CHAPTER 3
TECHNICAL SESSION 1
EXTENDED ABSTRACTS

Monday, March 11, 2013

Technical Session 1 10:20 am – 11:40 am

10:20am – 11:40am	T1-A Prescott 208	T1-B Prescott 222	T1-C Prescott 225	T1-D Prescott 304	T1-E Prescott 325
Technical Session 1	Instructional Division I	K-12 Division I	Administrative Division I	Civil Engineering Division I	Mechanical Engineering Division I
Moderator:	*Shih-Liang (Sid) Wang*	*Atin K. Sinha*	*Donna Reese*	*Ken Brannan*	*Robert Choate*

T1–A: Instructional Division I **PRESCOTT HALL 208**

T1–B: K-12 Division I **PRESCOTT HALL 222**

T1–C: Administrative Division I **PRESCOTT HALL 225**

* Abstract titles marked with an asterisk are presentation only and have no manuscript in the proceedings.

T1–D: Civil Engineering Division I **PRESCOTT HALL 304**

T1–E: Mechanical Engineering **PRESCOTT HALL 325**

175 - Engineering of Beer: Hard Work of Too Much Fun?

Monika Bubacz, Philip McCreanor, Hodge Jenkins

School of Engineering–Mercer University

EXTENDED ABSTRACT

It is human nature to give very little attention to available staple foods and drinks and their industrial production. That, unfortunately, is especially true for malt beverages. Beer, an example of such, is one of the oldest known and widely consumed by man. During the brewing process grains are converted through fermentation to produce desirable and distinct sensory characteristics. Since as early as 500 BCE, beer making involved many scientific disciplines including agriculture, chemistry, biology, pharmacology. Initially, scientific contributions were at then empirical level but at the end of the 19th century beer production became the subject of analytical research. As customer demand rose and subsequently mass production increased, the brewing industry applied a whole spectrum of new technical, biochemical, microbiological, and genetic inventions boosting the involvement of the scientific world.

It has been said 'Brewing is one of these things that can keep a curious mind very interested and very active.' Then, why not bring it to the engineering classroom and make our students the envy of their peers? A modern brewing engineering education would expose students to principles of fermentation sciences, systems design and many areas of engineering, and would also involve discussion of social, cultural, and ethical implications of food and beverage production. The brewing process is energy intensive and uses large volumes of water. It also produces vast amounts of waste, both liquid (wastewater) and solid (spent grains, hops, yeast). Spent grains are generally used as compost and livestock feed but could also serve as petroleum alternative or be burned and turned into heat or electricity to power machinery.

Aspects of many engineering courses (fluid mechanics, heat and mass transfer, materials, process design, process control, power, machine design, statics, engineering economics, pollution control, optimization, etc.) can be brought to bear in the evaluation of the brewing process. These specialties could be used in conjunction with sustainability and green design concepts to optimize design and operation of brewery. Moral and religious concerns with the production of alcoholic beverages could be an interesting focus for a module on ethics and social concerns.

Food engineering (of which brewing engineering is a part) continues to be a stable and growing area of employment for engineers. It is clear from the previous listing of the major brewing industry challenges that the topic of beer brewing is a rich area of multi-disciplinary design problems. In each of the seven areas discussed, several engineering and science disciplines are required to work together. Brewing can be a fertile area for true multi-disciplinary senior design projects. Engineering a product where taste is a paramount attribute, adds to the challenge. The topics associated with brewing engineering can be translated to many other food products and processing associated with their production.

This article outlines the steps used in beer brewing process and discusses various topics that could be easily integrated into an engineering curriculum.

177 - The New Frontier of Education: The Impact of Smartphone Technology in the Classroom

Jessica L. Buck, Elizabeth McInnis, Casey Randolph

Jackson State University

EXTENDED ABSTRACT

The modern classroom has taken on numerous forms. It expands beyond the traditional brick and mortar walls. The modern classroom can be accessed from homes, work, places of leisure, and more. Technology is integral in providing access beyond four walls Smart phone technology allows the 21st Century student to engage in a learning environment while being mobile. Educational applications (i.e. apps) assist students in accessing interfaces to virtual classrooms, researching specific subject matter, studying flash card notes, and much more. This method of learning appeals to the various learning styles of students, and it allows students to have autonomy and ownership in their learning process. Smartphone technology and applications also encourages educators to develop more creative pedagogy to reinforce subject matter content, and serve as a useful instructional aide. This paper will examine how smart phones are used for both secondary and post-secondary students, and how smart phones positively impact pedagogy and student comprehension.

*178 - The Role of a Freshmen Programming Course for Engineers on Student Success

Priya T. Goeser, Wayne M. Johnson and Delana A. Nivens

Associate Professor, Engineering Studies Program, Armstrong Atlantic State University / Associate Professor, Engineering Studies Program, Armstrong Atlantic State University / Assistant Dean and Professor of Chemistry, College of Science and Technology, Armstrong Atlantic State University

EXTENDED ABSTRACT

Computing for Engineers (ENGR1371) is a 3-credit hour course taken by engineering majors and as a computing course requirement by mathematics and applied physics majors at Armstrong Atlantic State University. The main objective of the course is to introduce students to the foundations of computing with an emphasis on the design and analysis of algorithms and the design and coding of programs for solving engineering problems. ENGR1371 is taught using MATLAB since it is a well suited programming language for engineers. This course is the first exposure to programming for most students. Hence, it is viewed as a collection of abstract concepts, rules and methods that are difficult to understand and apply to engineering problems. This contributes to the challenge of maintaining a high level of interest, understanding and information retention among the students. It is proposed that this challenge can be addressed through the use of MatLab Marina: a Virtual Learning Environment dedicated to the improvement of student learning of programming concepts using MATLAB.

This work presents an investigative study and analysis of a control group of students constructed by propensity scoring approximately 300 students from ENGR1371 (current and previous semesters). Scores are generated based on Math SAT, race, gender, and other factors to allow tracking of student progress and successes in ENGR1371 and subsequent courses with the objective to understand the following pertinent questions:

- What role do courses such as ENGR1371 play in influencing and preparing freshmen engineering students to continue in the engineering program?
- Is there a statistically significant difference in student performances in ENGR1371 for any particular grouping of students?
- What impact do supplements such as MatLab Marina have on student learning, performance and student success?

Further details including assessment results and recent developments in MatLab Marina will also be presented.

131 - Sustainable Development: Understanding How Things Break

Robert R. McCullough, Beth A. Todd, J. Brian Jordon
University of Alabama–Department of Mechanical Engineering

EXTENDED ABSTRACT

As our nation's economy and the overall global market continue to expand and develop, an understanding of the ability of our planet's natural resources to support our needs is imperative for students preparing to enter the workforce. Sustainability is essential to this understanding as it focuses on an understanding of the boundaries and limitations of those natural resources. For an engineer, it is vital to be able to effectively describe the performance and behavior of materials to better understand their potential applications, a process referred to as characterization. Understanding characterization allows for the optimization and minimization of the quantity of material used, selection of suitable materials for a given application, and determination of the life span of a design.

As structured, this module should be performed in two 50 minute sessions. The first section will contain a talk going over the introduction and background of the course material, including the definition of sustainability, and how a sustainable development mindset is integral to society as a whole. To enable enhanced student interaction, a in-class activity has been developed that allows for the class to be divided into groups of 2-3 and given the assignment of designing and building a set of laminate cantilever beams to test under bending loads.

The focus of these teams will be to observe the improvements that can be made in material performance based off of integrating multiple types of materials into a variety of laminar orientations to form various composite structures. Key to the construction of each team's beam (s) is optimizing the design based on quantity of materials and individual material performance The conclusion of the module will be the testing of the completed beams and the creation of short written summaries of the results. These summaries should contain a discussion on the testing results and an analysis of the correlation between each team's performance estimates and the experimental results.

The end goal of this module is for the students to develop a better understanding of the importance of sustainability in improving design, manufacture and implementation of systems through such practices as material optimization. The student should also have an idea of the importance of balancing composition of components within a design to get the most effective output performance and resource consumption. As conceived, this module will be tested in 8th grade science classrooms. The students will be surveyed and class work will be documented and analyzed for lesson and activity effectiveness and clarity..

*137 - The Economics of Electric Microgrids: An Engineering Conceptual Design Approach for Pre-College Students

Otsebele Nare, Ziette Hayes, Michael Reynolds[2], and Shannon Davis

Hampton University / [2]Thomas Nelson Community College

EXTENDED ABSTRACT

Various STEM pre-college programs have been developed throughout the United States as a motivation tool for students to study the respective subjects in college. However, many students leave some of the programs without an understanding of engineering and how engineering differs from other fields of study. In a two-week summer program, ninth-grade students were challenged to design an electric microgrid integrated with renewable resources for a university campus as a case study problem designed to introduce them to engineering. This paper reports on an approach that uses the microgrid case study to introduce students to engineering by teaching different aspects of the microgrid such as energy cost, energy capacity, renewable energy, etc. As a result, the student's case study designs were based on the knowledge that they obtained from various project activities in the program such as: the home energy simulation, the solar and wind energy prototyping, and ElectroCity® simulation. For example, the students started exploring engineering concepts of design and testing system operations using simulation tools. The home energy simulator software was used to introduce the concept of energy cost and effectiveness of using renewable energy. The students were able to simulate usage of various appliances and lights in a residential unit throughout a 24 hour time span with and without the use of solar panels. After a simulation was run on the home, with and without the solar panels, the students were able to compare their total energy generated, the average amount of energy used, and the energy cost savings. This work showed how the economics of energy was used as the focus to introduce students to how engineers solve problems and make decisions based on design constraints. The approach was applied by the students in designing their case study project.

In this session, we'll report on the initial implementation of this new curriculum and share details of the design courses. We'll report on successes and challenges to date and share our vision for advancing this unique curriculum past the start-up phase.

141 - Science Technology Engineering Program (STEP) Summer Camp for K-12 Students

Atin Sinha and Wanjun Hu

Albany State University

EXTENDED ABSTRACT

The Albany State University located in rural south Georgia started a summer camp in 2008 for K-12 students to attract them in computer programming at an early age as an effort to combat falling enrollment in that disciplines across the country. The weeklong summer program introduced students to the basics of computer programming through the Mindstorms Nxt programmable robots, various computer games and animation software such as Alice and Scratch. Each of the activities was covered in about a day to day and half. The equipment for the first camp was acquired from the seed money received from NSF as part of a grant to Georgia Institute of Technology.

In the following years, the camp activity was expanded to include programming in CNC machine, wind tunnel demonstration and part design in commercial CAD software including 3D printing to expose students to engineering subjects also. Though in the first year the camp participants were chosen from both high and middle schools, in the following years, enrollment was restricted to the middle school students only, as they were thought to be more receptive of new ideas. Pre and post survey questionnaire completed by the students during the initial years showed increased level of interest and confidence in computer programming, specifically in programming robots.

Demographically, most participants in the first few years were white; however, the camp held in past summer was attended overwhelmingly by African-American students. Though this time the camp did not make any dramatic change of mind for most of the participants regarding career choice, but pre and post assessment showed a significant increase in percentage of students who wanted to be scientists or engineers as a result of attending the camp.

The summer camps were funded primarily by a continuing grant from NASA's STEM engagement, Office of Education, though during the initial years the camp participants were charged a nominal fee.

*169 - Structures and Natural Disasters

Andrew T. Brammer, Beth Todd, J. Brian Jordan
University of Alabama, Department of Mechanical Engineering

EXTENDED ABSTRACT

Topics in the 4th-6th grade curriculum look at the effects of natural disasters as they study the dynamic earth. This module covers disasters and the effects that they have on the buildings around us. Topics including force are introduced, and the hands-on activity gives students the opportunity to practice creative thinking. The main activity in this module involves challenging groups of students to build a simple structure out of 200 index cards and 1 roll of tape with no instruction beforehand to influence potential designs. Then working with the class to determine what strengths and weaknesses are present in the various designs and why those are strengths and weaknesses under situations that occur in natural disasters. This will lead to a low level introduction to ideas such as tension, compression, torsion, and buckling. In a subsequent class the students will be challenged to build a new structure as a class that can outperform all of the various designs that were originally created.

170 - The Conversion of Energy to Heat

Joseph L. Waters and Beth A. Todd
University of Alabama–Departments of Electrical and Mechanical Engineering

EXTENDED ABSTRACT

Based on the current consumption of energy and the ever growing population, the world is bound to eventually run out of resources. One major reason is the high rate of consumption and decreasing rate of natural resources. Learning to use renewable resources such as solar power is one way to counteract this. Solar ovens are one of many devices that can be used to capture the sun's energy to heat foods. An activity was developed to stimulate high school chemistry students on the topics of energy, material science and solar power. During this lesson plan, the students will learn the properties behind temperature, the law of conservation of energy and the transfer of energy into food. The students will build a solar oven to test the amount of heat absorbed in different food substances in order to cook them. This paper provides a detailed description of multiple lessons used to successfully build a solar oven and how to use it in practical chemistry applications such as calculating the heat absorbed.

159 - Ten Years Experience with a Multi-University Collaborative Graduate Education Program

Colin P. Britcher and Bernard M. Grossman

Old Dominion University / Virginia Tech

EXTENDED ABSTRACT

The National Institute of Aerospace (NIA) was founded as a non-profit research and educational institution located in close proximity to NASA Langley Research Center (LaRC). NIA's academic member institutions are Georgia Tech, Hampton University, North Carolina A&T, North Carolina State, the University of Maryland, Virginia Tech, the University of Virginia, Old Dominion University and the College of William & Mary, supplemented by the AIAA Foundation. A core component of NIA's mission from the outset has been a relatively unique collaborative graduate education program, wherein a graduate student from one of the member institutions can take up to 50% of their coursework from other member institutions, while pursuing research alongside NASA engineers and scientists. Faculty advisors may be in residence at NIA (as distinguished Langley Professors, regular, or adjunct faculty), or at the student's home campus. The cross-registration model avoids the complexities of multiple institutional registrations by the use of "ghost" courses at the student's home campus. In nearly ten years of program operation, 119 students have successfully completed their programs, about two-thirds at the Masters level and one-third PhD. Many graduates have gained employment at NASA LaRC or its support contractors. The paper presents background, objectives, statistics on the program and addresses successes, failures, and lessons learned..

142 - The Use of a Fundamentals of Engineering Course to Enhance the Capstone Experience

David W. Johnstone, Charles D. Newhouse

Virginia Military Institute

EXTENDED ABSTRACT

All civil engineering students at the Virginia Military Institute (VMI) are required to take the Fundamentals of Engineering (FE) exam and pass a capstone design course prior to graduation. The FE exam tests the students' ability to retain the fundamental knowledge obtained throughout their bachelor's degree; whereas the capstone design course utilizes problem-based learning to combine the knowledge and skills acquired to solve engineering problems. In the past, the capstone design course was offered during the spring semester of the students' senior year and acted as a primary assessment of progress and knowledge. The shortcoming to this approach, however, was that less emphasis was placed on passing the FE exam which is the first step in becoming a professional engineer. In an attempt to combat this deficiency, a senior-level course covering the fundamentals of engineering was offered in the fall of the senior year as an additional component to the capstone design course. The success of this course has been overwhelming as VMI pass rates on the FE exam for first-time test takers increased significantly since the introduction of this course. Similarly, enrollment and enthusiasm has escalated with over 90% of current seniors electing to enroll in this course. These numbers indicate the need and desire for implementation of an FE review course in the curriculum. More importantly, the class has further enhanced the capstone experience. By offering a course in the fundamentals of engineering, the students gain valuable knowledge of subject matter not extensively covered throughout the curriculum and have the opportunity to clarify additional subject matter in question. In doing so, the students may then be accurately assessed on both the fundamentals and design of engineering practice.

