Finite Element Modules for Demonstrating Critical Concepts in Engineering Vibration Course

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Abstract
Vibration in many cases is a limiting factor in engineering designs. Knowledge about vibration is desired for mechanical engineers to analyze measure and control its harmful effects upon device performance (noise and fatigue failures, for example). An elective course on engineering vibration is recently offered for mechanical engineering seniors at the Purdue University North Central. The topic of vibration builds on previous courses in dynamics and engineering mathematics (kinematic and dynamic analysis, principles of energy, Laplace transform, eigenvalue problem, etc.) and covers all essential fundamentals in vibration such as modeling of single- and multiple-degree-of-freedom systems, free and forced response analysis, vibration measurement and suppression.

Finite Element (FE) method displays its unique abilities in simulating the performance of a mechanical part or system prior to building a physical prototype. It has been widely employed to solve problems relating to engineering vibration. Integrating appropriate FE learning modules in teaching is an efficient way to assist students in the learning of engineering vibration. Animations and graphical plots from FEA enable students to visualize the phenomena of vibrations, enhancing their comprehension and grasp of some of critical concepts.

This paper documents the development of a series of FE models for illustrating a variety of vibration phenomena, including transient response, steady-state response, natural frequencies and mode shapes, resonance and damping, and isolation and absorption of vibration. Comparisons of analytical analysis with FE visual results reinforce students' understanding of vibration theory learnt in class.

Key words: vibration, finite element

Incorporating Different Design Aspects of Land Transportation in the Introductory Level Undergraduate Transportation Engineering Course

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Abstract

Most undergraduate civil engineering programs in the United States offer an introductory level transportation engineering course during the junior or senior year of study. The material coverage in this course varies widely between institutions based on the instructor's expertise and the availability of other technical elective courses offered in transportation engineering area. For many students this is the only transportation engineering course they will take in their undergraduate civil engineering degree. In this introductory course majority of the instructors focus on land transportation with special emphasize on traffic and transportation planning and design. The faculty members area of expertize also dictates the material coverage in this course to some extent. Most faculty members who teach this course have traffic and transportation planning as their area of expertise. There is an ongoing debate among faculty who is teaching the introductory transportation engineering course about what needed to be included in this course. Several workshops and conferences were held in the past to discuss and debate this issue.

After studying the course schedule and syllabus from different institutions, the author found that this course primarily covers the traffic and transportation planning aspects in majority of the civil engineering programs. While developing the course to teach at his institution, he included various aspects of land transportation designs such as geometric design, pavement design along with traffic planning in the course. A small lab component was also added along with a comprehensive design project. In this approach, even if this is the only transportation course a student takes while in school, they still get an overall design details about land transportation. This will not only benefit them in their professional practice, but will also help with their preparation for the fundamentals of engineering and professional engineer exams.

Within approximately forty two class periods, the main spectrum of land transportation needed to be covered. So the author designed the course with equal coverage to all three areas and taught the class in spring 2010. Based on the student feedback, a design project was also introduced when the course was taught again in spring 2011, and 2012. Student teams were asked to work on a design project that incorporated the concepts and design methods learnt from all three areas. The author feels that this helped the students to have a clear understanding about transportation engineering. This paper provides the details on the development of this course, syllabus, and the student feedback.

Analogy and Humor as Tools for Understanding and Retention

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Abstract

Best practices for teaching require the instructor to endeavor to help the student learn, not just for the instructor to deliver content. Student learning involves gaining understanding of concepts and developing the ability to apply those concepts to problems, but also retaining these abilities. Many excellent mechanisms for achieving these outcomes have been developed, including techniques such as active learning and problem-based learning. This paper proposes the use of analogies and humor as complementary techniques for increasing the student's understanding of concepts and promoting their retention of those concepts. We give several illustrative examples, as well as an assessment of the effectiveness of these techniques in two courses where they were applied.

Interdisciplinary Collaboration to Address Mechanical Engineering Students' Writing

James V. Canino, Trine University

Sarah Young, Trine University

Abstract

Producing clear, concise technical writing is often challenging for engineering students, despite the necessity of strong communication skills in the workplace. This paper will discuss a collaborative effort between a mechanical engineering professor and an English professor to improve writing by senior level students in a design course. In previous years, the mechanical engineering professor had noted grammatical errors, substandard document design, and overly complex language in student writing. These errors were attributed to an almost four-year time lag between the freshman technical communication course and the senior design course. A technical writing handbook specific to engineering design reports was developed, as were content and writing-focused rubrics. These documents were intended to reinforce concepts that had been taught in the technical communication course but had been perhaps forgotten by students. Students were also encouraged to consult with the English professor at the university writing center. Additionally, writing quality was made a significant portion of the students' grades and the writing instructor was given responsibility for assigning that grade. The two instructors met regularly to discuss student work and grading decisions.

