Conference Program
Book of Abstracts

American Society for Engineering Education
Southeastern Section
Annual Conference and Meeting

April 2 – 4, 2006

"Best Practices in Engineering Education"

Hosted by

The University of Alabama

College of Engineering

Tuscaloosa, AL

THE UNIVERSITY OF ALABAMA ENGINEERING

College of ENGINEERING

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Program Editor: Michael Woo
The Citadel

Proceedings Editor: Barbara Bernal Thomas
Southern Polytechnic State University

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Conference Overview

Sunday April 2nd

Noon – 6:00pm	Conference Registration	Four Points Sheraton Lobby
1:00pm – 5:00pm	Workshop 2	University of Alabama Classroom – 251 Hardaway
1:00pm – 3:00pm	Workshop 3	University of Alabama Classroom – 252 Hardaway
3:00pm – 6:00pm	Workshop 4	University of Alabama Classroom – 286 Hardaway
6:00pm – 8:00pm	Welcome Reception	Four Points Sheraton

Monday April 3rd

7:00am – noon	Conference Registration	Bryant Conference Center
1:30pm – 4:00pm	Conference Registration	Bryant Conference Center
7:30am – 8:30am	Breakfast and Unit Meetings	Four Points Sheraton
8:50am – 10:10am	Plenary Session: Keynote Speaker	Bryant Conference Center
10:15am – 11:55am	Technical Session 1	Bryant Conference Center
12:10pm – 1:20pm	Conference Lunch: Award Speaker	Four Points Sheraton
1:40pm – 3:20pm	Technical Session 2	Bryant Conference Center
4:00pm – 5:40pm	Technical Session 3	Bryant Conference Center
6:30pm – 9:00pm	Reception and Awards Banquet	Four Points Sheraton Ballroom

Tuesday April 4th

7:30am – 8:30am	Breakfast and Division Meetings	Four Points Sheraton
8:50am – 10:10am	Technical Session 4	Bryant Conference Center
10:30am – 11:50pm	Technical Session 5	Bryant Conference Center
12:10pm – 1:30pm	Conference Lunch: Section Meeting	Four Points Sheraton
1:30pm	Conference Adjourned	

ASEE SE 2006 Conference Proceedings

The ASEE SE 2006 Conference Proceedings are provided in CD format to all full paying registrants and all program Deans of the Southeastern Section. To obtain additional copies of the CD version of the Proceedings, please contact

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Conference Welcome…..

ASEE SE President – Laura Lackey

Welcome to the 2006 ASEE Southeastern Section Meeting. This year's conference theme is centered on Best Practices in Engineering Education. I foresee both the workshops and technical sessions to provide an excellent platform for information sharing and for building collaborative relationships with likeminded individuals. In advance, I thank you all for making this sectional meeting an exciting and rewarding experience.

Many thanks to the Site Committee at the University of Alabama for hosting this meeting. I look forward to exploring and enjoying the campus, the Bryant Conference Center, named for the legendary Crimson Tide football coach Paul "Bear" Bryant and the associated Bryant Museum. I also want to thank the various section officers that have worked to coordinate the technical program, peer-reviewed manuscripts, coordinated workshops, organized the student poster session, prepared the CD-ROM containing conference manuscripts, etc. Obviously, the list of individuals within the section that volunteered their time and talents to make the conference a success was extensive and I appreciate all your efforts!

Your participation in this conference is appreciated and I anticipate that this meeting will provide a time for sharing and learning about the Best Practices in Engineering Education. Enjoy your time in Tuscaloosa.

Laura Lackey, Ph.D.
Mercer University
ASEE SE President

2006 ASEE SE Conference Site Chair – Joey Parker

On behalf of The University of Alabama and the Dean of the College of Engineering I am pleased to welcome you to Tuscaloosa and the 2006 ASEE Southeast Section Annual Conference. I hope that when you are in Tuscaloosa that you have time to visit some of our attractions, including the Alabama Museum of Natural History, Jemison-Van de Graaff Mansion, Paul W. Bryant Museum, Renaissance Art Gallery, and the Westervelt Warner Museum of Young America.

This year we an honored guest as our plenary/keynote speaker. Retired U.S. Navy Admiral David J. Nash of BE&K will discuss his involvement with the reconstruction efforts in Iraq.

I would like to thank Tory Shumpert, Donna Keene, and Brandie Nabors of our College of Continuing Studies for their help in organizing the facilities. Special thanks also goes to Teresa Caffee of the Four Points Capstone for her assistance with the fine meals we will have during the conference. Both Beth Todd and Jim Richardson of the College of Engineering have also been helpful with planning and arrangements.

I hope all of you enjoy your stay here in Tuscaloosa and enjoy our southern hospitality

Joey K. Parker, Ph.D., P.E.
The University of Alabama
ASEE-SE Conference Site-Chair

Conference Parking and Transportation

The 2006 ASEE-SE Conference is being held at the Bryant Conference Center on The University of Alabama campus. The conference hotel, Four Points Sheraton Capstone, is immediately adjacent to the Bryant Conference Center. The Sunday night reception and all meals will be held in the Four Points Sheraton Capstone. All technical sessions on Monday and Tuesday and the plenary session on Monday will be held in the Bryant Conference Center. The conference workshops held on Sunday will be conducted on The University of Alabama campus, which is a short walk or drive from the Bryant Conference Center and Four Points Sheraton Capstone facilities. A map to the campus facilities will be provided to all workshop attendees at registration.

Parking at the Hotel

Parking at the Four Points Sheraton Capstone is free to paying guests.

Parking at the Bryant Conference Center

All other visitors should park in the Second Avenue parking lot on the east side of the Bryant Conference Center in front of the Moody Music Building.

Campus Parking

Parking on the UA campus is free on the Sunday of the conference <u>only</u>. The workshops will be held in Hardaway Hall, which is on Seventh Avenue across from the Ferguson Student Center.

If you want to visit the UA campus on Monday or Tuesday, there are two public parking decks that can be used by campus visitors. These parking decks are free to enter, but cost $3 to exit. One is on the northwestern corner of Campus Drive and McCorvey Drive near the Ferguson Student Center. The other is on the southeastern corner of Campus Drive and Devotie Drive across from the new Shelby Hall and behind the Rogers Science and Engineering Library.

Conference Meals and Social Events

Welcome Reception: *Sunday April 2nd (6:00pm – 8:00pm)*

Four Points Sheraton

Unit Meetings Breakfast: *Monday April 3rd (7:30am – 8:30am)*

Four Points Sheraton

A full breakfast buffet will be served starting at 7:00. Join the Conference attendees for the Unit meetings. Sit down at one of the Unit table clusters and meet colleagues with interests in the following ASEE SE areas:

- Programs
- Publications and Promotions
- Awards and Recognition

There are many ways to be involved and contribute to ASEE SE!

Thomas Evans Award Luncheon: *Monday April 3rd (12:10pm – 1:20pm)*

Four Points Sheraton

The focus of the Monday lunch event is the presentation of the Thomas Evans Outstanding Instructional Paper.

Awards Banquet: *Monday April 3rd (6:30pm - 9:00pm)*

Four Points Sheraton Ballroom

This is a night to celebrate engineering education and the role of ASEE SE and its members. We will congratulate many for outstanding contributions to the field of engineering and engineering technology and celebrate formally, for the second time at an ASEE SE event, the accomplishments of our undergraduate students. Entertainment to be provided by the Alabama Girl's Choir.

Division Meetings Breakfast: *Tuesday April 4th (7:30am – 8:30am)*

Four Points Sheraton

Select your breakfast then join the Conference attendees for the Division meetings. Sit down at one of the Division table clusters and meet colleagues working in the following disciplines and interest areas:

- Bioengineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering and Technology
- Electrical Engineering
- Engineering Design Graphics
- Engineering Technology
- Industrial Engineering
- Mechanical Engineering
- Software Engineering
- Administration
- Instructional
- Research

Section Business Meeting Lunch: *Tuesday April 4th (12:10pm – 1:30pm)*

Four Points Sheraton

Please come to the ASEE SE Business Meeting to meet your present Section officers and vote for your Section officers for the upcoming year. We will also recap the events of the Conferences and officially announce the location for the 2007 Conference.

Conference Workshops

The ASEE SE 2005 Conference offers 3 workshops on Sunday (April 3rd) afternoon.

Workshop 2: 1:00 – 5:00 PM

Effective Use of Internet Resources for Teaching, Learning and Research

Fred O'Bryant, Librarian for Applied Sciences, The University of Virginia

This workshop seeks to examine a variety of information resources, both fee-based and freely available, that are essential to engineers and that typically are presented to users via the Internet. The resources covered comprise a fundamental suite of tools that every engineer and engineering student should be familiar with. These include journal article databases (and their alternatives), web search engines, book catalogs and online texts, online reference sources, current awareness tools, open-access journals, technical reports, government resources, standards, patents, sources of ethics information, online demonstrations, professional society resources, and military information. The workshop will highlight salient features of these tools and focus on how to use them effectively for teaching and research. The workshop will also show how to incorporate these resources into powerful, class-specific teaching and learning tools that complement lectures and assignments, help students produce better papers and projects, and prepare them to be effective, life-long information literate engineers.

Workshop 3: 1:00 – 3:00 PM

Experiential Learning Activities for Engineering Education

Jessica O. Matson and Kenneth W. Hunter, Sr., Tennessee Technological University

Experiential learning activities provide an innovative method for presenting engineering concepts in a way that more closely models real world problem complexity. Such activities support the concept of active learning and have proven to be especially effective for developing teamwork and leadership skills. This hands-on workshop will take participants through a series of experiential exercises to demonstrate the types of activities available, the variety of engineering topics that can be addressed, framing options, and facilitation techniques. Reference materials and example activities complete with scenario scripts and facilitation guides will be provided. Participants should wear comfortable clothing.

Workshop 4: 3:00 – 6:00 PM

Illustrating Design Using K'NEX

Paul J. Palazolo, Charles V. Camp, and Stephanie S. Ivey, The University of Memphis

The three presenters have been involved in a wide range of teaching activities using the K'NEX building system to illustrate engineering design concepts. These have ranges from structural analysis to mechanical systems to transportation and logistics problems. The simplicity of the K'NEX system allows for a wide range of skills to be demonstrated without requiring a high level of craftsmanship. K'NEX have been used to replace the traditional balsa bridge as well as mouse trap cars in the development where design was the emphasis. Participants will be shown examples of design situations where K'NEX have been used as the manipulative. Design problems framed with the emphasis of alternative analysis and performance will be illustrated using K'NEX. Participants will be broken into teams and will participate in design competitions using a variety of different types of commercially available K'NEX sets. An open discussion of the benefits and limitations of using the K'NEX will be made after the design competition.

Conference Keynote Speaker – David J. Nash

David J. Nash, Rear Admiral, U.S. Navy (Retired), has recently joined BE&K, a 33-year-old international engineering and construction company, as president of its newly formed Government Group.

Prior to joining BE&K, Rear Admiral David J. Nash was the director of the Iraq Program Management Office (PMO). Under his direction, the PMO managed the $18.4 billion provided by the U.S. to support the reconstruction of Iraqi infrastructure.

Rear Adm. Nash has 38 years of experience in building, design and program management in both the U.S. Navy and the private sector. His naval service included many leadership roles, including the dual position of Commander Naval Facilities Engineering Command and Chief of Civil Engineers. In that capacity he led a 20,000-person organization responsible for design, construction, facilities maintenance support, real estate, housing management, utilities procurement, environmental services, transportation equipment and support of the Navy's 2,000 military engineers.

Rear Adm. Nash also served as Commander, Pacific Division Naval Facilities Command, responsible for the entirety of the Pacific Command area, a region covering half the globe. He also commanded the Naval Construction Battalion Center in Port Hueneme, California, where he was responsible for the operation and maintenance of a 1,600-acre logistics base providing support for more than 11,000 military and civilian personnel working or living on the base.

Upon retiring from the Navy, Rear Adm. Nash began a long career with Parsons Brinkerhoff Construction Services. He first served as Program Director with the General Motors Corporation at the Warren Technical Center Campus in Warren, MI. He oversaw the complete renovation of the 2.2 million gross square feet Vehicle Engineering Center and rehabilitation of the 1 million gross square feet Powertrain Facility.

Rear Adm. Nash next served as Director for the Automotive/Industrial Division. He established a buildings business for Parsons Brinckerhoff in the private sector to include Life Cycle facilities services for clients in the industrial, commercial and institutional sectors.

In 2002, Rear Adm. Nash served as President for PB Buildings, a company offering program management, design, construction and operations and maintenance services for private sector facilities, such as office and commercial buildings, hotels, and industrial and manufacturing plants.

Rear Adm. Nash left Parsons Brinckerhoff in July 2003 to accept the position of Vice President for Government Operations with BE&K Construction/Engineering to develop the BE&K businesses for the public sector. However, BE&K allowed him to take a leave of absence from the company to begin work for the Program Management Office.

Conference Technical Sessions

Session and Presentation Timing

Technical sessions are either 80 or 100 minutes long.

80 minute paper sessions consist of 4 presentations. Introductions and instructions are allotted for the first 4 minutes of the session. Each paper is allotted 15 minutes for the presentation and 3 minutes for questions. All papers will start in 19 minute increments.

100 minute paper sessions consist of 5 presentations. Introductions and instructions are allotted for the first 5 minutes of the session. Each paper is allotted 15 minutes for the presentation and 3 minutes for questions. All papers will start in 19 minute increments.

If there is a no-show author in a session, a break will be called. **Papers will not be moved up or rearranged in sessions**.

Technology Available to Presenters

Each presentation room is equipped with a projector, laptop computer with USB, CD, and diskette drives, and wireless internet connection. Software common to each presentation room is the basic Microsoft Office package that includes Microsoft PowerPoint. If you are using other software, it is best to bring your own laptop.

Instructions for Technical Session Moderator Chairs

Be prepared to moderate the session.
Arrive 5 to 10 minutes early to the room where the session you are moderating is being held. Meet the presenters as they enter the room. Have each presenter load their presentation onto the computer desktop if not using their own Laptop. Bring a watch. Read through the bios in the session folder.

Provide presentation guidelines at the beginning of the session.
Introduce your self. Remind presenters of the time limitations (15 minutes for presentation, 3 minutes for questions). Inform the presenters that you are there to maintain the session schedule.

Introduce each presenter or presenters prior to their presentation.
Ask the presenter how they would like to be informed of the remaining time; do they want a warning with 5 minutes, 2 minutes, etc. remaining.

Maintain the presentation schedule
One primary responsibility of the moderator is to ensure that the presenters begin and finish their presentations on time according to the technical program. Maintaining the presentation schedule within the session allocated time helps to fair treatment for all presenters. In the event that a presenter, who is not last in the hour, is not present or has cancelled, please wait to begin the next paper until the scheduled time, so that all who planned to attend the remaining paper(s) can.

The moderator has the authority to stop a presentation that is about to run overtime.
NEVER let a presentation and Q&A overrun the 18 minutes.

Conference Special Session

The 2006 ASEE SE Conference is offering the second annual Student Poster Competition, immediately after the Monday morning plenary/keynote address.

Conference Student Poster Competition

The Student Poster Competition, a new ASEE SE offering sponsored by the Research Division, is being held Monday, April 3rd. The posters will be located in the Birmingham/Central room of the Bryant Conference Center. Students may set up their posters following the Plenary Session. Awards and certificates will be presented during the Monday evening awards banquet to the best individual project in the Undergraduate Research category and to the best design team projects in the following categories:

- Freshman/Sophomore Engineering and Engineering Technology Design Teams
- Junior/Senior Engineering and Engineering Technology Design Teams
- Cross-Disciplinary Engineering and Engineering Technology Design Teams
- Cross-Level Engineering and Engineering Technology Design Teams

The Student Poster Competition gives undergraduate students the opportunity to (1) share their research/project work with students and faculty from other institutions and (2) practice their visual, written, and oral communication skills in a professional/conference environment. The goals of the competition are to (1) improve the visibility of student efforts, (2) recognize excellence in student projects, and (3) promote the sharing and exchange of ideas about team projects and undergraduate research among the members in the Section.

Poster Specifications

Posters shall be set on one half of an 8-foot table. Posters shall be of standard student presentation quality (typically made of corrugated cardboard), and shall stand on their own when opened. Participants may use tape, glue, or pushpins to make attachments to the poster. Special, professionally fabricated presentation displays will NOT be allowed. All supporting display material shall fit on the table with the poster in the space provided. Electrical power will not be supplied.

ASEE SE 2006 Annual Conference Schedule

Sunday April 2nd 2006

	UA Campus - 251 Hardaway Hall	UA Campus - 252 Hardaway Hall	UA Campus - 286 Hardaway Hall	Four Points Sheraton Lobby
	Workshop 2 1:00-5:00 pm	**Workshop 3 1:00-3:00 pm**	**Workshop 4 3:00-6:00 pm**	
1:00-3:00 pm	Effective Use of Internet Resources for Teaching, Learning, and Research	Experiential Learning Activities for Engineering Education		Conference Registration and Check-in
3:00-5:00 pm			Illustrating Design Using K'NEX	
5:00-6:00 pm				
6:00-8:00 pm	Welcome Reception – Four Points Sheraton			

ASEE SE 2006 Annual Conference Schedule

Monday April 3rd 2006

	Lackey Room	Mason Room	Wilson Room	Mobile Room	Birmingham Room
7:30-8:30 am	Breakfast and Division/Unit Meetings - Four Points Sheraton				
8:30-8:50 am					
8:50-9:35 am	Welcome and Keynote Address				
9:40-10:00 am	Plenary Session				
10:00-10:15 am					**Student Poster Session**
10:15-11:55 am Technical Session 1	T1-A	T1-B	T1-C	T1-D	
	Instructional Unit	**Engineering Technology**	**Mechanical Engineering**	**Chemical Engineering**	
	2006040LAC 2006001BAT 2006038KRA 2006039GIL	2006019BAL 2006021ZHO 2006082WOO 2006037AHU	2006059HOD 2006083NAU 2006035BAK 2006052SCH 2006005JEN	2006043ARC 2006030VIS 2006017SUB 2006065MIN	
11:55-12:10 pm					
12:10-1:20 pm	Conference Luncheon: Thomas Evans Outstanding Instructional Paper				
1:20-1:40 pm					
1:40-3:20 pm Technical Session 2	T2-A	T2-B	T2-C	T2-D	**Student Poster Session**
	Instructional Unit	**Chemical Engineering**	**Computer Engineering &Technology**	**Instructional Unit**	
	2006051LIP 2006041WAL 2006042ARC 2006047BRA	2006029VIS 2006016SUB 2006048BRA	2006033JOH 2006045SHE 2006091HAL 2006066GUZ	2006071PLE 2006067BOY 2006068WEL 2006069CUR	
3:20-4:00 pm					
4:00-5:40 pm Technical Session 3	T3-A	T3-B	T3-C	T3-D	T3-E
	Instructional Unit	**Civil Engineering**	**Mechanical Engineering**	**Software & Industrial Engineering**	**Electrical Engineering**
	2006089BRO 2006044SHA 2006094HAR 2006020HAN	2006098BRA 2006015CAM 2006006DIO 2006008ELA 2006097SUL	2006095JEN 2006023NAI 2006086LEN 2006072MCC	2006034WIG 2006096SUL 2006004SCH 2006060SMY	2006090MCK 2006024SCO 2006074EFF
6:30-9:00 pm	Reception and Awards Banquet - Four Points Sheraton Ballroom				

ASEE SE 2006 Annual Conference Schedule

Tuesday April 4th 2006

	Lackey Room	**Mason Room**	**Wilson Room**	**Mobile Room**
7:30-8:30 am	Breakfast and Division/Unit Meetings - Four Points Sheraton			
8:30-8:50 am				
8:50-10:10 am	T4-A	T4-B	T4-C	T4-D
Technical Session 4	**Instructional Unit**	**Engineering Technology**	**Administrative Unit**	**Engineering Design Graphics**
	2006002SNI 2006061MIN 2006062LAW 2006009SNI	2006022MCD 2006050FOR 2006077ASG	2006013GRE 2006032STE	2006046ABA 2006085RAD
10:10-10:30 am				
10:30-11:50 am	T5-A	T5-B	T5-C	
Technical Session 5	**Instructional Unit**	**Research**	**Mechanical Engineering**	
	2006049MCC 2006025WIL 2006063MCC	2006010LAB 2006075EFF 2006080SIL 2006011CRA	2006007YEH 2006028BAK 2006054PAR 2006092JET	
11:50-12:10 pm				
12:10-1:30 pm	Section Annual Business Luncheon - Four Points Sheraton			
1:30 pm	Conference Adjourn			

Monday April 3rd 2006 Technical Sessions

Technical Session 1: 10:15 – 11:55 am

T1-A: Instructional Unit — **Lackey**

Chair: Richard O. Mines, Mercer University

Engineering Student Self-assessment in a Capstone Design Course — 2006040LAC
Laura W. Lackey, Richard O. Mines, Jr. and Hodge E. Jenkins, Mercer University

Using Technological Disasters to Teach Engineering Ethics and Technology in Society — 2006001BAT
Robert G. Batson, University of Alabama

Unified Lecture Software for Mechanics of Deformable Bodies — 2006038KRA
Scott L. Hendricks, L. Glenn Kraige and Don H. Morris, Virginia Tech

A Model for Broadening Participation in Computing — 2006039GIL
Juan E. Gilbert, Auburn University

T1-B: Engineering Technology — **Mason**

Chair: Randy Buchanan, University of Southern Mississippi

Using Steam Engines to Teach Parametric Modeling and Prototyping — 2006019BAL
Aaron K. Ball, Chip W. Ferguson and William L. McDaniel, Western Carolina University

Electromagnetic Radiation and Scattering of Wire Structures — 2006021ZHO
Zhaoxian Zhou and Randy Buchanan, University of Southern Mississippi

Incorporating Civic Engagement — 2006082WOO
A. Mitchell Wood and B. Neil Whitten, East Tennessee State University

Math Remediation in A First Semester Engineering Technology Course — 2006037AHU
Sandeep Ahuja, Virginia State University

T1-C: Mechanical Engineering — **Wilson**

Chair: B. K. Hodge, Mississippi State University

Using Computational Software Root Solvers: A New Paradigm for Problem Solutions? — 2006059HOD
B. K. Hodge and Rogelio Luck, Mississippi State University