136 - The Future of Course Work: Customizing Community College Curricula to Meet Industrial Needs

Amber C. Thompson, William L. McDaniel, Jo James, Chester Peeler, Steve Hollifield

Isothermal Community College/ Western Carolina University

EXTENDED ABSTRACT

Modern industry is requesting more from potential employees by way of third party skill-related credentials. Community colleges are now learning to supplement their courses with these outside credentials. Program instructors in applied sciences and technologies are faced with an additional teaching load above the required state course descriptions and expected learning outcomes.

A case study is presented on how a small rural community college in the foothills of western NC has strived to meet new local industry needs and help its service area overcome the devastation of thousands placed on unemployment in the last decade due to low-skilled job loss. The case study explores examples of actual strategies for implementation, best practices based on learning experience, and ways to approach financial and administrative barriers. This study also includes discussion on future research and practices in customized training and development on a broader level.

Findings show that with proper support channels, community colleges can focus in on training that is feasible and applicable to their region without overtaxing their resources. Employers and granting agencies are favorable to short term training that gets individuals back into the workplace faster. Certificate programs that can be finished in one semester matches this modular approach preferred by employers. The approach also provides a way for students to continue a college education and obtain stackable credentials at the same time.

130 - Impact on Retention From a Change In Undergraduate Computing Curricula

Donna S. Reese, T.J. Jankun-Kelly, Lisa Henderson and Sarah Lee

Mississippi State University

EXTENDED ABSTRACT

Mississippi State University (MSU), like many other institutions across the country, has seen a significant decline in the number of computing majors since the early 2000's when the dot com crash caused many students to shy away from majors involving computing. In addition, the diversity of the students who have remained in the field has decreased, particularly with female students making up a smaller and smaller percentage of majors in these fields. In the 2008-09 year a significant effort was made to re-design the introductory programming sequence in the Computer Science and Engineering Department. This introductory programming sequence is taken by students in computer science, software engineering, computer engineering and electrical engineering.

Implementation

Two major changes that were introduced into the curriculum were a change in the programming language used in the introductory programming sequence and the introduction of a course for first semester students that overviews the computing professions. The language in the introductory sequence was changed from C++ to Python. C++ is introduced in the second course so that students continue to have exposure to this important language. The introductory course introduces the students to teamwork skills, overviews the profession, and exposes them to the broader specializations within computing so that they understand computing professions are more than just programming.

Findings

The failure rates in the introductory programming classes have dropped significantly (from ~45% to ~25%) in the time the new courses have been in place. In addition, the first to second year retention within the major has climbed from ~62% to ~74%. We will continue to evaluate these courses and their impact on student success in the follow-on courses in our curricula.

183- Logistical Impact of Intermodal Facilities

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The University of Southern Mississippi

EXTENDED ABSTRACT

In today's growing global economy, intermodal facilities have become increasingly popular as a method of increasing efficiency and decreasing costs across the entire spectrum of supply chain operations. In order for a facility to be considered intermodal it must be accessible by more than one mode of transportation such as truck, rail, ship, or plane. Five primary functions are performed in intermodal facilities: transfer of cargo between modes of transportation, freight assembly in preparation of transfer, freight storage, logistical control and distribution of product flows (Slack 1990). These activities are centralized in order to concentrate critical operations in one location thereby providing opportunities for economies of scale. The increased focus on efficiency and cost reduction is a product of current shipping trends. According to the US Department of Transportation Statistics, the typical freight shipment "traveled nearly 40 percent farther in 2002 than in 1993 (Bureau of Transportation Statistics, 2004, p 4)." Increased distance traveled for freight implies that the cost associated with shipping has also increased. Intermodal facilities provide a number of advantages to companies. Thus, this paper presents the state-of-the-art on the logistical impact of intermodal facilities. This is important because strategically placed intermodal facilities within a supply chain provide flexibility to decision makers. These facilities allow operators to select the most efficient method of shipment for each freight container. Increased efficiency implies that less time is wasted on non-value adding activities.

134 - Confessions of a Novice Class Room Technology (CRT) User - Through the Eyes of a New Faculty Member

Alfred Kalyanapu

Department of Civil & Environmental Engineering– Tennessee Tech University

EXTENDED ABSTRACT

Advances in computers and technology has made it imperative for a need for engineering faculty to embrace classroom technology or instructional technology (IT) for the classroom. Specifically for beginning faculty, the knowledge about the frontiers of research in CRT and IT is crucial for gaining understanding on balancing traditional instructional methods with advances in information and technology. This is a self-study of my learning and assessment of using classroom technology (CRT) as a beginning faculty in the Civil and Environmental Engineering Department at Tennessee Technological University (TTU). The idea of this self-study exercise originated after I was introduced to CRT at TTU including WACOM® interactive display, Camtasia Relay® and an online learning resource called iLearn. As a part of this exercise, I assess my experience on using the CRT, following the conclusion of each class period for the courses I taught in fall 2012 semester. As the semester progressed, an informal student assessment was conducted to assess the benefits of CRT on improving student learning and briefly discussed here. The paper aims to highlight advantages and any limitations of implementing CRT, from a new or early career faculty's perspective and intend to provide recommendations to future faculty in adapting to newer teaching tools.

To test the effectiveness of CRT implementation in my Fall 2012 courses, students were requested to fill out a mid-term assessment survey of the effectiveness of the CRT for my two courses. From this preliminary qualitative assessment, it is observed that integrating CRT for both undergraduate and graduate level courses is found to be useful for the students in their review of classes for working on homework assignments and preparing for mid-term exams. The future of this work is to continue to monitor the effectiveness of these three CRT in my undergraduate and graduate classes and gather more student feedback on these CRT. A higher number of student participation will improve the assessment of CRT and also will improve any quantitative assessment of student learning and performance that can be done through questionnaire and quizzes.

106 - The Impact of Non-Traditional Laboratory Report Formats on Student Performance of Course Objectives

T. Kunberger

Florida Gulf Coast University

EXTENDED ABSTRACT

Numerous engineering courses include a laboratory component to augment comprehension of a given topic, with a lab report serving as a typical measure of student learning for these activities. Often times these laboratory reports are standardized across a course, or possibly even across a series of courses or curriculum and provide students with an established format and clear set of expected deliverables. The reports can ultimately serve as assessment of not only knowledge gained, but also the ability to communicate; albeit more often than not on a group basis. This paper investigates the theory that a complete lab report may not be necessary to achieve the desired course outcomes, but rather a series of non-traditional laboratory report formats may serve the same purpose, while keeping students engaged and appealing to a wider range of learning styles. The approach was undertaken in a Junior level Geotechnical Engineering I class, which includes approximately ten different laboratories over the course of the semester. These lab activities are standardized not only from semester to semester, but also compared to established testing methods, such as ASTM, typical of a traditional lab experience. Lab reports range from a complete standard report or select sections (such as an abstract and appendices only) of a standard report to less established methods of submission such as a poster presentation (on a standard 8.5" x 11" sheet of paper) or a pecha kucha, which is a PowerPoint presentation limited to 20 slides with each slide being shown for only 20 seconds. Results over three semesters show student performance on course objectives are independent of the type of report submission, suggesting that extended reports are not necessary for topic comprehension. Details on the various report formats, student performance on associated assessment measures, and instructor perspective on benefits and limitations associated with non-traditional report formats will be presented.

192 - Using the Toolbox Approach with Mathcad Prime 2.0 in a Computer Applications Course

Kenneth P. Brannan, Kaitlin H. Marley, John A. Murden

The Citadel

EXTENDED ABSTRACT

In the mid-1990s, the Department of Civil and Environmental Engineering selected Mathcad as its programming language for a computer applications class. Mathcad offers a comparable programming capability to previously used languages with additional advantages. These advantages include the ability to produce well-documented solutions, perform routine calculations, generate quality graphs with ease, and incorporate units as part of a computation. Since Mathcad's introduction, instructors have worked to improve the learning environment to increase student enthusiasm and enhance understanding by team teaching, active learning, frequent tests and assignments, flowcharting, pseudocode, debugging features, and clickers. Recently, Mathcad released a new software version, Mathcad Prime 2.0. This version offers many new features that greatly simplify learning in the Mathcad environment. The instructors of the course chose to take advantage of the new version, and at the same time, worked to advance the overall course again. After extensive discussion with students, the instructors identified that students often struggled to distinguish between content that should be memorized and content that should be adapted to various situations. To address this difficulty, the instructors chose to introduce the idea of a TOOLBOX. This TOOLBOX served as a representation of exactly what must be memorized in order to be successful in the course. Additionally, the active learning component of the course was strengthened to build interest in mastering course goals. Finally, a lifetime learning module was added to promote continued learning beyond the engineering classroom. This paper discusses the integration of Mathcad Prime 2.0, the TOOLBOX, the other changes in the course, and the positive outcomes that resulted. The substantial restructuring of the computer applications course appeared to improve attitudes toward Mathcad and improve motivation to solve problems in Mathcad. This observation is based on a comparison of surveys completed by students who took the restructured class in the fall of 2012 and by students who had taken the original course earlier. Survey responses of students who took the restructured course averaged 2.69 (mostly positive, based on Negative = 1, Neutral = 2, and Positive = 3) and responses of students who took the original course averaged 1.69 (slightly negative) on their attitudes towards solving problems in Mathcad. On the question, "How motivated did you feel in the course to solve problems using Mathcad?" those taking the restructured course averaged 4.06 out of 5 (with 5 representing very motivated) and those taking the original course averaged 2.14 out of 5. This paper discusses the details associated with restructuring the course and presents in more detail the results of the survey.

*195 - Introducing Statistical Analysis in Experimental Data Collection in an Undergraduate Fluid Mechanics Laboratory

Bruce Carroll, John Abbitt

Department of Mechanical & Aerospace Engineering, University of Florida

EXTENDED ABSTRACT

As a result of an internal ABET outcome assessment, it was decided that statistical analysis of experimental data required additional coverage in our undergraduate curriculum. We determined that the most appropriate place to do this was in the first lab of our senior level Fluid Mechanics laboratory course. We re-designed our existing Pipe Loss lab apparatus, and instrumented it with four pressure transducers and corresponding analog gages, three electronic flow meters of various flow ranges along with an analog gage, and a thermocouple. The data acquisition system was designed to allow the students to select sampling rates, sample size, and acquisition time. During the experimental planning stages, students are tasked with establishing a data collection plan that will provide results within prescribed uncertainty error bounds. This requires students to estimate errors in individual measurements and to consider error propagation to the final computed result. By adjusting sample sizes, students can utilize signal averaging strategies to reduce uncertainty. Establishing cost factors for various measurement approaches (both analog and digital transducers) students are asked to arrive at an efficient solution to meet the defined experimental goals.

138 - Reynolds Transport Theorem Applied to Classical Thermodynamics

David Calamas, Alan Hewitt, John Baker and Beth Todd

Department of Mechanical Engineering–The University of Alabama

EXTENDED ABSTRACT

The Reynolds Transport Theorem is often used in undergraduate fluid mechanics courses to transform governing equations from a Lagrangian to an Eulerian coordinate system. As such, it is a useful tool for developing control-volume based expressions for the momentum and conservation of mass equations. Traditional undergraduate thermodynamic texts present the laws of thermodynamics for open systems in a manner that does not directly link them to the original expressions for a closed system. Three recent undergraduate level thermodynamics texts as well as three fluid mechanics texts have been reviewed to form an opinion on the traditional approach to closed and open systems. This paper is intended to further student appreciation of the direct connection between the statements of the First and Second Law of Thermodynamics for closed systems and the corresponding statements for open systems. The Reynolds Transport Theorem will thus be utilized to develop expressions for the First and Second Laws of Thermodynamics for open systems. The goal of the paper is to present an alternative approach to teaching thermodynamics that is more closely aligned to instructional methods in fluid mechanics courses. By reconciling the two approaches, it is hypothesized that students will gain a better understanding of the laws of thermodynamics and the subtle differences between open and closed systems. It is believed the use of the Reynolds Transport Theorem as applied to the First and Second Law of Thermodynamics in undergraduate thermodynamics curriculum would help to unify the use of Reynolds Transport Theorem as applied to the continuity and momentum equations in undergraduate fluid mechanics curriculum.

*114 - Determination of Building Envelope and Duct System Integrity through the Quantification of Air Flow Leakage Rates

Justin Hayes and Robert Choate

Western Kentucky University–Mechanical Engineering Program

EXTENDED ABSTRACT

To encourage and increase undergraduate student research, Western Kentucky University began an internal grant program called Faculty - Undergraduate Student Engagement (FUSE) Grants in academic year 2012-2013. These grants are designed to support undergraduate students' intellectual development by fostering active engagement in the areas of research, creative and scholarly activities, and/or artistic performances. The student researcher/first author was funded through this initiative.

The focus of this research was on developing power law relationships between differential pressure and leakage rates based on aperture geometry with the intent of applying the study to better model leakage in building envelopes and conditioned air distribution systems and in an attempt to better quantify and understand energy loss associated with leakage phenomena. Air leakage, through apertures or cracks in building envelopes and ducts, is of growing concern to the HVAC industry as energy resources continue to become more expensive. These inadequacies, in building envelope construction and maintenance, can have devastating impacts on the overall efficiency of an HVAC system and overall residential and commercial energy consumption.

This effort creates relationships between: differential pressure, series of geometrically diverse openings, and overall air leakage flow rate. These geometrically diverse openings are used to model various flaws that may be introduced into the building envelope during construction or due to various aging factors. Functional representations between differential pressure and leakage rate through individual openings were created to help understand the relationship between the crack geometry and its leakage characteristics. These power law relationships can then be used to model more complex building and duct systems, and to predict either flow rate based on known crack characteristics, or to predict crack characteristics based on a measureable flow rate at a given differential pressure.

This presentation will include the design decisions and challenges, as well as the benefit of allowing a student to collaborate with faculty to design, build, and test a system. This presentation will also detail faculty - student observations and project outcomes.

151 - Simple Demonstrations in Basic Mechanics Courses

Richard Kunz

Mercer University

EXTENDED ABSTRACT

At Mercer University, as at many engineering schools, the basic mechanics courses of Statics, Dynamics, and Mechanics of Materials are taught in a traditional lecture format with no laboratory component. Students are typically exposed to abstract concepts such as forces, moments, rigid body kinematics, stress, kinematics of deformation, strain, and stress-strain transformations through sketches, mathematical derivations, and equations. They often struggle with connecting the mathematical representation of these concepts with the physical world and with their own intuition.

