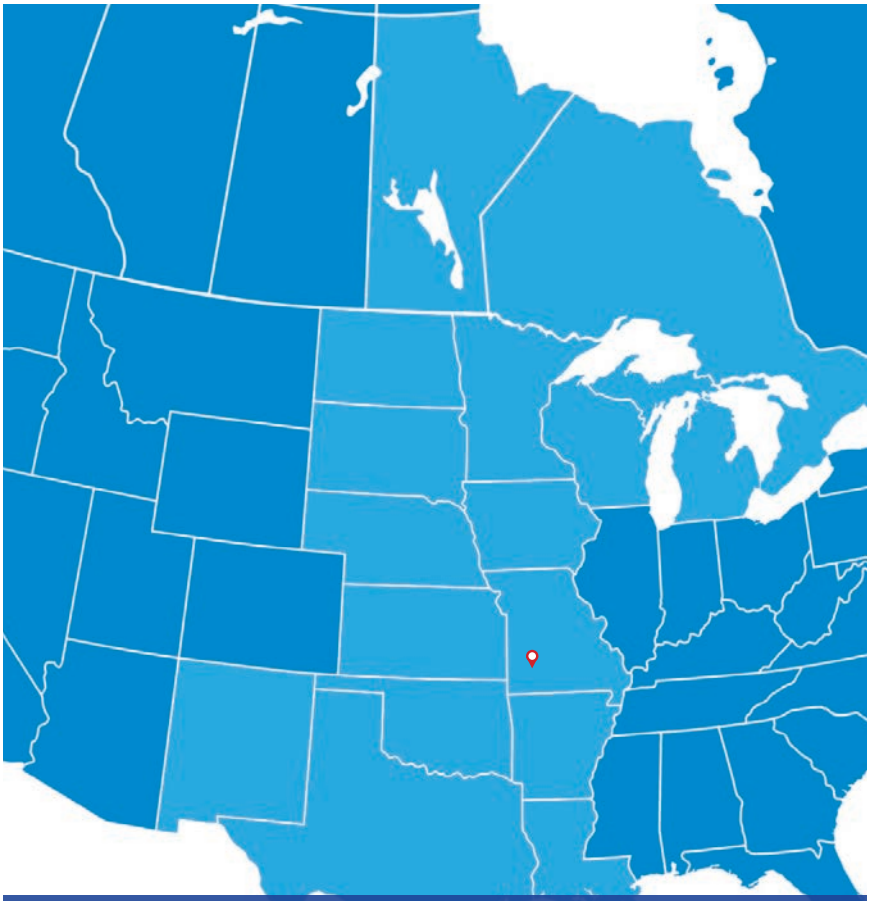
ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Zone III

Meeting 2015



September 23 – 25, 2015
Springfield, Missouri

Christi Patton Luks

Welcome to the first ASEE Zone III Meeting in Springfield, Missouri!

I am excited about the opportunity for members of the North Midwest, Midwest, and Gulf Southeast sections to expand their professional networks at this meeting. Other Zones meet periodically and have enjoyed the expanded audience this affords while maintaining the same friendly atmosphere as a traditional Section meeting. I hope that our first Zone meeting is such a positive experience.

I hope that you can find time to explore the Springfield/Branson area while you are here. During the course of planning this conference, I moved from Tulsa to Rolla, Missouri. Having recently moved to the area, I am still particularly enthralled with the beauty of the Ozarks. There are wonderful places to hike and fish in the area. There are also many caves you can explore. Springfield has a ride-through cave which is very interesting. You are on Route 66, so take a moment and visit the Route 66 Museum. A few steps away is a marker commemorating the first gun battle of the Wild West days. There are several microbreweries in the area that are worthy of a visit. A visit to the Bass Pro Shop in Springfield is a special treat, even if you are not intending to shop. After the conference closes, you may be planning to drive down to Branson to take in a show or go to Silver Dollar City. The area has many great activities for all ages and interests. I hope you enjoy your free time in the area.

I would like to thank the people of Missouri University of Science and Technology for rallying to help organize this committee. Michelle Wiginton, Lisa Strauser, and Sue Turner of the Missouri S&T Distance & Continuing Education have been tremendously helpful in the logistics for this conference! S&T faculty members served as the conference committee include Steve Watkins (Zone chair), Bijaya Shrestha (session coordinator), Theresa Swift, and Amardeep Kaur (poster session coordinator). Thank you also to Doug Carroll, another S&T faculty member located in Springfield, for setting up the Welcome Reception for Wednesday night.

Christi Patton Luks, Ph.D.
Conference Chair

Welcome to the 2015 ASEE Zone III Conference

I hope that you enjoy the opportunity to meet ASEE members located in our member sections – the Midwest Section, the North Midwest Section, and the Gulf Coast Section. Our section meetings and conferences and now this zone conference are important venues for engineering educators to meet and to present. The papers in our technical sessions have been reviewed and will be archived by the zone. We are pleased to have a student poster session which, showcases student design activities. I hope you enjoy the program and the local area.

I am pleased to have my home section as the host of the conference. Many people have contributed to the organization of the conference activities – the conference committee, paper reviewers, paper authors, facilities staff, etc. We thank them for their many hours in support of the conference.