Senior Capstone Design Experiences at the University of Tennessee: NASA and DOE Student Programs — 2006083NAU
Viatcheslav I. Naumov, David K. Irick, Lawrence A. Taylor and Masood Parang, University of Tennessee

Near-Space and the BAMASAT Program — 2006035BAK
John Baker, Sadie Cole, Emad Abdel-Raouf and Bob Taylor, University of Alabama

	Integrating Materials Science into the Mechanical Engineering Curriculum Judy Schneider, Mississippi State University	2006052SCH
	Frame Analysis and Design Computer Classroom/Laboratory Module for Machine Design Hodge Jenkins, Mercer University	2006005JEN
T1-D:	**Chemical Engineering**	**Mobile**
Chair:	Donald P. Visco, Tennessee Technological University	
	The Experimental Prototype: Critical Thinking and Real-World Problem Solving in Engineering Education Pedro E. Arce, Joseph Biernacki and Perry Melton, Tennessee Tech University	2006043ARC
	A Freshman Course in Chemical Engineering Donald P. Visco, Jr. and Pedro E. Arce, Tennessee Technological University	2006030VIS
	Computer Facilitated Mathematical Methods in Engineering – Similarity Solution Venkat R. Subramanian, Tennessee Tech University	2006017SUB
	Applying Techniques Learned in an ASEE –SE Workshop: Adoption of a High Performance Learning Environment (Hi-PeLE) for Group Experiments Adrienne R. Minerick, Mississippi State University; Pedro Arce, Tennessee Technological University	2006065MIN

Technical Session 2: 1:40 – 3:20 pm

T2-A:	**Instructional Unit**	**Lackey**
Chair:	Ted J. Branoff, North Carolina State University	
	The Feasibility of Online Laboratories John W. Lipscomb, Jr., University of Southern Mississippi	2006051LIP
	Technology in the Throes of a Paradigm Shift B. Wayne Walters, University of Southern Mississippi	2006041WAL
	Forget about Teaching: It is all about Learning! Pedro E. Arce, Tennessee Tech University	2006042ARC
	Online Learning in Engineering Graphics Courses: Research, Tools, and Best Practices Ted J. Branoff and Richard A. Totten, North Carolina State University	2006047BRA

T2-B: Chemical Engineering **Mason**

Chair: Donald P. Visco, Tennessee Technological University

Using Graduate Students to Teach an Undergraduate Class 2006029VIS
Barath Baburao, Saravanan Swaminathan and Donald P. Visco Jr., Tennessee Technological University

Faculty Mentoring – a Protégé's Perspective 2006016SUB
Venkat R. Subramanian, Tennessee Tech University

Renovation and Upgrades of Chemical and Biological Engineering Unit Operations Lab to Teach Technical Skills in Emerging Engineering Fields 2006048BRA
Christopher S. Brazel, Peter E. Clark, Tonya M. Klein, Alan M. Lane and Stephen M.C. Ritchie; University of Alabama

T2-C: Computer Engineering and Technology **Wilson**

Chair: Gary Johnsey, University of Southern Mississippi

Adding Practice and Realism to Information Technology Courses 2006033JOH
Gary Johnsey, University of Southern Mississippi

Radio Frequency Identification (RFID) Applications in the Medical Field 2006045SHE
Shelton Houston and Wesley Blackwell, University of Southern Mississippi

Using FPGAs to Simulate and Implement Digital Design Systems in the Classroom 2006091HAL
Tyson S. Hall, Southern Adventist University; James O. Hamblen, Georgia Institute of Technology

Hands-On Operating Systems Made Easy 2006066GUZ
Juan Carlos Guzmán and Patrick O. Bobbie, Southern Polytechnic State University

T2-D: Instructional Unit **Mobile**

Chair: Keith Plemmons, The Citadel

Application of Pedagogy or Andragogy: Understanding the Differences between Student and Adult Learners 2006071PLE
Keith Plemmons, The Citadel

A Back to the Basics Approach to Teaching Engineering Ethics 2006067BOY
Michael D. Boyette, North Carolina State University

The Declining Work Ethic of the American Engineering Student 2006068WEL
S. Michael Wells, Tennessee Tech University

Positive Experience with Challenge-Based Instructional Modules across Engineering Disciplines 2006069CUR
Amy de Jongh Curry, J. Daniel Strahl, Deborah L. Lowther and Eugene Eckstein, The University of Memphis

Technical Session 3: 4:00 – 5:40 pm

T3-A:	**Instructional Unit**	**Lackey**
Chair:	Eugene F. Brown, Virginia Tech	
	Learning by Doing—Hands-On Experiments for a Middle-School Outreach Program Eugene F. Brown, Virginia Tech; Robert A. Kavetsky, Office of Naval Research; Robert L. Stiegler, Naval Surface Weapons Center, Dahlgren Division (NSWCDD); Juanita Jo Matkins, College of William and Mary; Gail B. Harding, College of William and Mary; Andrea L. Bengier, Stafford County Public Schools; Ray Gamache, Naval Surface Weapons Center, Dahlgren Division (NSWCDD); Jason Kremar, Naval Surface Weapons Center, Dahlgren Division (NSWCDD)	2006089BRO
	Preparing Engineers for the Job Search Through Mock Telephone Interviews with Alumni Julie E. Sharp, Vanderbilt University	2006044SHA
	An Online Capstone Project Evaluation System B. Morrison, B. Harbort, S. Bajracharya, L. Barge, W. Carlton, W. Phillips and B. Smoot, Southern Polytechnic State University	2006094HAR
	Construction Management Program Curriculum Content Derived from Industrial Workflow Processes John Jeffrey Hannon, University of Southern Mississippi	2006020HAN

T3-B:	**Civil Engineering**	**Mason**
Chair:	Thomas R. Dion, The Citadel	
	Ten Years Later: Teaching Mathcad as a Non-Traditional Programming Language John A. Murden and Kenneth P. Brannan, The Citadel	2006098BRA
	Student Engagement in Elementary Surveying Shane M. Palmquist and C. Warren Campbell, Western Kentucky University	2006015CAM
	Teaching Design Throughout the Civil and Environmental Engineering Curriculum Thomas R. Dion, Kevin C. Bower, Timothy W. Mays and William J. Davis, The Citadel	2006006DIO
	Transportation Systems Curriculum for High Schools Matthew E. Elam, Daniel J. Fonseca, and Jay K. Lindly, University of Alabama	2006008ELA
	State-of-the-Art: Law Enforcement Surveillance Impact on Construction Zones Tulio Sulbaran and David Marchman, University of Southern Mississippi	2006097SUL

T3-C:	**Mechanical Engineering**	**Wilson**
Chair:	L. Brent Jenkins, Southern Polytechnic State University	
	The BEST Approach to Middle and High School Outreach L. Brent Jenkins, Southern Polytechnic State University	2006095JEN
	PH Grade Assist: Homework in the Twenty-First Century Gregory H. Nail, University of Tennessee at Martin	2006023NAI
	"The New 3-D Printer is Here, What do We Do Now?" Rapid Prototyping in the Undergraduate Engineering Environment H. Joel Lenoir, Western Kentucky University	2006086LEN
	A MathCAD Function Set for Solving Thermodynamics Problems Stephen T. McClain, University of Alabama at Birmingham	2006072MCC
T3-D:	**Software & Industrial Engineering**	**Mobile**
Chair:	Cecelia M. Wigal, University of Tennessee at Chattanooga	
	Project-Based Learning of Engineering Design and Graphical Communication Cecelia M. Wigal, University of Tennessee at Chattanooga	2006034WIG
	An Experience of a Course Management System in Construction Scheduling framed within TAC-ABET Accreditation Criteria Tulio Sulbaran, University of Southern Mississippi	2006096SUL
	Using Multimedia Case Studies as Teaching Aids for a Discrete Event Simulation Course Scott R. Schultz, Mercer University	2006004SCH
	Financial Analysis of Industrial Engineering Capstone Design Projects William N. Smyer, Mississippi State University; Richard F. Smyer, Hanson Building Materials America, Inc.; and TaMesha R. Conerly, Mississippi State University	2006060SMY
T3-E:	**Electrical Engineering**	**Birmingham**
Chair:	Robert Basanti, The Citadel	
	Sparking Interest in Middle and High School Students Using a Robotics Competition Mark McKinney and Robert Barsanti, The Citadel	2006090MCK
	A Very Functional Transistor Circuit to Demonstrate Biasing, Voltage and Current Gains, and Frequency Response Robert J. Scoff, University of Memphis	2006024SCO
	Consolidating Design Experience Through Product Development Chris B. Effiong, Ronny Howard and Allen Crittendon, University of Tennessee at Martin	2006074EFF

Tuesday April 4th 2006 Technical Sessions

Technical Session 4: 8:50 – 10:10 am

T4-A:	**Instructional Unit**	**Lackey**
Chair:	Arthur David Snider, University of South Florida	
	An Art Class for Engineers	2006002SNI
	Arthur David Snider, University of South Florida	
	Talking & Working for Diversity When You Don't Belong to a Minority Demographic	2006061MIN
	Adrienne R. Minerick, Ebonye-Rosa T. Allen and Bill B. Elmore, Mississippi State University	
	Using Case Studies to Bring Real World Situations into the Engineering Course Learning Environment	2006062LAW
	Thomas M. Lawrence, University of Georgia	
	USFKAD: An Expert System for Partial Differential Equations	2006009SNI
	Arthur David Snider, University of South Florida; Sami Kadamani, Hillsborough Community College	

T4-B:	**Engineering Technology**	**Mason**
Chair:	Robert Scoff, University of Memphis	
	Using the Great Teachers Model for Engineering Technology Faculty Renewal: A Strategy that Works	2006022MCD
	William L. McDaniel, Western Carolina University; Steven L. Smith, Richmond Community College	
	Implementing a National Competition Design Project as a Capstone Course at Middle Tennessee State University	2006050FOR
	Saeed Foroudastan and Michael B. Anderton, Middle Tennessee State University	
	Biomedical Engineering Technology As An Option In EET	2006077ASG
	Austin B. Asgill, Southern Polytechnic State University	

T4-C:	**Administrative Unit**	**Wilson**
Chair:	Robert A. Green, Mississippi State University	
	Development and Implementation of an Introductory Course on Engineering and Public Policy	2006013GRE
	Robert A. Green and Gerald A. Emison, Mississippi State University	
	Image Summer Bridge: A Model of Recruitment and Retention of Students of Color in Science, Technology, Engineering, and Mathematics	2006032STE
	Tommy Stevenson, Mississippi State University	

T4-D: Engineering Design Graphics — **Mobile**

Chair: R. Radharamanan, Mercer University

Multi-Media Interactive Self-directed CAD Application Tool for the Building Construction Student — 2006046ABA
Hussein F. Abaza, East Carolina University

Integrated Laboratory Instruction on CAD/CAM and Robotics at MUSE — 2006085RAD
R. Radharamanan, Mercer University

Technical Session 5: 10:30 – 11:50 am

T5-A: Instructional Unit — **Lackey**

Chair: Claire McCullough, University of Tennessee at Chattanooga

Information Literacy: A Critical Component in Engineering Practice in the Twenty-First Century — 2006049MCC
Claire L. McCullough, University of Tennessee at Chattanooga

Aerospace-Focused Multidisciplinary Project-Based Introductory Engineering Course — 2006025WIL
Timothy A. Wilson, Lisa K. Davids, Charles N. Eastlake, James G. Ladesic, Farahzad Behi, Mark D. Fugler, Paul L. Quinn, Steven R. Lehr and Christopher D. Grant, Embry-Riddle Aeronautical University

Projects and Deliverables Used in a Freshman Engineering Design Course — 2006063MCC
Philip T. McCreanor, Mercer University

T5-B: Research — **Mason**

Chair: Miguel A. Labrador, University of South Florida

Fulfilling Mentors' Expectations: An REU Site Experience — 2006010LAB
Miguel A. Labrador and Rafael Pérez, University of South Florida

Project-Based Learning: An Evaluation from Student Perspective — 2006075EFF
Chris Effiong, University of Tennessee at Martin

Increasing Student Participation in the Technical Program at Professional Conferences — 2006080SIL
David L. Silverstein, University of Kentucky

The Student Perspective on the State of Complex Systems in Australian and American Mechanical Engineering Programs — 2006011CRA
Nadia Kellam, University of South Carolina; Llewellyn Mann, University of Queensland; Veronica Addison, University of South Carolina; Michelle Maher, University of South Carolina; David Radcliffe, University of Queensland; Wally Peters, University of South Carolina

T5-C:	**Mechanical Engineering**	**Wilson**
Chair:	P. S. Yeh, Jacksonville State Univeristy	
	Effect of Boundary Conditions on Two-Dimensional Temperature Distribution in a Transformer P. S. Yeh, Jacksonville State University	2006007YEH
	Introducing Space Exploration into Engineering Curricula John Baker, University of Alabama	2006028BAK
	A Longitudinal Study of Mechanical Engineering Student Performance on the FCI, Phase I Sally J. Pardue, Corinne Darvennes and Paula Engelhardt, Tennessee Technical University	2006054PAR
	Effectiveness and LMTD Correction Factor of the Cross Flow Exchanger: A Simplified and Unified Treatment Sheldon M. Jeter, Georgia Institute of Technology	2006092JET

Engineering Student Self-assessment in a Capstone Design Course

Laura W. Lackey, Richard O. Mines, Jr., Hodge E. Jenkins

School of Engineering, Mercer University

EXTENDED ABSTRACT

As a result of an expanding global marketplace and multidisciplinary technological advances, the successful, modern engineer must work effectively in teams. Further emphasis on the importance of preparing students for teamwork was promulgated by ABET's Engineering Criteria 2000. While the concept of team-based learning is valued among many educators, the evaluation and quantification of individual student performance associated with a team-based deliverable can be challenging. The focus of this research was to evaluate the ability of engineering students enrolled in a multidisciplinary, team-based capstone design course to evaluate their personal, peer and team performance. A team-based peer/self evaluation form, developed by the Synthesis Coalition and modified by the instructors to fit the needs of the course, was utilized to collect the assessment data. Data were collected for a three year period by an individual faculty member that served as instructor. Data analyses were performed to show the relationships between student self-evaluation and faculty measures. Factors such as student gender and ethnicity were considered.

This manuscript focused on data from two questions from the modified Synthesis Coalition assessment form. Question 1 dealt with how an individual student and their associated technical advisor perceived their overall team performance while question 2 asked students to rate their individual performance on multidisciplinary teams. Similarly, faculty technical advisors were asked to rate student teaming skills. The following inferences were observed:

1. When student and technical advisor rankings were averaged for question 1 that assessed group productivity, a moderate to strong positive correlation ($r=0.65$) was observed between student and faculty response. Results indicate that weaker teams tended to over predict group productivity while over achievers tended to under predict their success.
2. When student and technical advisor rankings were averaged for question 2 that assessed student ability to function on a multidisciplinary team, a weak positive correlation ($r=0.20$) was observed between student and faculty response. Results indicate that weaker students tended to over predict their teaming skills while over achievers tended to under predict their abilities.
3. Student scores relating to group productivity correlated positively with faculty assigned course grades ($r=0.53$ with $p<0.0001$).
4. Results indicated that students perceived their performance during the building and testing phase of the project inferior to their performance during the planning phase.
5. During first semester activities, male students tend to rank their ability to perform on multidisciplinary teams higher than their female peers.

Using Technological Disasters to Teach Engineering Ethics and Technology in Society

Robert G. Batson, Ph.D., P.E.

Department of Industrial Engineering, The University of Alabama

EXTENDED ABSTRACT

Two difficult-to-address criteria within ABET Criterion 3, Program Outcomes and Assessment, require engineering graduates to understand: (f) professional and ethical responsibility and (h) the impact of engineering solutions in a global and societal context. To address professional and ethical responsibility, many programs use the ABET Canons of Engineering Ethics and associated Guidelines, present ethics-specific case studies on video or in text, engage the students in role-playing games, etc. For example, the University of Alabama (UA) Industrial Engineering (IE) Department uses the well-known Lockheed-Martin Ethics Challenge board game in facilitated role-playing. This game puts students in the virtual experience of working for a corporation with a code of ethics and "ethics hotline" to ascertain how they would react to various realistic situations a working-level engineer might encounter. After the students respond to each situation, they receive feedback from the instructor on what was the most ethical of several courses of action from which they had to choose. The criterion on engineering solutions in a global and societal context presents an even more difficult pedagogical challenge, especially on campuses such as ours that have no "Technology and Society" course available.

In the UA IE Capstone Design course, while students are working on their design projects, we use part of the class time to explore technological disasters and global industries. Each student specializes in one disaster and one industry, performs background research on each, and makes two oral reports to the class and written reports to the instructor. There are two learning cycles at work: One is the "Classical Learning Cycle" of Read-Interpret-Write that is very common in higher education; the second is the "Experiential Learning Cycle" of Experience-Reflect-Conceptualize-Apply. One purpose of this presentation is to illustrate how experiential learning, even though the experience is virtual, is a natural pedagogical approach for ABET Criteria 3f and 3h. Engineering ethics, principles of industrial and system safety, and the role of technology in society are taught in an integrated manner based on virtually experiencing the disaster from the point of view of the engineers, manufacturers/constructors, operators, maintainers, and concerned members of the public. A second purpose of this presentation is to suggest to other engineering educators that this is an efficient and valid approach to satisfying ABET Criteria 3f and 3h.

Technological disasters not only provide the opportunity to consider whether engineers and managers acted ethically, but they also expose students to a number of societal expectations and legal boundaries for technology such as patents, warranties, concepts of liability, design for safe operations and unintended use, the role of regulatory agencies and the engineers who work there, cost/schedule pressures in public projects, and relationships between engineers and their organization's managers and equipment operators/maintainers. Global industries and specific corporate practices such as global markets and supply chains, virtual design teams, outsourcing, and off-shoring provide the students with insights beyond the limited industries in their particular state or region.

The conclusion is that an approach to satisfying ABET Criteria 3f and 3h has been proven in the BSIE program at Alabama—the addition of two research and writing assignments that incorporate both classical and experential learning. We explain how we recently added these assignments to augment, not replace, the existing requirement for students to become familiar with the ABET Canons of Engineering Ethics in our Capstone Design course.

Unified Lecture Software for Mechanics of Deformable Bodies

Scott L. Hendricks, L. Glenn Kraige, and Don H. Morris
Virginia Tech

EXTENDED ABSTRACT

Newly developed lecture software designed to supplement an undergraduate course in mechanics of deformable bodies is presented. The software is primarily designed to be used by the instructor as an in-class lecture supplement. The students are also able to view the same software online. The Flash-based lecture software provides a concise review of the theory and numerous examples. Animation is used heavily to help the student visualize and understand key concepts in the course.

A Model for Broadening Participation in Computing

Juan E. Gilbert
Auburn University

EXTENDED ABSTRACT

As a result of post 9/11 security policies and substantial economic development in Asia, the number of graduate students within the United States enrolled in Science, Technology, Engineering, and Mathematics (STEM) disciplines has significantly declined. Additionally, the dot-com bust had a significant impact on computing sciences enrollments at all post-secondary levels. In fact, this year the National Academies issued a report called “Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future”. The 20-member panel, reporting at the request of a bipartisan group in Congress, said that without such an effort, the United States "could soon lose its privileged position." It cited many examples of emerging scientific and industrial power abroad and listed 20 steps the United States should take to maintain its global technological edge. "Decisive action is needed now," the report warned, adding that the nation's old advantages "are eroding at a time when many other nations are gathering strength." (NY Times, October 13, 2005). Moreover, the National Science Foundation created a new program in their Computer and Information Science and Engineering (CISE) Directorate called Broadening Participation in Computing (BPC), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13510&org=NSF&from=fund. The BPC “program aims to significantly increase the number of students who are U.S. citizens and permanent residents receiving post secondary degrees in the computing disciplines. Initially, its emphasis will be on students from communities with longstanding underrepresentation in computing: women, persons with disabilities, and minorities. Included minorities are African Americans, Hispanics, American Indians, Alaska Natives, Native Hawaiians, and Pacific Islanders.”

African-Americans represent 5.2% of all university faculty in the United States of America. In Computer Science, African-Americans represent 1.1% of the faculty, and 0.88% of tenure track faculty. By contrast, 3 of the 18 tenure-track faculty in Auburn University’s Computer Science and Software Engineering (CSSE) Department are African-American--7% of the tenure-track African-American Computer Science faculty in the country. At the doctorate level, there are 173 African-Americans in Computer Science Ph.D. programs nationwide—14 of these students attend Auburn University. Over the past five years, Auburn has graduated five African- Americans at the Ph.D. level--one third of Auburn’s Computer Science Ph.D. graduates. How does Auburn do it?

With funding from the NSF and Auburn University, the CSSE Department at Auburn has had tremendous success with increasing the representation of African-Americans and women in our graduate program. This presentation will discuss the NSF funded ITWF:Scholars of the Future program (http://www.ScholarsOfTheFuture.org), the new NSF BPC: African-American Researchers in Computing Sciences (AARCS) program and other initiatives that are making an impact at Auburn University, within the state of Alabama and throughout the nation.

Using Steam Engines to Teach Parametric Modeling and Prototyping

Aaron K. Ball, Chip W. Ferguson, and William L. McDaniel
Western Carolina University

EXTENDED ABSTRACT

Over the years a transition seems to cycle between old and new, so bring back the steam engine! A golden opportunity to teach parametric modeling and prototyping can be found in the archives of steam engine engineering. One such approach was undertaken using J.B Root steam engine design from the 1860's and incorporating modern engineering design and machine tools. Using reprints from Root's original engine, students in the Engineering Technology Department at Western Carolina University embarked on creating parametric models, virtual assemblies, and animations in a senior level course. Further, rapid prototype models were produced to conduct fit analysis. Simultaneously, students in a machining and prototyping class developed a production system to fabricate the engines using CAM software and CNC technology. Further, the students were encouraged to collaborate between courses in order to make improvements in the design and quality of the final product. This paper will describe how the project was integrated into the Engineering Technology curriculum at Western Carolina University. Emphasis will be placed on collaboration strategies and teaming approaches applied to rapid manufacturing. Techniques including parametric modeling, fit analysis, rapid prototyping, fixture design, CAM procedures, CNC program generation, fabrication, assembly and evaluation will be discussed. How these techniques were integrated into parametric modeling, prototyping and machining courses will be described, and the educational merit of such an approach will be presented.