Instructors in these courses have long recognized the difficulties that our students face and have sought to augment traditional chalkboard lectures with supplementary material to give physical meaning to abstract concepts. Computer animations have come to be a popular approach, but today's students are accustomed to sophisticated computer graphics; unless really well-done, animations can seem cartoonish and lacking in reality. To many students, understanding of physical concepts is most effectively achieved through physical artifacts.

In devising in-class demonstrations, the instructor is constrained by time, space, cost, and simplicity. The author's classroom experience has indicated that students tend to respond best to simple physical demonstrations that illustrate concepts that are difficult to grasp otherwise. A broad survey of demonstrations developed and used by the author and colleagues are discussed. A few detailed examples are presented that deal with rigid body kinematics, kinematics of deformation, and transformation of strain. All can be (and have been) made from commonly available materials requiring minimal cost and skill. The presentation is made in the spirit of sharing with the larger educational community what seems to work.

CHAPTER 3
TECHNICAL SESSION 2
EXTENDED ABSTRACTS

Monday, March 11, 2013

Technical Session 2 2:15 pm – 3:35 pm

2:15 pm–3:35 pm	T2-A Prescott 208	T2-B Prescott 222	T2-C Prescott 225	T2-D Prescott 304	T2-E Prescott 325
Technical Session 2	Instructional Division II	K-12 Division II	Administrative Division II	Engineering Technology Division	Mechanical Engineering Division II
Moderator	*Monika Bubacz*	*Sally Pardue*	*Atin K. Sinha*	*Jerry Newman*	*Don Van*

T2–A: Instructional Division II **PRESCOTT HALL 208**

T2–B: K-12 II **PRESCOTT HALL 222**

T2–C: Administrative Division II **PRESCOTT HALL 225**

* Abstract titles marked with an asterisk are presentation only and have no manuscript in the proceedings.

T2–D: Computer Engineering and Technology Division **PRESCOTT HALL 304**

T2–E: Mechanical Engineering Division II **PRESCOTT HALL 325**

115 - Improving Student Interest in Engineering Curricula – Exciting Students about their Classes

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EXTENDED ABSTRACT

In this paper, we explore what events, activities, and teaching styles invoke student interest in engineering courses. The research is based on inputs from some of the best and award winning faculty members across disciplines. The activities that professors use to keep students engaged are highlighted. Similarly, the actions that professors take to turn students away are discussed. As engineering educators, it is not hard to observe that often time's students take a lot more interest in certain engineering courses than others. There are courses that students wait to enroll in, the classes fill up quickly and there is often a waiting list. Most of the class sessions are well attended. Students often stay back after the classes and pursue the professor to proactively learn the material. Student performance in these classes is often reflected in their grades. On the other hand, there are classes in which students enroll only because those classes are required for the degree they are pursuing. Those classes usually do not fill up, students often skip sessions, and the poor performance is reflected in the grades. In this study, the author explores what makes some classes so appealing while the others are often perceived as dull and tedious. The research is based on feedback received from some of the best professors in various disciplines. It is observed that professors who go an extra mile can make just about any class interesting. An engineering class can be made interesting and enjoyable by engaging students in activities beyond those required in a typical class. These engaging activities include but are not limited to inviting guest speakers, taking students on field trips, showing related documentaries, involving students in laboratory work, involving students in research projects, having students develop laboratory apparatus and involving them in writing grants and research papers. By using these and other activities, professors not only earn respect in the eyes of the students but also make the discipline of engineering a worthwhile field of study.

117 - Teaching Adult Engineering Learners – Ease and Challenges

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EXTENDED ABSTRACT

In this paper, the faculty and student perspectives of the challenges faced by adult students are highlighted. Data is collected through various interviews. It is observed that adult students may experience certain challenges e.g. being out of touch with technology and feeling isolated from other students in class. Despite these challenges, adult students bring experiential knowledge into the classroom, which can add tremendous value to the educational experience for all students, if the faculty members are open to leveraging that knowledge. The overall objective of this study is to make faculty members aware of the needs of adult students, acknowledge and appreciate the students' presence and their contributions in the classroom.

Adult learners are referred to as non-traditional students who are returning to school to earn their education at an older age. These students are typically not in the 18-21 year age group and have work and life experiences. Due to lack of experience with technology, non-traditional students may feel intimidated when returning to college. They are usually in the minority when surrounded by younger students. In some cases, they may also have a professor that is younger in age. This creates an awkward position for the non-traditional student (and the professor). These adult students may bring to class much knowledge about the subject matter or they may have forgotten the pre-requisite material. Having worked in their field, they may have a difficult time relating classroom theory to the practical applications. In this paper, the authors explore challenges faced by the adult students; highlight what faculty can do to accommodate their adult students; and review, through a series of interviews, how faculty members make their adult students comfortable in their classes.

*200 - Transforming Undergraduate Laboratories for Sustainable Engineering – Expanding the Use of Case Studies and Project Based Learning in Laboratory Courses

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EXTENDED ABSTRACT

This educational research seeks to develop novel laboratory modules by using *Case Studies* to introduce sustainability and environmental engineering concepts to 21st century learners. The increased interest in "going green" has led to a surge in the number of engineering students studying sustainable engineering concepts in their courses. This educational research project has worked to improve critical thinking and transfer of lab concepts to tangible real world applications for students. A total of four case study lab modules have been developed for a junior level, Environmental Engineering Laboratory course. The case modules focus on providing (1) the contextual case-study or problem based learning modules that link engineering topics to real world sustainable engineering issues and (2) hands-on experiences for students that are designed to address new areas in sustainable engineering. This educational study consisted of assessing student learning using the Index of Learning Styles (ILSS) and using case studies as a method to target these differing learning styles. Pre- and Post-assessments indicate students demonstrate increased understanding, interest, and comprehension of lab topics.

Results

Feedback from the student interviews suggested they felt the case studies and problem-based methods used in the course were more engaging compared to their traditional laboratory classes they had taken during their education. The students particularly enjoyed the real world approaches and seeing how they could expect to apply course lab skills to their real jobs after graduation. They felt some aspects of the labs were similar to the traditional lab format, yet the problem based learning and real-life scenarios added a new spin on the topics that made them more interesting. From a faculty perspective, the PBL and case study method required more initial faculty preparation time for the projects and the case studies selected for the lab. Implementation in the course required a very organized approach to guiding the students and maintaining a schedule to accomplish course objectives. The amount of interest the students demonstrated in their designs was exciting to observe because the students were engaged and actively participated in the discussions for their projects. Due to the amount of time the case study/PBL method needed, it was difficult to implement all four modules during the semester therefore the course schedule was vital. We are interested in identifying other faculty interested in the case studies in Sustainability as a method to test the modules and to improve the modules for laboratory courses to use this method.

152 - The Final Exam – To Have or Have Not

Hodge Jenkins and Scott Schultz

Mercer University

EXTENDED ABSTRACT

The time honored tradition of final examinations has long been a standard assessment tool to evaluate student performance, and to provide a means for students to potentially improve their grades. Students must demonstrate knowledge, critical thinking, and competence through these examinations. While most courses have several components for assessing student proficiency of knowledge and understanding, the cumulative final is typically regarded as the best measure of retained knowledge in a subject area. However, knowledge retention and future application by students is unknown, but truly the desired result of learning.

In many engineering courses student work and assessment includes homework, quizzes, projects, 1-hour exams, papers, class room participation, in addition to a final exam. Of these the final is usually weighted the heaviest. While it has been long recognized that students have different learning styles, little attention has been focused on how best to assess the imparted and retainable knowledge and learned abilities of students. Examinations are intended to do just that. However, does the student who crams for the final exam have more knowledge and ability, months after the course than the student who studied all semester and missed the mark on the final? Is other coursework (homework, projects) by students a better tool for assessing a higher level of learning the application of course knowledge? Or, does having several short exams throughout the semester better predict student performance?

This paper reviews two common engineering subject areas and investigates different means of assessing student learning and the effect of final exams on student grades. Results indicate that the final exam scores correlate well with the other course assessment tools. Thus, assessment components based on activities for which students spend large amounts of their time may yield the same results without the necessity of a final exam. (Students may not remember what was on their final exams within a short time period of the final examination; however, they more likely will always remember projects and papers they created.) While not the goal of this study, it is conceivable that project work alone may be a better means of assessment, however, the final exam has and remains the easiest means to review and score.

In conclusion, student grades analyzed from two different engineering subject areas (Statics, Engineering Economy) over a ten-year period show a similar effect, the final exam does little to change the majority of student grades.

*162 - Using Engineering, Science and Literacy to Improve Math Understanding

Cecelia M. Wigal, Kay Cowan, Louis Elliott, Betsy Darken

The University of Tennessee at Chattanooga

EXTENDED ABSTRACT

Over the last year individuals (engineers, physicists, and staff) in the College of Engineering and Computer Science at the University of Tennessee at Chattanooga (UTC) teamed with UTC math and education professors to work with middle school math and science teachers to help them tie math with engineering, science, and literacy to improve student learning of mathematics. The program, titled Technology, Engineering and Literacy + Math Understanding (TELMU) Academy is supported by Tennessee First to the Top funds under an initiative to increase Science, Technology, Engineering, and Math (STEM) applications in Tennessee schools. TELMU's goal was to use (1) projects successful at the middle school and 9th grade levels in introducing students to engineering principles, (2) technology that engages the students and assists the teacher in building and administering activities, and (3) proven pedagogy for strengthening literacy for both the student and teacher in general and with regards to STEM application to improve mathematics understanding and thus mathematics learning.

The Academy kicked off in January 2012 with a one day introductory workshop. The Academy continued in the summer with a two week nonresidential workshop that introduced the participants to student STEM activities that include engineering, science, and literacy components requiring applications of math. The summer workshop was followed by two one day workshops in fall 2012 where the participants reviewed with their peers lessons they used in the classrooms.

This presentation provides a review of the activities of the TELMU Academy and their outcomes to summarize the effectiveness of the program. Specifically discussed are those outcomes that were not anticipated but emerged and those that were envisioned but did not emerge. Of particular discussion is the divide between what the K-12 teachers and the higher education professors see as (1) technology and (2) the role of technology in student learning.

202 - Teaching Physical Properties of Water Using Hydraulics

Tabatha Dye, Beth Todd, and Pauline Johnson

The University of Alabama

EXTENDED ABSTRACT

This paper describes an activity for the second grade that will teach students about liquid properties, force and pressure. The lesson is to teach the students about how water or liquid can be moved or pushed. The objective is for the students to better understand the physical characteristics of water. A discussion of how water guns and pistons work is included as background material. The students will make their own water gun out of plastic cups, drinking straws, and other materials. Then they will discuss how it is different if air, a solid, or another liquid is put in the water gun. The paper will discuss how the topics are covered including pre and post activity lectures and questions, how the water gun is built, and a list of the necessary supplies. The paper includes useful tips to help the teacher be prepared for a full second grade class. Also included is a one-page handout that is useful as reference during the activity. The lesson will be taught to a second grade class and evaluated on the level of knowledge learned and how much the student enjoyed the activity via a question period. Specific topics learned by the students over the course of the lesson are included. The specific Alabama Department of Education Science learning objectives for second grade that are included in this lesson are indicated.

203 - Using College Student Competitions to Recruit Middle-School Students to Engineering: The Visual Display Competition at the ASCE 2011 Southeast Student Conference

Steven M. Click

Tennessee Tech University

EXTENDED ABSTRACT

The process of recruiting students to engineering fields in general – or to any university in particular – now requires advanced contact with students. Gone are the days of college fairs for graduating high school seniors. The best students are making their choices much earlier than their senior year. Perhaps more importantly, if students have not discovered and interest in engineering fields before entering high school, they are unlikely to take the advanced math courses needed to help them succeed in a college engineering program. In a continuing effort to recruit students to engineering fields, many entities including ASEE have started programs, which provide or encourage outreach to middle school students, hoping to spark an interest, which will lead to a future in engineering… and to proper selection of high school courses.

This paper provides information about a recent Visual Display competition at the ASCE 2011 Southeast Student Conference. Teams of civil engineering students were challenged to create a visual display which would teach an engineering design or problem-solving process to middle school students in a career-fair atmosphere. Of the twenty-six schools attending the conference, sixteen entered the visual display competition. During the conference, middle schools from the surrounding area were invited to come and view the displays.

Included in the paper is information regarding the competition rules, judging and scoring, brief descriptions of some of the displays, and anecdotal comments from both college and middle school participants.

*225 - Overview of Next Generation Science Standards for K-12: What impact on K-12 Engineering Outreach?

Sally Pardue

Tennessee Tech University

EXTENDED ABSTRACT

The Next Generation Science Standards (NGSS) are in development and are expected to be released in final form in later Spring 2013. Many states are considering the adoption of the NGSS once the final form of the standards is released. In the coming years, school systems will be working to implement these new standards. Higher education engineering schools and programs should pay careful attention to how their partnered K-12 systems will be accommodating a shift to the new standards. Faculty involved with K-12 engineering outreach programs, whether directed at teachers, students, or both, will need to be highly engaged in understanding what key features of the new standards are and how these features can be leveraged to enhance engineering education.

Preceding the standards, the National Research Council released a publication in 2012 titled "A Framework for K-12 Science Education" which serves as the foundation for the writing of the NGSS. Within the Framework document is a detailed description of three dimensions regarding science education: 1) science and engineering practices, 2) disciplinary core ideas, and 3) cross-cutting concepts. This presentation will offer an overview of the three dimensions and an orientation to the structure of the NGSS so that engineering educators are informed and can seek further information from the resources provided.

160 - Novel First Year Engineering Summer Session

Gail D. Jefferson, Sally Steadman, Tom G. Thomas, Kuang-Ting Hsiao

University of South Alabama

EXTENDED ABSTRACT

Retaining students in engineering programs is a national problem that has been addressed in many, varied ways. The University of South Alabama has implemented a novel program to increase retention in engineering, especially among high achieving students. A pilot program was conducted last summer with extremely successful outcomes. Funding for the program was provided through NSF EPSCoR, so there were no costs to the participants.

Students spent two weeks immersed in interdisciplinary engineering topics ranging from robotics to composite materials. LabVIEW programming was integrated into each topic. The students explored instrumentation, sensors, and control using Lego Robots. They also used LabVIEW to investigate material properties and behavior for metals, polymers, and composites. Each topic was introduced by a series of short lectures followed by hands-on interactive laboratory sessions, culminating in an open ended design project.

An accompanying thread for the program was critical thinking. Following a brief exposure to basic concepts of the affective and cognitive principles and strategies essential to critical teaching, the students took an on-line test to evaluate their critical thinking skills before beginning the workshop activities. The same test was administered as a post test, with an average increase of 10 % in their skills.

The research activities were conducted in a team environment, hence the students had strong teaming experiences and will be able to work more effectively and collaboratively in their coursework. The students also interacted one-on-one with undergraduate and graduate engineering students who shared their enthusiasm for engineering.

Highly motivated, inquisitive incoming freshmen were identified for the program, based on ACT scores, high school GPAs and completed high school coursework (math, chemistry, and physics). Admissions decisions were based on academic achievement and interest (demonstrated through an essay). The program was offered to 60 students (27% of the freshman class) and 12 were accepted for the program. Due to cost constraints and unknown demand, the program did not include a residential component which would suggest that most of the participants would be from the local area. However, half of the students came from distant cities and moved into their rooms on campus or stayed with relatives.