A questionnaire gauging student satisfaction with the program indicated that students found all aspects of the program useful. Both faculty members also benefited from the collaboration, seeing not only improvement in student writing but also opportunities to improve writing instruction in their respective courses. These improvements will be discussed as will the exposed need for additional interdisciplinary communication.

PROBLEM-BASED LEARNING TO PROMOTE STUDENT CREATIVITY

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ABSTRACT

The authors investigate the effectiveness of problem-based learning to promote creative thinking in a classroom setting. Three problem-based learning exercises were given to students to encourage them to practice their creative-thinking skills as part of a graduate course in engineering management.

The first exercise asked the students to develop a team-based process that would allow them to perfectly sort a set of six decks of highly shuffled playing cards as quickly as possible. Direct observation of time trial results through three generations of process design allowed direct observation of significant improvement in team performance. The second exercise required the students to design a mailroom system for a medium-sized company, with a focus on accurate and efficient mail delivery. Students were encouraged to question assumptions, eliminate unnecessary overhead tasks, and optimize the critical path of the mail delivery process. Again, direct observation of simulated mail delivery results demonstrated significant improvement in team performance throughout the activity. Finally, students were asked to tackle a real-world problem by working with each of the two co-teachers to suggest creative new directions for research projects associated with the faculty members' research areas: virtual reality and nanotechnology. The students were able to develop several very interesting suggestions that are being evaluated for future research work and potential publication.

Assessments of self-efficacy in a variety of creativity domains were performed by the students before the first exercise, after each of the three exercises, and at the end of the course. The results of these assessment efforts demonstrated a statistically significant improvement in students' perception of their own creativity throughout the three-week duration of the study. The average self-efficacy score increased after each of the three problem-based learning activities, suggesting that the beneficial effect of successive problem-based learning experiences is at least partially cumulative.

DEVELOPMENT OF ORAL COMMUNICATION SKILLS IN ENGINEERING EDUCATION

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ABSTRACT

The development of oral communication skills in engineering education has been receiving increasing attention as a result of the following: engineering educators' perception that these skills need further development, the current engineering accreditation criteria, and comments from employers of engineering graduates in the United States. Some possibilities for incorporating oral communications into the engineering curriculum include individual and group presentations, student team debates on controversial issues, competitive design reviews, oral examinations, and five-minute summaries of the current or previous class period. The challenges of oral communication include both the selection and implementation of the most suitable format for a specific classroom setting.

This paper is intended for engineering educators who are looking for methods of incorporating more oral communication skills development into their courses. With the purpose of developing stronger oral communication skills in the student, the authors have focused on three approaches: student team debates, competitive design reviews, and oral examinations. The first approach has evolved over a period of years and is being used currently in Fall, 2012. The other two approaches have been developed conceptually to a sufficient extent and are ready to be used in Spring, 2013. The authors discuss specific goals, educational benefits, and implementation of each approach in a mechanical engineering program. These approaches can be used in any engineering program.

Multidisciplinary Instrumentation Student Projects

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Abstract

During the fall 2012 semester, electrical engineering and chemistry students at Trine University collaborated on design projects to build instrumentation systems. These multidisciplinary design projects are discussed in this paper. In the beginning of the semester, electrical engineering students in the class entitled Instrumentation were introduced to the software languages MATLAB and Labview, and they were introduced to how to write data acquisition (DAQ) software using these languages. For the last month of the semester, teams of students were responsible for designing computer controlled data acquisition systems. There were seven teams each working on a different instrumentation system including a filter fluorometer, a system to measure thermal conductivity, and a syringe pump system.

These projects were very open ended and involved significant design by the student teams. Electrical engineering students were responsible for design of both the hardware and software of their systems. Students were responsible for selecting the hardware to use and determining how to interface it to the computer. Some groups used USB DAQ boxes to get data from sensors to a computer while other groups used serial cables. Electrical engineering students selected whether to use MATLAB or Labview, and they were responsible for determining the specifications and writing the software needed. Students also were responsible for determining how to calibrate their systems. Chemistry students acted as advisors during the projects. They provided technical advice and helped write users guides for the systems. The resulting projects varied quite a bit because of the many decisions made by the students.