Again, welcome to Springfield, Missouri and this event.

Steve E. Watkins, Ph.D.
2015 Zone III Chair

Steve E. Watkins

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THURSDAY'S SPEAKERS

Welcome Topic & Speaker

Do Taxonomies Matter for Engineering Education...?

Ian Ferguson, Ph.D.
Vice Provost and Dean, College of Engineering and Computing
Missouri University of Science and Technology

A number of taxonomies exist to help quantify educational aims and objectives and have been applied to engineering education. One of the first and most used is Bloom's taxonomy which has identified three types of learning; cognitive, associated with mental skills; affective, associated with growth in feelings or emotional areas; and psychomotor, associated with manual or physical. Other educational taxonomies such as SOLO (Structure of Observed Learning Outcome) have also been proposed and investigated. This taxonomy proposes that learning complex material such as that often seen in engineering disciplines needs to be broken down into less complex tasks and later integrated to form a solid understanding of the subject. In most of these taxonomies the traditional lecture typically only addresses the lower levels of learning. The transition to higher levels of complexity in student's learning ability typically requires a more dialectic approach with an individualized interaction with the professor. This has been missing, for example, in most Massive Open Online Course (MOOCs) since they do not typically deliver the one-on-one interaction that the student has with the instructor. This presentation will investigate if hierarchical transitions delineated in taxonomies are important for the student's journey of learning such as that acquired in experiential learning and entrepreneurial activities.

Ian Ferguson joined Missouri University of Science and Technology in August 2014 as vice provost and dean of the newly formed College of Engineering and Computing. Formerly professor and chair of electrical and computer engineering at the University of North Carolina at Charlotte, he was instrumental in establishing that university's Energy Production and Infrastructure Center to address the needs of the region's energy industry. A former member of the electrical engineering faculty at Georgia Institute of Technology, Ferguson holds a Ph.D. in compound semiconductors from Scotland's University of St. Andrews. He also holds a master of science in optoelectronics and laser devices from St. Andrews and a bachelor of science degree in physics from Heriot-Watt University in Scotland.

Luncheon Topic & Speaker

K-12 Outreach and Broader Impacts

Troy Sadler
Professor, Science Education
Director – The ReSTEM Institute

This presentation will explore ways in which STEM faculty and other professionals can build relationships and partnerships with schools, teachers and students. In order to be successful, we need to recognize and understand 1) the kinds of expertise that teachers can contribute to partnerships, 2) factors that motivate teacher participation in outreach opportunities, and 3) the constraints with which they work in today's schools.

THURSDAY'S ENTERTAINMENT & SPEAKER

Reception Entertainment

String Theory Quartet

Denise Minard | Joseph Baleta
Caroline Tran | Carly Ecker
Missouri University of Science and Technology

The String Theory Quartet is a string quartet comprised of engineering students who perform at a number of events around Missouri S&T and the local community. Their repertoire includes anything from classical to pop to light rock music. Members consist of Denise Minard (violin), Joseph Baleta (violin), Caroline Tran (viola), and Carly Ecker (cello). Find them on Facebook, or contact them at stringtheoryqt@gmail.com.

Banquet Topic & Speaker

My Vision for ASEE

Joseph Rencis
ASEE President 2015-2016
Dean of the College of Engineering, Clay N. Hixson Chair for Engineering Leadership and Professor of Mechanical Engineering
Tennessee Technological University

Joseph J. Rencis is the 2015-2016 President of ASEE. Born in New Jersey, Rencis received his A.A.S. and B.S. degrees from Milwaukee School of Engineering (MSOE), his M.S. from Northwestern University, and his Ph.D. from Case Western Reserve University. From 1985 to 2004 he was an Assistant, Associate, and Professor of Mechanical Engineering at the Worcester Polytechnic Institute (WPI). At WPI he was Director of Engineering Mechanics from 1995 to 2004. From 2004 to 2010 he was Department Head and the inaugural holder of the Twenty-first Century Leadership Chair in Mechanical Engineering from 2007 to 2010 at the University of Arkansas. Rencis was a tenured Professor of Mechanical Engineering at Arkansas. He is an inaugural fellow of the Southeastern Conference Academic Consortium Leadership Development Program. From 2006 to 2010 he was Chair and Vice Chair of the American Society of Mechanical Engineers (ASME) Mechanical Engineering Department Heads Committee. Since 2011 he has been the Dean of Engineering, the inaugural holder of the Clay N. Hixson Chair for Engineering Leadership, and Professor of Mechanical Engineering at Tennessee Technological University.