Formal assessment of the program is underway. Preliminary results are extremely positive, with both faculty and students highly satisfied with the program activities. FREE participants were genuinely excited about learning new things – and they were able to quickly pick up concepts. It is obvious that the program ignited interest in engineering for the students.

161 - Transfer Student Retention

Gail D. Jefferson, F. Carroll Dougherty, Sally Steadman, Tom G. Thomas

University of South Alabama

EXTENDED ABSTRACT

Many students are not adequately prepared for the transfer from a two-year college to an engineering curriculum at a four-year institution. A comprehensive program has been developed at the University of South Alabama to address issues associated with the transfer process. This student success initiative, USA-LINK, is an NSF funded program that stimulates enrollment, enhances retention in engineering programs at the university, and increases the technical workforce. Important lessons have been learned during the early stages of the program.

A key component of the program is a seminar that assists in the transition process. The USA-LINK seminar includes student support activities designed to enhance the academic success of transfer students. Academic success skills (such as time management and study skills) are introduced in the seminar. The students explore engineering majors through problem-based applications, gaining essential experience with engineering problem solving. The seminar also focuses on social involvement and interpersonal skills. Students are introduced to careers and research/internship opportunities and to job placement skills so they are well prepared to enter the technical workforce.

An important factor in student retention is the sense of community that a student develops, which is enhanced through the seminar. The USA-LINK program incorporates a community-building model to build a cohort among the participants. Each USA-LINK student is assigned a Peer Mentor and a Faculty Mentor. These triads meet regularly to assist in the student's transition to and involvement in the university.

Preliminary results indicate that the program has been successful in recruiting and retaining transfer students and that the seminar is a key component. A focus group is held with the USA-LINK students at the end of the first semester. Several issues have been identified: advising, faculty approachability, homework and exam frequency, campus resource availability, as well as personal/family problems. Some of these issues can be addressed by better advising. Hence we have identified a specific advisor in each department to deal with all transfer students; these advisors are also better equipped to handle personal/family problems. Other issues can be addressed in the seminar so transfer students are more aware of university procedures and resources. We have recommended that all transfer students be offered the opportunity to take the seminar.

We are also working with area community colleges to address these issues. These schools can provide orientation session(s) for students transferring to 4-year schools. Community college faculty need to be better acquainted with curricula for each engineering degree, so students are better prepared for the transition.

116 - Advising Engineering Students – Demands and Challenges

Adeel Khalid[1], Jessica Williamson[2]

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[2]*Academic Advisor, School of Engineering, Southern Polytechnic State University*

EXTENDED ABSTRACT

The role of an academic advisor is emphasized in this study. There is only one academic advisor in the School of Engineering at the Southern Polytechnic State University (SPSU). The academic advisor addresses the advising needs of more than 1,200 engineering students. The importance of professional advising and the need for higher advisor-student ratio is highlighted. Both advisor and student perspectives are addressed in this paper.

Many high school students will realize early on that they want to become an engineer of some sort for various reasons. These reasons include but are not limited to; excelling at mathematics, prompting by teachers or parents, expressing a great deal of curiosity, enjoying taking things apart and putting them back together, or a combination of these factors. Even though many students are drawn to the field of engineering, most are not clear when it comes to choosing a specific engineering discipline. Sometimes they may become confused or frustrated with their chosen program of study and end up changing to another discipline. To retain these curious minds, it is important that proper advice is given to them so they not only choose the sub-specialty that is right for them but also stay interested and engaged. After having decided on their major and sub-specialty, students often need further advice on what classes to take within their discipline. Over the years, engineering disciplines have become vast and deep. There are numerous sub-specializations available. It can be expected that these sub-areas of specializations will continue to increase in number, giving students a multitude of choices. The academic advisor's job is crucial in helping students make the important decisions in determining their major. This task is as essential as that of a parent or a professor. Making key decisions such as choosing a major can affect not only the student's future career goals, but also, in some cases, the course of their lives. In this study, we explore some of the common questions that students need help with while seeking academic advisement. We also analyze the central role academic advisors play in helping retain students. Retention is crucial to a University's growth. Academic advisors try to keep students interested and engaged by building a successful rapport with them. This allows students to feel comfortable in an academic setting and they tend to be motivated to follow through and progress to graduation with degrees in engineering. The passion they possess about their field helps to fuel their desire to continue, despite the challenges they face, and these students end up as successful individuals.

166 - Math Requirements and Expectations for Lower Division Engineering

Christopher D. Wilson

Department of Mechanical Engineering–Tennessee Tech University

EXTENDED ABSTRACT

The math requirements for ABET-accredited engineering programs are generally satisfied through two semesters of single-variable calculus, one semester of multivariable calculus, one semester of matrix algebra and one of ordinary differential equations. Many engineering programs also include computer programming, statistics, numerical methods and engineering analysis. These addition courses are often taught outside of the math department. In addition, some students actually will take other math and statistics courses depending on their technical interests.

Many engineering students start their academic careers in pre-calculus if their math placement warrants it. Therefore, these students are often one semester behind schedule from the very beginning of their students. An engineering math course developed at Wright State University has been developed and adapted at several universities and community colleges as an alternative to placement into pre-calculus. For students having already taken pre-calculus in high school, this model has been very successful in promoting retention and persistence.

This presentation reviews the actual math requirements for lower division engineering courses as surveyed by the faculty at Tennessee Tech University. The following courses were considered: engineering graphics, computer programming, calculus-based physics (two semesters), statics, dynamics, a first-course in electric circuits and mechanics of materials. The actual math requirements are then compared to full list of math topics in the required set of courses. For completeness algebra and trigonometry concepts are also included. This comparison is followed with a discussion of the expectations of engineering faculty and of math faculty regarding the subject matter. The presentation continues with a recommendation to modify the so-called Wright State Engineering Math Model to better synchronize the expectations of both engineering and math faculty.

174 - Newsvendor Problem Simulation of Operations

Hassan Alfadhli and Leticia H. Anaya

University of North Texas

EXTENDED ABSTRACT

This paper covers the design project of a Labview simulated modeling of a five station production assembly line with stations rearranged both in a series and in a parallel format. In this assembly line, each station behaves as a characteristic news vendor problem. Under this scenario, production and demand are random variables and associated with these variables, a trade-off exists between excess inventory costs due to overproduction and opportunity costs associated with not meeting the needed demand. In the simulation, production levels for each station are forecasted to meet expected demand and demand is an unpredictable variable that affects the customer service level that the manufacturing operation can provide. Here, service level is defined as the proportion of time that the assembly line can meet the customers' needs. In this research, the opportunity costs and the excess inventory costs are to be investigated as a function of the service level of the final product for both a five station production assembly arranged in a series format and in parallel format. This research will explore the relationships between production, demand, profit and opportunity costs associated with a manufacturing operation to determine the variables that will optimize the service level. In the process of investigating these relationships, statistical process control techniques will be used to analyze and compare the performance of both the in series and the in parallel format assembly lines. The contribution of this research is that the expected conclusions will allow manufacturing operations to cope better with forecast errors and maximize the service level that these operations can provide while minimizing both excess inventory costs and opportunity costs.

199 - Engaging Students in Electromagnetics Through Hands-On Skills and Computer Simulation

Zhaoxian Zhou

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EXTENDED ABSTRACT

Electromagnetics has always been among the most difficult courses in electrical engineering and physics, and consequently, innovative teaching techniques are necessary to change the way teachers teach and students learn. The electronics engineering technology program in the University of Southern Mississippi has been offering an optional applied electromagnetics course as well as imbedding electromagnetics concepts into lower level electronics courses for several years. The students' interest in electromagnetics has increased through new teaching and learning styles. This paper introduces in detail a new practice where students learned electromagnetics through projects. Particularly, in one of the projects, students designed and implemented an electromagnetic can crusher. In addition to hands-on skills, theory and computer simulations were also involved. Students worked in a group to construct an electromagnetic can crusher, while the instructor introduced the theory and computer simulation process.

This paper gives details about the theoretical aspect of the lecture, including derivation of necessary formulas used for computer simulation. A survey was conducted to ascertain the reactions of the students towards this mode of teaching and learning. Results showed that students learned by cooperating and interacting with each other and participated actively in their own learning process. Students also learned to cultivate teamwork, communication, management and interpersonal skills.

102 - Implementing the Design-Build-Instrument-Test Approach for Curriculum Integration in Engineering Technology

Paul M. Yanik and Aaron K. Ball

Western Carolina University

EXTENDED ABSTRACT

Rapid changes in engineering design and instrumentation have caused Engineering Technology programs to look constantly for innovative methods to deliver quality education that provides students with the skills necessary to enter engineering careers. As Engineering Technology programs have historically taken the direction of engineering applications (as opposed to engineering science) in traditional instruction, they have tended to create islands of applications for new technology within the curriculum. Western Carolina University has long sought to provide a more integrated approach, and thus, continuity across targeted subject areas within the engineering technology program. This paper presents background on the importance of curriculum integration as a means of enhancing both learning and retention in an undergraduate program in Engineering Technology. A method is discussed which demonstrates the interdependence between subject areas by providing students with opportunities to apply the design-build-instrument-test approach to the engineering process.

Instructional Approach

This paper presents a project conducted through a pair of undergraduate courses which covers the design, fabrication, instrumentation and testing of a working (pneumatically driven) steam engine. In a junior-level course in Rapid Tooling and Prototyping, students were tasked with generating 3D computer models of a candidate design from published drawings. The course addressed skills needed to produce these models in a planned lecture sequence. The best model was selected as a master for generation of CNC machining programs and subsequent fabrication by student teams. A senior-level class in industrial automation then utilized the fabricated project as a platform for instrumentation, data collection, and analysis of the working design. Using LabVIEW®, students created a virtual instrument which captured, logged and graphically displayed data associated with system pressure and angular crankshaft position of the engine. With this instrument, students were able to perform analysis of the engine and to correlate changing pressure with the valve position caused by the moving crankshaft.

Summary and Conclusions

Using an integrated curriculum focusing on design-build-test-analyze approach to teach engineering applications, knowledge gained in individual courses may be carried forward and applied in a logical sequence to enable a more concrete understanding of concepts. Essential topics are addressed in a cohesive manner that offers tangible and rewarding outcomes. This may facilitate student learning, retention, and improved quality across the Engineering Technology curriculum.

179 - Building a Community of Successful Technology Scholars

Laura E. LeMire

Engineering Coordinator and Associate Professor, Community College of Baltimore County

EXTENDED ABSTRACT

T4: Technology Training for Today and Tomorrow (T4-STEM) is a project that provides educational opportunities to low-income, academically talented, community college students through scholarships and student support services to promote full-time enrollment and degree attainment in STEM technology disciplines - specifically Engineering, Networking, Information and Multimedia Technology. Over the past two years, a community has been formed comprised of the scholars and faculty mentors. A total of 84 *T4-STEM* scholarships have been awarded over 4 semesters to 40 different students (39% women) with at least a 2.8 GPA. Minority groups historically under-represented in STEM fields are well represented among the awardees where 56% were Black/African-American/Multiple Races and 3% were Hispanic/Latino. The scholarship budget increased each year to make funding available for new awardees while funding eligible returning scholars, including those that transferred to four-year institutions.

To increase their likelihood of success, T4-STEM scholars worked with a mentor and attended workshops. These workshops included icebreaker activities and team building exercises that strengthened bonds between the students helping to develop a "technology community." In addition, faculty and other guest speakers gave presentations on careers and job seeking skills, which provided the students with tools for future success in school and career. As the number of awardees grew, the number of professors acting as mentors for the *T4-STEM* scholars increased from 5 to 17. By enlisting additional faculty, mentors were able to spend more time with their students and focus on their situation and needs. Surveys conducted each semester found between 80% and 100% of the scholars: 1) did not consider a *T4-STEM* major until college, 2) said the scholarship was instrumental to their staying in a *T4-STEM* program, 3) affirmed that participation in the workshops influenced them to remain in a *T4-STEM* program, and 4) believed that having a mentor was important to their success. All confirmed they would continue in their *T4-STEM* major.

111 - Residential Emergency Solar Power in Western North Carolina

George Ford and Sung Joon Suk

Western Carolina University

Extended Abstract

This paper provides a discussion of the costs, configurations and capabilities of small solar PV systems to provide lighting and minimal power for other uses during winter storm events in western North Carolina. Costs and benefits are compared to gasoline emergency generator systems. The paper identifies that it is affordable to combine solar photovoltaic panels with an automotive battery, suggesting an alternative to back-up electrical generators.

In western North Carolina, installation of solar photovoltaic (PV) arrays is becoming more popular for private homeowners. State and federal tax rebate programs currently allow North Carolina homeowners to recoup 65% of initial capital costs, and grid connected systems can even provide an income stream for owners. Even with these rebates and income streams, many systems do not have an acceptable rate of return. Finding a suitable site for PV arrays in the Smokey Mountains of western North Carolina is often a challenge for many home owners. Mountain and vegetative shading causes significant reductions in power output potential in PV systems eliminating acceptable financial benefits of a given system. In addition to avoiding electricity costs, non-grid connected solar PV may be used to provide emergency power for lighting. In North Carolina's mountainous, rural regions during the winter months, power outages are common, especially during heavy snows.

120 - Using Animations to Enhance Understanding of Energy System Concepts

B. K. Hodge and Govinda Mahajan

Mississippi State University

EXTENDED ABSTRACT

Traditional engineering education presentations use static pictures/illustrations to visualize/demonstrate various concepts, some of which can be quite involved. In many instances, the sequence of static pictures is interspersed with explanations to deepen understanding of the physical concepts. Since animation software and animation development are becoming less expensive and more common, animations that will reduce lecture time devoted to a topic and enhance student understanding are becoming more affordable. Animations permit salient features of phenomena to be combined in a readily visible fashion for understanding. This paper will explore the effectiveness of an animation example taken from an energy systems design course and examine in detail the water hammer animation since it is a good example that illustrates many facets of water hammer. All of the salient features of water hammer can be shown on a static illustration/diagram, but the animation in more effective in demonstrating the scope of the water hammer phenomena. Cognitive issues for enhancing animation effectiveness are examined. Student survey results and instructor anecdotal experiences comparing the effectiveness of the animations as compared to traditional static coverage are discussed. Student survey results confirm that the water hammer animation was successful in enhancing understanding.

103 - Biovolatilization, a Different way to Gasify Biomass

David Domermuth
Appalachian State University

EXTENDED ABSTRACT

Biovolatilization is a method of converting biomass to useful products. Biomass is broken down into solid, gas, and liquid using heat, I.E. pyrolysis. This is the third paper, in a series, that describes the efforts of our local university (not named) to convert lignocellulose to useful products. The research has progressed to specific tests, including energy and mass balances and an overall evaluation of the process. An economic analysis of the process and products is included. The system has six potential revenue streams and promises to be the best of the pyrolysis conversion techniques. Biomass, usually chipped wood, is volatilized to release the hydrocarbons as fuel gas and smoke. The six potential revenue products are, waste stream elimination, biochar production, biocrude production, heat, carbon sequestration, and fuel gas. The project focus for this research is small scale application, home, farm, and community. The goal is the creation of a viable method of augmenting building heating while producing useful products from pyrolysis. The work has been sponsored by and EPA, P3 grant.