Electromagnetic Radiation and Scattering of Wire Structures

Zhaoxian Zhou and Randy Buchanan
School of Computing, University of Southern Mississippi

EXTENDED ABSTRACT

Electromagnetic radiation and scattering are considered important topics in electrical engineering and technology, and help form the foundation of electromagnetic interference and electromagnetic compatibility. A comprehensive understanding of the radiation and scattering phenomenon will benefit the students who want to be engineers in the fields of RF circuit design, antennas and wireless communications, Radar engineering, and high-speed networking. This paper will discuss the physics of electromagnetic radiation and scattering of wire structures, which can be adopted to understand more complicated applications. After an introduction of the basic theory, discussion of the phenomena from the perspective of engineering is presented.

Numerical simulations from time domain will be provided for several fundamental wire structures. This effort fosters the students' interest in electrical engineering. The University of Southern Mississippi is in the process of enhancing its electronic engineering technology program, and materials presented in this paper will be utilized in the development of future courses.

Incorporating Civic Engagement

A. Mitchell Wood and B. Neil Whitten

East Tennessee State University

EXTENDED ABSTRACT

This presentation examines the intangible, and often unquantifiable, value in incorporating a high level of civic responsibility in a student's engineering or engineering technology education. An arguable foundation has been developed to encourage curriculum committees to incorporate community involvement as part of a student's ongoing engineering and/or engineering technology education. It is shown that programs that support this argument, by requiring community engagement, add significant value to their students and communities. Most importantly, critical thinking skills and leadership instincts are developed and brought to bear on non-text book problems. This abstract summarizes a model of student governed community participation – one that was developed to complement a curriculum lacking steadfast requirements. It exists to facilitate community engagement during every level of a student's engineering or engineering technology education.

An Indirect Method

The model presented describes East Tennessee State University's method of incorporating civic engagement into the curriculum, but with an indirect method: with the exception of the capstone course, it is completely student developed and deployed. That is to say, there are no exams, no immediate requirements for participation, no formal contract between the student and the department. However, there is overwhelming faculty support. It removes administrators and approved formality in the learning environment and places the responsibility squarely on the shoulder of the students – the intended recipients of such an education.

The Model

While enrolled in the capstone course in the Engineering Technology department at ETSU, seniors define, develop, and propose a solution to problem that currently exists in the community. Historically, these problems and solutions remain stale in the confines of the classroom. Instead of "pitching" the proposal to other seniors in the course, the ideas are presented to the membership of the student organization – an organization with a voluntary membership. Once the problem is understood, members of the organization are required to assist in the solution's implementation based on their current level of knowledge within the curriculum. The resulting value for the senior is leadership and organizational management experience. The value for the department is true civic engagement. With this model as presented, a freshman entering the program today will have had an increasing level of experience in several "real-world" community based initiatives by the time they are in the position to take the leadership role as seniors.

Math Remediation in a First Semester Engineering Technology Course

Sandeep Ahuja
Virginia State University

Extended Abstract

The Engineering Technology Programs at Virginia State University are in the process of converting the 'Introduction to Engineering Technology' course to a modular format to increase retention and to meet more ABET requirements. One of the modules' goals is to improve the math skills of entering freshmen. This paper presents our approach for this module and includes data from an assessment test. Data analysis of results from this assessment test from 31 students for three semesters shows an average improvement from the base score of more than 25%. Improvement is evident for all students' knowledge and in all the topics covered in this class but the data also reveals that student's knowledge in the topics of planar and spatial geometry, word problems, ratios and algebraic ratios is still weak. The students who enter the class with the lowest grades gain the most with this modular approach.

Using Computational Software Root Solvers: A New Paradigm for Problem Solutions?

B. K. Hodge and Rogelio Luck
Mississippi State University

EXTENDED ABSTRACT

Many of the "procedures" for solving engineering problems are formulations to solve an algebraic equation or a system of algebraic equations—to extract roots. Computational software systems, such as Mathcad, Mathematica, Matlab, and EES, make possible "direct" solutions of root-finding problems in which the solution procedure is transparent to the user. These computational systems permit a unified approach, a "new" paradigm, to be used for the solution to many engineering problems. The unified approach consists of three steps: (1) formulate a well-posed system of algebraic equations, (2) use a computational system root solver to do the "arithmetic," and (3) verify the results. This paper explores the use of the unified approach for mechanical engineering problems and investigates the pedagogical inferences of the unified approach using computational software systems in undergraduate mechanical engineering education. Examples are presented for an engineering economics problem, a vibrations problem, a pipe flow problem, and a cooling/bypass loop simulation. Although Mathcad is the computational software system used in this paper, other computational software systems possess similar capabilities and could be used equally well. The unified approach permits the student to focus more on the engineering aspects of a problem than the "arithmetic" aspects. With less time spent on arithmetic, more time is available for students to engage is higher-level synthesis.

Senior Capstone Design Experiences at the University of Tennessee: NASA and DOE Student Programs

Viatcheslav I. Naumov, David K. Irick, Lawrence A. Taylor, Masood Parang

University of Tennessee Department of Mechanical, Aerospace and Biomedical Engineering / University of Tennessee Department of Mechanical, Aerospace and Biomedical Engineering/ University of Tennessee, Department of Earth & Planetary Sciences/ University of Tennessee, College of Engineering

EXTENDED ABSTRACT

An effective way to introduce engineering students to aerospace and mechanical engineering issues is to implement exciting NASA, DOE, ASME, and other student programs into the senior year capstone design experience. The University of Tennessee's implementation of DOE's Advanced Vehicle Technology Competitions as capstone design projects began with the Methanol Marathon in 1988 and has continued through various alternative fuel and hybrid electric vehicle competitions; the current competition is Challenge X. Later, two new projects, named "Microgravity" and "Lunar Rover Vehicle" were included as capstone design options. An important benefit of these projects for the students has been the unique opportunity to meet and communicate with NASA and DOE specialists and to get involved in the solving of real engineering and scientific problems, understand the impact of engineering solutions in a global/societal context as well as, participate in unique competitions.

The UTK involvement in hybrids began with the 1993 Hybrid Electric Vehicle Challenge and continues with the current Challenge X competition. Several vehicles have been built by the students and have competed successfully in the competitions over the years, placing first overall several times and demonstrating best in class in fuel economy and emissions.

The Reduced - Gravity Student - Flight Opportunities Program provides a unique academic experience for undergraduate students to successfully propose, design, fabricate, fly, and evaluate a reduced - gravity experiment of their choice. During 2002-2006 academic years, three Reduced-Gravity Projects where initiated. This project produced interesting qualitative results about two-phase fluid flow in reduced gravity conditions. The detailed description of the test apparatus, experimental performance, and scientific results were presented and published in the proceedings of 42nd and 43rd AIAA Aerospace Science Meeting and Exhibit.

The NASA Moonbuggy Program addresses the design, fabrication, assembly, and testing of a human powered vehicle inspired by the Lunar Rover, or moonbuggy. In August 2002, this program was offered for the first time as a senior capstone project for ME students. Three moonbuggy vehicles were designed fabricated, assembled and tested over the past 4 years.

Years of experience have demonstrated that these programs are very suitable in offering senior students unique opportunities to improve their analytical abilities, develop design skills, gain experience in working in multi-disciplinary teams and solve cutting edge engineering problems. Various pedagogical problems were identified and resolved during the experience with these projects.

Near-Space and the BAMASAT Program

John Baker, Sadie Cole, Emad Abdel-Raouf, Bob Taylor

Department of Mechanical Engineering
The University of Alabama

EXTENDED ABSTRACT

Near-space is defined as altitudes of between 20 km (approximately 65,000 ft.) and 100 km (approximately 328,000 ft.) above the surface of the Earth. Near space has historically received little attention in terms of development, primarily because near-space altitudes are too high for aircraft and too low for satellites. Recently, there has been a growing community interested in developing craft that can achieve near space altitudes, i.e. nearcraft. In 2004, The University of Alabama became a member of this community with the establishment of the BAMASAT program. The BAMASAT program is an undergraduate design program where students design, build, and fly nearcraft. To date, the program has successfully launched and recovered two nearcraft. The first of these nearcraft achieved an altitude of approximately 85,000 ft. while the second achieved an altitude of approximately 100,000 ft. The primary function of these initial nearcraft was high altitude imaging. The mechanism by which students have received credit for their participation in the BAMASAT program is by using the project as a capstone design experience.

This paper will examine the challenges associated with developing and flying nearcraft as an undergraduate design project. The paper will detail the BAMASAT nearcraft system and the process by which it was developed. The goal of the paper is to provide an engineering faculty member, interested in starting a student near space program, a starting point from which to develop their first nearcraft. The paper will discuss both the technical challenges associated with nearcraft design as well as lessons learned from managing a student near-space program. The paper will also provide information on Internet-based informational sites that are valuable for developing nearcraft.

Integrating Materials Science into the Mechanical Engineering Curriculum

Judy Schneider

Mechanical Engineering Department
Mississippi State University

EXTENDED ABSTRACT

Much of the challenge in introducing Materials Science concepts into the engineering curriculum arises because this is the first time many students are tested on their conceptual understanding rather than just the ability to “plug in” numbers and solve equations. Several approaches can help to bridge this gap: tailoring the Materials Science course to a specific engineering curriculum, incorporating laboratory exercises to reinforce concepts, and including industrial "real world" examples. By building a Materials Science course around the requirements of a Mechanical Engineering (ME) Curriculum, students are introduced to the conceptual as well as computational understanding of the interaction between materials selection and suitable processing methods in the ultimate performance of an engineered device.

At Mississippi State University (MSU), the ME department has taken ownership of the traditional service course entitled: "Introduction to Materials Science" by offering the renamed course within the ME Department. This allows the faculty member to tailor this "Materials for Mechanical Engineering Design" course to ensure that students are introduced to the conceptual as well as computational understanding of the interaction between materials selection and suitable processing methods in the ultimate performance of an engineered device.

Currently the "Materials for Mechanical Engineering Design" incorporates a semester long Project to compliment the lectures. "Life of a Casting" is a specially designed, semester long project which is used to demonstrate the importance of materials science in manufacturing processes by providing the students with hands-on exposure. The students work in groups to collectively cast, heat treat, machine, and perform hardness and tensile tests on a given aluminum alloy and temper. To link the microstructural evolution with the mechanical properties, the students mount and polish specimens to view the microstructure before and after heat treatments. The various stages of the project correspond with lecture topics and serve as enforcement of basic concepts of diffusion, phase diagrams, strengthening mechanisms, and processing/property/microstructure relationships. Students correlate hardness tests results with their measured tensile test results. At the completion of the course, the students submit group reports documenting the correlation of processing, microstructure, and property relationships. When students are asked on the final student evaluation, "What did you like the most about the class?" One hundred percent of the students respond, "The project - because I got to get out of the classroom and do something."

Frame Analysis and Design Computer Classroom/Laboratory Module for Machine Design

Hodge Jenkins

Department of Mechanical and Industrial Engineering
Mercer University

EXTENDED ABSTRACT

Frames and trusses designs are often improperly handled by undergraduate mechanical engineering students as they design, model, and evaluate machine frames. A one-day, computer-based, classroom/laboratory module was created to address this situation. The module was developed for use in a junior-level machine design course. This module provides students with a means for improving understanding and knowledge about designing three-dimensional frames. Alternative modeling representations for obtaining stress and deflection results from static analysis of frames, utilizing idealized beam elements are presented. Limitations of using conventional finite solid elements to model long, thin-walled members are shown through a hands-on case study during class. Additional goals of the module are increased student interest in engineering design and analysis, increased student awareness of mechanical modeling implications, and improved student readiness for engineering practice. This frame modeling and analysis module is an advanced topic in a sequence of solid modeling and finite element modules that span the mechanics curriculum in the mechanical engineering specialty at Mercer University.

Instructional materials developed for the laboratory session and related homework are provided and discussed. Multiple computer-generated solutions are compared with simplified, closed-form solutions to provide bounding cases for verification of results. While materials for this module were developed for specific software, the concepts and topical problem presented for investigation may be used with other design and analysis software. The materials may also be used as a self-paced tutorial.

Observations

The primary goals for the computer learning module 1) increase student understanding of frame design and analysis by improving visualization and modeling idealization, and 2) provide an apparent link between design and analysis have been met. Maximum deflections and stresses for the structural models using three different methods (hand calculations, solid element models and ideal beam models) are performed by students. Students observe a significant computational advantage in using ideal beams for analyzing frames.

The Experimental Prototype: Critical Thinking and Real-World Problem Solving in Engineering Education

Pedro E. Arce, Joseph Biernacki, and Perry Melton

Department of Chemical Engineering
Tennessee Tech University

EXTENDED ABSTRACT

Today's engineering educators emphasize lecturing, recitation, and laboratories. The dominant characteristics of these "traditional approaches" are (1) following of the procedures and (2) completion of the tasks. "Effective" activities are typically considered to be those theoretical and experimental cases that are carefully planned and trouble free. When encountered, even the most simple mistake or difficulty is often blamed on the instructor and leaves students waiting for the master to fix the problem. This approach would be great if real-life problems could be solved with a cookbook and if a chef was always there to correct things when the recipe goes wrong. However, experiments fail, theories do not match data, and computational models do not always correctly predict observed trends. That's real life!

Instructors using enhanced approaches assign but do not supply particular instructions or explanations. This is, indeed, a much better approach than those that spoon feed the students with all details about the equipment and even the protocol for the experiment! Students in these environments then become wonderful "technicians" instead of engineers in the making; moreover, the device will always eventually work since it is all proven and has been used before. The story would be completely different if the apparatus did not exist and rather if students must bring it to reality from fundamental engineering concepts. For example, within the AIChE, the Chem-E-Car Team project is a wonderful example that, when properly implemented, enhances the students' learning with real world experiences.

As an alternative to prescriptive training, the authors will describe the use of experimental prototypes to create a more realistic learning environment in engineering laboratory settings. In this environment, students are required to plan, design, and test devices that must deliver an outcome, such as the measurement of a property (i.e., viscosity) or a process condition (i.e., flow rate or flow field). Here, the application of fundamental principles helps students to understand the device performance, whereas constructing to a budget and meeting scheduled deadlines help students explore real world constraints. Experimental prototypes for fluid mechanic applications are used here to illustrate the methodology.

A Freshman Course in Chemical Engineering

Donald P. Visco, Jr. and Pedro E. Arce

Tennessee Technological University

EXTENDED ABSTRACT

In many engineering curriculums, the first opportunity for students to become acquainted with their discipline is in the Sophomore or Junior years. While such an approach allows for general Freshman and/or Sophomore engineering classes, it creates other problems as well as misses several opportunities. At Tennessee Tech, we have designed a 1-credit class for first semester Freshman enrolled in Chemical Engineering. This course, which was designed with much student input, includes on a variety of areas such as: (1) time management, (2) departmental indoctrination, (3) meeting the faculty, (4) how do all the courses fit into the curriculum, (5) hands-on experimentation (6) what chemical engineers do in practice and (7) student research opportunities Such a course looks to cultivate the intrinsic interest that students have in this area while addressing issues which are important in sustaining these student to graduation. In this presentation, we will discuss the lessons learned from this course as well as provide assessment information for use in future offerings.

Student assessment of this course indicated that, on average, the course was effective at reaching the stated goals (score of 4.2 out of 5.0). Each class session itself was assessed by the students. The top performers were the three "hands-on" experiments that were performed. In a students' comments section of the assessment, it was emphasized that more "hands-on" work should be included when this course is offered next semester. While it is too early to determine if this course was effective from a retention standpoint, anecdotal information suggests a substantial reduction in the number of students transferring out of Chemical Engineering this year (so far) relative to last year.

Computer Facilitated Mathematical Methods in Engineering – Similarity Solution

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EXTENDED ABSTRACT

High-performance computers coupled with highly efficient numerical schemes and user-friendly software packages have helped instructors to teach numerical solutions and analysis of various nonlinear models more efficiently in the class room. One of the main objectives of a model is to provide the insight about the system of interest. Analytical solutions are closed-from in the system parameters and can be used for analyzing the system for various values of parameters directly as opposed to a pure numerical solution. Having taught/co-taught applied math for both senior undergraduate and first-year graduate students for five years, the author feels that students do not appreciate the value of analytical solutions because (i) they wrongly feel that numerical methods can be used to solve complex problems using high-speed computers (ii) they are not comfortable and confident of doing the complicated integrals, rigorous algebra, and transformations involved in obtaining analytical solutions. Computer algebra systems such as Maple, Mathematica, MATLAB, REDUCE etc. can be used to perform the tedious algebra, manipulations, complicated integrals, variable transformations, differentiations *etc.* involved in applying various mathematical methods.

In this paper, we show how Maple can be used to facilitate similarity transformation technique for solving chemical engineering problems. A traditional approach to teach this technique would involve doing the complicated variable transformations and integrals by hand. In this paper, we show how an analytical technique could be facilitated using computers and software.

Applying Techniques Learned in an ASEE –SE Workshop: Adoption of a High Performance Learning Environment (Hi-PeLE) for Group Experiments

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EXTENDED ABSTRACT

During the 2005 ASEE Southeast Regional conference, a workshop on "Design, Implementation and Assessment of High Performance Learning Environments" was conducted with the participation of instructors of several engineering colleges in the South East. After a discovery based learning module that led the workshop participants to experience the flow and progression of learning environment, groups were formed to brainstorm ways the technique could be applied in the classroom and/or lab environments. This contribution discusses the adoption of the workshop-developed project in the High Performance Learning Environment (Hi-PeLE) style for a capstone Process Controls class at Mississippi State University.

Hi-PeLE is a flexible learning tool that can be adapted to a variety of courses either as small projects, semester-long projects or variations of these two limiting cases. Hi-PeLE puts the students on the driver seat of the learning process and this focus brings the students to achieve higher levels of competence in a given subject, of maturity in the handling of abstract principles, and of motivation to become life-long learners. In short, the approach helps students to master engineering concepts with a higher retention rate than other more traditionally oriented methodologies.

The specific goals of the Hi-PeLE project as they related to the Controls project were to a) replace recipe-like experiments with a focus on the discovery process using unfamiliar temperature control equipment, b) lead the students to sequentially plan tasks and meet deadlines in a structured team environment, c) facilitate student's rediscovery of the "adventure of figuring things out." The project was organized into three phases; Phase 1 was dedicated to background research and defining the project, Phase 2 was to focus on developing model equations and running the experiment, while Phase 3 included data analysis, synthesis of ideas, and producing a final concluding report for an instructor. The teams were selected following a functional-based team member selection approach and were comprised of three students. Each student had the opportunity to be a leader for a phase of the project and a supporting team member for the other two phases.

In this contribution the authors will discuss the merits of Hi-PeLE and comment on their experiences associated with applying the learning tool. Recommendations for future adoptions of Hi-PeLE will be given and student evaluations of the Hi-PeLE team learning experience will also be discussed.

The Feasibility of Online Laboratories

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EXTENDED ABSTRACT

Higher education is a market economy in which students seek value. However, a college education has become very expensive. College costs are outpacing inflation and a traditional college education obtained by attending face-to-face classes is becoming less available to high school graduates. Parents are urged to set aside college money using tax-deferred annuities for each child as soon as possible. Fortunately, education is information transfer that is ideally suited to an information society. For an impressive perspective on modern information transfer, educators are encouraged read "The World Is Flat: A Brief History of the Twenty-first Century" by Thomas L. Friedman. He describes the impacts of the recent massive investments in technology (computers and software) and infrastructure (fiber optic cable and ISP's). Due to the large economic and convenience advantages of online learning, it will continue to grow quickly. Any English-speaking educator on earth with an internet computer can teach an online course at a time and place convenient to their students. There are many such educators in the U.S, Canada, Europe, India, and Australia. Fortunately, there are also many students in these countries. Online classes have been developed for most disciplines but engineering and technology are lagging behind because of problems with graphic communication and laboratory experiences. Funding for laboratory equipment continues to be a problem for engineering and technology education. Replacing old lab equipment is difficult because it is often not research equipment. There are two general types of laboratories – skill labs and knowledge labs. Soldering an integrated circuit onto a circuit board requires hands-on motor skills and hand to eye coordination. Just knowledge of how to do it is insufficient. However, many technical labs do not require learning a skill and are information transfer experiences. If a student misses an "information transfer" lab, a good videotape of the lab might be a reasonable substitute. Could the videotape be used for all students? Economically, the benefit to cost ratio would be very large. Modern laboratory equipment at private labs or other institutions could be used and the experience could actually be better than a face-to-face laboratory with outdated equipment. Also, labs could be presented using equipment not available at the institution. Thus, online/distance laboratory experiments using audio-video and other more sophisticated information transfer methods can substitute for some laboratories and improve the variety of experiments available. The need for high quality online laboratory experiments is obvious. Whether online laboratories can satisfy accreditation probably depends on the sophistication of the online presentation. Students and faculty are becoming more familiar with online learning and teaching. This method of instruction can be expected to evolve and better satisfy both the learner and teacher. The phenomenal improvements in virtual reality computer programs clearly indicate to this author that virtual laboratories will eventually be developed to meet any reasonable ABET accreditation criteria.

Technology in the Throes of a Paradigm Shift

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EXTENDED ABSTRACT

History tells a story of many of mankind's exciting creations over the centuries. From prehistoric tool-making thru the Industrial Revolution's manufacturing developments and into the innovations of the twenty-first century, the way-of-life of our societies has been advanced as a result of some remarkable inventions and discoveries. We now use a term, paradigm shift, to denote many of these profound changes. A paradigm shift, as the term is normally used, describes radically changed, common methods of performing activities in business or science that occur over a short period of time.

Truly we have entered the new millennium with many radically changing ways of conducting our affairs. Most of these have occurred because of technological advances in computing and communications. The development of new, smart devices points to a common theme led by the Internet: high tech industry appears to be entering a vibrant, new phase of growth, upheaval, and innovation. Much of today's business is transacted via some form of smart technology. Most businesses, especially medium to large companies that sell products or provide services, can benefit from an Internet presence. The Web will continue to challenge traditional industries from Publishing to Telecommunications to develop new business models.