Views on Flipping Engineering Thermodynamics

James V. Canino, Trine University

Abstract

The implementation of the flipped classroom model in engineering thermodynamics course at Trine University will be discussed. A flipped classroom is when the students watch recorded lectures at home thereby freeing up class time for working problems or other activities. While there are multiple reasons for choosing to use a flipped classroom teaching model, the primary reasons in this case included a desire both to improve student learning and to provide a more interactive learning environment.

Some of the technology needed to flip a classroom, such as the software programs often used to record lectures, will be discussed. These include the use of BB Flashback Express for producing the screencasts and Vimeo as the video hosting site. A brief look at using Camtasia for producing screencasts is also presented. In addition to the pros and cons of the software programs used, details will be given on how the flipped classroom was implemented in this thermodynamics course including the use of fill-in-the-blank notes, classroom worksheets, and classroom rules.

The results from student questionnaires gauging student satisfaction with the flipped classroom along with the instructor's own views on the success and failures of this effort will also be shared. Some preliminary statistics will be presented in an attempt to assess the effect of the semester-long flipped classroom on student achievement in thermodynamics.

Future plans for the flipped thermodynamics class might focus more on applying knowledge and less on course content. Specific classroom activities might include open ended problems, experimental investigations, and other interactive activities.

Incorporation of Sustainability in the Senior Design Project: a Multimedia Water Filtration System

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Abstract

Sustainability is an important topic in engineering education. It requires conservation of the natural resources and energy, while minimization of the impacts of a product or a system to the natural environment to a level within the nature's self-sustaining capacity. In typical classroom teaching, students have rare chances to practice the concept of sustainability. However, the capstone projects for senior engineering students provide a valuable opportunity for them to utilize and to practice the concept in a system or in a technological design, build and evaluation. In this paper, a group of Civil Engineering students designed, built and tested a chemical-free multimedia filtration system to treat the St Joseph River water for clean water supply. Small-scaled water treatment systems are important supplements to centralized drinking water supply, because of their minimal or even no chemical usage, low start-up and operation costs, high mobility, and the ability to be built economically to meet different water quality requirements. All these characters fit the requirements of sustainable development. The system utilized natural gravel and sand as the filter media. There were four filtration columns with the first three filled with gross, medium, and fine gravels, respectively; while the last column was a slow sand filter (SSF) filled with fine sand with diameter of 0.2-0.3 mm. The multimedia filtration system was tested by feeding the raw St. Joseph River water to the system continuously at the filtration rate of 0.15-0.25 m/hr. The average turbidity removal rate of the system was 95.5%, which is comparable to coagulation, flocculation, and sedimentation together, the conventional drinking water treatment processes. After completion of the project, the students better understood the concept and the principles of sustainability in engineering design and system evaluation.

Competitive Problem Based Learning in an Environmental Engineering Laboratory Course

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Abstract

The Problem-based learning (PBL) pedagogical approach to instruction has become widely used in engineering courses. This paper describes implementation of the PBL approach to an environmental engineering laboratory course. The course serves as an elective option for students pursuing a Bachelor of Science in Engineering degree. The PBL approach was used for the laboratory component to provide an applied context to traditional experiments implemented in this course. Two problems were defined and used to motivate the design of weekly laboratory sessions. The first problem was to design a treatment system to produce drinking water from river water. Laboratory sessions were used to conduct a variety of relevant water quality tests and examine different treatment methods. Relevant drinking water regulations were presented to provide a treatment goal. A water treatment competition was designed to provide a creative outlet for presenting the final treatment schemes. The competition required each team to integrate experience from previous laboratory sessions. Each team was scored based on the quality of the treated water, efficiency of treatment, experimental techniques, and the final design report. The second problem concerned evaluating the performance of an activated sludge wastewater treatment plant. Students visited a local plant and obtained samples for testing. Both problems required extensive use of traditional experimental procedures and reinforced many of the course lecture topics. Students were required to maintain a laboratory notebook and submit two reports detailing the two problem solutions. The PBL approach was implemented in lecture using a series of class problem set packets. Interactive problem solving sessions were conducted to solve the problems with short periods of traditional lecture interjected as needed. Lecture material was introduced as needed to solve the problem sets. Student feedback regarding the lecture and laboratory components of the course was very positive. Advantages of this approach include greater connectivity between lecture and laboratory topics and a greater focus on experimental design, a requirement of ABET outcome 3b.

An In-Class Demonstration Used as an Introduction to the First Law of Thermodynamics for an Open System

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Abstract:

The First Law of Thermodynamics for an open system is a core topic in any first course in thermodynamics. A typical approach to teaching this topic might begin with explaining what an open system is followed by a qualitative discussion of the energy interactions across the system boundary. The bulk of the presentation(s) focus on the mathematical formulations needed to solve various open system problems. Usually this leads to examples involving a group of classic open devices such as turbines, pumps, etc.

