiences based on wind energy modules. With this aim, several practical laboratory and software sessions based on wind generators have been proposed and carried out by our students: Technical University of Cartagena and Universidad de Castilla La Mancha, Spain. Both simulated and collected results have been compared and analyzed as a preliminary approach to real industrial environments. The proposed models take into account electrical, electronic and control subsystems that comprise a simplified electric drive and wind generator. The main advantage of the present study is that students can verify and quantify the real discrepancies between laboratory and simulated results. Moreover, through these analyses, they can also progress, strengthen and expand their theoretical knowledge. The proposed methodology has been implemented along the last years in different modules related with electric and electronic fields. Academic results and student reaction are also discussed in the present paper.

WORK IN PROGRESS - A TRANSPARENCY AND SCAFFOLDING FRAMEWORK FOR COMPUTATIONAL SIMULATION TOOLS

Alejandra J. Magana, Dragica Vasileska and Shaikh S. Ahmed

Technological advances in cyberinfrastructure have paved the way for research grade computational simulation tools, such as those available on nanoHUB.org. Even though benefits have been acknowledged for incorporating these tools into teaching and learning environments, difficulties have also been identified. To address some of these difficulties researchers have emphasized that inquiry learning with simulations, in order to be successful, needs adequate but not intrusive scaffolding. As a response to this need, nanoHUB.org affiliated faculty have proposed tool-based curricula to be used for training 21st century engineers in the nanoelectronics field. Motivated and informed by our previous

work and related literature on inquiry learning with simulation, a transparency and scaffolding framework is proposed to be integrated into existing nanoHUB tool-based curricula.

Session S4H: Can students learning CSET subjects through games?

Time: Saturday, October 15, 2011, 3:00 p.m. - 4:30 p.m.

Holiday Inn Room Salon BC

EARLY PROJECT BASED LEARNING IMPROVEMENTS VIA A "STAR TREK ENGINEERING ROOM" GAME FRAMEWORK, AND COMPETITION

Peter Jamieson

In this work, we show how providing a constrained project framework for a second year digital design course improves the number of working student projects from 55% to 86%. Instead of an open-ended project as in previous years, we introduce an optional project framework, called "Redhawk Duels". Redhawk Duels is a game framework in which students design control algorithms and interfaces for a virtual ship. Once a competition begins, two opposing groups and their respective ships attempt to incapacitate the opposing ship by finding the opponent, shooting them, and budgeting their energy accordingly. Fifteen of the twenty-one groups in the 2010 class participated in Redhawk Duels for their final project, and 86% of these projects were working and demonstrated with sufficient complexity. The remaining six groups chose to implement open-ended projects and had a 66% success rate. This rate is similar to the 55% success rate of the 2009 class which were all open-ended projects. We surveyed the students involved to see how they felt the project helped them and how much they enjoyed the activity. The results show that the students strongly agree that participating in the framework motivated them and will help them in future engineering design projects.

WORK IN PROGRESS - USING MOBILE & SOCIAL GAME TECHNOLOGY WITH LOCATION-BASED SERVICES FOR BUILDING LEARNING COMMUNITIES

Anthony Ellertson and Patrick Seeling

In this Work in Progress, we describe the 'my Learning Community' application design principles and theoretical foundation. The application is a learning community support tool, which we implement in a peer mentoring project in the Department of Computing and New Media Technologies at the University of Wisconsin-Stevens Point. Combining different learning frameworks, we implement location-based services utilizing publicly available interfaces to Foursquare/Gowalla, which allow the identification and tracking of student participation in study sessions and identification of experts ("mayors"), which in turn mentor fellow students. As students progress through the curriculum, the identified student participation will allow for a transition of students into informal topic leadership. The student and study group location and additional communication among participants of study sessions will be facilitated by the 'my Learning Community' application, which we make available to our students for installation on mobile and desktop devices and are currently implementing our approach.

NASH MEETS VAN VALKENBURG: A GAME-THEORETIC APPROACH TO EFFECTIVE LEARNING AND TEACHING IN ENGINEERING

Quanyan Zhu

This work uses game-theoretic approaches to understand the strategic behaviors of students and to achieve an effective teaching and evaluation tool for instructors to adapt their instructions to students' behaviors. We propose game-theoretic models to quantitatively investigate two specific education scenarios. One is on the curriculum design and the other is on the inventory-based test design for first-year undergraduate level courses. The game-theoretic approach allows us to consider multiple factors into one model and provides solution concepts from a holistic viewpoint combining sociology, psychology and engineering education. In addition, this work provides a theoretic and quantitative basis for future studies on effective learning and teaching in engineering community.

WORK IN PROGRESS - USING A COMPUTER GAMING STRATEGY TO FACILITATE UNDERGRADUATES' LEARNING IN A COMPUTER PROGRAMMING COURSE: AN EXPERIMENTAL STUDY

Kuo-Chuan (Martin) Yeh and Wei-Fan Chen

This study implemented and evaluated an educational computer game as a supplemental instructional method in a fundamental computer programming course. Twenty undergraduates who enrolled in a fundamental computer programming course for non-computer science majors participated in the study. They were randomly assigned to use one of two different supplemental instruction delivery methods for a three-week period of instruction. One group used an electronic quiz program and the other group used an educational computer game. Both methods used the same set of quiz bank and all quizzes were selected randomly by the applications. After the instructional treatments were implemented, students' intrinsic motivation and final achievement scores were measured and analyzed. The result of the study indicated that students in the treatment group had positive attitude toward the educational

computer game. Specifically, the students in the educational computer game group demonstrated higher intrinsic motivation and better achievement scores compared to the students in the control group.

ASSESSMENT OF THE PILOT IMPLEMENTATION OF A GAME-BASED GEAR DESIGN LABORATORY

Yizhe Chang, El-Sayed S. Aziz, Sven K. Esche and Constantin Chassapis

Taking advantage of game technology for offering truly immersive and interactive learning experiences to undergraduate engineering and science students has now become a real possibility. An immersive interactive virtual laboratory environment has been created for the laboratory component of a junior-level undergraduate mechanical engineering course on mechanisms and machine dynamics. For instance, a laboratory system implemented using a multi-player computer game engine provides the students with the flexibility to perform various experiments related to the concepts of the fundamental law of gearing and to the planetary motion of gears. Assessment tools such as pre- and post-experiment tests are an integral part of this game-based laboratory environment and form the basis for providing different levels of support to the students at every step of the laboratory exercise. Furthermore, the game environment can be equipped with functionality for monitoring the students' progress and learning outcomes, thus enabling skill-based assessment. This paper will report on the learning assessment conducted as part of a pilot implementation of this gear design laboratory. The evaluation metrics for the virtual laboratory environment as well as the collected data on learning effectiveness will be presented and the general student feedback will be discussed.