We must learn newer and better methods for managing the development of these new products to meet the needs of our rapidly changing business environment. The demand for new products plus the demand for new software engineers will strain our ability to deliver without new, innovative ways of being more productive. One promising methodology is Open Technology Development. Open Technology Development uses open standards and interfaces, open source software, and collaborative development to provide better software products at more reasonable costs.

The components of Open Technology Development are not new but by combining the components, effective ways of developing software are being demonstrated. There is a ground swell of support for Open Technology Development in government and industry. Academicians need to move to the forefront and work to find ways to make new methodologies more acceptable. Our graduates need to know about the changes that they will be facing within the next few years.

Forget about Teaching: It is all about Learning!

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EXTENDED ABSTRACT

During recent times there has been a renewed effort to upgrade teaching methodologies, improve lecture methods, and incorporate more hands-on activities for the training of future engineers. These are welcome efforts to develop individuals with better skills and more independent thinking capabilities. However, one possible weakness of these efforts is that they are still focused on “teaching” rather than on “learning”. In fact, most of these approaches are still based on the less effective and un-motivating lecture method! A single direction of communication, very polished presentation strategies for the material, and very little interaction with the learners are some of the key characteristics of this prominent teaching methodology. Many of the so-called “enhanced” methods seem to be an “enhanced lecture approach” rather than a new approach based completely on the learning needs of students. No wonder engineering students “talk about leaving” for other more “rewarding” and exciting disciplines such as management, economy, medicine, sports, and music. All of these disciplines have adopted student-centered and learner-based methods that make the student the center of the learning process and leave the instructor in more of a facilitator or coaching role.

It is quite clear how a player can be developed to be a successful individual in a team sport, how a management student can become a successful employee for a business, or how a violinist will masterfully play a Vivaldi concerto…surely, not by “teaching approaches”, but rather by learning methodologies! It seems to be time for switching from the old-fashion teaching methodologies to modern and more effective learning approaches in engineering education that will impact the great majority of students. Good salaries, high demand in the profession and other factors seem to have contributed partially to the “old fashioned teaching status” in engineering education. Time and market demands have changed…so we need to re-assess the instructional methods from a more fundamental learning point of view and with the students at the center of our new focus.

The author will present illustrative cases in a variety of professions that closely parallel the much more needed “hands on” approach in engineering education and will introduce the need for a switch to learning-based environments in this discipline. The discussion will cover basic aspects, training techniques, class/lab section facilitators, and possible assessment tools for these hands-on approaches. The author will draw on his knowledge and expertise in active and collaborative learning environments and as an author in the development of several of these successful engineering approaches.

Online Learning in Engineering Graphics Courses: Research, Tools, and Best Practices

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EXTENDED ABSTRACT

For years we have had the ability to offer courses at a distance through online instruction. Many instructors have taken advantage of online tools to supplement their classroom instruction, but few embrace the full potential of online learning technologies. Some of these tools include course web pages, course management and development tools, and online tutorials. Reasons for not embracing online learning technologies include inadequate training in the necessary tools to develop an online course, perceived lack of interactivity or dialogue between the students and instructor and between students in online courses, lack of technology support at one's institution, or time required to develop online materials. In some cases online courses are not developed because face-to-face courses are sufficient to meet student demand. Engineering graphics instructors face additional challenges with issues such as finding appropriate ways to demonstrate CAD software, preparing materials that are graphics intensive, and determining adequate methods to evaluate student work. More recently, synchronous communication tools for learning have been developed that allow instructors to communicate with students in real-time. These technologies have increased the level of community within an online course by integrating audio, video, and other means for students to interact.

As these learning technologies have increased and become easier to use, faculty have found creative ways to offer their engineering courses. We now regularly see courses offered using Course Management Systems (CMS). These systems allow the instructor to take advantage of asynchronous technologies, synchronous technologies, and videoconferencing technologies. Whether these courses are offered for students at a distance or for on-campus students, these tools are giving faculty more options for delivering instruction. The CMS are available to meet the needs of all experience levels of faculty. Whether the instructor is just trying to add a small amount of course material online or has a desire to offer a course at a distance, systems exist at all price ranges. Examples of CMS include Angel™, Breeze™, Convene™, Blackboard™, Desire2Learn™, Embanet™, eCollege.com™, Elluminate™, Gradepoint™, Horizon LiveWimba™, IntraLearn™, Centra Symposium™, and WebCT™. These systems typically include both asynchronous and synchronous learning tools. Asynchronous tools can be used to deliver online instruction with some time delay between an instructor's action and when the learner accesses the instruction and responds. With synchronous online tools, participants are engaged in real time activities such as text chat, audio, and/or video.

This paper discusses some of the tools available that can be used to deliver instruction synchronously and asynchronously, summarizes research and experiences from engineering and other disciplines related to online instruction, describes some of the issues related to delivering engineering instruction online, and provides some solutions to issues related to online learning.

Using Graduate Students to Teach an Undergraduate Class

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EXTENDED ABSTRACT

The teaching preparation for a graduate student has been quite different across the nation. Some graduate students have very limited teaching experience; others have served as a teaching assistant in a couple of different courses; some have taught laboratories; others have taught a single course; and a few have independently taught several courses. This work suggests a procedural pattern for training graduate students as co-instructors to teach an undergraduate course with the supervision of a full-time faculty. This was implemented in a senior level chemical engineering controls course in the spring 2005 semester. The co-instructors' involvement with the supervisor was on various levels from the course design to the grading schemes. The co-instructors were also trained to design and teach laboratory experiments pertaining to the course material. Various aspects of active learning were also introduced to the co-instructors. This procedural pattern as well as the feed back from the students and faculty members provided a positive effect on the departmental perspective on training graduate students as co-instructors. Based on the feed back received from the students, it was concluded that this type of an academic ambience provided a learning experience for both the students and the co-instructors.

An interesting issue not initially expected was one of instructor availability. As most faculty members are married with children, their day on campus normally ends in the early evening. However, many students use the late evening to work on homework and, thus, a “teachable moment” at midnight is a difficult proposition. On the other hand, graduate students also keep late hours and, thus, were often available at times congruent with when students are actively engaged in homework.

Faculty Mentoring – a Protégé's Perspective

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EXTENDED ABSTRACT

Assistant professors in the beginning of their careers are hard-pressed for their time, efforts and resources. To obtain a successful tenure in an academic environment, the faculty candidates are assessed in many aspects in addition to research. While a Ph.D. degree in a particular discipline trains a faculty candidate to perform research, new assistant professors are not typically trained in variety of aspects including teaching, service, time management, etc. The requirements to obtain tenure vary from one university to another and often from one department to another within a particular university.

Experienced/tenured faculty members are assigned as mentors to new assistant professors to help them meet the department's criterion in obtaining tenure. The author's personal experience and gains will be presented at this conference. When the author was introduced to this, he did not know what faculty mentoring meant. While the roles are clear in a faculty – graduate student relationship, the roles in faculty mentoring depend on the personal behavior, culture, and experience/status of both the mentor and the protégé. The author had a different opinion/view/expectation on faculty mentoring based on his cultural-background. The author will present his initial views and how the faculty mentoring differed from his initial view.

Renovation and Upgrades of Chemical and Biological Engineering Unit Operations Lab to Teach Technical Skills in Emerging Engineering Fields

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Extended Abstract

A $250,000 laboratory renovation was recently completed in the chemical and biological engineering department at The University of Alabama to develop new experiments and respond to new technical challenges that our students will be facing in an increasingly diverse chemical engineering job market. The new equipment obtained as part of the renovation enables the department to offer laboratory experience in technical areas such as alternative energy sources, pharmaceutical formulation, biological toxicity testing, thin film deposition for electronic materials, continuous filtration for bioseparations (e.g., dialysis and ultrafiltration), drug delivery, enzyme kinetics, microencapsulation, transport phenomena and cell adhesion. Major new equipment purchases include a fluorescent microscope with camera, spray dryer with solvent recycle, hydrogen fuel cell, UV/vis spectrometer with water jacketed flow-through cells, flow filtration system, chemical vapor deposition reactor, and numerous biological implements and analytical tools. The redesigned laboratory allows space for team-based learning and offers a space for laboratory demonstrations in courses taught in the classroom across the hall, or for open houses, such as high school recruiting events. It also provides space and resources for advanced students working on independent research projects. The presentation will focus on the rationale behind the choices made for equipment upgrades and discuss specific experiments that have been enabled through the upgrade. A tour of the facilities will be available during the ASEE meeting.

Adding Practice and Realism to Information Technology Courses

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Extended Abstract

The design of a new course in the Information Technology program at the University of Southern Mississippi required the satisfaction of performance objectives concerning teamwork, journaling, and network-based applications. The goals were to encourage creativity, research, and the adoption of new technology in the solution of common problems in the Information Technology (IT) industry. The student teams would be presented with common problems but the individual solutions would be unique. However, by encouraging creativity and open-ended solution a major problem had to be overcome, i.e., the anticipation and installation of all the utilities, tools and application software the students might wish to use, not to mention the expense and technical support required and the vigilance to incorporate new technology with each course offering. The solution was to minimize these preparations and to place student activities in situ wherever possible.

The Internet and open-source software came to the rescue. The course is in its third iteration relying solely upon internet based resources. The paper discusses the successes and non-successes, and makes recommendations for future efforts. In general, the approach is a success. For example, the in situ nature of obtaining and configuring the needed resources contributed to realism and helped students form their own opinions without the bias of a pre-selected, single-product focus. Even the failures tended to be the same as might occur on-the-job and thus had educational value on their own.

Radio Frequency Identification (RFID) Applications in the Medical Field

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Extended Abstract

Radio Frequency Identification (RFID) is a technology that has existed for many years; however, industry opted not to pursue any of the suggested uses for this technology when first introduced due to the high cost associated with implementation. A RFID system consists of two major components, the first being a tag which is placed on the object that is to be tracked and the second is a reader that propagates a signal to and from the tag. Over the past several years this cost has gradually declined because of the reduced manufacturing expenses for developing the hardware required to operate an RFID system. Companies have begun to re-evaluate a variety of uses for this technology in their current infrastructure to accommodate a wide array of needs that were previously financially unviable. This paper examines an application of RFID tags in the medical field as well as legal and societal issues associated in any medical implementation.

Using FPGAs to Simulate and Implement Digital Design Systems in the Classroom

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EXTENDED ABSTRACT

Field-Programmable Gate Arrays have gained widespread popularity in digital design laboratories. Their flexibility and relatively low cost has made them ideal pedagogical resources. When FPGAs are used as the primary platform in a digital design laboratory, increased flexibility and topical integration is provided to the instructor. Topics that have traditionally been taught in separate, independent laboratory assignments can be bridged together to form a cohesive series of laboratory projects based on a single problem scenario.

This paper will present a series of laboratory exercises that center around a model train track with multiple tracks, trains, sensors, and switches. Possible laboratory projects include, HDL coding (VHDL or Verilog), developing state machines that control the trains and track switches, and developing a simple computer datapath and the necessary assembly code to implement a similar controller. An FPGA development board from Altera Corporation is used to implement both a VGA simulation engine for testing students' projects and an interface to a real model HO train track with Digital Command Control (DCC) capable trains. Thus, a single FPGA development board can be used to both simulate the problem scenario and then implement a control interface to a physical implementation of the same problem scenario. This paper will include a discussion of the implementation details of the train simulator and explore the interface necessary to build the physical implementation.

The large scope and variety of laboratory projects that can be created using this infrastructure make it an attractive option for entry-level digital design laboratories. In an earlier incarnation of the train design project before FPGAs and CAD tools, students used the model train system without simulations. However, the model trains wrecked so often that they rarely survived a semester. A modern DCC-capable train system has allowed the physical system to be used again. Seeing their state machine control real hardware adds to students' experience and to their overall sense of accomplishment. Using it in conjunction with the VGA train simulation protects the physical train setup from injury, and it also reinforces the need for simulation and testing.

Hands-On Operating Systems Made Easy

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EXTENDED ABSTRACT

This paper presents the experience that the authors have had in an Operating Systems course with a semester long project. This project allows students to implement major concepts taught in an O/S course in an object-oriented language, currently Java or C++. Object-oriented programming has been used to capture the underlying machine architecture, which will reinforce knowledge from Computer Architecture course, and it is being expanded for use in a Distributed Computing course.

The project consists of building an operating system for a very simple emulated machine that the instructors make available. They should complete features of modern O/S like scheduling of jobs and virtual memory. The availability of the machine lets the students concentrate in the course subject, rather than in software development. Still, they have to develop code, but nearly all their efforts go directly to learning the current concepts: Operating Systems. Students are not distracted by other chores like building the machine so that they could be able to build an O/S on top of it.

By using the simpler approach, we are confident the average student at our institution understands the concepts, while allowing the interested student liberty to explore the tool in more depth.

Application of Pedagogy or Andragogy: Understanding the Differences between Student and Adult Learners

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Extended Abstract

Psychologically, people become adults when they develop a self-concept of being responsible for their own lives. As people become biologically mature, start assuming adult roles, and take more responsibility for their decisions and actions, they also become self-directed in their learning. The appropriateness of instructional models relies heavily upon the psychological maturity of the learners. This paper explores and contrasts the meaning, application, and methods of pedagogical and andragogical instructional models for civil engineering undergraduates. Pedagogy, the art or profession of teaching, as an instructional model assigns the teacher a number of responsibilities, including making decisions about what content will be learned, how and when it will be learned, and how and when the learning will be assessed. The result of this teacher-directed education places the student in a submissive role in the educational dynamics because the teacher controls the student's grade and eventually decides if and when the student will be promoted and then graduate. This submissive role of the student is not congruous with ASCE BOK Outcome 9 of demonstrating "a recognition of the need for, and an ability to engage in life-long learning" (ABET i). In contrast to pedagogy, andragogy promotes self-directedness or self-concepts associated with adult-like roles normally assumed after college graduation, including control of the learning process. With adult learning defined as "the process of adults gaining knowledge and expertise," the result is an educational model for an adult learner consistent with his/her personal goals and ASCE BOK Outcome 9.

A Back to the Basics Approach to Teaching Engineering Ethics

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EXTENDED ABSTRACT

One of the essential characteristics of a profession is a set of rules generally defining the conduct of its practitioners in carrying out their special duties. This is true of the practice of law and medicine as well as engineering. Nowadays, most engineering curricula include the teaching of some form of ethics either as a separate course or often as part of the capstone experience. Driven by the spate of financial as well as engineering ethical failures of recent years, there is a pervasive sense among the public that ethics, if not ethical standards, are not what they once were. Given this climate and the notion that education, rightly so, conforms to the perceived needs of society, it is likely that ethics would have found its way into engineering curricula with or without the prompting of ABET.

Since it is universally agreed that the teaching of ethics is such a good thing, then regrettably, some have concluded it is so important it should be taught, not by engineers, but by professional ethicists who may be distrustful of technology and the engineers who create it. In this milieu, a lecture on engineering ethics can yield the subliminal and somewhat adversarial message of "what you (the engineers) ought to do to protect us (the non-engineers of society) from you and your technology". More useful would be to introduce the students to a well defined and articulated set of rules of engineering ethics such as the Canons of Professional Engineering. More often, these standards are bypassed for the more intellectually stimulating but highly ambiguous case studies, most of which are better suited to a debating society than an introduction to engineering ethics. This paper will discuss the pitfalls of this disturbing trend in engineering education and why we need to stay focused on teaching the basics of engineering education.

The Declining Work Ethic of the American Engineering Student

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Extended Abstract

The work ethic of our American engineering freshmen has been declining consistently for decades. The *Cooperative Institutional Research Program* (CIRP) survey, the most comprehensive study of American college freshmen, documents several alarming negative trends in our high school students—trends that set habits and continue into the students' college experience. The survey shows that High School grade inflation is steadily on the rise, students are studying less, more students are openly expressing their boredom in class, and an increasingly higher percentage of college freshmen consider themselves to be in poorer emotional health as compared to their predecessors. Adding to the problem is the practice of social promotion in our public school systems, and the unconstructive interference from parents. Because our nation's high schools are requiring less of students, incoming freshmen are ill prepared to perform well at our universities. Many students freely admit to having A averages in high school by simply attending class without any outside study whatsoever. When that same mind-set is carried over into freshmen engineering classes, the result is an unpleasant surprise, usually when they receive their first exam results. This leads to many switching to other majors, particularly business, where the curriculum is not as demanding and yet the expected salary upon graduation is nearly as high as that of engineering graduates. Meanwhile, South Asian countries, particularly China and India, are producing engineering students possessing a work ethic and ambition that makes them far more likely than Americans to continue their engineering education to the Masters and Ph.D. This latter fact is a serious concern for the national security and future of the United States. In this paper, there will be a more detailed discussion of the problem and suggestions as to how engineering educators might respond.

Positive Experience with Challenge-Based Instructional Modules across Engineering Disciplines

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Extended Abstract

We have used challenge-based instructional modules in conjunction with classroom technologies in biomedical, mechanical, electrical, and computer engineering as a result of team-teaching efforts between engineering disciplines. Two modules for first-year engineering courses have been developed based on the same engineered product but with two different foci: mechanics and electric circuits. The common learning objective for both modules is to manipulate, interpret and graphically represent dependent and independent variables as engineers would do. In both modules, the students are presented with a challenge of improving an existing product, a “smart” running shoe with computer-adjusted cushioning. For the mechanics module, students are required to use gait measurements such as stride intervals to suggest useful descriptions of walking for developing a smart walking shoe. In the electric circuit module, students use battery capacity specifications from commercial batteries and estimate the maximum current that can be drawn over a specified amount of time. The modules are implemented within the framework of the STAR-legacy cycle, an action/reflection learning cycle based on the “How People Learn” (HPL) model. The modules incorporate the Personal Response System (PRS), a classroom technology tool which allows the instructor to automatically display students’ electronic responses to questions posed during the lecture. Classroom observations revealed that students more frequently engaged in cooperative learning, student discussion, and project-based learning during challenge-based instruction as compared to traditional instruction. The instructor also more frequently used higher-level feedback and questioning and assumed the role of a facilitator of learning when challenge-based instruction was employed. Student surveys indicated that the majority of students found the challenges interesting and felt confident in performing similar analyses in the future. Students also reported that the PRS system was useful and increased attention during class. Overall, the assessments suggest the challenge-based approach is effective across engineering disciplines and is appropriate for general first-year engineering curricula.

Learning by Doing—Hands-On Experiments for a Middle-School Outreach Program

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EXTENDED ABSTRACT

This paper describes a series of hands-on experiments using LEGO Mindstorms kits and specially-built equipment used to give students practice in using the principles of math and science in solving engineering problems that were developed as part of the Virginia Demonstration Project (VDP), a middle-school math and science outreach program funded by the Office of Naval Research. In the first year of this project, these experiments were used by the students in the 7th grade science and math classes of the six middle schools of the Stafford County (Virginia) Public Schools and by a sub-set of these students in a week-long academic summer camp. The teachers were assisted by mentors drawn from the scientists and engineers working at the nearby Naval Surface Warfare Center in Dahlgren, Virginia, who served as role models and gave a real world, Navy flavored realism to the activities. The College of William and Mary supplied the educational and evaluation expertise and provided coordination with the school system. The ultimate objective of the program was to increase the number of students who earn degrees in the disciplines of math, science, and engineering.

There were two categories of problems used in the VDP: 1) Robotics Challenges that required the solution of problems having both a societal and Navy focus using LEGO Mindstorms equipment that were used in both the academic year and the summer camp programs and 2) Breakout Experiments that were used in the summer camp program to illustrate various specific mathematics and science topics. The paper describes these problems, the supporting materials for both students and teachers, the educational motivation for the experiments, and the experiments' connections with the Virginia Standards of Learning. In addition, professional development workshops for both teachers and mentors developed around these experiments in the areas of collaborative teaching, curricula development, rubric development, problem based learning, student team management, and ethics in the classroom are described, as well as the results of a continuing and comprehensive evaluation of the effectiveness of the program.

We believe, and the evaluations appear to confirm, that we have made an important start at increasing the interest of young people in pursuing careers in science and engineering.

Preparing Engineers for the Job Search Through Mock Telephone Interviews with Alumni

Julie E. Sharp

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EXTENDED ABSTRACT

This presentation reports on a work-in-progress project integrating the Vanderbilt Engineering Alumni Council (EAC) mentoring initiative with ES 210w Technical Communication, a course for all engineering majors. Alumni partnered with students to provide practice in the telephone job interview, a practice increasingly used by industry for the first interview. The presentation describes the first semester of this ongoing project and provides an initial assessment of project success based on the students' analysis.

The project had several components. Students first participated in an in-class workshop and assignment to learn interviewing skills. Then an EAC mentor was assigned to each student. Students, in collaboration with alumni, could choose to be interviewed for a simulated fulltime job, internship, or graduate/professional school, depending on the interest of the student and experience of the alumnus/alumna. Before the interview, alumni were sent sample questions and notes about the content of the students' interview skills workshop. Alumni could draw from their own experience, design their own questions, or use some of the questions in the handouts. Telephone interviews were approximately 30 minutes, followed by alumni suggestions for improvement. After the interview, students summarized the experience in a memo to the instructor. The purpose of the assignment was the following:

1. To teach students interviewing skills
2. To teach memo writing skills
3. To establish alumni-student networking to bridge the gap between school and work and to encourage a mentoring relationship beyond the ES 210w requirement

Students' assessment of the project was obtained through an anonymous 15-item questionnaire and comments in their assigned memo summaries. Students considered the project to be successful and recommended keeping this module in the course with a rating of 4.6 on a 5-point scale. They made many positive comments about the project. In addition, a meet-and-greet event with alumni was well attended. Some students recommended that more attention should be paid to matching alumni's majors to the students' majors. Unfortunately, since the students have a variety of engineering majors and the project depends on alumni volunteers, matching majors is not always possible.

Based on these results and discussions with alumni, a continuation of the project into the next semester was planned. Other plans included continued use of the student questionnaire and an additional questionnaire to gain feedback from alumni.

An Online Capstone Project Evaluation System

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EXTENDED ABSTRACT

As an integral part of assessing program outcomes for the computer science program at Southern Polytechnic State University, our students are required to complete the Senior Capstone course which involves a team-based project. At the end of the term the projects are evaluated by members of our Industry Advisory Board (IAB). To date, we have used a multi-page form for IAB members to record their evaluations and comments during a half-day session that includes team presentations to groups of IAB members, a poster session where all IAB members look at all the projects, and a debriefing meeting where the IAB offers feedback to the students.