Houston-based KiOR Inc. received a term sheet for a loan guarantee from the U.S. DOE to support a $1 billion-plus biofuels project. Part of this money, $222 million, was used to build a bio-crude oil conversion plant in Columbus Mississippi, that will produce 12 million gallons of biofuel per year. The billion dollars is one of the largest investments in bio-crude conversion; and there are numerous smaller ventures ranging up to $70 million for research and smaller refineries. The US imports a billion dollar of conventional crude oil that each day. The conversion of lignocellulose to gasoline is one way to offset some of our energy trade imbalance but this process is not easy. Biomass has roughly one third the energy density of conventional liquid fuels; and the energy extraction can be very inefficient. These two factors make biomass, alternative energy research challenging. The ongoing research efforts reported in this paper are the culmination of four years of testing and improvements.

171 - Process Analyzing of the Vortex Tube and The Teaching and Learning of Energy Efficiency and Sustainability

Don Van, Joel Ingram, Kenneth Mayo and Kian Jost

Union University

EXTENDED ABSTRACT

Vortex Tubes (also known as "Ranque Vortex Tube", "Hilsch Tube", "Ranque-Hilsch Tube" and "Maxwell's Demon") produce hot air and cold air from a high pressure air source using no moving parts. It is possible to get a two-hundred and ten degree Fahrenheit difference between the hot and cold exits [4]. Vortex Tubes have been used in industry for spot cooling machines [2] as well as for mine cooling [Jianggang, 3]. Previous research has shown that Vortex tubes are not efficient at all when compared to standard air-conditioning units, a standard air-conditioning system will have a coefficient of performance up to thirty-four times greater than the coefficient of performance of a Vortex tube [Newton, 4]. Although the efficiency is not stellar compared to standard air-conditioners, they do have the advantage of being simpler and using air directly, instead of a refrigerant. Since Vortex Tubes are simpler designs than standard air-conditioners, there is less maintenance required [Swing, 5]. How does this fit in the realm of energy sustainability and environmental responsibility? This paper will show an analysis of the operation of the vortex tube with regard to the relevant conversion of energy. Experimental data will be used to quantify the efficiency of the device as a function of compressed air inlet. Teaching and learning of energy efficiency and sustainability will be shown using the analyses conducted using this device. A feasibility study will be presented with regard to a potential use of a vortex-tube based air-conditioning system.

CHAPTER 3
TECHNICAL SESSION 3
ABSTRACTS

Monday, March 11, 2013

Technical Session 3 3:50 pm – 5:10 pm

3:50 pm - 5:10pm	T3-A Prescott 208	T3-B Prescott 222	T3-C Prescott 225	T3-D Prescott 304	T3-E Prescott 325
Technical Session 3	**Cancelled**	K-12 Division III	Computer/ Software Division	Research Division I	Professional Skills Division I
Moderator:		*Sally Pardue*	*Randy Smith*	*Gillian Nicholls*	*Adeel Khalid*

T3–A: Cancelled

T3–B: K-12 Division III **PRESCOTT HALL 222**

T3–C: Computer/Software Division **PRESCOTT HALL 225**

T3–D: Research Division I **PRESCOTT HALL 304**

* Abstract titles marked with an asterisk are presentation only and have no manuscript in the proceedings.

T3–E: Professional Skills Division I **PRESCOTT HALL 325**

* Special Session: ASEE Initiatives and Activities and the Challenges Facing Engineering Educators

*119 - K-12 STEM Outreach Pilot: Autonomous Quadcopter Assembled and Tested By Middle School Students

Jamil Anaguano and Yosef Allam

Graduate Student / Assistant Professor–Freshman Engineering Department, Embry-Riddle Aeronautical University

Embry-Riddle Aeronautical University (ERAU) has many ongoing K-12 science, technology, engineering, and mathematics (STEM) outreach efforts from College of Engineering student design project teams, as well as other university-level STEM outreach efforts. In an effort to mentor local K-12 students through community outreach and instruction in the areas of STEM, CARABO team, and STEM Outreach Club from ERAU, combined efforts to inspire a group of five outstanding students from Campbell Middle School in Volusia County, Florida.

This K-12 STEM outreach pilot project is distinct from previous institutional efforts in that local, traditionally underrepresented sixth and seventh grade students are able to assemble, test, and fly a hands-on quadcopter unmanned aerial vehicle (UAV) kit. The project took place on Saturdays during the 2012 Fall Semester. Operated from the ERAU Daytona Beach Campus, and consisting of a truly multinational student team, both CARABO Project and the STEM Outreach Club combined knowledge of Aerospace, Mechanical, Systems, and Software Engineering as well as other disciplines which are used to inspire the next generation and strengthen the ranks of up and coming STEM professionals.

Students from Campbell Middle School got exclusive hands-on experience while assembling a new quadcopter kit as the first stage of the three-stage project. The next stages involved running flight simulations, and testing the final UAV. The software, tools, processes, and techniques used by the sixth and seventh grade project participants were same as those used by CARABO team. The project had three systems to engage students – airframe, propulsion, and controls. Students were actively involved in all three project stages and UAV systems under the supervision of the team members of both CARABO and STEM Outreach Club.

To gauge the impact of the project experiences on the students throughout the Saturday sessions, an open-ended survey to query participants' knowledge, interest, and self-efficacy was used before, and after the project. Specifically, students were asked to describe engineering and tell all they knew about engineering, engineering careers, aspects of engineering that most interest them, and the difference between engineering versus science and mathematics. This term-length hands-on K-12 outreach impact study is an attempt to report on K-12 students' conceptualizations of engineering and issues related to studying and pursuing engineering before and after engaging in engineering-related hands-on project activities. Experiences from this study will be used to provide descriptive step-by-step process to guide future K-12 hands-on STEM outreach projects at the university.

127 - Understanding Barriers to Engineering as a Career Choice for Appalachian Youth: Investigating the "HEART" of the Region

Matthew Boynton, Cheryl Carrico, Marie Paretti, and Holly Matusovich

Virginia Tech Engineering Ed.

EXTENDED ABSTRACT

Literature provides common barriers students may face related to entry and success into engineering and STEM fields. Students within the Appalachian region of the United States often experience a lack of exposure to STEM fields, role models, below average economic conditions, and other factors that limit their full range of career options. Research specific to Appalachia can inform relevant interventions by taking geography and culture into consideration which in turn can help students gain a full understanding of engineering career pathways. As part of a National Science Foundation (NSF) grant, the authors will conduct a three phase mixed method project to research influencing factors specific to Appalachia. This paper provides background on the research project and reasons for beginning the project in the Central Appalachian region. In particular, information on, education, economics, and population migration patterns within the Central Region of Appalachia, as defined by the Appalachian Region Commission(ARC), is provided to show the uniqueness of the region.

The ARC divides the Appalachian into the northern, southern, and central regions. Within these regions differences in economic growth, educational attainment, and population changes exist. Understanding these variables, how they compare within the different regions of Appalachia, and how they compare, on average, to the United States is a necessary first step to understanding the uniqueness of the region.

147 - A Strategic Case of Infusing Sustainability and Integrative Education in a Korean High School Pre-Engineering Course

Yonghan Ahn and Hyuksoo Kwon
Tennessee Tech University / West Carolina University

EXTENDED ABSTRACT

Sustainable development brings many potential benefits to our society and the environment. Therefore, on both the global and national level, many educational communities have taken efforts to accept and implement the concepts of sustainability in K-12 classrooms. Recently the Korean government announced an educational policy emphasizing integrative efforts among STEM (Science, Technology, Engineering, and Mathematics) subjects. This study was started with the intent to deliver contents related to sustainability concepts and integrating their STEM contents into the K-12 classroom. This study investigated a case of infusing sustainability and integrative education in a high school classroom. In this case, systematic course development was conducted in three steps: preparation, development, and improvement. In addition, this study implemented sustainability through the systematic course development process. One semester pre-engineering course for 10^{th} grade students was developed and delivered to 127 high school students in four classrooms. A self-reporting instrument was administered to the participants regarding their administered to the participants regarding their academic motivation toward science and technology school subjects and their attitude toward engineering. Data collected from the instruments and interviews were analyzed qualitatively and quantitatively. The research findings included: 1) High school students' learning motivation toward science and technology subjects was significantly improved through this pre-engineering course and 2) Their attitudes toward engineering were significantly improved through this pre-engineering course. These findings provide sound evidence supporting integrated sustainability concepts delivered through the STEM framework into K-12 educational settings.

148 - Research Trends and Priorities in K-12 STEM (Science, Technology, Engineering, & Mathematics) Outreach

Twanelle Majors, Jennifer Meadow, Laura Luna, Hyuksoo Kwon

Tennessee Tech University

EXTENDED ABSTRACT

K-12 STEM (Science, Technology, Engineering, and Mathematics) education is enjoying full attention in both national policy discussions and funding opportunities. This attention for K-12 education area has been increased due to the significance and benefits related to the implementation of K-12 STEM education. A great concern has arisen on the insufficient number and preparation of K-12 STEM teachers and low academic achievement of K-12 students toward STEM subjects in the U.S. K-12 STEM teachers and practitioners have suggested that informal STEM learning opportunities are as important as formal K-12 STEM learning. The goal of this study was to investigate contemporary research trends and priorities of STEM education, especially for informal settings. Our team followed three stages: (1) Preparation, (2) Analysis, and (3) Presentation. At the preparation stage, this study reviewed relevant prior studies investigating K-12 STEM education in informal settings and established a sound foundation on identifying STEM education research and practices. The analysis sought to obtain data such as project goals (objectives), concentrated disciplines, outreach institutes, research subjects (grade, gender, race, etc.), and their expected outcomes for all the abstracts of NSF (National Science Foundation) funded projects. Targets for these analyses were limited to searchable prior research papers (Advancing Informal STEM Learning (AISL) under the NSF DRL division: Research on learning in formal and informal setting). At the presentation stage, this study communicated the key research trends and priorities in K-12 STEM outreach research and practice. This study can provide an outline for designing K-12 STEM outreach related research and projects.

193 - Formulation and Development of the Wasson Systems Engineering Process Model

Rabah Aoufi
DeVry University

EXTENDED ABSTRACT

Some Colleges are beginning to create what they call "Entrepreneur Centers", where students from Business, Technology and Medical programs are teamed up to collaborate on a "killer application" type project. After graduation, participants go on to either market the idea on their own through a startup or within an existing company that they join. The key ingredient to make this endeavor a success idea consists of, not only teaching engineering students timely subjects but also cultivating creativity and innovation to bring the entrepreneurship college experience to another level. This paper gives a comprehensive view showing how developing state of the art mini-projects used in my microcontroller class, helps students innovate new products to solve societal problems. The three projects described are 1) RFID-based Prohibitive Texting and Driving system: When a simulated GPS signal, indicating the car is moving, is received by the cell phone, all form of texting and browsing for outgoing and incoming transmissions using the device are disabled. Only the voice function is still enabled. Two RFID readers are installed in the back of the two front vehicle seats and one reader is installed under the glove compartment. Each passenger's phone is equipped with a RFID tag. The RFID reader, at proximity to the passenger only location in the vehicle, will turn on the mobile phone data and texting functions. The driver compartment lacking such a reader will leave these functions disabled only on the driver's mobile phone and thus, preventing the driver from using the phone functions other that voice, while driving. 2) RFID-based Voting system: A registered voter would cast a tagged ballot by dropping it in a slot box equipped with a RFID reader. The system tabulates the votes and sent them to a secured database. In case of a contested election outcome, similar to the year 2000 in the Florida presidential election debacle, all the casted ballots in a particular ballot box can be re-read and re-tabulated instantly without having to be moved out of the box. Finally, 3) RFID-based Self Check Out system: While in the shopping cart, packages and boxes with RFID tags are read directly, without a line-of-sight, by the readers installed at the checkout counters. All these three projects used the HCS12 microcontroller-based Dragon Board from Wytec and the RFID reader from Parallax..

112 - Use of Facebook Group Feature to Promote Student Collaboration

Anthony Choi

Electrical and Computer Engineering, Mercer University

EXTENDED ABSTRACT

This paper presents the experiences of implementing Facebook Group feature to promote student collaboration and learning in an introductory programming class in Mercer University School of Engineering. Facebook group has built in features and infrastructure to support class collaboration and settings to deal with privacy issues. Facebook has many advantages over other mediums. Key advantage is that almost all of the students are actively using Facebook for social communication. It is a natural extension for them to extend their preferred method of communication for academic purposes. This experiment was highly successful for the faculty and the students involved. Facebook groups have great potential to enhance student learning and student collaboration. The conclusions are supported by student comments and by quantitative results of a survey in multiple class sections.

In the context of this study, a Facebook group was an overwhelming success in promoting collaboration among students. Student satisfaction is evident in the very positive comments concerning their experience during the semester. Common comments from students were fast response, access to other students, access to help at odd hours, opportunity to discuss and observe another students mistakes and solutions.

Students are heavily active on Facebook. By leveraging their preferred method of communication, academia can benefit greatly by using Facebook groups to enhance student collaboration.

172 - A Multi-Level Curriculum in Digital Instrumentation and Control Based on Field Programmable Gate Array Technology

Omar Elkeelany and Mohamed Abdelrahman

Electrical and Computer Engineering, Tennessee Tech University /Texas A&M University

EXTENDED ABSTRACT

Digital Instrumentation and Control (I&C) plays an increasingly essential role in monitoring, control and protection of modern industry. Modern industry in the USA is in the process of replacing aging analog systems with digital I&C. Digital I&C technologies are known for high processing capabilities, which allow them to perform intelligent on-board computing that supports functionality such as self-checking. They also provide for improved accuracy, flexibility and easy calibration. However, digital I&C pose some challenges for sensitive environments such as nuclear power plants, or biomedical applications. Such challenges require special skills, and awareness from engineers in the design, operation and maintenance.

In this paper, we present how we can enhance the students' design experience and competencies in digital I&C using FPGA and System-on-Programmable Chip (SoPC) Technology, and increase the awareness among Engineering Educators of the design of digital I&C using the state of the art FPGA SoPC design techniques. We aspire to enhance the robustness of such systems and their applicability in sensitive (*Safety Critical*) environments such as nuclear power plants or biomedical applications. Thanks to the advances in FPGA technology and the initiatives taken by the FPGA industry, more FPGA-based educational components can be developed.

Our innovative idea is to effectively combine digital I&C with FPGA design course using hardware description language. This will be accomplished using multidisciplinary multi-step integrated curriculum components, with industrial collaborative linkages, offered at appropriate points starting from sophomore level, and extending to senior levels.

143 - Positive and Negative Motivators and Their Effect on Engineering Student Success

S. Michael Wells and Sabrina D. Wells

Tennessee Tech University

EXTENDED ABSTRACT

In this era of increasing global competition we as educators are continually looking for ways to better attract and retain quality students. In the long term our success will be a large factor in the future of our country. Other nations are gaining on the United States; and our prestige as the number one world power is at risk. Many of us in engineering education see capable young people who could succeed at engineering if only they had adequate motivation. The question arises as to what types of motivating factors are effective at driving students to succeed? Are students who enter engineering because it is their parents' wish just as likely to succeed as those students motivated by the financial reward expected in the engineering field?