Studies have shown that in-class demonstrations as well as other interactive methods are often more effective ways of helping students gain deeper understanding of subject matter than lectures alone. This paper describes an example of the use of an in-class demonstration to help students better understand first law concepts for open systems. This particular demonstration is more than a "show and tell" for the students. It involves the students in the presentation through the use of worksheets and discussions as the demonstration progresses. It typically uses up a complete class period.

Briefly, the demonstration described in this paper uses a pair of hair dryers as the open systems. Students are asked to predict how the output temperatures will change as switches are move into a variety of combinations. (There is a switch for the power and a separate switch for the fan speed). A LabView VI is used to monitor this on a screen in the room for the whole class to see. Various things occur during the demonstration that appear to violate the first law. In addition to these apparent violations, the students are also confronted with two hair dryers that do not act the same way. In fact, the temperature outputs are significantly different, not just in magnitudes but also in the direction of temperature changes as switch positions are changed. Through interactive discussions and the worksheets the students are challenged to reason out what is happening. This paper describes the demonstration and the work sheets used in class along with the expected outcomes of the exercise.

DESIGN OF A PHOTOVOLTAIC PANEL EXPERIMENT FOR AN UNDERGRADUATE HEAT TRANSFER LAB

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ABSTRACT

Renewable energy sources and systems have become popular topics of study for engineering students. In this article, the authors present a renewable energy project that they have integrated in a junior-level heat transfer laboratory at Indiana University–Purdue University Fort Wayne. The project makes use of a photovoltaic panel that is mounted on a portable frame which allows adjustment of the panel tilt angle. A bank of resistors is available to provide a variable load on the device, and the panel is instrumented to read voltage and current. The incident solar radiation is also measured using pyranometer. In the project, students are required to design an experiment to determine the resistance load that results in the maximum power output. Then, they investigate the effect of the panel angle on the power output and determine the efficiency of the panel in converting solar radiation to electrical power. This type of activity serves to enhance the students' understanding of renewable energy sources and energy conversion processes. It also provides the students an opportunity to apply knowledge acquired in an electric circuits course to a practical application.

Exploring the Efficacy of Interactive Classroom Methods Assessed by the Competencies of Information Transference

Brian W. Loss, J.D.

Steve Schaffner, M.S

Abstract

As instructors in a Building Construction Management program it has been our observation that the traditional lecture, memorize, test pedagogy is a less than ideal platform to convey the material our students require for success. Specifically, the traditional format does not inspire motivation among students or deliver the information transference conducive to the critical thinking necessary to develop effective leadership skills for industry. This paper is based in part on the experience of the authors in developing an effective curriculum for the instruction of construction management (CM) for the undergraduate program. This curriculum is based upon Dialogical Teaching (DT) and Problem Based Learning (PBL*)* pedagogy as opposed to the traditional Lecture, Memorization and Testing (LMT) approach long common in the college classroom. Instruction of CM is inherently practical; we are about the business of inculcating practical understandings that are to have immediate application in an industrial setting. These understandings require levels of student motivation and involvement that are more likely to be achieved than in a traditional classroom environment. Specifically, we have found that leadership and its corollaries, such as effective, spontaneous, jobsite communication and negotiating skills, are understandings that defy mastery without a motivated student involvement. It is that motivation as well as how it is to be achieved that we explore in this paper.

TSAT VLF and Electric Field Sensor on Boom System

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Abstract

The Earth's Electric Field (ThEEF) sensor will be included on the Taylor Satellite (TSAT) nanosatellite project. This instrument fulfills two roles, a Very Low Frequency (VLF) sensor and an Electric Field (E Field) sensor. The instrument will collect ground breaking data from the lower reaches of the atmosphere, roughly between 300 km and 100 km. This is a cross section of the Earth's atmosphere that is, surprisingly, not very well understood to date. While in orbit of the Earth, TSAT will obtain information about VLF wave propagation characteristics in the region, providing potential fresh insights into the Sun/Earth coupling-system. It will also measure the vertical voltage per meter, giving the vertical E Field of the Earth. The ThEEF sensor will be flown on a brand new boom system design. Unlike previous booms used by other institutions, this present design is electronically controlled and fully retractable. Additionally, the booms will provide an isolated collection surface for the VLF sensor while doubling as an aerodynamic stabilizer, much like the steadying effects that feathers have on an arrow in flight. The effectiveness and validity of the nanosatellite field will be validated by such design innovations. From an academic standpoint, due to the relatively low costs associated with such a design venture and the opportunity for flight made available by agencies such as NASA, this demonstration project could pave the way for underprivileged students to be given the opportunity for a meaningful hands-on engineering experience.