In the spring of 2005, one IAB member commented that it would be easier and more efficient to complete the evaluation forms online. He correctly observed that most of the IAB members are far more used to typing than writing, and suggested that we automate the process. We explored the idea and concluded it was feasible to implement. Thus it became a capstone project.

CS Capstone projects at SPSU are assigned by the faculty coordinator, and teams are assembled based on students' skill sets. This year, we assembled a team to develop a web-based IAB evaluation form and data collection system for the IAB to use in completing the evaluations. Capstone student presentations will be given in classrooms equipped with workstations at each seat to enable IAB evaluators to enter pertinent parts of the form as they watch the presentation. A small computer lab next to the room with the poster session serves as a workroom in which the IAB evaluators can subsequently add to their evaluations.

The system uses a PostgreSQL database for saving partially completed results and for producing final reports and files for assessment and accreditation purposes. The system was developed using only open source software. The details of its operation are configurable and the configuration is stored as XML descriptions. It runs on the same server the students use for developing their capstone projects, but is secure and password protected. It communicates final results automatically to the server where the CS Faculty Course Assessment Report (FCAR) system is hosted.

In developing the evaluation program this way, we made the IAB members customers of the team doing the project. The IAB members benefit from the system, since it reduces their workload during the evaluation meetings. It provides far better data collection for assessment, feeding back seamlessly into both the capstone project coordinator's grading system and the CS Department's assessment reporting system. Finally, it is a benefit to the students in the capstone project course, since it allows them to receive full feedback immediately rather than making them wait while manual forms are finalized, made anonymous, copied, and distributed several days after the evaluation meeting.

Construction Management Program Curriculum Content Derived from Industrial Workflow Processes

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EXTENDED ABSTRACT

Purpose

Construction Management Program (CMP) curriculum content is typically derived from institutional and program mission, historical evolution, accreditation criteria, and student, faculty, and industrial advisory inputs. Accreditation bodies assure that critical thinking and communication skills are delivered and/or content is delivered in broad topical areas. Accreditation emphasis is upon Program Educational Objectives (PEO) and their measurement. This paper challenges that practice. What are the PEOs based upon? How does a CMP ensure that critical and basic industrial competencies are delivered to students? How does a program track and control the teaching and delivery of these competencies amidst ever changing institutional requirements and individual course changes? This paper proposes that the answer lies in developing sets of competencies from industrial workflow processes which can then map a course or program's objectives and outcomes.

Methods

With critical and analytical thinking underlying the entirety of the educational objectives, this system can be modularized for allocating competencies across the curriculum (program). The premise of the paper's proposed model is as follows: Define and validate the work-flow processes of the industry segment, define the competencies required to accomplish the industrial processes (tasks), group these defined processes into modules for organizational and classification purposes, then develop course and program objectives based upon the competencies.

Conclusions

The technique provides a systematic method to allocate the scope of course and program content and competencies. Modularizing course content from the construction project life cycle ensures that comprehensive industrial career skills are offered in the construction management program curricula. This method gives validation to the competencies upon which course objectives should be based (in the Construction Engineering Technology context). Modularization also benefits the accreditation process as the sections can be labeled and weighted with accreditation criteria.

Ten Years Later: Teaching Mathcad as a Non-Traditional Programming Language

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The Citadel

EXTENDED ABSTRACT

To assess the changes over the past ten years in student use of Mathcad, a follow-up survey was conducted among sophomore, junior, and senior civil engineering majors at The Citadel. The survey was designed for comparison with a similar survey conducted in the fall of 1997, one year after a Computer Applications in Civil and Environmental Engineering course was first taught using Mathcad. The first survey showed a high level of student enthusiasm for Mathcad. According to the first survey, about 93% of the students were still voluntarily using Mathcad to develop solutions to problems one year after taking the course. Since approximately half the faculty who implemented the change to Mathcad have either retired or changed positions, and only a few students who currently take the course have had prior programming experience, it was important to determine if student utilization was still high. The second survey showed that 81% of the juniors and 87% of the seniors voluntarily use Mathcad, a level higher than achieved with any programming language used by the authors prior to the change to Mathcad. Since the first survey, student use of Mathcad for numeric computation has apparently increased and writing multi-line functions has decreased. Juniors and seniors taking the second survey overwhelmingly agreed that taking the course improved their ability to order steps in a problem solution and that the course improved their problem-solving skills. Seniors most often attributed their improvements in problem-solving skills to writing functions and tracking units while juniors pointed to writing functions and creating graphs. A survey of faculty administered in parallel with the student survey indicates that while 44% of the faculty members require Mathcad in assignments, 100% of the faculty reported receiving work from students who had voluntarily selected to use Mathcad. Despite the fact that over half the faculty are only somewhat familiar with the CIVL 209 course topics and use Mathcad no more than a small percentage of the time, students make frequent voluntary use of Mathcad where they employ a substantial range of the features taught in the computer applications course. The responses to the 2005 faculty and student surveys provide evidence that the students completing the Mathcad-based computer applications course acquire a wide range of computer-based tools and improved skills that serve them throughout their academic careers, a trend that has been sustained over ten years.

Student Engagement in Elementary Surveying

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EXTENDED ABSTRACT

Western Kentucky University (WKU) is a leading proponent of community engagement of civil engineering students. The teaching philosophy of the civil program focuses on project based learning, where the faculty is encouraged to seek opportunities to involve students in projects of community interest as well as private interest. This is accomplished by placing competent, practicing engineers with years of experience in the classroom as professors.

A project that involves students and provides a significant learning experience is the ultimate aim of this paradigm. For example, senior hydrology students at WKU developed a set of improved flood maps for Bowling Green, Kentucky. These maps expanded the flood zones and added several buildings to the floodplain. Some of the residents affected allowed WKU access to their property for the study. This meant that if they had a mortgage on their home, they were now required to have flood insurance costing at least a few hundred dollars per year. To appeal the decision, they would need a licensed surveyor or engineer to prepare an elevation certificate for their property. The cost would be no less than a few hundred dollars.

Flood insurance rates are determined from the elevation certificate by comparing the flood elevation to the height of the lowest floor of the building. Several teams of students performed the same survey so that results could be compared. Most of the teams agreed on the critical elevations within a few millimeters, but some had blunders with errors of more than a meter. Students were pleased to have a realistic lab exercise. Property owners were pleased to have their flood insurance uncertainty removed. The faculty was pleased to have students engaged in a meaningful engineering project. Everyone won.

Teaching Design Throughout the Civil and Environmental Engineering Curriculum

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EXTENDED ABSTRACT

The Accreditation Board for Engineering and Technology (ABET) has promulgated criteria for accrediting engineering programs in the United States under the heading ***ABET Engineering Criteria 2005-2006***. Criterion 2 provides for each institution seeking accreditation or re-accreditation to have in place a published list of educational objectives that are supported by a curriculum and process of ongoing evaluation that demonstrates achievement is met along with continual efforts to improve program effectiveness. Criterion 3 provides outcomes that every accredited engineering program must demonstrate that their graduates meet, using a process of assessment. These program objectives are commonly referred to as "a" through "k" outcomes. More specifically, category "c" stipulates that each graduate have the "ability to design a system, component, or process to meet desired needs." In concert with ABET's criteria, the American Society of Civil Engineers (ASCE) has published ***Civil Engineering Body of Knowledge for the 21st Century—Preparing the Civil Engineer for the Future***. This publication has been referred to as the "Body of Knowledge" (BOK) by ASCE's Committee on Academic Prerequisites for Professional Practice. It contains what should be taught and learned, and incorporates the eleven "a" through "k" ABET outcomes while adding four additional ones addressing technical specialization, project management, construction, asset management, business and public policy and administration, and leadership. The BOK further delineates what level of competence a student is expected to achieve for each of the fifteen outcomes from either a Bachelor's Degree program plus a Master's Degree (or 30 hours plus experience) (**B+M/30**), additional experience, or additional post-licensure education and experience. The BOK indicates that the "design" outcome can be met where a student can "recognize" and "understand" design as a result of completing requirements for **B+M/30**, while the ability to design is achieved with additional experience.

This paper examines what constitutes engineering design and how it is influenced by communication skills, team work, social, environmental, political, and sustainability issues within an undergraduate academic environment. In addition, this paper focuses on how engineering design can be incorporated into a curriculum with the goal of achieving the intended ABET and ASCE-BOK outcomes through evaluation of individual courses typically offered in an undergraduate Civil and Environmental Engineering program, and means to track design related topics through the curriculum to ensure continuity and completeness. Assessment of student learning throughout the curriculum is included, with specific examples taken from The Citadel's undergraduate Civil and Environmental Engineering program.

Transportation Systems Curriculum for High Schools

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EXTENDED ABSTRACT

This paper presents the development of a transportation systems curriculum for high schools. The purpose of the curriculum is to educate juniors and seniors in high school about transportation systems in a non-intimidating and exciting way, and to motivate and prepare them to study a transportation systems related discipline (e.g., civil and construction engineering, operations systems management) in college. Its development and implementation is funded by the University Transportation Center for Alabama (UTCA) and The University of Alabama (UA). The UTCA conducts transportation education, research, and technology transfer activities using faculty members and students from UA, The University of Alabama at Birmingham, and the University of Alabama in Huntsville. The UTCA was created by a resolution of the Board of Trustees of The University of Alabama System. The driving force that activated the UTCA was the Transportation Equity Act for the 21st Century (TEA21), which established the UTCA as a University Transportation Center of the U.S. Department of Transportation. Upon approval of its Strategic Plan by USDOT, the UTCA officially began operation on March 15, 1999 (http://utca.eng.ua.edu/about/).

The transportation systems curriculum will initially be implemented in five Alabama high schools having large percentages of underrepresented populations both unaware that transportation systems is an area of study in college and needing further preparation while still in high school for studying transportation systems or a related field in college. The curriculum includes learning modules covering introductory topics in highway and mass transit issues, the role of transportation in society, mobility issues, urban growth patterns and transportation, efficient and safe transportation, and ethics in transportation, each with a focus on their systems aspects. It will be taught during parts of the semester of an existing elective course. The curriculum will be delivered using highly portable computer software developed by the authors either downloadable from the internet or on a CD, which means that the curriculum will be widely available to high schools throughout the U.S. The internet download and CD will also include lecture material (i.e., PowerPoint slides and handouts) to accompany the modules and a software tutorial developed by the authors for high school faculty to self-learn the curriculum. Included as part of the curriculum are university recruiting materials, which will consist of general university information, application and scholarship information, descriptions of transportation systems and related majors, and a list of courses to take in high school to prepare for studying transportation systems or a related field in college.

State-of-the-Art: Law Enforcement Surveillance Impact on Construction Zones

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University of Southern Mississippi

EXTENDED ABSTRACT

Maintenance and construction programs are arguably one of the most important functions of States DOT (as represented by the percentage of the budget invested). Maintenance and construction programs have a direct impact on the economic development, improve quality of life of the citizens, increase people productivity and increase accessibility to locations.

On the other hand during the construction period, there are temporarily traffic disruptions, which increase the number of accidents with associated deaths and injuring thousand of people every year. It is estimated that every year over 1000 people are killed and over 40,000 people are injured nationwide in work zones [Safe Roads 2003]. Therefore, several states have taken a proactive role in implementing special measures in construction zones to reduce number of accidents. One of these special measurements is the increase of law enforcement surveillance in construction zones.

The work presented herein is a part of a project funded by the Mississippi Department of Transportation to determine the safety effectiveness of increased law enforcement surveillance in construction zones in Mississippi. More specifically, this paper presents a series of assessments done nationwide to measure the impact of law enforcement in construction zones. The content of this paper was them used as the foundation to establish the method to determine the impact of law enforcement surveillance increase in Mississippi.

This work followed a descriptive research methodology with a systematic literature review performed in the databases of the following organizations: Transportation Research Board (TRIS), Federal Highway Administration (FHWA), American Association of State Highway and Transportation Officials (AASHTO), National Highway Traffic Safety Administration (NHTSA), Transportation Research Board - Research In Progress (TRB-RIP), The National Work Zone Safety Information Clearinghouse (WZSRD), American Traffic Safety Services Association (ATSSA). The results presented in this paper could be used as the foundation for similar studies in other states and it has the potential to directly benefit construction education by serving as an example of good practice in engineering education.

The BEST Approach to Middle and High School Outreach

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EXTENDED ABSTRACT

BEST Robotics is a non-profit Middle and High School outreach program that was founded in Sherman, Texas in 1993. BEST, which stands for Boosting Engineering, Science, and Technology, seeks to generate vocational interest in the fields from which its name is derived. BEST has grown to include 28 local competitions and three regional competitions scattered across 13 states; over 9,000 students participated in BEST in 2005.

BEST competitions incorporate open-ended projects that provide realistic perspectives into the engineering development process; teams face time and resource constraints as they design and construct remotely-controlled robots to meet a challenging set of objectives. At the start of each local competition, teams are provided with a new set of objectives, a collection of raw materials, and an inspection of the game-specific arena where the competition will be held. Teams are then given six weeks to prepare for a sports-tournament-styled competition complete with mascots, cheerleaders, and bands. As teams weigh their design alternatives, they must also plan strategies that will enable them to earn the most points in an environment that is not entirely predictable or under their control. Some scoring opportunities require cooperation between competing teams, but varying strategies must be employed since team pairings vary from match to match and team standings vary throughout the competition. Teams are strongly encouraged to form a cohesive group of students with a diverse set of skills—teams must be able to apply technical knowledge in an effective manner, but they must also possess good communication and teamwork skills. These skills are, of course, the very same skills that employers frequently identify as the skills their technical employees need to possess.

This paper summarizes the history and present extent of BEST Robotics, especially as it relates to states in the Southeast. It describes the general structure of the competition and the specific objectives that have defined the most recent competitions. It identifies the resources that are needed to conduct a successful competition, and it describes the procedure for starting a new competition site. The paper concludes by discussing the impact that BEST is believed to be producing.

PH Grade Assist: Homework in the Twenty-First Century

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EXTENDED ABSTRACT

PH Grade Assist (PHGA) is an internet-based application supported by Prentice Hall (© 2005 Prentice Hall, Inc., a Pearson Education Company, Upper Saddle River, New Jersey 07458). It is accessible by instructors and their students through a web site. The web site allows instructor access to resources accompanying Prentice Hall engineering, scientific, and mathematical texts. Instructor access includes many hundreds of problems lifted from previous editions of the texts, converted to electronic form. These electronic files have been developed in a format that allows interactive use. The instructor can select from among these files to form an assignment, which is then available for student access. There are many ways in which a given assignment can be configured and assembled. The final result is an on line assignment accessible by students.

An unusual feature of PHGA allows some, or all, of the values given with a problem statement to take on differing values. The differing values appear when the problem is viewed or attempted multiple times. Use of this feature enabled the instructor to assemble and present to students on line homework assignments which were individualized. This capability was included in the implementation and is discussed in detail. Additional capabilities of PHGA include automatic grading.

This paper describes an implementation of PHGA in an undergraduate Dynamics course. This experience with PHA occurred at The University of Tennessee at Martin – during the Fall 2004 and Spring 2005 semesters. Initial difficulties as well as subsequent adjustments and successes are discussed. The instructor's belief in the educational value of individually worked homework assignments was a primary motivating factor in carrying out the implementation.

"The New 3-D Printer is Here, What Do We Do Now?" Rapid Prototyping in the Undergraduate Engineering Environment

H. Joel Lenoir

Western Kentucky University

EXTENDED ABSTRACT

Rapidly declining prices are making rapid prototyping machines increasingly attractive to undergraduate engineering education. Western Kentucky University has been using one of the smaller 3-D printers for nearly two years in the Department of Engineering. Although other rapid prototyping machines have been available on campus in the past, this is the first machine widely available for student use. The machine has had a profound impact on the design skills of the students. They now view prototyping as an integral phase of the design process, whether virtual or rapid prototyping. However, use of the machine has revealed some unexpected problems when included as a tool available to the student. For instance, the motto "think it, draw it, print it" has led to designs that can only be made on the 3-D printer. Problems such as this and the resulting opportunities for student learning are included.

A MathCAD Function Set for Solving Thermodynamics Problems

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EXTENDED ABSTRACT

A set of MathCAD functions was constructed to evaluate the thermodynamic properties of steam, R-134a, air, and twelve ideal gases. The functions were created to ease the need for time-consuming interpolation using tabularized thermodynamic data while reinforcing the functional representation of traditional thermodynamic property tables. A consistent and easily remembered scheme has been adopted for naming the functions. An example is provided to demonstrate the use of the functions in an undergraduate applied thermodynamics course. The example seeks the reheat pressure that maximizes the efficiency of a Rankine-reheat power cycle provided fixed boiler and condenser pressures. The example is presented in its entirety in the appendix to demonstrate the report-quality worksheets possible using MathCAD. While the example provided represents a use of the functions in an undergraduate applied thermodynamics course, the functions have also been used in an internal combustion engines course and in a turbomachinery course. Survey results from three courses and several student comments are discussed.

Project-Based Learning of Engineering Design and Graphical Communication

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EXTENDED ABSTRACT

Retention of engineering students from the freshmen year to the sophomore year is a concern of many engineering institutions. Also of concern is the ability of students to take knowledge learned in one application and transfer it to another application. To address these issues, the Engineering program at the University of Tennessee at Chattanooga (UTC) has recently redesigned its freshmen introduction to engineering design course (IED) to excite students to independently learn, to create an environment for peer learning, to increase student in-class and out of class participation, and to emphasize and connect the role of graphical communication in the design process. It is believed that these objectives are instrumental for exciting students about engineering, for increasing student retention, for motivating learning, and for improving students' knowledge transfer capabilities especially in the application of engineering design.

To meet these objectives, the IED course has introduced (1) the use of 3D modeling software in the design process and (2) an instructional structure that embodies Project-Based Learning (PBL) concepts. PBL is a pedagogical model for teaching design that integrates divergent and convergent thinking in real world applications. PBL encourages students to assume responsibility for their learning by shifting from passive learning to active learning. The traditional lecture-based teaching approach is minimized to allow students to experience, reflect, then reapply.

This paper presents the PBL process initiated by the engineering program at UTC in the Fall of 2005 that introduces design and graphical communication in the freshmen year. Descriptions of the course objectives as well as projects and assignments are provided. How students use technology, specifically, computerbased systems such as SolidWorks software and prototyping, to enhance learning is also discussed.

An Experience of a Course Management System in Construction Scheduling Framed Within TAC-ABET Accreditation Criteria

Tulio Sulbaran, Ph.D
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EXTENDED ABSTRACT

The delivery media used in construction engineering technology (as in many other majors) in higher education is evolving to take advantage of new information technology resources. However, there is lack of data supporting the educational impact of these new information technology resources in construction and engineering education.

The work presented herein describes an experience in implementing one of the many information technology resources available - Course Management System (CMS). The CMS was implemented in a construction scheduling class and its evaluation was framed within TACABET criteria to support the accreditation process.

This work followed a qualitative research methodology. The construction scheduling content was disseminated to the students using the CMS during a complete semester. At the end of the semester the students received a survey that was developed to mainly assess the impact of CMS on the students' ability to demonstrate Criterion 1 of the TAC-ABET accreditation.

The results from the evaluation indicate that the students benefit from the CMS and that this type information technology resource can be used to support the TAC-ABET accreditation process. Therefore, the work described in this paper has the potential to directly benefit construction education and serve as an example of good practice in engineering education.

Using Multimedia Case Studies as Teaching Aids for a Discrete Event Simulation Course

Scott R. Schultz
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Extended Abstract

In an applied introductory Discrete Event Simulation course, students learn the mechanics of developing simulation models and how those models can be used to analyze and improve processes. Often models are developed from word descriptions of manufacturing or service processes. The problems are also intentionally simplified to facilitate students who are being exposed to simulation for the first time and who also have varied backgrounds and experiences. In order for a more complex, real-world process to be assessed, students need a common understanding of or exposure to the process under study. The best method to assist with this leveling of student understanding is to have students spend time viewing the process. However, this is not always practical in a classroom setting. Therefore with the help of several students, I developed a multimedia case study for my Discrete Event Simulation course. The case study is hosted on a frames-based web environment, and includes numerous pictures, drawings, a movie file, and a simulation model with animation. In this paper I discuss the rationale for using a multimedia approach, the advantages of the multimedia approach, and students' reaction to the multimedia case study.

Financial Analysis of Industrial Engineering Capstone Design Projects

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Mississippi State University

Extended Abstract

This paper presents the development of the financial analysis process for industrial engineering capstone design projects at Mississippi State University. In Design of Industrial Systems, project teams perform a comprehensive venture analysis of a manufactured product, including market analysis, site selection, process analysis, methods analysis, material handling, facility layout, and financial analysis. Early in the semester the client (instructor) provides a letter of authorization to the project teams in which project requirements are formally transmitted, including the financial analyses that are expected. The projects culminate with oral presentations to a group of practicing engineers and managers, who evaluate the projects for the client. The involvement of a corporate development director to bring the reality of corporate venture analysis to the financial

Sparking Interest in Middle and High School Students Using a Robotics Competition

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EXTENDED ABSTRACT

For the past three years, The Citadel's Department of Electrical and Computer Engineering has held a Lego robotics baseball World Series where local area schools and Citadel freshman design autonomous baseball-playing robots to compete against each other during Engineers Week. Three distinct groups enter the competition: middle school students, high school students and The Citadel's college freshman. The primary purpose of the event was to provide an exciting and engaging competition where students could learn aspects of engineering design, robotics, machine intelligence, and programming. Secondary objectives were to bolster excitement for electrical and computer engineering in general, and The Citadel's ECE Department in particular. Over the past two years, changes in the promotion and the logistics of the competition have resulted in improvement of both the quantity of participants and the quality of the robots. This paper outlines the competition, the lessons learned in hosting the event, and future plans.