Given a choice, most people would prefer positive motivators over negative ones; it is more pleasant to perform a task to earn a reward rather than to have to perform a task in order to avoid a loss. Even so, it may be that negative motivators can actually be more powerful and effective. We at Tennessee Tech have just implemented a Student Success Center to help students stay motivated in engineering. If there are general weak motivator types that can be determined, and the students are willing to discuss their own motivation with the staff of the Success Center, it might be possible to better identify and assist those students at risk.

To possibly identify positive or negative motivator types that may predict student success, nearly 300 freshmen engineering students at Tennessee Tech University were given a survey during the first week of fall semester 2012 classes. The survey listed five positive motivating factors and five negative ones, and the students were asked to rate the significance of each factor. The academic averages of the students at the midterm of the semester was then analyzed to see if there were any trends regarding motivator type and student success up to that point.

The findings were that a significant plurality of the students indicated the primary reason they were studying engineering was for the joy of working in a field related to science and mathematics. There were no strong correlations, however, between any one type of motivator and student performance up to the midterm of the semester. It was concluded that *intensity of motivation*—not *type*—along with other possible factors are what apparently play the more key roles in student success.

150 - Encouraging Undergraduate Engineering Students to Generate Research and Design Publications

Philip T. McCreanor, Laura W. Lackey, Hodge Jenkins, Michael Leonard, Sinjae Hyun

Mercer University

EXTENDED ABSTRACT

Approximately sixty students in Mercer University's School of Engineering published design and/or research work at the 2010 through 2012 ASEE-SE Annual Conferences. These publications include twenty posters, one podium presentation, and four proceeding papers with podium presentations. The same two female students presented at all three of these conferences. Undergraduate efforts in the Environmental Engineering Department and Engineering Honors Program are primarily responsible for these student publications. However in 2012, the School of Engineering's Fall 2011/Spring 2012 senior design course sequence generated several posters. In the Environmental Engineering Department, students in the Senior Environmental Engineering Laboratory (Fall semester course) conduct an open-ended experiment on a lab-scale system. One of the final deliverables for this course is a poster with the expectation that an abstract will be submitted to the ASEE-SE Student Poster Competition. Undergraduate environmental engineering students conducting independent research are typically required to develop a poster for the ASEE-SE Student Poster Competition. The Engineering Honors Program is structured around independent research projects with yearly, public presentation requirements. The primary deliverable for Sophomore Engineering Honors II (Spring semester course) is a publication at the ASEE-SE Student Poster Competition. The potential for leveraging the research and design work associated with the capstone senior design sequence into publications at the ASEE-SE Student Poster Competition was explored successfully in the Spring of 2012. This paper provides extended details on the courses and initiatives generating student publications at the ASEE-SE Conference as well as Mercer University's on campus Engineering Exposition event which is being used to provide opportunities and enthusiasm for students to present their research and design efforts. Logistics, financial commitment, and administrative support required to provide these opportunities are described.

Recommendations for programs looking to increase undergraduate publications and presentations include:

- Re-considering structure and deliverables in upper-level laboratory courses to identify research and publication opportunities
- Initiating an in-house undergraduate poster symposium, and
- Identifying and targeting a regional student poster symposium for a group trip

186 - Analyzing Time to Student Course Withdrawal Patterns for Predictive Modeling

Gillian M. Nicholls

The University of Alabama

EXTENDED ABSTRACT

The University of Alabama in Huntsville has a generous policy course withdrawal policy that permits any student to withdraw from a course until approximately one month before the end of classes for that semester. As a result, many students will register for a course, attempt it for one to two months, and then withdraw if they are not doing well. A course withdrawal does not affect a student's academic record other than appearing on the transcript as a "W". Other than the expense of paying for a class without receiving academic credit, there is no penalty for not completing the course. The disadvantage to the university is that student throughput is hampered and course resources are not fully utilized.

The undergraduate Engineering Economic Analysis course has a high rate of students registering and then withdrawing. In Fall 2011, 29 of the 179 students (16.2%) that registered for the class withdrew from it. Another 3 students functionally withdrew by remaining enrolled in the class while ceasing all participation in it after the second or third exam. These figures do not include students that dropped the class in the first two weeks. This course is in heavy demand as it is often the first class taken by engineering students transferring in for their junior year after completing the first two years at a community college. Year round, each section quickly reaches full enrollment, yet a persistently large percentage do not complete the course and must retake it later. Engineering Economy is a required class for most of the engineering majors and students must achieve a C or better to use it as a pre-requisite.

A study was done to collect data about the students' gender, academic backgrounds, transfer student status, major, homework grades, exam grades, and whether students were taking the class for the first time. The Course Management System (CMS) was used to collect attitudinal, experiential, and environmental variables from the students. Homework assignment submission and exam-taking were used to establish a date during the 100 days of the semester at which students stopped actively participating in the class. Students that remained actively participating throughout the end of the semester were treated as censored data since the event of interest (course withdrawal) did not occur. The time to event data was analyzed with Kaplan-Meier life tables and hazard functions to identify significant factors predicting withdrawal.

Gender and transfer student status were statistically significant predictors at the start of classes. Transfer students were at a much higher risk of withdrawal as early as Exam 1. Female students were at a higher risk of withdrawal than their male counterparts regardless of transfer status. Although females were only 24% of the class they were 45% of those who withdrew. Once variables showing academic performance within the course such as Exam 1 and 2 scores became available, gender and transfer status become less valuable predictors.

135 - Introducing Technical Communication Through Science Fiction: A Freshman Seminar

Amy Barton

Bagley College of Engineering–Mississippi State University

EXTENDED ABSTRACT

First-year seminars allow freshmen to adjust to university life and the scope of academic options available to them. This is particularly true of subject-specific seminars, as students considering a particular major can learn about career possibilities and the demands of a curriculum in an engaging, informal environment. Mississippi State University (MSU) encourages faculty to teach "one for fun," emphasizing the importance of making the one-hour seminar as unique and interesting as possible so freshmen can appreciate the passion the instructor has for the discipline rather than just absorbing a general introduction to a major. This paper describes an attempt to introduce freshman engineering majors to the principles of responsible, clear communication in a way that would interest even those resistant to a traditional writing/speaking course. The freshman seminar "Ignorance is NOT Bliss" examines communication about science and technology through the history of science fiction movies, which often represent the ignorance and fear of a public subjected to misleading information. Topics discussed include galvanism and Frankenstein's monster, the atomic age, the Cold War's effect on the space race, and pandemics. Students analyze examples of misleading communication and contrast those with samples of clear, objective writing and speaking. To practice the strategies presented, students prepare a paper and presentation on a topic in their field. The primary goals of the course are to help students define clear technical communication, learn to be discerning consumers of information, and embrace their ethical responsibilities as future experts. A secondary goal is to demonstrate that analyzing communication techniques is a pursuit both worthwhile and enjoyable.

*188 - Ethics and Biomedical Informatics: a Research Experiences for Undergraduates Program at the University of Tennessee at Chattanooga

Claire L. McCullough and Yu Cao

University of Tennessee at Chattanooga

EXTENDED ABSTRACT

The University of Tennessee at Chattanooga, in collaboration with biomedical researchers and healthcare practitioners from the University of Tennessee: College of Medicine Chattanooga and Erlanger Health System, has conducted the first iteration of a three-year Research Experiences for Undergraduates program on Biomedical Informatics, with a special emphasis on ethics as related to the student projects. Potential impact of research activities in the area of bioinformatics on the practice of medicine is great. These impacts include enhanced and supported decision making and data mining tools for clinicians and biomedical researchers, new computing resources for biomedical research platforms and telemedicine, and new protections against potential security breaches, which can lead to improvements in patient privacy and safety. Because of the ethical implications of all of these areas, this project has added a special emphasis on ethics. The ethics activities included lectures, combined with a heavy emphasis on discussion of current events related to ethics in Biomedical Informatics and computer fields. One of the primary goals of this ethics component is to introduce fundamental theory and practices on the ethical and social issues facing the healthcare and biomedical research industry as it adopts information technologies to provide safer, faster health care service with lower cost, while preserving patient privacy, and eliminating the possible consequences of misuse of personal medical information. This paper discusses the specific bioinformatics projects begun in the first year of the program, the details of the ethical emphasis and activities, results of initial program assessments, and plans for the remaining years of the program.

156 - An Ethical Approach to Hydraulic Fracturing

Andrew Potter and M. H. Rashid

University of West Florida

EXTENDED ABSTRACT

The following discourse will attempt to weigh the ethical issues concerning hydraulic fracturing. The current technology will be reviewed, along with its impacts on the public. Workable solutions will be offered and each weighed in order to find a solution that is acceptable to both the oil and gas industry and the concerned public.

Hydraulic fracturing involves injecting millions of gallons of water, chemicals, and particulate down a drill shaft to fracture the shale below. The fractured rock will release any gas stored within the formation.

Hydraulic fracturing or fracking has been in existence since the 1940s but has only recently become economically feasible. Global demand for petroleum and the resulting price increase has made hydraulic fracturing more profitable. New York has issued a moratorium on all hydraulic fracturing of the Marcellus shale formation with the state borders until the process and its effects on the environment are understood. Only after intensive study can proper regulations be implemented to protect the populations living near drill sites and the watersheds that could suffer damage.

The balance must be struck between the interests of industry and the quality of life of communities near drill sites. Utilitarian principles combined with Respect for Persons allows for a creative middle ground solution that can be implemented on the state and town level.

The key to successfully extracting the shale gas is careful regulation. Any new regulations proposed by New York should protect the three assets most impacted by gas drilling; the watershed, the land, and the communities nearby. The regulations need to specify minimum distances from drill sites to water sources, plans for disposing of used water from hydraulic fracturing, testing routines of aquifers before and after drilling, and approve chemical mixtures used in fracking fluid.

Hydraulic fracturing of wells is a resource intensive process. Millions of gallons of water are needed, toxic chemicals are used and generated during the process, and there is a potential to contaminate nearby water supplies. While hydraulic fracturing sounds like a process best left alone, it has the potential to unlock a large supply of gas to help ease the reliance of the U.S. on foreign energy supplies. When the industry is regulated properly and rules established that clearly define how the process can be completed safely, the public and the gas and oil companies will benefit. The creative middle ground between no regulation and over regulation will allow the Marcellus shale to be developed for the benefit of all stakeholders

CHAPTER 3
TECHNICAL SESSION 4
ABSTRACTS

Tuesday, March 12, 2013

Technical Session 4 8:45 am – 10:05 am

8:45 am – 10:05 am	T4-A Prescott 208	T4-B Prescott 222	T4-C Prescott 225	T4-D Prescott 325
Technical Session 4	Engineering Graphics Division	K-12 Division IV	Mechanical Engineering Division III	Civil Engineering Division II
Moderator:	*Priya Goeser*	*Claire McCullough*	*Monika Bubacz*	*Michael Woo*

T4–A: Engineering Graphics Division **PRESCOTT HALL 208**

T4–B: K-12 Division IV **PRESCOTT HALL 222**

T4–C: Mechanical Engineering Division III **PRESCOTT HALL 225**

* Abstract titles marked with an asterisk are presentation only and have no manuscript in the proceedings.

T4–D: Civil Engineering Division II **PRESCOTT HALL 325**

144 - An Interactive Tool for Visually Presenting Conic Sections to STEM Students

Matthew K. Swenty, Gregory N. Hartman, David W. Johnstone, Daniel S. Joseph, Troy J. Siemers, and James C. Squire

Virginia Military Institute

EXTENDED ABSTRACT

Studies show students in Science, Technology, Engineering, and Mathematics (STEM) fields are particularly at-risk of changing majors when they are enrolled in introductory mathematics courses. The use of visuals and interactive lessons has been shown to keep students' interest in courses but can be challenging to implement. A technology combining these techniques into one tool could help students grasp concepts more efficiently and effectively. We have developed software that provides a simple and practical visual tool for use by professors and students alike in their exploration of the mathematics behind conic sections.

Conic sections provide fertile ground to develop mathematically-interesting questions for undergraduates and the proper computer tools let them visually and interactively assess the geometry behind their mathematical reasoning. Yet there exists no simple tool to efficiently display the generalized quadratic formula $Ax^2+Bxy+Cy^2+Dx+Ey+F=0$. Most software packages plot curves defined by implicit functions by finding the intersections of surfaces and planes. This is computationally intensive and it is not uncommon for numerical inaccuracies to appear. Students are often discouraged when computers "struggle," perceiving this to mean that the mathematics is "too hard." Other packages can solve the problem symbolically, but this is typically slow and these packages tend to be expensive.

This paper describes a new method that finds a one dimensional parametric solution for the implicit quadratic function using only linear algebra that is both accurate and fast. This permits development of smoothly-animated interactive software, such as one we developed that demonstrates the continuity of solutions among parabolas, ellipses, and hyperbolas by allowing a user to click and drag five control points while the conic section that connects them is computed and shown in real time. Demonstrations such as this enhance traditional teaching methods by showing the connection among the different conic sections in a visually-compelling way.

181 - Pilot: Extra Credit-Incented Collaborative Learning & Reflection in an Engineering Graphics Course

Yosef Allam

Assistant Professor, Freshman Engineering Department–Embry-Riddle Aeronautical University

EXTENDED ABSTRACT

EGR 120: Graphical Communications students were assigned to peer groups of two members or more per group to complete optional missing line and missing view exercises together outside of regular class time for extra credit such that teammates collaborate to complete problems and visualize solutions. Students also completed self-reflection writing assignments regarding their level of understanding on various engineering graphics concepts at the point in the semester during which the extra credit assignment was given, and answered questions about their meta-knowledge of the topics covered in the course.

The pilot implementation has encouraged periodic self-reflection writing assignments which qualitatively seem beneficial to students as their progress through the curriculum is made apparent both to the students themselves and the instructor. These self-reflection activities thus serve a formative function as well.

Another outcome of the extra-credit team assignment and self-reflection papers is in terms of the quality of participation and work submitted for group projects, which are demanding. Students are given an opportunity to work with others in the class before committing to the team project, and the periodic self-reflection assignments allow students to pause and think more deeply about how they are approaching their project solutions. In addition, the instructor is given feedback on areas that require more or less focus in the classroom during the semester.

This paper presents a narrative of the evolution of an instructional intervention initially intended to focus purely on developing foundational spatial visualization skills through peer collaboration on additional exercises. As the pilot continued and then efforts were repeated in the subsequent semester, it became evident that while the initial visualization activity remained available, the practice truly beneficial to the dynamics of the classroom became regular in-class written and oral reflective writing communications between students and the instructor.