Convergence
Engineering and Business Education Enhancements

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Abstract

We define the Convergence academic process as developing curricula, forming industrial partnerships, and increasing faculty scholarship to educate engineering and business students who can identify, develop, and capitalize on high-potential business opportunities. This paper describes our plan to develop, implement, and measure our convergence educational model. First, the definition, vision, and mission of convergence will be introduced. Second, the product (our planned convergence curricula) will be described. Next, our strategy map and associated metrics for success will be presented.

Convergence education will require changes, not just in curricula but in the culture of how business and engineering students and faculty learn and interact. It goes beyond the classes, it's the experience, interaction, and the environment we are establishing.

From the Foster College point of view, the goal is to weave into a solid business education the experience and understanding of technology-based businesses that will launch our graduates on a trajectory of business growth and development, entrepreneurship, and leadership. Through convergence our business students, they will gain the knowledge, experience, and skills to:

• Identify, evaluate, and capitalize on high-potential business opportunities, particularly ones based on new technologies.
• Integrate the functional areas of business to effectively plan for the growth and development of technology-based businesses.
• Effectively communicate and work efficiently in teams with technical professionals to produce marketable results.
• Develop business models and plans for new businesses, the development and expansion of current businesses, commercialization and technology transfer.
• Work successfully with the technical side of the product planning and development cycle.

From the Caterpillar College point of view, the goal is to weave into a solid engineering education the professional business skills and experiences that will firmly set our graduates on a

path to industrial leadership positions. Through convergence, we will equip our engineering students with the knowledge, experience, and skills to:

- Identify and capitalize on high-potential business opportunities.
- Effectively communicate, work efficiently in teams to produce marketable results, and develop rapport with business professionals.
- Understand the drivers of business success (i.e., profitability).
- Continuously learn and evaluate new technologies.
- Have the confidence gained through real-world experience to succeed in today's global and fast-paced business environment.

Introducing Design of Experiments in a Civil Engineering Junior Level Laboratory Course

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The Accreditation Board for Engineering and Technology (ABET) - Engineering Accreditation Commission (EAC) has established eleven (a through k) student outcomes for assessment under Criterion 3. Many engineering programs have chosen to express their Student Outcomes differently than the (a) through (k) listed in the EAC Criterion 3: Student Outcomes. The University of Evansville's Civil Engineering program outcome b states that Students will design and conduct laboratory experiments as well as analyze and interpret data which is similar to the EAC-ABET outcome b (An Ability to design and conduct experiments, as well as analyze and interpret data).

In the junior civil engineering soil mechanics lab, the students conduct various soil tests and prepare laboratory reports throughout the semester. Before the experiments are conducted in the laboratory, the test procedures are explained in the classroom and with the help of the instruction and data sheet provided by the instructor the students conduct various soil testing. In order to accurately assess the ability to 'design experiments' component in the ABET criteria, two laboratory experiments were assigned in spring 2011 and 2012 as the "design of experiments" lab wherein the student teams had to design the entire experiment based on the existing test standards and specifications before the testing began. When the laboratory report scores were analyzed in different aspects of the report such as the test procedure explanation, presentation of test results, interpretation of results, conclusion and recommendation, the students performed very well in these two 'design of experiments' lab. The two year results were analyzed, and it was found that the scores improved by a letter grade (approximately 10%) in each category when compared with other regular experiments. This activity not only helped to fulfill the AB

The Development of a Radio Frequency Identification based Interactive Academic Advising System

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Abstract The advising process is a key ingredient in the success of engineering education and it is sincerely reviewed during the ABET accreditation visit. However, most universities do not have a system that prevents students from taking courses without having taken prerequisite courses. Consequently, most engineering programs are relying on the advising process to manually review students' audit systems in order to ensure that engineering students take courses in the correct sequence and gain the ultimate engineering education planned through each curriculum. This paper attempts to demonstrate how a Radio Frequency Identification based Interactive Academic Advising System (RFID-based IAAS) is developed and implemented to provide a robust system for the engineering advising process in an engineering program. This RFID-based IAAS system has provided the capability to retrieve each student's records in a real-time fashion when one student walks into the advisor's office. Then, the student's coursework, which is based on the ABET course map, appears on the computer screen automatically to facilitate the discussion between the faculty member and the student. This system allows faculty to select courses in the future semesters for students. Finally, two copies of the result are printed and signed by both parties. The developed RFID-based IAAS system has been implemented and resulted in time savings and a reduction of advising training due to its user-friendly process. The implementation outcomes, the real time displaying and the systematic process of such a development will be demonstrated at the conference and presented in this paper.