A Very Functional Transistor Circuit to Demonstrate Biasing, Voltage and Current Gains, and Frequency Response

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EXTENDED ABSTRACT

Over the last four years The Engineering Technology Department at The University of Memphis developed a very functional and easy to use transistor circuit to demonstrate almost every aspect of transistor circuit operation. It is a common emitter amplifier with a standard four resistor bias network with easy to calculate base, emitter, and collector voltages. All the resistor values are common, off the shelf values. Almost any NPN small signal transistor will work. A 2N3904 was used, but the transistor selection is not critical. When the circuit is built, the measured bias voltages always compare favorably to the calculated voltages. The calculated and measured voltage and current gains at mid band frequency also always compare favorably. The gains are high enough to be meaningful, but low enough to not cause oscillations. The Bode plot of the frequency response is also easy to do and verify. There are two low frequency cutoffs which are almost equal and one high frequency cutoff. When this circuit is used, the students get to analyze and test it very thoroughly. From biasing, to mid band frequency gains, to frequency responses, students get to work with a circuit that really shows all these things. By learning how to analyze and build one circuit very well the students gain a firm foundation on which to build their understanding of solid state circuitry.

Consolidating Design Experience Through Product Development

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EXTENDED ABSTRACT

Engineering education starts with the formal training in the physical sciences and mathematics, which are usually completed in the first three or four semesters of a four year undergraduate program. Engineering curricula are designed to lead the students from the basic sciences background to engineering body of knowledge through lecture and laboratory exercises. Over the years, the acquisition of formal engineering design skills by undergraduate students has been emphasized in addition to the development of soft skills. To make sure that these skills are acquired at the time of graduation, most undergraduate engineering programs have adopted the Capstone Design Project (Senior Design project) as a requirement for graduation. In this paper, a senior design project, which consolidates design experienced through product development, is presented.

The project undertaken by the students was the design and development of a prototype dc-dc converter for the automobile industry. The product development process took the students through the iterative process of design and development. A broad knowledge base was necessary for the completion of the project. Knowledge gained from courses such electronics (digital and analog), circuits, communications, materials, engineering methods and design, and electromagnetics were utilized. Computer aided design tools, which included EWB MultiSim, MATLAB, and AutoCad were used in simulation and analysis. Other skills such as budgeting, teamwork, time management, documentation, and presentation were all horned during the process to consolidate the students design experience.

The product developed satisfied the functional specifications given to the students. From economic considerations, the budget and the unit cost were achieved. The results of the analysis and evaluation of the product show promise for future development of an efficient, low weight, low cost, and compact dc-dc converter for specific use in automobiles. From the experience gained, the students were able to make recommendations for improvement of the product.

An Art Class for Engineers

Arthur David Snider

University of South Florida

Extended Abstract

An exposure to the arts is an essential part of every undergraduate's curriculum, but we feel that the course offerings adopted by most universities to acquaint their engineering students with the fine arts fail to meet their objective. Herein we describe a different type of fine arts course for engineering students which approaches the subject matter through an avenue that they can see as valuable and empowering. The key objectives of the course are to approach the subject of fine art from a perspective where technology-oriented students would have an advantage, rather than a handicap; to exploit the experience so as to reinforce some aspect of engineering science by reviewing it in a new context; and to place the engineering students in an environment composed mostly of others in the same discipline.

Talking & Working for Diversity When You Don't Belong to a Minority Demographic

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Dave C. Swalm School of Chemical Engineering
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EXTENDED ABSTRACT

Have you ever encountered a situation related to diversity that you were unsure how to approach, so you did nothing? Does the fear of not handling situations in the perfect "politically correct" manner keep your department from addressing the needs of students from different backgrounds? Have you noticed a segregation of races / demographics in your program or any adverse trends that affect one demographic more than another? For example, have you noticed African American students sit in one corner of your classroom and not be included in leadership roles in student organizations? Have you ever overheard a student telling another that they will surely get a job because they are a minority? Have you ever seen indicators ignored because colleagues just don't want to believe adverse situations persist in this day and age?

In this paper, two faculty members openly discuss their experiences of talking and working for diversity in their roles as NOBCChE (National Organization for the Professional Advancement of Black Chemists and Chemical Engineers) and AIChE (American Institute of Chemical Engineers) faculty advisors, respectively. These discussions are augmented by the perspective of a senior, African American, Chemical Engineering student. This paper will provide resources for people who do not necessarily belong to a minority demographic, but who are committed to mentoring students from underrepresented minority groups. Discussions include how to a) develop a reputation for being approachable, b) develop credibility as a source for sound advice, c) talk with students about their perceptions, d) obtain feedback on climate in classes, etc., e) learn about background / circumstances that can adversely affect the journey to an engineering degree, and f) proactively improve perceptions and climate for future students.

It is vital to the future of our society that individuals from diverse backgrounds and experiences excel in the engineering profession. While those of us who do not belong to a minority demographic might feel intimidated to take a proactive role in encouraging and mentoring towards a healthy, diverse, climate in engineering, this paper strives to open a dialogue, potentially dispel paradigms, and provide starting resources to accomplish this very goal.

Using Case Studies to Bring Real World Situations into the Engineering Course Learning Environment

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EXTENDED ABSTRACT

Case studies are a primary teaching tool in disciplines such as business. In this context, case studies are based on real events or hypothetical scenarios, and are designed to illustrate key points through the analysis of business management situations. This paper presents observations from a trial implementation of using case studies as the primary learning tool for a course in the fall of 2005. The purposes of the paper are to provide an example for others considering this approach and to present the lessons learned.

The students studied four different situations that are typical of projects done by a consulting or plant engineer in industry. Each case was presented during an initial information class meeting and the students worked on the analysis and design necessary to complete the assignment over a period of several weeks. Students were required to write their results in the form of a report that mimics one that would be completed for a consulting firm's client. A survey of students taken near the course midterm indicated that they enjoyed the course more and felt a greater connection between the cases studied and real situations they will encounter in a professional job. A follow-up survey taken at the end of the semester confirmed these findings and results are reported here. The students also recognized other lessons learned from the course structure helped them to be more efficient with their time, to communicate their results effectively in a professional style, and to recognize the need to avoid the pitfall of procrastination.

Although the case study concept can be applied in any discipline, in an engineering program it may be better suited for use in upper level courses that tend to be more application-oriented. Suggestions are presented on how to structure engineering courses to include case studies as a core pedagogical tool.

USFKAD: An Expert System for Partial Differential Equations

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EXTENDED ABSTRACT

The execution of the solution, by the separation of variables process, of the Poisson, diffusion, and wave equations (homogeneous or nonhomogeneous) in rectangular, cylindrical, or spherical coordinate systems, with Dirichlet, Neumann, Robin, singular, periodic, or Sommerfeld boundary conditions, can be carried out in the time, Laplace, or frequency domains by a decision-tree process, using a library of eigenfunctions. We describe an expert system, USFKAD, that has been constructed for this purpose. The user follows a menu to enter his/her choices and the output is a LaTeX file containing the formula for the solution together with the transcendental equation for the eigenvalues (if necessary) and the projection formulas for the coefficients. The file is suitable for insertion into a book or journal article, and as a teaching aid. Virtually all cases are covered, including the Mellin, spherical harmonic, Bessel, modified Bessel, spherical Bessel, Dini, Hankel, Weber, MacDonald, and Kantorovich-Lebedev expansions, mixed spectrum, and rigid body modes. The system is downloadable from the author's Web site: http://ee.eng.usf.edu/people/snider2.html .

Using the Great Teachers Model for Engineering Technology Faculty Renewal: A Strategy that Works

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EXTENDED ABSTRACT

Faculty renewal in Engineering Technology is a constant challenge. With continuous demands placed upon faculty in the areas of teaching, scholarship, and service, administrators frequently search for ways to keep their colleagues informed. The newly formed School of Technology at Western Carolina University recently engaged in a groundbreaking activity for the institution. A Great Teachers Retreat was planned and implemented recently for all members of the school. Based upon the National Great Teaching model founded in 1969 by David Gottshall, the retreat allowed members of the Engineering Technology faculty to gather at a location away from the university campus to celebrate great teaching.

There have been many successful adaptations of the original *Great Teachers* model and all of those surround Gottshall's original purpose of "rigid minimal structure." Rigid minimal structure assures that there is a dependable and identifiable set of practices in place for the retreat and assures that each retreat will be unique because of the particular combination of people, values, and expertise represented. The quintessential element of all *Great Seminars* is not discipline specific, but intensely focused on the art of teaching.

The success of the National Great Teaching model is evidenced by Gottshall's motto of "less is more." Notably, there is no head office or national director, no telephone, how-to manuals, dues, or handbooks. Most importantly, since there is no ownership there are no egos nor power struggles. Rather, the success of the Great Teaching model is based upon the celebration of great teaching by great teachers.

This paper will highlight the history, purpose, premises, format, and processes associated with the *Great Teachers* model, and specifically their application to the Engineering Technology Great Teachers Retreat at Western Carolina University. In addition, an analysis of its application and outcomes is also included.

Implementing a National Competition Design Project as a Capstone Course at Middle Tennessee State University

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EXTENDED ABSTRACT

The Engineering Technology and Industrial Studies department at Middle Tennessee State University offers as a choice for the senior level capstone course the chance to participate in a national design competition. The latest addition to the choice of projects was the Society of Automotive Engineers Mini Baja Series.

Engineering students are tasked to design and build an off-road vehicle that will survive the severe punishment of rough terrain and in the East competition—water. This involves the planning and manufacturing tasks found when introducing a new product to the consumer industrial market. Teams compete against one another to have their design accepted for manufacture by a fictitious firm. Students must function as a team to not only design, build, test, promote, and race a vehicle within the limits of the rules, but also to generate financial support for their project and manage their educational priorities. For this project, seniors were given course credit for leading teams of freshmen and sophomores in the design and construction of a Mini Baja off-road vehicle.

The seniors learn leadership and project management skills, and exercise their engineering creativity. The freshmen and sophomores gain lots of experience and can see the engineering principles they are being introduced to put in to practice. When the freshmen and sophomores become seniors they are able to put all of those hands on experiences and class room learning into leading their own teams to design a new and improved vehicle. This cycle will continue, producing skilled, competitive students ready to enter the workforce. The department also benefits from increased retention and recruitment.

Biomedical Engineering Technology as an Option in EET

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EXTENDED ABSTRACT

The ECET department at Southern Polytechnic State University (SPSU) is considering the introduction of Biomedical Engineering Technology (BMET) as an option under its Electrical Engineering Technology (EET) program. The health care industry forms a major segment of the U.S. economy with spending expected to surpass $2 trillion in the next decade. Biomedical devices represent one of the fastest growing segments of the health care economy. Though there are currently many Biomedical Engineering programs, few Biomedical Engineering Technology programs have been developed to address the need for qualified technologists in this filed. With a solid track record of producing highly qualified graduates for the electrical/electronics industry, EET program graduates receive a broad-based hands-on experience that encompasses circuit analysis and design, digital electronics, electronic devices and systems, telecommunication circuits and systems, data communications, signals and systems, controls, and electrical machines. The program provides an excellent framework for the introduction of the BMET option. The primary objective for the BMET option would be to produce graduates that will have the requisite skills for a successful career in the biomedical engineering/technology field. This paper examines some of the issues and considerations for the proposed development of the BMET option.

Development and Implementation of an Introductory Course on Engineering and Public Policy

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EXTENDED ABSTRACT

The need for engineering students to have a better understanding of public policy issues is clear. Studies by the National Academy of Engineering and anecdotal evidence from engineers in government indicate that engineering students neither fully understand nor appreciate the public policy issues involved in most technical issues. Furthermore engineering students do not always appreciate the methods by which policy decisions are reached. Similar issues also exist on the other side of the debate; political science students and others involved in policy decisions do not always understand and appreciate the engineering aspects of the decisions they make. Bridging this gap requires education of both political science and engineering students, but there are few, if any, undergraduate courses available to accomplish this important task

At Mississippi State University, the James Worth Bagley College of Engineering and the Department of Political Science and Public Administration in the College of Arts and Sciences joined forces and developed a course, specifically for undergraduate engineering and political science students that provides a foundation for policy analysis. The course is supplemented with engineering case studies, a review of policy institutions, and the role of values and ethics in making policy decisions. In class, technology issues related to public policy are covered and discussed in the setting of policy decision-making. Through discussion and assignments, engineering and political science students are exposed to each other's thought processes, further bridging the gap between engineering and the social sciences. The course covered five interlocking modules: 1) The policy process; 2) American public policy institutions; 3) Ethical aspects of public engineering decisions; 4) Application of public policy considerations to specific engineering topics such as environmental protection, telecommunications, homeland security, etc.; and 5) a capstone legislation oversight hearing simulation.

This paper discusses the development of the Engineering and Public Policy course, how communication skills, ethics, and values were integrated into the class. Findings are presented which demonstrate that a deeper understanding of the policy process was achieved by the students and a better understanding of the seemingly disparate professions was realized. Finally, a plan is outlined that will build upon this foundation course and offer several other courses which will provide interested students the opportunity to develop their skills and expertise in the area of engineering and public policy.

Image Summer Bridge: A Model of Recruitment and Retention of Students of Color in Science, Technology, Engineering, and Mathematics

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EXTENDED ABSTRACT

Increasing Minority Access to Graduate Education (IMAGE) gives undergraduates who show potential for graduate study and early exposure to and preparation for scientific study and research. IMAGE incorporates many programs designed to assist and support students throughout their undergraduate education. The programs nurture the holistic development of IMAGE students and substantially increase the likelihood of them pursuing a graduate research degree.

For the past ten years, the IMAGE program has evolved into a vital component in increasing the number of students of color in science, math, engineering and technology. One of the primary goals of the program is to create a seamless system beginning at the K-12 level. Once students have enrolled in college, the program continues with a support system to assist them in their progression throughout their collegiate years. Since it inception, over 1000 students have participated in the IMAGE program and hundreds have participated in the summer bridge program.

This research study sought to examine the recruitment and retention strategies of the IMAGE program at Mississippi State University. Furthermore, the conclusions drawn from this study were based on findings gathered over the past ten years and have been used to further enhance the recruitment and retention efforts of students of color at MSU.

Multi-Media Interactive Self-directed CAD Application Tool for the Building Construction Student

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EXTENDED ABSTRACT

This paper presents multi-media, online, interactive, self-directed set of CAD instructions to assist students at East Carolina University in the learning and utilizing CAD applications related to the building construction. These instructions provide the students with the CAD skills applicable to architectural and construction graphic applications. The instructions include video-clips, which were built from AutoCAD screen captures and imported to Camtasia software. These video-clips were enhanced with pop up written instructions, voice instructions, and warning messages. The multi-media files were also linked to self-directed written instructions to assist students in the learning process. The large size media files were place on the university server and hyperlinked to the course site on the Blackboard. The CAD instructions were used at “Fundamentals to Construction” course for the Construction Management students at East Carolina University. The students were asked to use these instructions to complete twenty structured assignments. The assignments were designed to prepare the students for essential CAD skills such as communicating and printing CAD files, preparing and modifying CAD drawings, importing and exporting CAD files to other building construction related software, using Auto CAD for surveying, quantity takeoffs, and other related subjects.

The students were allowed to complete the structured assignments at the computer lab, home, the university library, or at any other location were they have access to the required software and a high-speed Internet connection. List serve and discussion group sites were also used to allow the students to post questions and share information. The CAD Instructions allowed students to work on their own speed and without a direct supervision. Since some of the students have some CAD experience from high school while others do not, the students were not required to comply with one deadline to submit assignments. The students who were ahead in completing their assignments were also challenged to complete more advanced CAD assignments. The outcome of these CAD instructions was outstanding. The course in which these tools were used had obtained the highest score at the university level in the Students Opinion of Instructors Survey. These instructions saved much for the class time for other class activities. The CAD instructions also provided tutorial and reference support to other Construction Management classes.

Integrated Laboratory Instruction on CAD/CAM and Robotics at MUSE

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EXTENDED ABSTRACT

In this paper, how the manufacturing laboratory facilities, and design/automation hardware and software available are effectively integrated to teach Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), CAD/CAM integration, measurement and inspection using Coordinate Measuring Machine (CMM), and robotics with appropriate hands-on experiences at MUSE are presented and discussed. The following three modules developed and taught, and the results obtained from the student teams are presented, analyzed, and discussed.

CAD/CAM and CMM Module

The objective of this module is to train the students to design, fabricate, and measure a simple part using the knowledge they gained in the manufacturing processes course, ISE 370 which is offered in the Fall Semester of the junior year. This module is open-ended and consists of three sub-modules (design - CAD, fabrication – CNC machining center, and measurement - CMM) with appropriate instructions. A Mickey Mouse designed, fabricated, and measured by a three-member student team is presented and discussed.

Design and Fabrication of Spline (DFS Module)

This module is designed and taught to the students in the Computer Assisted Manufacturing Systems (ISE 424) course during the Spring Semester of the junior year. It consists of designing a spline with 6, 8, or 12 grooves using one of the design software packages such as AutoCAD or Pro-Engineer, making the spline using the rotary axis of the CNC machining center, measuring certain dimensions of the part made, and making an error analysis. The design, fabrication, and measurement of a spline with 12 grooves made by a student team is presented and discussed.

A Sample Laboratory Experiment in Robotics

Robotics (ISE 429) course is offered in the senior year as an elective course. A student team of four in this course programmed the CRS A255 robot arm to simulate a kindergarten student painting the first letter of four students' first names, spelling "KATE". The design of fixtures, the major robot movements to create "KATE" in different colors, and the process flow diagram are presented, analyzed, and discussed. Typical laboratory modules on CAD/CAM and CMM, design and fabrication of a spline, as well as the experiment in robotics presented and discussed in this paper clearly shows the learning opportunities provided to the students. The effective use of theory classes, design and manufacturing lab facilities, and co-op opportunities available at MUSE, provide the students the needed expertise and prepare them well to meet the challenges in the industrial workplace.

Information Literacy: A Critical Component in Engineering Practice in the Twenty-First Century

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EXTENDED ABSTRACT

As available information proliferates, the necessity of being able to correctly select, interpret, and measure the "goodness" of the information, and therefore how much it should be relied upon, becomes more and more critical to all fields, but especially to the practice of engineering. However, this is a skill which is not taught or stressed in many engineering education programs today. Ranging from when, or whether, a certain method or process or theorem is applicable to a hypothetical problem in the classroom, to what sources of data and what software simulations should be used to estimate hardware failure probabilities in crisis situations such as the Columbia space shuttle disaster, the ability to select, evaluate, and apply the best available information is critical to success. Yet while most engineering educators and practitioners would agree that this is a vital skill set, the burdens of assessment required by ABET EC2000 have led some programs to concentrate almost exclusively on the ubiquitous ABET a-k. The question then arises as to how, or whether, information literacy fits in with the current ABET accreditation requirements. Also, in an era when more and more state legislatures and university administrators are reducing the number of hours engineering programs are allowed to include in their graduation requirements, educators reasonably ask how anything else can possibly be squeezed into already time-crunched programs. This paper presents common standards of information literacy, a discussion of why it is necessary to engineering study and practice, how information literacy meshes with current ABET requirements, and how it can be incorporated into existing courses without an undue burden on faculty or students. The conclusion is that information literacy is more than a necessary element of education: it is the very *essence* of education.

Aerospace-Focused Multidisciplinary Project-Based Introductory Engineering Course

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EXTENDED ABSTRACT

Introduction to Engineering (EGR 101) is a multidisciplinary, project-based, two-semester-hour course for first-time students in all the engineering disciplines at the Daytona Beach campus of Embry-Riddle Aeronautical University (ERAU–DB). The course is part of the common first-year experience for students in all programs offered by ERAU–DB's College of Engineering (COE); it replaced the degree-specific introductory courses previously taught in the individual programs. The goals of EGR 101 are to introduce students to the multidisciplinary nature of engineering practice in the aerospace fields, to motivate students to succeed in engineering at ERAU–DB, and to facilitate students' development as engineers. EGR 101 incorporates and emphasizes interrelated multidisciplinary projects performed in teams, including several substantial, comprehensive, and challenging design projects. The aerospace-focused projects involve designing a space launch system, parts of an imaging satellite, and an aircraft. The projects emphasize the systems integration intrinsic to multidisciplinary design: For example, the launch system project including sub-projects to design the launch vehicle (Aerospace), the ground support systems (Civil and Mechanical), and launch sequencing hardware and pseudocode (Computer and Software), as well as the necessary Systems Engineering to integrate the various sub-projects. The satellite project includes analysis of the satellite orbit (Aerospace), design of the satellite power system (Electrical), and design of a digital imaging system (Computer). Additional course features include content harmonization with mathematics and physics classes; role-playing ethics investigations; an emphasis on professional development, resume building, and internships; implicit learning communities; and course delivery through a combination of twice-weekly section meetings with weekly assemblies. This paper describes the development, delivery, and assessment of EGR 101 by a team of engineering educators from the relevant disciplines.

Projects and Deliverables Used in a Freshman Engineering Design Course

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EXTENDED ABSTRACT

The Introduction to Engineering Design Course at Mercer University's School of Engineering is taken predominantly by first-year students, but also by the majority of transfer students. This course introduces the concept of a design process, presents techniques used to evaluate designs and design options, and develops the foundation for the capstone two-semester senior design sequence. The Introduction to Engineering Design Course consists of two structured design experiences solved by student teams. The first design project is a toothpick bridge which the students solve in six weeks. In this project, students attempt to build the most efficient bridge. Bridge efficiency is measured as the ratio of weight supported to weight of the bridge. Student teams spend the remaining nine weeks of the semester working on one of six different vehicle-type projects. These vehicular projects include a boat, an amphibious vehicle, a ramped-course vehicle, a cable car, a flat-course vehicle, and a tug-of-war. The course culminates in a field day during which the student teams compete against each other in a double elimination contest. Competitions are conducted in a head-to-head format. In the majority of the competitions, the vehicles advance at each other and ultimately collide. The exception is the tug-of-war, which uses a running start. The winning vehicle is the one to cover the greatest distance. This head-to-head format has produced more creative designs than the speed based (timed runs) competitions used previously. Both the toothpick bridge and vehicular projects are constrained by limiting the supplies available to achieve the project specifications. Project kits are prepared and provided to the students so that all teams are working with the same supplies. Students are graded based on written and verbal presentations of design reviews and their individual contribution to the team's efforts.

A difficulty encountered in many freshman-level design courses is that the students do not possess the engineering tools that would typically be used to evaluate a design prior to construction. Mercer University has addressed this issue by incorporating simplified technical content into the course materials. In the toothpick bridge project, a bridge technology packet covering the basic concepts associated with truss and arch bridges is provided to the students. For the competition vehicle project, a series of technical seminars with support materials are provided. These technical seminars cover forces and moments, motors, gears, energy, and buoyancy.