105 - Engineering Summer Camp for High School Students from Underserved Communities

T. Kunberger, K. Csavina, and L. Zidek

Florida Gulf Coast University

EXTENDED ABSTRACT

In the summer of 2012, the U. A. Whitaker College of Engineering at Florida Gulf Coast University hosted a week-long engineering summer camp for students from the rural underserved central Florida region. Forty high school students, mostly rising sophomores and juniors, from 10 high schools and 6 counties spent five days on the FGCU campus. The camp was designed to be highly interactive and contained four main types of activities: speed designs, discipline specific activities, broader impact activities, and a colossal challenge. Speed designs were structured to challenge students to work as a team and think outside the box, as well as introduce students to the engineering design process. Discipline specific activities included an introduction (via PowerPoint) to the specific engineering field and a number of activities focused on that discipline. A seminar on global engineering projects and two college student driven discussion panels on why engineering and why Florida Gulf Coast University were held as part of the broader impact activities. The overarching activity was a team colossal design challenge based on the Discovery Channel show "Unchained Reactions" and involved larger than life Rube Goldberg machines that encompassed large portions of a classroom. This paper will present the general layout of the week-long program, as well as specifics for each type of activity. Results from pre and post Likert surveys from the students will be summarized as well as written feedback from the participants. Also included will be reflections from the organizers with respect to things to consider when planning and hosting such a program.

*104 - Engineering Education – Past, Present and Future

Marcos Chu
Capella University

EXTENDED ABSTRACT

Engineering education is not a new topic. Studies and developments date from the mid-1800's. However, from a scholar/practitioner perspective, this area is relatively new, with only a few major universities offering PhD programs at the turn of the 20th century. This abstract examines a grass-roots movement in urban communities to develop a full-pipeline engineering education, from elementary to high school level and on to college study. The integrated curriculum involves not only the students and the school but also the community at large. Many urban schools involved in the robotics program have experienced multi-generational academic failure and it is necessary to develop a framework in which is sustainable where the funding for the program is raised locally and the materials provided are non-partisan from a technological point.

The focus in the past have been on Science, Technology, Engineering and Mathematics (STEM) where the goals is to motivate students to pursue careers in STEM or help them develop their knowledge and skills thru formal pre-engineering formal program. The challenges of this framework has been primarily in funding and in been able to attract and develop teachers to implement the program in an effective way. The main focus on STEM rather than on the problem solving aspect of engineering education has made STEM education the focus and engineering as a tool to accomplish the goals for STEM education. Another challenge is that those programs provide great benefits to their core constituents but they are not portable and replicable from a learning community perspective where you might have other stakeholders from a non engineering background.

It is necessary for engineering education to focus on the process of solving problems where in the most minimal process includes brainstorming, trade-study, prototyping and testing an idea. The curriculum needs to be project based with increasingly systematic learning techniques and expanded measurements for children's understanding of the process for solving program and use all the tools available be it in the Science, Technology, Engineering, Arts or Mathematics (STEAM) domain where it will allow them in the future to tackle real-life problem within realistic business constraints such as schedule and cost. The future of engineering education includes the measurement of student performance of meeting the challenges within the constraints as a team representing the whole school and be able to showcase their talents at a high visibility venue such as the Engineering and Science Festival in Washington D.C.

The future of engineering education involves including the topic of engineering affordability as part of the curriculum where students are given a real life challenge where they need to develop a solution to be implemented in the future when they are just entering the workforce.

187 - Real-World Design Challenges - A Crucial Component of STEM Teaching and Learning

Rebecca Jaramillo and Colin Britcher

National Institute of Aerospace (NIA) / Old Dominion University

EXTENDED ABSTRACT

Educators at the National Institute of Aerospace's Center for Integrative STEM Education (CISE) develop engineering design challenges for the K-12 classroom. As experienced teachers, NIA educators bring an understanding of student learning and real-world experiences with practicing scientists and engineers to the classroom. Current research drives the development of each design challenge and the accompanying professional development opportunities for educators.

Each challenge developed by the CISE educators is a real-world engineering problem identified by NASA with unique components. All design challenges incorporate a balance of hands-on activities, modeling and simulation, and testing. Reflective practices are encouraged through open-ended design packets. Access to scientists and engineers is provided to teachers and students through free online video clips, online tutorials, or synchronous webinars.

Importance of Engineering Design Challenges

For the first time, the word engineering takes a prominent place in science classrooms across the United States. Students are challenged to think like scientists and engineers; to understand how engineering and science are similar and how they differ; and to design solutions for real problems. But what connection does engineering have to science and how does the introduction of engineering design impact student learning?

The educators at CISE have created a series of engineering design challenges for teachers unfamiliar with the process of design solutions. Three initial engineering design challenges were created as part of the NASA eClips™ suite and are available online at no charge. The challenges use the 5-E model of learning and guided inquiry to increase teacher understanding of engineering design and build confidence in the implementation of design challenges. A virtual world challenge provides students a unique opportunity to develop modeling and simulation skills. Reflective practices in each challenge, allow teachers to assess student understanding and correct misconceptions. The challenges allow students to design and refine their solutions, demonstrating the iterative nature of problem solving, while changing student perceptions of failure and enhancing their understanding of science and mathematics content. Professional development opportunities for teachers provide support for implementation of the challenges while virtual and video support from NASA subject matter experts provide content expertise, building teacher confidence and increasing the likelihood that teachers may implement design challenges in the classroom.

129 - Using Future Engineers Camps to Advance STEM in Western North Carolina

William L. McDaniel and Sidney G. Connor

Western Carolina University /Appalachian State University

EXTENDED ABSTRACT

Ask – Imagine – Plan – Create – Improve. These five words were at the center of all activities introduced during Future Engineers summer camps held at the North Carolina Center for Engineering Technologies. Using the Engineering Design Process, the students learn about engineering through hands-on activities led by licensed public school and college teachers. Beginning in 2010, these camps were developed as a collaboration between the North Carolina Center for Engineering Technologies, Catawba Valley Community College's Champions of Education, and NC State University's College of Engineering. The 4 camps offered in the summer of 2012 added to the previous 4 camps make a total of 8 camps offered over the past three years. These camps were attended by 339 students ranging from rising 3rd to rising 8th graders. Special care was taken to ensure participation by females and minorities. Students participated in a week-long intensive immersion into engineering design and fabrication techniques. The application process was competitive and students from 12 counties were invited to apply. Applications have exceeded the available slots each year, as the program continues to grow. The primary goal of the camps is to introduce elementary children to the engineering design concept through hands-on activities using math and science skills.

This paper highlights the history, development, and implementation of the summer camps, and their impact on the community. In addition, results from parent surveys will be presented as an impetus for further development in STEM in the public schools. Other institutions should be able to utilize lessons learned in their respective communities.

182 - An Engineering Elective on Energy Resources

Shih-Liang (Sid) Wang

Department of Mechanical Engineering–North *Carolina A&T State University*

EXTENDED ABSTRACT

The energy sector in the past several years has gone through transformative changes and the implications are huge. According to a recent IEA (International Energy Agency) report, America could become the world's largest oil producer by 2020, outstripping Saudi Arabia and Russia. It could also be more or less self-sufficient in energy by 2035. To prepare our students for jobs in the energy sector during these transformative changes and equip them with energy literacy and numeracy, the author is offering an engineering elective covering renewable energy, nuclear power, and fossil fuels.

The objective of this course is to introduce fundamental principles of various energy options as we face climate change and other environmental impact, and to develop an appreciation of the energy challenges that confront our present and future generations. Although several textbooks are useful as references to this course, additional resources are needed to make the course contents contemporary and relevant. This paper reports the author's effort in preparing course materials for this course. The course was offered in Spring 2012 as a special topics course with an enrollment of 17 students. Student surveys are very positive and the course will be offered in the future.

128 - Novel Design for the Total Replacement of Finger and Toe Joints

Andrew Weems

Department of Biomedical Engineering–Mercer University

EXTENDED ABSTRACT

Current total metacarpophalangeal joint replacements (TJR), the most popular a one-piece silicone implant, do not provide the normal biomechanical range of motion and functionality. The proposed design attempts to correct this through the use of design geometry and functional anatomy. A tongue and groove joint is used to prevent medial/lateral dislocation with a ridge located superiorly to prevent hyperextension as well as to allow for the extensor tendons to move without catching on the mechanism.

The natural joint and one-piece implant were compared using two dimensional static and dynamic analysis. The forces taken into consideration were the flexor and extensor tendons that cross a metacarpal-phalangeal joint, as well as the joint capsule and joint reaction forces. The analysis was done over a length of bone equivalent to the length of the arms of the total joint replacement, with the length and radii of the bones of metacarpal and phalangeal bones assumed to be equal, respectively. To do this, an internal shear, moment and normal force were included in the models. For the one piece implant, additional forces are the moments associated with the geometry of the joint and the frictional forces holding the joint arms in place. Computational analysis was performed using Solidworks and ANSYS Multiphysics softwares to determine the force distributions across the joint replacement.

The proposed joint was designed by using the static and dynamic model of the natural joint. The static analysis showed the same behaviors, and the dynamic models were the same save for mass and moments of inertia. Computation analysis showed maximum force values between 3 and 4 MPa were found for loads of 10 N, with displacement values of less than 1.0 mm.

Theoretical testing of the joint demonstrated a high tolerance for applied stresses from daily activity involving the joint. The assigned forces were applied from assumptions made about basic tasks involving the joint, such as force applied parallel to the digit with the TJR. The second major force application was perpendicular to the fully extended digit. It is very plausible that this design can be used in total finger and toe joint replacement surgeries. Future work will include cadaver implantation of varying joint sizes, to determine the range of difficulty for surgeons and patients in terms of time of implantation, biomechanical functionality, and tissue destruction.

165 - Shaft Deflection—A Very, Very Long Example

Christopher D. Wilson and Michael W. Renfro

Dept. of Mechanical Engineering/Center for Manufacturing Research, Tennessee Tech University

EXTENDED ABSTRACT

Most textbooks in mechanics of materials and components of machine design describe numerous methods for determining shaft (beam) deflections. The examples in these textbooks are quite varied, but most are not interrelated or follow-up examples in which the same problem is attacked using different methods. Further, most examples are worked out by hand and do not emphasize numerical methods used in common practice, such as the finite element method. Finally, some of the examples omit enough steps that average students may miss subtle points and below-average students may simply fail to grasp the solution.

This paper presents several solutions for a single problem: a stepped-shaft in bending. The problem is statically determinate. First, superposition of beam table solutions is used to estimate the shaft deflection in a bounding fashion. Then, the deformed shape is exactly (exactly meaning that the assumptions of Euler-Bernoulli beam theory are exactly satisfied) determined using piecewise double integration and the determination of many constants of integration. The equations are set up by hand and then MATLAB is employed to solve the resulting system of equations. The complete elastica is determined. Then, the same problem is solved using Castigliano's Second Theorem at a small number of points of interest along the shaft. Here, Maple is used in a nature manner to develop the solution. Simple numerical integration (actually, successive integration) is used to determine the complete elastica. A discussion of the convergence of numerical solutions is made. Then, a simplified finite element model is constructed. The finite element coding is given in MATLAB. Solution convergence for both the numerical integration and the finite element solution is discussed.

The first author's experience with the example problem in a machine design course has been very successful. Students appreciate having a second (or third or even fourth) chance to successfully solve a problem. The example has been given to the class in three ways. First, the example has been used as an in-class case study spanning parts of lectures over a three-week period of studying design for stiffness principles. The total time expended for the example given here is approximately three hours (approximately one-third of the total time allocated for design for stiffness in the course syllabus). Second, the example (and other similar ones) has been used in successive homework assignments and quizzes. With this approach, students worked through three homework assignments in a series, having feedback (grades) before tackling the next assignment. The third way was a review problem set/example given at the end of the term in preparation for the final exam---no class time was expended. The anecdotal responses from students was good for all three approaches. However, no quantitative measurements of student improvement have been made.

*205 - Integrating a Design Project Into an Undergraduate Mechanics of Materials Course

Joseph J. Rencis and Hartley T. Grandin, Jr.

Tennessee Tech University / Worcester Polytechnic Institute

EXTENDED ABSTRACT

This paper presents a just-in-time approach developed and used by the authors to integrate a design project into an introductory undergraduate mechanics of materials course. The design project discussed in-depth is a statically determinate hoist frame structure. The hoist is used to lift an object of weight. It is assembled with smooth pins and is symmetric about the two-dimensional plane. Three other design projects discussed briefly include a brace structure, beam hanger, and simple hoist structure. Lecture examples, homework problems, and design project problems are solved with all equations formulated symbolically. One major advantage is that symbolic equations can be solved for any variable value. Furthermore, the design process generally requires solving problems over a range of variable values to obtain a satisfactory design. The design project involves all or almost all topics, covered in an introductory undergraduate mechanics of materials course. The project is divided into seven phases. The background required to complete each phase is based on the material covered up to that point in the course. After a topic is covered in lecture, reinforced through homework and classroom quizzes, the project phase related to the topic area is assigned.

153 - Compressive Strength Analysis of Mortar Mixes Consisting of Recycled Plastics

John W. McDonald and Charles D. Newhouse

Virginia Military Institute

EXTENDED ABSTRACT

In an effort to find new ways to minimize the amount of plastic waste the Virginia Military Institute (VMI) sends to local landfills, and part of a collaborative effort between the Civil and Environmental Engineering Department and the VMI Physical Plant, a research project was performed as part of the VMI Summer Undergraduate Research Institute (SURI). Researchers wanted to determine the viability of using recycled plastics as a fine aggregate in standard mortar mixes. The recycled plastics were collected, sorted by type, melted, shredded, batched into a standard mortar mix, and tested to determine the compressive strengths of the resulting mixes. Several testing procedures were developed in order to replace 25% of the fine aggregate by volume. One procedure developed allowed researchers to determine the specific gravity of the plastics, which was difficult to determine through traditional testing procedures because plastic is less dense than water, causing it to float. On average, the mixes produced from the varying plastic types maintained roughly 55% of the compressive strength of a standard control mix. These compressive strengths are in line with previous research and show that it may be possible to use mixes produced from recycled plastics for systems that require lower strength concrete such as: concrete formed homes, pedestrian sidewalks, decorative concrete, and more. It was also discovered that the water demand was more than anticipated and deserves additional consideration. The Environmental Protection Agency's (EPA) "Reduce, Reuse, Recycle," campaign urges citizens of the United States to address the amount of waste they generate and how it is ultimately disposed. Keeping with the EPA's charge, this research showed that it is viable to keep plastics out of landfills by incorporating them in lower strength concretes.

145 - Modeling Groundwater Flow Experiment

Daniel Bunei and Beth Todd

The University of Alabama– Department of Civil Engineering
The University of Alabama –Department of Mechanical Engineering

EXTENDED ABSTRACT

There are commercial groundwater flow models that can be used to teach students about groundwater flow. However, involving students in building their own groundwater flow models experiment increases their enthusiasm and learning. The purpose of this experiment was to enable students to conceptualize and understand the working of an aquifer, contamination of groundwater sources and mathematical concepts of measurement and unit conversions.

Groundwater flow modeling experiment is done in a science classes. However, this experiment was done by six graders taking math therefore mathematical concepts of measurement and unit conversions had to be incorporated in the experiment. The students were fully involved in building a group groundwater flow models using locally available materials. They brought different types of soils and two liter plastic soda containers for their models to be built in school. GK 12 program provided syringes and food dyes used as contaminants in the experiment. Students were divided into groups of four before the experiment. The experiment was started by first building the groundwater flow models. Thereafter, the models were used to demonstrate the workings of an aquifer and contamination of groundwater.