Thermal and Ultraviolet Modeling, Balancing, and Sensing

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ABSTRACT

A modeling system and a set of sensor arrays is proposed for demonstrating the thermal behaviors of a nanosat in extremely low earth orbit (ELEO). The Thermal and Ultraviolet Modeling, Balancing, and Sensing project (ThUMBS) is the proposed system, with the primary goal of ensuring the safe operating temperature of the second generation Taylor Satellite (TSAT 2) -unit CubeSat in ELEO for the sake of failure mitigation. A secondary goal consists of observing the behavior and influences of this temperature for use and analysis in future studies. ThUMBS is comprised of a modeling subsystem to ensure a 220K - 320K target operating range, a thermal sensor array with 0.5K resolution, and a UV sensor array capable of monitoring incoming radiation from A, B, and C-bands of UV. Tertiary goals include passive observation with the UV arrays of phenomena such as lightning strikes and solar flares. A summary of the system level overview of the proposed ThUMBS project is outlined in this paper, and an educational focus on documentation of deliverables and assumptions, as well as the process of optimization to meet project goals is discussed. Implementation of such a regimented documentation-protocol coupled with the software modeling used throughout is believed to be of benefit to enhancing student learning and their overall appreciation of the technological advancements made in the applied sciences.

TSAT Solid State Detector and Plasma Probe Particle Detectors

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Along with its other sensors, the Taylor Satellite (TSAT) will house solid state detectors and a plasma probe. Each of these instruments takes in-situ measurements. Both the solid state detectors and the plasma probe provide location specific data throughout the orbital lifetime of the satellite. As an outgrowth of the Senior Capstone class, student work for the solid state detector includes prototyping the front end circuit and setting up 16 processor counters to track the number of particles detected. Major features of the plasma probe involve its adaptation to use 5V power instead of 9V and matched transistors in an amplifier feedback loop to create a logarithmic scale. Both the solid state detectors and the plasma probe will share a PIC18F2620 microcontroller. The microcontroller will collect count data, control a voltage sweep, and read temperatures at the transistor junction. This microcontroller communicates serially with the instrument processor board. Developing the solid state detectors and plasma probe systems serves the dual purpose of furthering satellite research and education. Working with a diverse team on a project with real costs, deadlines, requirements, and a real launch with NASA is an invaluable experience. The opportunity to work with the particle detectors has especially given the students a unique exposure to the challenges facing circuit and processor algorithm design.

TSAT Student Flight Processor and Ground Support Equipment

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The Taylor Satellite (TSAT) will utilize a student flight processor for on-board data acquisition and transmission. The data will be packaged in an array, which will then be sent to the main flight processor, and then sent to the ground support equipment. Two student processors will be flown. The PIC18F2620 is a familiar processor used in multiple Taylor University balloon and satellite projects. The cutting-edge Actel Fusion Field-Programmable Gate Array (FPGA) is a brand new chip featuring low power and robust computing capabilities. Although the Actel Fusion is flight-certified, it has never been flown in space. The TSAT project will be the first satellite to fly the Fusion, which will be flown in conjunction with the 18F2620. The main data sets will be secured through the 18F2620, while the FPGA will receive paralleled analog data to test and check the flight-readiness of the new Fusion chip. The design and implementation of the Ground Support Equipment (GSE) software will receive/retrieve data from various student and faculty developed sensors that will be on board the TSAT cube satellite and store/display the data. The innovative part of the GSE is the ability to utilize the Iridium network of satellites during the inflight stage of TSAT for all the data acquisition. The Iridium satellite constellation is a large group of satellites providing voice and data coverage to satellite phones, pagers and integrated transceivers over Earth's entire surface. This subsystem also involves building GSE hardware to control the power supplied to the sensor and microcontroller during the testing phase of development. The 34972A LXI Data Acquisition / Data Logger Switch Unit will be the driving instrument for this part of the GSE. The hardware system will also capture important data from each sensor such as a voltage and current draw as well as the current draw from the entire student bay. Together the student flight processor and GSE will manage data acquisition, telemetry, and manipulation in order to accomplish TSAT's mission. Developing the student embedded processor and ground support equipment serves the dual purpose of furthering satellite research and educational learning objectives. Working with a diverse team on a project with real costs, deadlines, requirements, and a real launch with NASA is an invaluable experience to students on the present research mission, and to future students of related learning endeavors.