This presentation will include details on the project specifications, project kits, project deliverables, technical content, and student performance on the projects.

Fulfilling Mentors' Expectations: An REU Site Experience

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EXTENDED ABSTRACT

Undergraduate research is one of the recommended activities by the National Science Foundation to address several important problems in Engineering education such as dropout and graduation rates and enrollment in graduate programs. These and other problems are particularly acute in under-represented minority groups, the same groups that exhibit the fastest growing population rates in the country. This paper describes our experience running a Research Experiences for Undergraduates (REU) Site in Computer Science and Engineering (CS&E) and provides guidance to run these demanding programs successfully. After describing our REU program unique characteristics and main objectives, the paper describes the most important aspects that need to be considered in these programs. Finally, the attention is focused on the faculty mentors, a sometimes overlooked and important aspect in these programs. An entire section describing in detail how the mentors were evaluated and what aspects need to be considered to fulfill their expectations is included.

Project-Based Learning: An Evaluation from Student Perspective

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EXTENDED ABSTRACT

As new ideas and techniques are discovered through research and made available to the academic community, educators generally make moves to include such ideas and techniques in their curriculum and/or course. Since fundamental concepts are very essential in the development of any given body of knowledge and engineering in particular, it is therefore prudent to cover the fundamentals in a course and creatively extend that fundamental knowledge to include new ideas, advanced concepts and applications. Engineering educators have used different pedagogical paradigms to enhance engineering education. One of such paradigms is the Project-Based Learning (PBL). This PBL has been used in the teaching of an analog electronics course to extend the course content and coverage beyond what could be covered in a single semester.

At the beginning of the semester the students are introduced to the central topic of the project that will be given to them. The basic concepts of the course that will enable the students to execute the project are covered by the sixth or seventh week of the semester. At that point, the detailed description of the project and the requirements for completion are given to the students. Amongst the requirement is the keeping of a daily journal by each student. The students record a narrative of their learning experience through the project. They have to indicate specific knowledge which they have acquired as individuals and as a team. The journals are turned in to the professor at the end of the project.

Evaluation of the learning process is done in two steps. In step one the instances of learning experience are extracted from the student journals by the professor to form a list of acquired knowledge. The list is compared with the expected knowledge list compiled by the professor at the beginning of the project. In step two the students fill out a questionnaire, which is designed to track the student’s list of knowledge acquired during the performance of the project.

The results obtained from the research showed that the method of Project-Based Learning (PBL) can be used to engage students in complex activities to develop high-order thinking skills, which in turn enables the students to acquire new knowledge. It can also provide experiences that exploit individual student abilities.

Increasing Student Participation in the Technical Program at Professional Conferences

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EXTENDED ABSTRACT

There never seems to be enough class time in any course. Student participation in conferences, particularly when combined with faculty absences, causes strain on an already tight course schedule. Since students are already attending a conference for reasons that are ostensibly educational in nature, why not utilize the opportunity to provide for an assessable contribution towards course and program learning objectives? In addition to course specific objectives, this project contributes towards ABET EC2000 expected outcomes in multidisciplinary teams, life-long learning, communications, and contemporary issues. The paper discusses the how attendance at the 2003 and 2004 AIChE National Student Conferences was used to meet objectives for courses at all levels of the chemical engineering curriculum at the University of Kentucky Extended Campus Programs in Paducah, Kentucky. Students from multiple courses were assigned roles as part of a start-up bio-tech or nano-tech company with indecisive management. The student's role was to determine ahead of the conference a product or process in which the company should engage, keeping in mind the opportunities available at the conference. Students attending the conference then collected information from technical talks and from exhibitors relevant to their company's proposed focus. Students not attending the conference collected information from library, vendor, and internet sources. Each student was responsible for topics relevant to their role in the company as defined by the chemical engineering courses in which they were enrolled. Upon their return, the teams prepared reports summarizing their proposal and findings. The graded reports counted as homework assignments in each participating course, and the team report writing time was credited to all students to make up for one of the class periods missed during the conference.

Assessment data collected to date indicates students developed a familiarity with emerging areas in chemical engineering (biotechnology and nanotechnology) well beyond what they would have learned through class assignments alone. Senior team leaders developed management skills in dealing not only with their classmates, but with some students whom they had never met. Underclassmen developed working relationships with upperclassmen which have led to improved interaction amongst students of all class standings. The biggest flaws with the first implementation are addressed in the second implementation, specifically a lack of teamwork training and a lack of preparation for group leaders.

The Student Perspective on the State of Complex Systems in Australian and American Mechanical Engineering Programs

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EXTENDED ABSTRACT

Complex systems study refers to the study of a holistic system and how it interacts with other systems. In the realm of engineering, complex systems study requires that an engineer has an awareness and understanding of not only the technical aspects of a system, but also the social, environmental, economical, and global aspects. Industry and the broader society are responding to this concern, but engineering education is lagging behind.

This research project involved conducting focus groups with undergraduate mechanical engineering students at the University of South Carolina and at the University of Queensland. This study investigated and compared the extent of complex systems study integration. Out of the focus group analysis emerged a more detailed investigation which focused on three specific components within each educational domain: undergraduate engineering course content, extracurricular activities, and work experience. A significant conclusion of this study is that there is a minimal amount of complex systems study present in required undergraduate courses. In America, the required humanities courses are not a source for complex systems integration. Extracurricular activities would be an opportunity to learn about complex systems; however none of the student participants reported participating in extracurricular activities. The Australian students learned about complex systems during their work experience and understood the purpose of required courses after their work experience. American students believed that work experiences would expose them to complex systems study; however they did not personally have any work experience. Overall, these findings suggest that the educational experience could be altered to expose students to complex systems, i.e. restructure the curriculum, support larger extracurricular programs, and/or require work experience.

This study benchmarked the state of complex systems study in engineering educational programs in America and Australia. The authors strongly suggest that engineering graduates need to have a holistic understanding of engineering and how engineering influences and is influenced by the world around it. Ways to change the existing engineering educational development emerge when comparing American and Australian engineering educational programs. These changes could begin to address many of the recurring concerns in engineering education, such as understanding the interrelationships of engineering with typically non-engineering, in addition to being life-long learners, effective communicators, and ethical professionals.

Effect of Boundary Conditions on Two-Dimensional Temperature Distribution in a Transformer

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EXTENDED ABSTRACT

A residential transformer is usually of cylindrical in geometrical shape, and is a step-down distribution transformer. It reduces the primary electrical voltages from a power line, which can be from 5 kV to 35 kV, but are mostly in the 15 kV range, to the secondary voltages of 120/240 V for the use of homes, stores, and schools. The transformers are normally mounted near the top of a power pole, even though some can be placed on a concrete pad on the ground surface, or installed in an underground vault for sub-surface electric power distribution.

The nameplate rating of a residential transformer can be from 10 kVA to 100 kVA. The energy loss at full operating load can be from 178 W to 1,177 W. The transformer consists of a cylindrical steel tank and a core-and-coil assembly placed concentrically inside the bottom part of the tank. The tank is filled with cooling and insulating fluid nearly to the top, with a small air space of 15 cm (6.0 in) at the top. The heat generated inside the core-and-coil is continuously dissipated to the surrounding air, mainly in the radial direction, through the natural convection of the cooling fluid. The steel tank has a diameter ranging from 38 cm (14.8 in) to 55 cm (21.7 in), and a height ranging from 57 cm (22.5 in) to 112 cm (44.0 in). The core-and-coil assembly has a diameter from 29 cm (11.6 in) to 47 cm (18.6 in), and a height from 23 cm (9.0 in) to 51 cm (20.0 in). Many residential areas use the 25 kVA transformer, which has a tank size of 45 cm (17.8 in) in diameter and 64 cm (25.2 in) in height, and a core-and-coil of 37 cm (14.6 in) in diameter and 29 cm (11.5 in) in height. Its full-load heat loss is 355 W, and it can supply electrical energy sufficient for three average size houses.

The core-and-coil assembly is the major element in a distribution transformer. It is the part where heat is generated, and in which the temperature needs to be analyzed. In a previous study conducted by the author, it was treated as a cylindrical shell or tube, with a metallic (i.e., iron) core placed at the axial center. In the present study, the core-and-coil assembly is assumed to be a solid cylinder, extending from the axis to the outer surface. The results of the two studies will be compared.

Within the core-and-coil assembly, the mode of heat transfer is through conduction. In order to set up the governing differential equation, heat flow in both the radial- and axial-direction are analyzed for a differential element, then, in conjunction with the fundamental law of heat conduction developed by Jean Fourier, the energy balance is taken in both directions for the element, resulting in a two-dimensional partial differential equation.

For engineering students, the numerical analysis of a partial differential equation can be performed with a packaged computer program using the finite element analysis. However, in order to see the beauty and the power of science and mathematics, it is probably best to express the solutions in a mathematical form, and then to extract the necessary numerical values from these final equations.

Introducing Space Exploration into Engineering Curricula

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EXTENDED ABSTRACT

Recent reports indicate that the United State can expect to experience a critical shortage of qualified scientists and engineers in the near future. Stated reasons for this anticipated shortage include: a decreased number of international students due to stricter immigration laws, the aging of the U.S. population, and a culture in which the scientific and engineering fields are no longer valued as much as they once were. While the exact reasons for this complex problem can be debated, it is clear that something must be done to stimulate an interest in science and engineering and retain those students who have already chosen engineering as their field of study. In a recent article in *Mechanical Engineering* magazine, the space race between the United States and the Soviet Union was credited with creating a time when engineers were "heroes". It is generally accepted that Sputnik was at least partially responsible for the focus on science and engineering in the United States during the 1950s and 60s. Since that time, the exploration and development of space has continued to motivate students to choose engineering as a career. In fact, there are few things inspire students like the prospect of traveling to and exploring space.

Today, we find ourselves at the beginning of a new age of space exploration. Can we once again use space exploration to ignite a strong interest in science and engineering? This paper will explore how space exploration and astronautics can be incorporated into an engineering curriculum. The goal of such activities will be to keep those students already in engineering excited about their chosen field. To be more specific, the paper will examine how space-related, experience-based courses can be used to challenge and inspire engineering students.

A Longitudinal Study of Mechanical Engineering Student Performance on the FCI, Phase I

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EXTENDED ABSTRACT

For mechanical engineering students, the ability to correctly model forces is key to success beginning in sophomore physics and continuing through senior level mechanical engineering classes. Student competency grows as they are continually challenged in successive courses to produce correct answers. Whether students are truly utilizing core principles or emulating techniques is hard to distinguish. The Force Concept Inventory (FCI) provides a baseline for comparison of student understanding of force concepts, independent of algorithmic number based solutions. Is a source of engineering student difficulty with dynamics due to a retention of force misconceptions or a reversion to prior held misconceptions? A trivial interpretation of the question might lead to the answer: Yes, obviously.

Our hypothesis is that students have difficulty with dynamics due in part to force misconceptions revealed by the FCI. A detailed investigation will reveal whether students do return to misconceptions, if indeed prior held misconceptions were given up in the short term due to educational intervention, or whether students retain misconceptions regardless of intervention. Improvement in student understanding of force after physics instruction, as determined by a pre- and post-FCI assessment during sophomore physics, will be tested for long term retention two to three semesters later in the mechanical engineering program. A correlation is expected between a student's capability in dynamics and their score(s) on the FCI. The initial phase of research in Fall 2005 will assess, via the FCI, 28 sophomore mechanical engineering students enrolled in Dynamics and 35 junior/senior level students enrolled in Dynamic Modeling and Controls. Individual student FCI scores in Dynamics or Dynamic Modeling and Controls will be correlated with their prior FCI performance in physics. The data gathered to answer the research question will support ongoing efforts to improve engineering education.

Effectiveness and LMTD Correction Factor of the Cross Flow Exchanger: a Simplified and Unified Treatment

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Extended Abstract

The cross flow exchanger is possibly the dominant heat exchanger type in overall usage. For examples, cross flow exchangers are ubiquitous in heating, ventilating, and air conditioning systems not only as cooling and dehumidification coils but also as heating coils and air-cooled condensers. They are also commonly encountered as vehicle engine radiators and in other process and component cooling and heating applications. In contrast, shell and tube exchangers are relatively uncommon in daily life, being mostly restricted to purely industrial applications. The cross flow exchanger is thus an important everyday device, while the shell and tube exchanger is less familiar and seemingly exotic to the typical undergraduate. For its practical importance and for the inherent educational benefit, the cross flow exchanger deserves enhanced treatment in undergraduate courses.

The most common cross flow exchanger is probably the configuration with one fluid mixed and the other stratified or unmixed. The mixed fluid often flows inside a pipe. A unified and somewhat simplified, although generally complete, analysis of the performance of this very common cross flow heat exchanger is presented in this paper. The exposition begins with a thorough analysis by the effectiveness method. The usual effectiveness formulas as functions of the number of transfer units are obtained. Next an analysis of the mean temperature difference is undertaken. This concept and methodology is interesting but, perhaps unfortunately, no longer much in use. By reusing some findings from the effectiveness analysis, the correct formula for the mean temperature is rather quickly obtained. Finally in LMTD analysis, the critical feature is the geometrical correction factor. A general formula to calculate the correction factor from effectiveness results is developed and presented, and this formula is then applied to the cross flow exchanger. The three approaches are presented in enough detail that a real appreciation for each type of analysis and an understanding of the application of the respective results can be developed. The usual plots of the effectiveness, geometrical correction factor, and mean temperature difference are presented; however, interested professors and students can now obtain the spreadsheet used to generate the plots and data from the author for their own use.

The present author has found this treatment worthwhile for several reasons. One major reason is that the proper and appropriate application of the well established theory is not always entirely straightforward. Mistakes are possible unless the practitioner has a firm understanding of the underlying technology and analysis. Indeed, a student could easily misinterpret some examples in popular textbooks. A minor reason is that a possibly confusing typo error was found in an historically important paper, and the error is identified and corrected in this paper.

Student Poster Session Abstracts

Assessment of Hurricane Katrina's Flood Damage to Education Infrastructure on the Alabama Coast

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EXTENDED ABSTRACT

Hurricane Katrina devastated the north coast of the Gulf of Mexico on August 29, 2005. It is one of the deadliest and most costly natural disasters in U.S. history. The Alabama coast suffered severe damage caused by Katrina's storm surge. The purpose of this study is to assess the impact of Hurricane Katrina on the education infrastructure in south Alabama. Field survey of the flood damage is carried out. Historical data of storm surges on the Alabama coast is gathered from the U.S. Army Corps of Engineers. An engineering analysis of the water surge generated by this catastrophic storm is performed to determine its occurrence frequency. The results will be applicable in assisting engineers and the coastal communities in rebuilding the Alabama Gulf Coast.

Field Inspection and Assessment

Assessment of the flood damage to educational facilities and relevant infrastructure on the Alabama coast consists of field inspection, personal interviews, and analysis of damage reports prepared by K-12 schools and public libraries in this region. Relevant information on storm surge modeling at the University of South Alabama's Coastal Transportation Engineering Research and Education Center as well as flood maps produced by the Federal Emergency Management based on the post-Katrina survey of high watermarks are used in the assessment. The flood damage assessed consists of several educational facilities and their adjacent infrastructures, such as roads and utilities in the low lying areas along Alabama's coastline. The extent and causes of the damage at each facility are documented and analyzed.

Engineering Probability Analysis

The second component of this project involves collecting historical flood data and performing engineering frequency analyses. Over sixty years of water level measurements are gathered from the U.S. Army Corps of Engineers Mobile District. The data are used as a basis for extreme value prediction, using several theoretical distribution functions to predict storm surge flooding associated with particular exceedance probabilities. The theoretical distribution functions used are the Normal, Log Normal, Log Pearson Type III, and Weibull. We compare the results, based on the best fit curve, to determine which of these estimates is most representative of the observed historical data. We then extrapolate the data to make predictions of the probability of future storms. This type of engineering statistical analysis provides civil engineers with the necessary technical information for rebuilding the education facilities to a standard that will reduce the impacts of future storm events.

Quantification of Erythrocyte Rupturing in a Dielectrophoretic Microdevice

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EXTENDED ABSTRACT

Dielectrophoresis (DEP) is the movement of particles in a non-uniform alternating current (AC) field. Under the influence of a non-uniform (inhomogeneous) AC field, charged particles become polarized and move due to the dielectrophoretic force. Dielectrophoresis is one method whereby particles can be manipulated on a micrometer or nanometer scale. Cell rupturing is one of the responses to the application of DEP force to the suspended cells. When an alternating field is applied via perpendicularly positioned electrodes, the resulting electric field varies in density from high density at the point electrode to low density at the flat electrode. The electrodes are positioned within a microdevice. These devices, or laboratories-on-a-chip, are seen as one of the key growth industries for the 21st century. Because of their small size, the microdevices can be easily accessed when they are needed. The devices can provide a decrease in the cost of analysis for blood testing, and they can be adapted as point of care devices for use at home to monitor vital indicators for diseases. For this research, the microdevices are used for the cell rupturing.

The fresh human blood was obtained via venipuncture by a certified phlebotomist; samples were stored in K_2 EDTA anticoagulant at 5˚C. The blood was diluted with a 0.143M sodium phosphate saline buffer (PBS) just prior to experimentation in a microdevice consisting of a glass slide constructed out of perpendicularly positioned 100 micron platinum wire. Dielectrophoretic fields were applied via the microdevice electrodes. A Zeiss Axiovert 200M inverted light microscope with a high resolution Axiocam camera was used to record images of the experiment every twenty seconds. The frequencies were varied from 1 kHz – 5 kHz and the field intensity for a series of dependence experiments was varied from $1V_{pp}$/200µm to $6V_{pp}$/200µm. The total number of RBC in each image was analyzed manually in 1minute intervals over the 8 minute experiment. These counts were tabulated in a spreadsheet and graphed using a number fraction (number of RBC at a specific time/number of RBC at time=0) as a function of time.

Results from this process show that there exists a relationship between the age of the blood sample and the applied field. The optimal field density for rupturing A+ human blood was $5V_{pp}$/200µm. At this field density, 50% of the cells were ruptured within 220 seconds and complete sample rupture was accomplished after only 360 seconds. Varying the frequency of the process showed that it indeed had an effect on rupturing, but the results were not conclusive. Additional experiments at frequencies between 1 and 3 kHz will need to be conducted to elucidate this dependence completely. The age dependency of the rupturing for a single sample was conducted over a five day period. When all samples were compared a clear trend was not discernable. More experiments for a period of ten days are planned to further reveal any statistical dependencies on age.

A Simplified Design Procedure for Steel H-Piles in Areas of High Seismicity to Include the Effects of Pile Buckling

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Civil Engineering, The Citadel

Extended Abstract

Section 1808.2.9 of the *International Building Code* [1] states that certain types of soils called fluid soils (e.g., liquefied sands and bay mud) are not capable of resisting pile buckling and piles used in such soils should be designed as unbraced columns. This paper presents a unified approach for designing steel H-Piles in areas of high seismicity where soil liquefaction and/or loss of lateral support are design considerations. A general procedure for pile design is formulated based on governing codes, accepted practice, and relevant literature. The procedure is in compliance with the *International Building Code* [1], the *AISC Seismic Provisions for Structural Steel Buildings* [2], and the *AISC LRFD Specification for Structural Steel Buildings* [3]. Using beam-column design provisions, interaction diagrams (ϕP_n vs. ϕM_n) are developed for several hot-rolled H-Pile Sections that are permitted in areas of high seismic risk. The exclusion in this paper of some standard H-Pile sections is a result of local buckling instability as determined by limiting width-thickness ratios presented in the *AISC Seismic Provisions for Structural Steel Buildings*. Numerous interaction diagrams are developed for each pile size so that practical unbraced lengths resulting from nominal soil support afforded by marine clay and liquefied soil layers can be directly accounted for in the proposed design procedure. This paper provides a simplified approach for designing steel H-Piles to include the effects of pile buckling, the development of interaction diagrams needed for the simplified procedure, an overview of other code requirements for steel H-Piles in high seismic zones, and a practical application example.

A Bounded Approach to Magnitude Estimation of the 1886 Charleston, SC Earthquake Based on Structural Analysis of Surviving Historic Buildings

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The Citadel / NAHB Research Center / The Ciadel

EXTENDED ABSTRACT

Current seismic maps found in the International Building Code [1] used to design buildings in South Carolina include seismic hazard from a characteristic earthquake assigned a moment magnitude of M7.3. This magnitude represents an estimated magnitude of the 1886 Charleston, SC Earthquake. Although it is well established in South Carolina historical records that the 1886 Charleston, SC Earthquake caused significant damage to coastal South Carolina and was felt as far away as Wisconsin, previous research regarding magnitude estimates has focused on MMI assignments that contain large margins of uncertainty. As a result, current estimates vary from M6.8 to M7.3. The methodology for magnitude estimation presented in this paper includes an approach for estimating the magnitude of historic earthquakes that considers the pseudo dynamic analysis of significant buildings in Charleston, SC that survived the 1886 earthquake with well recorded damage, and using these results to back calculate the probable earthquake magnitude that would have caused such damage. Specifically, the finite element programs RISA-3D are used to perform linear and nonlinear pseudo dynamic analyses of two historic structures with upper and lower bounds placed on material properties and localized soil effects. Because the presented magnitude estimates are developed using an independent approach, they are valuable in terms of providing additional constraints for the MMI-based procedures. This paper presents upper and lower bound magnitude estimates for the 1886 Charleston, SC Earthquake based on pseudo dynamic structural analysis of the Miles Brewton House and Charleston City Hall. These two famous historic structures are both located in the historic district of Charleston, SC.

Examination of the Dielectrophoretic Reduction of *Vibrio Parahaemolyticus* and *Vibrio Vulnificus*

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EXTENDED ABSTRACT

Vibrio parahaemolyticus and *Vibrio* v*ulnificus* are food born pathogens that are commonly found in raw seafood. This bacterium causes extreme food poisoning symptoms in healthy adults and can be deadly among immuno-compromised individuals. Both bacteria have had a significantly negative economic impact to the raw oyster industry in the Gulf Coast region of the US. The warm waters in the Gulf of Mexico are more conducive to the growth of these bacteria than the Chesapeake Bay region, which can harvest oysters more months out of the year and provide them at a lower cost per oyster.