This paper gives a brief description of aquifers, saturated and unsaturated ground zones, contamination of groundwater, soil horizons and learning about groundwater flow. The procedure for the experiment, the materials required and learning outcomes are outlined.

Modeling groundwater flow experiment simplified the explanation of aquifer recharge and depletion, and contamination of groundwater sources for six grade students.

This experiment was part of GK 12 program funded by NSF GK-12 Grant No. 0742504.

185 - A Case Study Comparing the Container Shipping Industry in the US and Panama

Tulio Sulbaran, Ph.D., and Matt Gathof

The University of Southern Mississippi

EXTENDED ABSTRACT

Container shipping is the service of transporting goods by means of high-capacity, ocean-going ships that transit regular routes on fixed schedules (World Shipping Council). The universal sizes of shipping containers allow them to be transferred seamlessly between trains, trucks, and ships. Over the last several decades, container shipping has become an even more important aspect of trade, with an increase of outsourcing due to globalization. Today, approximately 90% of non-bulk cargo worldwide moves by containers stacked on transport ships (Ebeling). The container shipping industry has been an integral part of the success of globalization. Shipping companies are forced to maximize value to remain competitive in global markets. Reduced import and export duties go a long way in minimizing the cost of container shipping. An excellent geographical location, the Panama Canal, tax-free processing zones, and a zero percent tax rate on profits made outside of the country make Panama a world leader in container shipping. Thus, this paper presents a case study comparing the container shipping industry in the US and Panama. In Panama, information gathered from experts at the Panama Ports Company and the Manzanillo International Terminal was used to formulate a thoroughly developed case study on the container shipping industry in Panama compared to that of the US.

CHAPTER 3
TECHNICAL SESSION 5
ABSTRACTS

Tuesday, March 12, 2013

Technical Session 5 10:25 am – 11:45 am

10:25 am – 11:45am	T5-A Prescott 208	T5-B Prescott 222	T5-C Prescott 225
Technical Session 5	Instructional Division III	Professional Skills Division II	Research Division II
Moderator:	*Richard Mines*	*Richard Kunz*	*Gillian Nicholls*

T5–A: Instructional Division III **PRESCOTT HALL 208**

T5–B: Professional Skills Division II **PRESCOTT HALL 222**

T5–C: Research Division II **PRESCOTT HALL 225**

* Abstract titles marked with an asterisk are presentation only and have no manuscript in the proceedings. 3-82

125 - A Preliminary Investigation of the Effectiveness of Peer Ratings in Engineering Design Teams

Richard O. Mines, Jr. and Joan M. Burtner

Mercer University

EXTENDED ABSTRACT

At the Mercer University School of Engineering (MUSE), participation in engineering design teams is an essential component of our engineering curriculum. Students who earn a Bachelor of Science in Engineering from MUSE must successfully complete three semester-long courses in engineering design. One course, Introduction to Engineering Design (EGR 107), is included in the freshman year curriculum; two courses, Senior Design Exhibit I (EGR 487/ ECE 485) and Senior Design Exhibit II (EGR 488/ECE 486), are included in the senior year curriculum. Faculty members at MUSE are using a peer rating system developed by Professor Rob Brown and refined by Professor Rich Felder to assist them in evaluating individual and team performance in these engineering design courses. For a specific assignment, students confidentially assess themselves and their team members using a nine-item rating scale that ranges from "excellent" to "no show". After assigning a numerical value to each rating, the instructor calculates a grade adjustment factor by dividing the team average rating (TAR) by the individual average rating (IAR). The grade adjustment factor is then applied to the final grade for the assignment or to the final course grade.

The objectives of this study were to investigate potential correlations between final course grades and average peer ratings as well as correlations between final course grades and individual self-assessment ratings. We also investigated the possibility that peer ratings would be influenced by minority status. Based on non-parametric statistical analysis, we drew the following conclusions:

- There were significant correlations between final grades and peer evaluations for the preliminary design report (PDR) at both the freshman and senior design level.
- Statistically, there was no significant correlation between peer and self reviews in the freshman design course. However, strong correlations existed between peer and self reviews for both the PDR and critical design report (CDR) in the senior design courses at a 0.05 level of significance.
- In the freshman design course, there was a significant difference in the ratings given *by* non-minority when compared to those given *by* minority students for the PDR; whereas, for the CDR, there was a significant difference in ratings given *to* non-minority students when compared to those given *to* minority students.
- In the senior design courses, there were no significant differences in the ratings given *by* or given *to* non-minorities and minorities.

189 - Student and Faculty Impressions of an Online Computer Based Signal Processing Lab

Thomas Murphy and Christopher Williams

Armstrong Atlantic State University

EXTENDED ABSTRACT

Introduction to Signal Processing at Armstrong Atlantic State University is a four credit hour course consisting of three lecture hours and three lab hours (3-3-4). Prior to fall 2012, this course has been offered using traditional face-to-face lectures and face-to-face laboratory time. In fall 2012, the course was offered as a hybrid course with the traditional face-to-face lecture component but with the lab component online. This was necessary due to the larger than usual number of students enrolling in the course and a shortage of computer lab space due to some campus renovations.

The introduction to signal processing lab is easier to convert to an online format than most engineering labs since it is computer based. The necessary lab equipment is MATLAB software and a computer capable of running the MATLAB software. Students taking online courses should already have a computer and a student edition of MATLAB can be purchased for $99 from MathWorks. The lab content is a combination of analysis and design work, advanced programming, and interpretation of results.

This paper presents student impressions of the online lab format, lab material dissemination, availability and convenience of help, lab assignment submission, return of graded lab assignments, as well as some initial comparison of student performance in the online lab versus past student performance in the face-to-face offerings of the lab. The paper also presents faculty impressions on lab preparation, mechanics of receiving and returning assignments, and grading lab assignments.

194 - Using Technology to Enhance Undergraduate Learning in Large Engineering Classes

John Abbitt and Bruce Carroll

Senior Lecturer, Department of Mechanical & Aerospace Engineering, University of Florida, Gainesville, FL

Associate Professor, Department of Mechanical & Aerospace Engineering, University of Florida, Gainesville, FL

EXTENDED ABSTRACT

Lecture classes with enrollments in excess of 250 students and lab classes with enrollments of over 100 have become the status quo at many universities, and it is expected this trend will continue with class sizes becoming even larger. Traditionally, it has been thought that the quality of the learning experience is diminished in such large classes. However, as we adjust to the new norm, we are finding that it is possible to actually improve the learning experience by employing new classroom technologies and better management of existing resources. Improved internet based content delivery technology provides opportunities for blended learning strategies. In this paper, we describe how two classes are conducted at the University of Florida that employ blended learning. The first class is an introductory fluid mechanics class with an enrollment of 265. In this class, three traditional lectures a week are video-recorded with students watching these on-line at their convenience. Students then attend one mandatory recitation section per week which is devoted to problem solving. The recitation sections are relatively small with enrollment limited to 30 students. During the recitation sessions, instructors serve in the role of facilitator or mentor as students work in teams of two to apply the content covered in the internet based lectures. Conceptual errors are identified and resolved efficiently as compared to traditional instructional approaches. The other class described in this paper is a fluid mechanics/thermodynamics laboratory class with an enrollment of about 100 each semester. In this class, laboratory demonstrations are recorded for student viewing and on-line quizzes are administered. Thus, pre-lab preparation is automated and standardized across instructors and teaching assistants. During the lab sessions, student preparation for the lab is improved by allowing more time for instructors to spend interacting with students on conceptual aspects of the experiments. Specific multimedia technologies utilized in these courses include Sakai e-learning system and Camtasia Studio screen/audio capture software. The University of Florida EDGE (Electronic Delivery of Gator Engineering) facilities are also utilized for recording lectures and delivering video content via internet streaming video.

157 - Modern Drone Warfare: An Ethical Analysis

Joshua Olson and Dr. Muhammad Rashid

University of West Florida

EXTENDED ABSTRACT

The revelation of drone warfare presents an onslaught of new and never-before considered ethical issues. These aircraft are the equivalent of the robotic armies discussed in so many science fiction novels. While indeed drones do a great justice by protecting the lives of our countrymen and preventing the unnecessary loss of thousands of soldiers' lives, the long-term impact of this approach is not yet well understood. Popular culture uses terms like "Convenient Killing", "Death by Remote Control", "PlayStation Mentality" and "Death Machine" to describe these drones. This very much describes some of the issues surrounding this technology. Drones simplify the time and effort required for effective military operations, and remove the soldier from the reality of the situation. It is very difficult to distinguish true drone operations from a video game, and in fact, the military markets such positions within the gaming industry. The thought being, if you can fire a missile in a video game with accuracy, you will be similarly effective behind a drone control console. With the ever-changing defense technology industry, our policies and strategies need to progress correspondingly, and so far, they have not.

Student Learning Activities

This work is intended to develop the following student learning outcomes (a) ability to identify a contemporary ethical issue, (b) the ability for life-long learning, (c) ability to disseminate the information in the form of research paper within ethical dimensions.

140 - Project Haiti 2012: Providing an Experiential Learning Experience Through the Design and Delivery of a Water Purifier in Haiti

Yung Wong, Johnathon Camp, Shavin Pinto,Kyle Fennesy, Marc Compere, Yan Tang

Embry-Riddle Aeronautical University, Daytona Beach, FL

EXTENDED ABSTRACT

The earthquake that destroyed much of Port-au-Prince, Haiti in January 2010 was a rallying point for Embry-Riddle engineering students to help in a hands-on, tangible way. The desperate need for basic necessities like food, water, and shelter motivated the students to respond with a strong desire to help. The student chapter of the American Society of Mechanical Engineers (ASME) promoted the effort and raised funds to build the Project Haiti 2010 water purifier. This unit was based on an earlier Civil Engineering department's senior design project and provided 1 gallon per minute (gpm) of clean water. One student and one faculty from Embry-Riddle joined a larger group's travel for the installation. The following year, Project Haiti 2011, eight students from the Clean Energy Club and faculty designed and installed a purifier system to deliver 4 gpm powered entirely from the sun [Tang, 9]. During the summer of 2012, a team of thirteen installed the Project Haiti purifier delivering 20 gpm in Onaville, one of Haiti's largest tent cities, which has a population of roughly 100,000 Haitians.

196 - Humorous Improvisation Tailored for Technical Innovation

Peter Ludovice, Lew Lefton, Richard Catrambone

Georgia Institute of Technology

EXTENDED ABSTRACT

The Enhancing creativity among U.S. engineers has been labeled a high priority by government, industry and educational institutions. We applied humorous improvisation to various engineering design classes by using the creative energy derived from humor as the stochastic fluctuations in a Monte Carlo search of idea space. Analysis of the initial results of various innovation workshops using improvisation allowed the development of a three step process ideally suited for technical innovation. While humorous improvisation has been used successfully for decades in generating business and marketing ideas, it has not been successfully applied to engineering innovation. This lack of success is due to a significant difference in the shape of idea space between technical and non-technical fields. Technical idea space is more constrained than its non-technical counterpart, and therefore requires a systematic procedure that reflects this fact. Our three step approach to engineering innovation uses humorous improvisation in an initial divergent step to traverse idea space. This is followed by a convergent and emergent step that is required to address the constrained nature of this idea space. This three step procedure was applied to engineering design in various academic and professional groups. We present an analysis of this method and how it effectively addresses technical innovation. How it can be applied to engineering design classes is also discussed. Analysis of these applications indicates that this three step approach is superior to humorous improvisation alone. Other tests indicate that this method can also be applied in a video conference format.

124 - Measuring engineering students' conceptual and empirical understanding of sustainability

Adebayo Ogundipe and Olga Pierrakos

Department of Engineering –James Madison University

EXTENDED ABSTRACT

Engineering professionals are in a pivotal position to influence the way societies function and as problem solvers, their primary responsibility is to produce solutions that work in the real world, with all the attendant constraints. Traditionally, engineers have tackled most problems pertaining to individual dimensions of sustainability retroactively, but current challenges facing society require a more proactive orientation to the teaching and practice of the profession. This indicates that engineers, engineering managers, and technologists are now being tasked with understanding the broader social, economic, and environmental implications of their work. There are currently many efforts to introduce sustainability concepts in various classes across engineering departments. However, these efforts tend to simply promote the appreciation of sustainability as an ideal rather than introduce specialized technical content necessary for providing engineering based solutions. If engineers are to be effective participants in sustainable development, sustainability must become part of the engineering practice paradigm. This, on the other hand, can only be achieved if it becomes an integral part of engineering education programs, not a mere 'add-on' to the 'core' parts of the curriculum. Embedding sustainability within the curriculum does not simply mean including new content. There is currently no available assessment instrument to gauge the competencies acquired by students in the variety of sustainable engineering education efforts. More so, there is no data that tells us if any of the learning objectives developed by various programs are truly in line with what will be expected of the next generation of engineers. This work proposes a framework for assessing the changes in the conceptual and empirical understanding of sustainability by engineering students as wells as determining the degree to which engineering graduates are being imparted with the requisite skills to solve engineering problems in the context of sustainable development by first, determining and articulating what these skills should be. A model for the development of a research track on measuring the degree of attainment of sustainability learning objectives is proposed. The ultimate goal is to develop a basis for curricula and pedagogical changes to engineering education in preparation for sustainability challenges. As the competency requirements for the next generation of engineers change in line with changing global challenges and foci, we need to ensure that we are indeed preparing engineering students to competently address the problems of today and tomorrow. The fact that many professional bodies acknowledge this necessity attests to the broad impact this area of research can transfer to society through engineering education.

113 - Integrating Research Experience into Entry Level Electrical Engineering Graduate Courses

Thomas Yang and Ilteris Demirkiran

Embry-Riddle Aeronautical University

EXTENDED ABSTRACT

For engineering graduate students, it is highly beneficial to introduce research activities as early as possible in their graduate study. Through research activities, students develop domain expertise, gain an understanding of engineering research process, and improve their communication, problem solving, and critical thinking skills. Moreover, research experiences enhance student motivations in studying highly theoretical course materials, because they develop first-hand understanding of practical applications of such knowledge.

A common problem with Master's level engineering curriculum is the lack of research component in the beginning part of the curriculum, especially at primarily teaching institutions that do not offer Ph.D. degrees. Master's students are often not exposed to research experience until the time for thesis or graduate research project, which typically occurs during the last one or two semesters of graduate study. In this paper, we describe our recent effort in incorporating small-scale research project experience in two entry-level graduate courses in the Master of Science in Electrical and Computer Engineering program at Embry-Riddle Aeronautical University (ERAU). Supported by ERAU's Center of Teaching and Learning Excellence, we conducted initial experiments and assessment of the teaching practice in two courses: "Random Signals" and "Linear Systems". We concluded that many benefits were achieved, including: enhanced motivation in learning theoretical knowledge; cultivation of critical thinking and problem solving skills; ability of using popular software programs for research purposes; ability to interpret data obtained from computer simulations; ability to communicate effectively, especially technical writing skills. It is particularly noteworthy that, several students even asked for an additional research project to explore on their own at the end of the semester, which indicated the success of our teaching practice in inspiring students' enthusiasm in engineering research.

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