The Use of Undergraduates as Research Assistants

By Carmine Polito[1]

Doing journal-quality engineering research at an undergraduate-only university presents a unique set of challenges and benefits, many of which are not experienced at Research 1 institutions. Over the last six years, the author has had a number of undergraduate students who have performed research with him, most of whom later earned graduate degrees.

There are several advantages to using undergraduate students as research assistants, such as one-on-one mentoring and getting to teach about a topic that the faculty member is passionate about, and potentially certain financial benefits. Similarly, there can be drawbacks such as the time commitment necessary for training the students and the typically lower production rates they exhibit.

This paper will examine the pros and cons of using undergraduate students as research assistants. Additionally, the typical problems associated with this situation and ways of minimizing the difficulties and maximizing the experience for both the student and the faculty member will be discussed.

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Analysis of a Worker Assignment Model in a Lean Manufacturing Environment

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Abstract

This paper describes an expansion of a multi-period worker assignment model for a lean production cell that produces a single product family. The hypothetical cell operates eight hours per day, twenty days per month and has six workers performing ten tasks. The model assigns the workers to tasks and determines the levels of additional training that may be necessary to meet customer demand, quality requirements, and cross-training provisions. The two main factors analyzed are the number of workers trained beyond two tasks and frequency of job rotation. Four levels of workers trained and three levels of job rotation frequency are evaluated. The four levels of worker training are zero, two, four, and six workers trained on more than two tasks (the minimum number of tasks learned in order to be considered cross-trained). The three levels of job rotation are eight, four, and two hour rotations per day. The solutions from the model are analyzed to determine the impact the two factors have on net present costs, quality costs, and training within the work month. The model expands upon the research of McDonald *et. al.,* [1] by allowing workers to be trained more than a single skill level on tasks during the 20-day planning period and removing the budgetary constraints for training. The results of this model are expected to provide insight on the impact worker training and job rotation frequencies have on production line performance and provide guidance on training policies.

A result of two accrediting agencies: Integrating machine burden and customer demand analysis into group technology

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Abstract

This paper is evidence of how solving the problem of two accrediting agencies, at odds with each other, can force engineers to find the diamond in the rough. The research on this paper was fully done by Ms. Liang due to the various pressures of course adjustment. The full paper will be submitted to an appropriate journal.

Group Technology is widely applied in industry. However, this method has more complicated steps when it comes to large scale product and machine problems. This study illustrated a simple and new way that implements a VBA program to Group Technology in large scale industrial problems. In this new methodology, parts were grouped based on processes similarity. This study makes the processes similarity flexible so that every company can decide and manage their own processes similarity. After gaining group families, we compared families' cycle time and customer demand (Takt time) to test if the production schedule is able to meet customer demand under current group. Machine burden analysis was performed in this research.

Keywords: Group Technology, VBA, Takt time, Machine burden analysis

The Future of Energy:
Analyzing the Topography of Solar Cells

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Efficiency is a major focus of solar cell research. Previous research has been conducted showing a connection between the topography of a solar cell and its efficiency using atomic force microscopy (AFM).[1] Researchers have investigated the effects different production processes have on efficiency as well as the efficiency involving different solutions of donor and acceptor layers of one type of solar panel.[2] This paper focuses on the use of AFM to characterize the topography of both crystalline and organic solar cells. A connection between a solar cell's surface area and efficiency is investigated.

IDENTIFYING REFLECTIVE PRACTICE IN ONE ENGINEERING DESIGN MEETING.

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Introduction

Conceiving design as a reflective practice, a concept proposed by Schön (1999), is one of many possible ways that we have to understand design. Besides, reflective practice have been presented as one of the key differences that separate the novices from designers with higher expertise. We were wondering how we could determine if engineers, in a design meeting, were showing reflective practice. An analysis of qualitative data (audio transcripts and sketches from an engineering design meeting) was proposed trying to answer this question. The present work presents the first attempt to understand reflective practice defining the categories related to reflective practice.

Research questions

We will analyze the transcript from a meeting that was hold by engineers. In the meeting they were designing. We will try to answer the following question: How these engineers reflect while designing?

SIMULATION FOR TEACHING ORGANIZATIONAL CULTURE

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Abstract: Organizational culture is widely recognized as a significant factor influencing organizational success. A simulation was developed for a high-tech client to direct change in their culture. Simulation content was captured in ethnographic interviews with employees and included cultural ideals. Significant employee attitude change was measured. Teaching students about organizational culture is difficult because much cultural knowledge is tacit. This simulation is now used in an MBA class "Leadership and Organizational Culture" and offers valuable experience. The client had a high-commitment culture that contributed to success and contains constructs and practices that many organizations may wish to adopt.