A variety of common food treatments and temperature shock have been examined, but none have been able to reduce the bacterium concentrations by the necessary 5 log magnitude. Therefore the overall scope of this research was to test whether the application of a dielectrophoretic field could reduce *Vibrio* concentrations free in solution. Dielectrophoresis (DEP) is the application of a non-uniform alternating current (AC) electric field to a conductive suspension of cells or particles. The goal of this research project was to experimentally find a resonant frequency at which the cell wall of the bacteria could be compromised, thus lysing the cell.

V. parahaemolyticus were cultured in a 37^{o}C incubator in a Difco 70% NaCl nutrient enriched broth. Prior to testing the DEP in the micro-device, the bacteria were isolated from the broth solution by centrifuging the bacteria down to a pellet and then decanting off the liquid. The bacteria were then washed several times and then resuspended in a saltwater buffer solution to 2.5% by weight. Control plates were streaked with this suspension, DEP tests were performed, and three additional plates were streaked with the treated solution. The number of viable cells was determined via standard plate culture counting techniques. The average percent reduction was based on a mean of several experiments run as well as an average reduction of the three plates from each experiment.

The *Vibrio* concentration was reduced in the dielectrophoretic fields and depended greatly on the electric field frequency. From the experiments the greatest reduction in the *Vibrio* concentration was 91% ± 3% at 39 MHz. Through these preliminary tests we were able to establish a 3 log reduction of *Vibrio para.* at 39 MHz and 5 volts peak to peak using a square waveform. However, several other frequencies showed reduction between 15%-78%; this phenomenon suggests that the 39 MHz resonant frequency may also express overtones. In conclusion, it is possible to reduce the bacteria concentration in solution with the application of a non-uniform electric field (DEP). However, further work is needed to determine if the necessary 5 log reduction can be achieved.

Polarization Capabilities Added to Undergraduate Eye-safe Atmospheric Lidar

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Physics and Astronomy, Agnes Scott College[1]
GTRI/EOEML, Georgia Institute of Technology[2]

EXTENDED ABSTRACT

An eye-safe atmospheric aerosol lidar with polarization sensitivity has been developed, allowing researchers to distinguish between spherical and non-spherical particulate. The technique used to add polarization capabilities to a pre-existing aerosol lidar will be discussed and results of imaging boundary layer aerosols using polarization capabilities will be shared.

The Agnes Scott College-Georgia Tech Research Institute Eye-safe Atmospheric Research Lidar (EARL), was developed for undergraduate research of atmospheric aerosols. EARL's abilities have been extended through the incorporation of a pockels cell into the lidar transmitter and a polarization beamsplitter cube in the receiver, allowing for a polarized transmitted beam and a polarization sensitive receiver. Polarization capabilities allow researchers to distinguish between spherical and non-spherical aerosols.

Data analysis routines have been developed by undergraduate researchers to utilize the polarization capabilities of EARL in current and future student studies concerning the boundary layer thickness and variations there of, stratospheric aerosols, pollution monitoring, etc.

Magnetothermal Matrices for Controlled Drug Release

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Extended Abstract

Experiments were conducted to study magnetothermally controlled drug release using magnetic nanoparticles imbedded in polymeric matrices. Once a magnetic field is applied, these magnetic nanoparticles in the polymeric matrix will heat up and release small amounts of drugs in a controlled and effective manner in the body. This release capability may one day be used with targeting vectors to noninvasively trigger the release of agents to kill cancer cells.

To achieve our goal, we created hydrogels based on poly(N-isopropylacrylamide) or PNIPAAm, a thermally sensitive polymer, and poly(2-Hydroxyethyl methacrylate) or PHEMA, a nonthermally sensitive polymer, that contained magnetic nanoparticles and drugs. At lower temperatures the mesh size of the PNIPAAm matrix swells, releasing the drug and holding the magnetic particles in the polymer. It was proven that the magnetic particles stayed in place in the polymers studies. We looked at the swelling ratios of the hydrogels by themselves, hydrogels loaded with drugs only, hydrogels loaded with magnetic nanoparticles only, and hydrogels loaded with drugs and magnetic nanoparticles to analyze the thermal responsiveness and diffusion characteristics of the hydrogels with each alteration.

Drug release experiments using theophylline as a model drug showed that the drugs were released faster at lower temperatures than higher temperatures for the PNIPAAm hydrogels, but were released at approximately the same rate for the PHEMA hydrogels.

Another important part of this research was to look at the polymerization of PNIPAAm with hydrophilic comonomers such as methyacrylic acid, acrylic acid, N-vinyl pyrrolidinone and acrylamide. By making these copolymers, the lower critical solution temperature can be increased to create a system that can be activated by temperatures somewhat higher than body temperature (e.g., 43°C). This temperature can be achieved using magnetic nanoparticles with tailored compositions to achieve low Curie temperatures.

Analysis of Mississippi's Intermodal Transportation Infrastructure Relative to Prospective Sites of Automotive Assembly Plant Sites

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EXTENDED ABSTRACT

This research project assesses possible locations for automotive assembly plants around the state of Mississippi, from a logistics point of view. Each prospective site is evaluated based on relative logistics costs from the standpoint of nation-wide product distribution. The purpose is to identify high leveraged opportunities for improving site attractiveness to the automotive industry. This study is supported by the MDOT (Mississippi Department of Transportation) and it is in line with MDOT's economic development goal of "providing a transportation system that encourages and supports Mississippi's economic development."

The study is conducted in two phases: (1) data collection and (2) quantitative analysis. In the first phase, data on potential sites, automotive demand, and logistics costs is collected. In the second phase, a mathematical model is built to evaluate the lead times and the outbound logistics and distribution costs. The model is used to analyze the current (AS IS) costs and lead times for the sites identified. The results of the analysis give insights about potential changes (such as changes in the current highway/rail infrastructure) that may impact the logistics costs and lead times of automotive manufacturers in Mississippi.

A Compressive Strength Analysis of Dry-Stacked Concrete Block Piers in Housing Construction

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Extended Abstract

Concrete-block piers are used in the housing construction industry as internal supports. The piers are dry-stacked (concrete block) from the ground to standard height and then mortared from that point on. The Federal Housing Administration (FHA) no longer allows dry-stacked piers as internal supports because their strength and stability are not documented. Buildings with dry-stacked piers are no longer eligible for federal loans. The FHA now requires that all piers have mortared joints.

The strength of dry-stacked piers may be improved by applying a surface coating of cement and fibers, but little data exists on this construction process. It is possible that the FHA may approve loans for houses with surface-coated piers if it can be shown that the strength of the piers is comparable to mortared piers.

The purpose of this research is to study the compressive strength of dry-stacked concrete block piers, as compared to piers with mortared joints and surface-coated piers. This research also concentrates on how height affects strength. The first set of specimens consisted of dry-stacked concrete block. The second set was coated by special surface-coating cement. The third set was mortared. The test was to test block compressive strength. Results from the tests showed that: 1) average maximum strength did not differ significantly; 2) the height of specimens had no effect on strength. Based on these findings, all three specimens have the same compressive strength and could be interchanged in construction.

Self-Consolidating Concrete

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Extended Abstract

Self-consolidating concrete, also known as SCC, is a type of concrete that is up-and-coming in the concrete industry. SCC is so liquefied that its stability is measured by "slump flow." It can be placed into a single place and flow around the form without any mechanical consolidation. The advantages of using SCC for particular applications have been proven and can certainly outweigh any disadvantages as compared to using traditional concrete. By focusing on characteristics, mix proportions, and typical applications of SCC, a clearer understanding of the advantages of SCC over traditional concrete can be observed. Also, sixteen different states were contacted by phone or e-mail or researched on their Department of Transportation's website to determine if their state had implemented specifications for SCC.

There are several advantages of using SCC as compared to using traditional concrete. To begin with SCC is more mobile than traditional concrete. For example, a truck that is carrying traditional concrete may sometimes have to be moved several times in order to apply all of the concrete to the project; whereas, a truck that is carrying SCC may be parked one time in order to apply all of the concrete to the project. This allows for faster application and a better finished product. Another important factor that concerns SCC is that no vibration is required in order to get concrete into the correct position. Since SCC "flows like water," it goes to the correct position by itself. Therefore, the cost of labor and equipment are significantly decreased. For that reason, the higher cost of the SCC is compensated through the cuts made in labor and equipment. Given that it flows into position, the only labor required is the truck driver and the crew members who smooth the top of the product. The formwork is more consistent throughout, and this results with a finished product that has a better appearance. By a better appearance, the profit can be maximized.

Typical applications of concrete are very important factors to examine when comparing traditional concrete and SCC. Although traditional concrete has many different applications, SCC can be used for quite a few of those same applications. SCC used on these projects can be faster than traditional concrete and more efficient. Typical applications of SCC are walls, columns, footings, finishings, girders, other typical small jobs, and some larger jobs as well. For smaller projects, SCC gives a better appearance than traditional concrete. By using SCC for these jobs, labor and equipment costs are decreased. Therefore, SCC is a good choice to consider when the above applications are part of a job.

SCC is certainly an incredibly exceptional form of concrete. By applying SCC to walls, columns, footings, finishings, girders, any other typical small jobs, or high-paced large jobs, cost may be reduced due to savings in labor and equipment. SCC is also time-efficient, and the mobility of it makes it a perfect alternative to traditional concrete if it can be applied to a project. SCC is rapidly on the rise, and it is projected to be one of the leading alternative materials in the concrete industry.

Modeling and Assessment of Porosity Effects on Mechanical Properties of Tissue Scaffolds

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EXTENDED ABSTRACT

Engineered tissue has become one of the most urgent goals in therapeutic modalities in the 21st century. A 3D tissue scaffold is an essential prerequisite to the development of engineered tissue. A manufactured tissue scaffold must have adequate mechanical properties to support cells, allowing them to thrive, divide, and organize themselves into a 3D tissue as they do in nature. Therefore, characterization of mechanical properties of scaffolds is important for matching biomaterial properties to the *in vivo* microenvironment. In tissue-engineering applications where mechanical failure can be catastrophic, such as vascular and orthopedic applications, mechanical characterization is of particular importance. However, the random pore architecture of polymer tissue scaffolds makes a structural analysis very challenging.

To improve the understanding of scaffold properties such as yield stress, modulus, especially localized mechanical properties that cannot be directly observed from experiments, a micro-domain of the scaffold has been modeled as made of sub-units, arranged in a sphere-based pore architecture. This study provides a solid modeling approach to create and mesh polymer scaffolds with different porosity. An expression to calculate porosity was also derived for the scaffold architecture. A series of finite element simulations of compressing alginate scaffolds were performed at different strain rates to evaluate the effect of porosity on quasi-static and viscoelastic mechanical behavior corresponding to 65%, 75%, 85%, and 95% porosity. The developed FEA model is capable of computing scaffold strength and moduli and predicting localized mechanical behavior without destructive materials testing.

Ania's Communication Mount

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EXTENDED ABSTRACT

Purpose

The purpose of our design project was to build a mount for the SpringBoard Communication System that improves Ania's independence by making her communication device accessible and independent of caretakers. Ania is four-years-old and plagued with I-cell disorder, Because of her disorder she has short limbs and cannot verbally communicate. Thus, Ania must use a handheld computer device to communicate. Presently, someone holds this device for her use when she is in her wheelchair and her small wooden chair.

Methodology

The design team consisted of four University of Tennessee at Chattanooga (UTC) students in the Introduction to Engineering Design freshman course. We first met with the client and Ania to gather information about design needs, wants, constraints, and background information. We then held several sketching and design sessions where each member came up with several design possibilities. We compared the ideas and critiqued each design possibility. After a few sessions we chose two design options that we wanted to concentrate on.

We then applied theories of statics, to see how the designs would hold up against the weight of the device as well as the pushing and pulling of other children. Next, we began using SolidWorks to 3D model the design sketches.

The most important thing we did after the initial modeling exercise was to go back to our client for feedback on our proposed designs. We showed our clients the initial design options and they told us what they liked about them and what they thought we could change. We came away from the meeting with a completely new design idea.

We then compiled a decision matrix for our three designs using the clients' needs and constraints as criteria for comparison. After we chose our "final" design we created 3D models and machine drawings, bought the required materials, and then machined each piece in the UTC machine shop, using the CNC machine for the complex parts.

Conclusion

The design team had seven weeks to take the project proposal from initial understanding to prototype development. The resulting prototype adequately grips Ania's small chair and holds the communication system in place. However, the mount is difficult to adjust and tighten. The adjusting knobs are also easy for children to manipulate. A second freshman design team is now taking what we learned and developed and improving the mount for a final working device.

AutonoNAS

Ken Evensen and Matt Link

Embry-Riddle Aeronautical University

EXTENDED ABSTRACT

AutonoNAS- autonomous National Airspace System is a senior design project for computer and software engineering students at Embry-Riddle Aeronautical University. The AutonoNAS project consists of 20 engineers assembled into three software, one hardware, and one firmware teams. This project is using real-world computer applications in the aviation domain.

The AutonoNAS system controls and tracks multiple aircraft inside the specified airspace. The flight system automatically performs a mission profile. The mission profile consists of an unmanned aircraft to taxi, take-off, navigate, and land through predetermined waypoints.

In controlled airspace, the aircraft will have the ability to be routed into a traffic pattern for landing. When exiting the traffic pattern, the system will allow the aircraft to align with the runway and waypoints plotted to bring the plane into its decent for landing. The supplied graphic interface will track the positioning of all objects within the system. This will also allow the user to modify the path that the aircraft takes while it is in uncontrolled airspace by allowing the user to add, insert, and delete waypoints to the aircraft's flight path.

The creation of AutonoNAS requires a multidisciplinary team that joined the skills of hardware design with those of software creation. Every interaction and need that the current National Airspace System requires must be replaced, primarily the ability to fly the aircraft and to guide multiple aircraft through take-off and landing. Each component in AutonoNAS has a specific purpose to meet these needs. The system components that make up AutonoNAS include the graphical user interface (GUI), database system, control system, and flight system.

The flight system will provide the functionality required to navigate to a given waypoint, request to enter controlled airspace, and to perform a low-pass maneuver. The database system is responsible for communication and data storage for the flight, control and GUI systems. This will be handled by a set of clients for each of the systems that will communicate to a central database server. The database is responsible to maintain the current position of all the objects (i.e., aircrafts airports, obstacles, etc) in the system. The GUI will provide the user a way to monitor the current positioning and status of the different objects. It also allows the user to give the information needed by the system. The control system is responsible for directing an aircraft into controlled airspace, allowing the aircraft to enter the traffic pattern, and finally plotting a course for the aircraft landing.

These systems communicate through defined interfaces. Through these interactions, the goals and responsibilities of the AutonoNAS system are achieved.

Motor Control Application using LABVIEW

Souma B. Wanta, Antonia McNair, Darnell Dixon, and David Wiggins

Virginia State University

EXTENDED ABSTRACT

What do you think of when you think about ‘Motors’? Motors are one of the largest technical and mechanical devices in the world. They perform many functions.

In this poster presentation, the functions of motors, the various types of motors and the advantages and disadvantages of using them will be discussed.

The reasons for using motors are almost endless for example; motors are ideal for jobs that require repetitive, precise rotational movements. Human workers get bored doing the same thing over and over. The uses for motors are almost as endless as the reasons for using them. There are five main areas in which dc motor used. Ninety five percent of motors are used in factory.

Composting Toilets: Benefiting All Who Come in Contact

Heather Cochran, Amy Gilfilen, and Elizabeth Watts

Lipscomb University

Extended Abstract

A good engineer is the culmination of technical skills, good leadership, and a desire to make the world a better place. These qualities can be taught to some extent in the university setting. However, some of the best real world preparation cannot be learned in a classroom, but from solving problems faced by real people. Lipscomb's Engineering Missions provides students access to these problems and the chance to make a difference. Students voluntarily give their spring break and/or summer to try and help solve these issues. Student leaders in charge of design teams gain the valuable experience of following a project from concept through completion as well as the added benefit of project management experience. This experience improves the quality of life of the people served while contributing to the development of future engineers.

This was the third year that Lipscomb's Engineering department has gone to work at a remote clinic in the mountains of Honduras. Past projects include building a water tower to provide a constant supply of water and bringing light and refrigeration to a previously dark place by harnessing solar power. This year the chosen project has taken another need and provided a solution. The disposal of human waste is an ever-present issue that requires attention. The system in place was crude and unpleasant. Previously, there was a pit latrine as well as a water-based latrine that masked the underlying problem of sanitary waste disposal, and thus they were not an acceptable long-term solution. A team of students was challenged to find a solution. With a problem defined, a team assembled, and a student leader chosen, different ideas were explored. The answer came in the form of a composting toilet. Many resources on composting toilets were consulted, but the clinic presented a unique problem. The composting system needed to be adaptable for 4 to 40 people at any given time. Most systems are designed for seasonal or small family usage. Thus the chosen design was forced to combine aspects from several sources. It consists of compartments which catch the waste and are interchangeable, thus providing the flexibility for small and large groups. The compartments are lined with a small mesh to provide ventilation and keep out bugs which could cause disease. This design should be easy to maintain, and the end product will help fertilize the poor soil found in that area. Implementation of this design brought about its own unique challenges in coordinating with the locals about available resources. Significant cultural differences, such as the way that time is regarded, proved to be problematic and were obstacles of communication.

The design team was challenged to find a solution to a problem outside their area of expertise. The student leaders were faced with the challenge to coordinate busy schedules, contact resources, research a previously unknown subject, stay organized, and stimulate team members who aren't being paid or graded. Additionally, it was a challenge to follow through with implementation with the distance, language, and cultural barriers that are present, but the end result is a working product and a great experience.

Mercer University School of Engineering Paper Recycling Program

Kevin Berry

Environmental Engineering, Mercer University

Extended Abstract

The purpose of this project is to determine how a mixed paper recycling program should be implemented into Mercer University's School of Engineering. This will be done by collecting and examining data collected throughout a period of time. Certain methods will be used in collecting the recyclable paper. Some of these methods include how often the paper is collected, how it is separated and how it is weighed. The data will be examined in order to determine certain things such as the number of containers, how often it should be collected and how the mixed paper should be sorted. The results and conclusions of this paper will provide a concrete solution for how the School of Engineering should go about implementing a paper recycling program.

Failure Analysis of AF1410 Aircraft Structural Steel under Fatigue

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EXTENDED ABSTRACT

Structural aircraft components such as arresting shanks, hooks and landing gears were subjected to fatigue and sustained peak loads combined with environmental conditions compromising its mechanical performance upon service. Trapezoidal and sinusoidal waveform fatigue tests were performed at different hold times and hydrogen concentrations respectively. Furthermore, corrosive marine environment were simulated using 3.5%NaCl solution at the crack tip. The effect of hold time was found to be largely unaffected by the sodium chloride solution in comparison to tests conducted in room air. In the other hand, the specimen with hydrogen underwent a dramatic reduction in the lifetime increasing the hold time. Compared with baseline tests in air, a gradual reduction in lifetime was observed as a function of increasing concentration of hydrogen in the specimens. The results are corroborated with SEM analysis where a clear shift in mode of failure and morphology of the cracked surface has been observed as a function of type of environment, hold time and amount of hydrogen.

Characterization of Functionally Graded Aluminum Matrix Composite Using Atomic Force Microscope

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EXTENDED ABSTRACT

This work reports the use of AFM to characterize topographically the resulting surfaces of wear tests and superficial hardness tests done on functionally graded aluminum matrix composites (FGM-AMCs) reinforced with AlB_2 particles. These composite materials contain reinforcement particles with volume fraction varying continuously from the inner to the outer sections of the casting. The particle redistribution produces non-uniform cross-sectional microstructure with a continuous property gradient. This type of composite material is useful in applications where a combination of high surface wear resistance and high toughness of the interior bulk material is required. Unlubricated pin-on-disk configuration wear tests and superficial Rockwell hardness tests were conducted on the external and internal zones of Al-2wt.%Mg with 1, and 4 wt.% B composites produced by centrifugal casting and on stationary (gravity) cast specimens (disks). The topographical wear test results reveal that the smallest wear depths were obtained on the external regions of the FGM casting. On the other hand, the internal zones underwent larger wearing (deeper wear tracks). The gravity-cast sample displayed a wear depth in between those exhibited by the outer and inner regions of the centrifugally cast sample. Finally, the roughness results obtained on the superficial hardness test indentations display, a similar behavior to the trend observed in the wear track results.

Radio Repeater Project for Predisan

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EXTENDED ABSTRACT

Purpose

The purpose of building a radio tower for Predisan in Catacamas, Honduras is to increase communication between clinics. Predisan is a medical mission that provides medical attention to Hondurans at clinics in El Encino, Las Cabas, Cedeco, Agua Caliente, La Union, Wasparani, and Masicales. These clinics are equipped with radios to communicate with the home office in Catacamas by relay through the Cedeco Facility. However, communication is frequently not possible for some of the outlying clinics, and people have died as a result. Lipscomb University is going on a mission trip to install a simplex repeater system on top of a nearby mountain so all the clinics will be able to communicate with each other and the home office in Catacamas.

Method

The first step was to decide where the best location for the repeater would be. We used a computer program called DGTV Line of Sight that showed the 3-D topography of the land of Honduras, and the program calculated the line of sight for potential repeater placement sites. The latitude and longitude for each clinic was entered into the program, and line of sight calculations were calculated for several test points to determine the best location. Predisan then tested the site we chose in Honduras to verify that it was work, and it did. The design for the simplex repeater is to have a pocket repeater, marine band radio, deep cycle sealed battery, solar panels, a charge controller, an antenna, and a mast. The battery, repeater, radio and charge controller will all be encased in a secure, ventilated case. The case and the solar panels will be attached to the mast. The antenna will be on top of the 30 ft mast. When a signal comes in from any clinic on the radio, the repeater will record the message, and the message will then be repeated back to the radio on the same channel so that every location will hear the message.

Group

The team consisted of four members who all had different responsibilities. Kara was the team leader, and also worked on the radio and repeater interface. Matt worked on the antenna, mast, and metal base design. Jonathon researched solar panels. Sheena designed the physical setup inside the case. Dick Peugeot was our technical advisor who guided us in our design and choices. All group members researched the best repeater location, and had input in the final decisions of what to buy and how to assemble all components.

Conclusions

The radio tower will be an asset which will have a great impact on these Honduran clinics. It will be an invaluable method of communication between the main clinic and the outlying clinics in the mountains for Predisan and the surrounding community.