An Evaluation of the Critical Engineering Literacy Test Instrument through Item Analysis and Comparison to the Critical Assessment Test

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Abstract

This paper reports reliability and validity measures for a two-tiered multiple choice instrument developed by the authors to assess information literacy skills in an engineering context. Classical test theory was used to describe item difficulty and item discrimination. Internal reliability was determined using the Kuder-Richardson *KR*-20. Content validity was assessed with a correlational analysis that explored the relationships between the CELT instrument and the validated Critical Assessment Test (CAT). This study was conducted in three first year courses ($N = 188$) in the Fall 2012 semester at Purdue University: engineering ($N = 72$), aviation technology ($N = 91$) and nursing ($N = 25$). Preliminary results indicate that overall, the CELT instrument has *KR*-20 of 0.67. Individual item analysis shows that 12 of the 18 items have sufficient item discrimination with discrimination scores greater than 0.15. In addition, for a sub-set of the population who took both the CELT and CAT instruments, there was a moderately strong association between the total scores ($r = 0.45$, $p < 0.05$, $N = 44$). The preliminary results indicate the CELT has good internal reliability for a multiple-choice instrument and appropriate levels of item difficulty. However, item discrimination results indicate that some individual items still need revision.

STEM Thinking in Informal Environments: Integration and Recommendations for Formal Settings

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Abstract

Learning in informal environments often takes the shape of authentic learning experiences that lend themselves to integrated perspectives. In addition, learning in informal environments typically does not silo understanding into distinct disciplines as often encountered in formal education. As engineering education researchers begin conducting research on learning in informal environments, understanding how engineering thinking occurs in informal environments can inform meaningful learning experiences in both informal and formal settings. Furthermore, learning in informal environments can be viewed as low-risk venues for educational experimentation that may inform STEM (science, technology, engineering, and mathematics) integration designed for formal learning environments. Identifying boundaries that separate science thinking, technology thinking, engineering thinking, and mathematical thinking in informal environments can be difficult since significant overlap exists in the various learning spaces. Instead of trying to dissect these boundaries, it may be useful to identify examples of each and understand how these seemingly independent ways of thinking can be integrated in a holistic concept of STEM thinking in informal settings. This paper will provide a synthesis of previous research focused on learning in informal environments with concrete examples of activities that can foster STEM thinking and recommendations for integrating aspects of STEM thinking.

Towards Evaluating the Content, Assessment, and Pedagogy in Instructional Laboratories

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Abstract

This paper presents a rubric to assess the educational design of instructional laboratory courses in engineering. This rubric can be used as a tool for researchers investigating engineering laboratories as well as by instructors evaluating and improving their own courses. The rubric is based on a rigorous course design framework. It evaluates the content of the course based on centrality to the discipline, challenge to students, and clarity of learning objectives. Assessment is evaluated based on variety of assessment types and purposes and justification of their use. Pedagogy is evaluated based on use and justification of canonical educational principles. Further, the rubric explores the alignment between content, assessment, and pedagogy. In order to develop and assess the usefulness of the rubric, we used it to evaluate the course design of published reports of engineering laboratories. In general, the courses described presented strong pedagogical techniques and demonstrated strong alignment between pedagogy and content, but weak alignment between content and assessment. We also found that while the rubric could be used to evaluate courses based on their reports in conference and journal papers, additional forms of data such as syllabi or course observations might have been applicable as well.

Updating the Leadership and Team Ideas We Present To Students

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Updating the Leadership and Team Ideas We Present To Students

Engineering students often say that they don't want to be a leader, but they do want to increase their leadership skills (*Goodman & Wolf, 2012*). Employers and funding agencies say technical competencies will get new engineers in the door, but team development and leadership will help them thrive when they work collaboratively within the organization's walls. Even our accrediting agencies say that the programs must prepare graduates to apply knowledge integrating these human behavioral areas with the problems or projects we specify, design or implement. Students must know *how* to choose and use individuals, groups or teams of people to complete the work of designing, verifying, implementing, applying and maintaining systems or products. As educators, we have said that we are building our students' capacity in these areas, but our teamwork and leadership vocabulary is generally underdeveloped and our teaching strategies are also behind what leadership and team researchers currently know. We understand that ideas about communication, conflict and goals are important to collaborations, but teach these concepts as we did in many years ago.