MEETING SCHEDULE AT A GLANCE

Wednesday, September 23, 2015

5:30 p.m. – 7:30 p.m.
Conference Registration - *Ballroom Registration*

5:30 p.m. – 7:30 p.m.
Welcome Reception & Tours of Springfield Missouri S&T Facilities

Thursday, September 24, 2015

7:30 a.m. – Noon
Conference Registration - *Ballroom Registration*

8:00 a.m. – 8:50 a.m.
Welcome Topic & Speaker: Dr. Ian Ferguson - *Oklahoma/Illinois*

9:00 a.m. – 10:20 a.m.
Concurrent Technical Session I
Attracting and Keeping Our Students - *Kansas A-B*
The Active Classroom - *Colorado*

10:20 a.m. – 11:00 a.m.
Morning Break - *Ballroom Lobby*

10:15 a.m. – 1:30 p.m.
Student Poster Session - *Ballroom Lobby*

11:00 a.m. – Noon
Concurrent Technical Session II
Classroom Challenges & Innovations - *Kansas A-B*
Recruitment & Retention - *Colorado*

Noon – 1:30 p.m.
Luncheon Topic & Speaker: Troy Sadler - *Oklahoma/Illinois*

1:30 p.m. – 5:00 p.m.
Conference Registration - *Ballroom Registration*

1:30 p.m. – 2:50 p.m.
Concurrent Technical Session III
ABET and Assessment - *Kansas A-B*
Improving our Programs - *Colorado*
NSF Broader Impacts 101 - *Oklahoma/Illinois*

2:50 p.m. – 3:10 p.m.
Afternoon Break - *Ballroom Lobby*

3:10 p.m. – 4:30 p.m.
Concurrent Technical Session IV
Classroom Activities - Are they Effective? - *Kansas A-B*
Innovations Using Computing Tools - *Colorado*

6:00 p.m. – 7:00 p.m.
Reception, Cash Bar & Entertainment - *Ballroom Lobby*

7:00 p.m. – 8:30 p.m.
Meeting Banquet Topic & Speaker: Joseph Rencis - *Oklahoma/Illinois*

8:30 p.m. – 9:30 p.m.
Midwest Section Executive Meeting - *Kansas A-B*
North Midwest Section Executive Meeting - *Colorado*
Gulf Southwest Section Executive Meeting - *Oklahoma/Illinois*

Friday, September 25, 2015

7:30 a.m. – 11:30 a.m.
Conference Registration - *Ballroom Lobby*

7:30 a.m. – 8:30 a.m.
Campus Representatives Meeting - *Colorado*

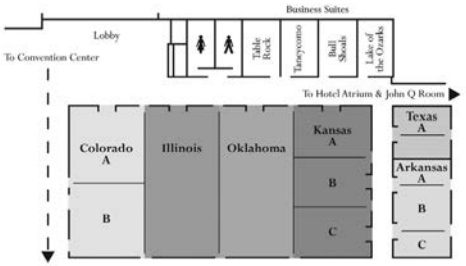
8:30 a.m. – 9:50 a.m.
Concurrent Technical Session V
Projects! Projects! Projects! - *Kansas A-B*
Experiential Learning - *Colorado*

9:50 a.m. – 10:10 a.m.
Morning Break - *Ballroom Lobby*

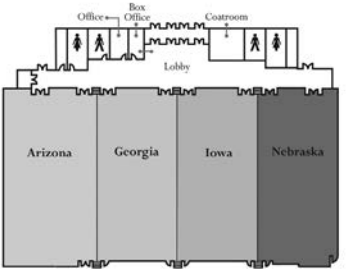
10:10 a.m. – 11:30 a.m.
Concurrent Technical Session VI
Technology Curriculum Enhancements - *Kansas A-B*
The Liberal Education - *Colorado*

11:30 a.m. – 1:00 p.m.
Lunch, Awards & Business Meeting - *Oklahoma/Illinois*

Grand Ballroom



Convention Center



MEETING PROGRAM

Wednesday, September 23, 2015

5:30-7:30 p.m.	**Meeting Registration** – *Ballroom Lobby* **Welcoming Reception & Tours of Springfield Missouri S&T Facilities**

Thursday, September 24, 2015

7:30 a.m.-Noon	**Meeting Registration** – *Ballroom Lobby*
8:00-8:50 a.m.	**Welcome Topic: Do Taxonomies Matter for Engineering Education...?** **Speaker: Dean Ian Ferguson, College of Engineering & Computing, Missouri S&T** Introduction: Dr. Steve Watkins – *Oklahoma/Illinois*
9:00-10:20 a.m.	**Concurrent Technical Session I** *Titles & Authors p. 9* **Attracting & Keeping Our Students** – *Kansas A-B* **The Active Classroom** – *Colorado*
10:15 a.m.-1:30 p.m.	**Student Poster Session** – *Ballroom Lobby*
10:20-11:00 a.m.	**Morning Break**
11:00 a.m.-Noon	**Concurrent Technical Session II** *Titles & Authors p. 9* **Classroom Challenges & Innovations** – *Kansas A-B* **Recruitment & Retention** – *Colorado*
Noon-1:30 p.m.	**Lunch Topic: K–12 Outreach and Broader Impacts** **Speaker: Troy Sadler, UM** Introduction: Dr. Steve Watkins – *Oklahoma/Illinois*

CONCURRENT TECHNICAL SESSION I | 9:00 a.m. – 10:20 a.m.

Attracting & Keeping Our Students

Session Chair: R. Joe Stanley | *Kansas A-B*

9:00 a.m. – Project Lead the Way (PLTW), Preparing for Engineering and More from Kindergarten through 12th Grade
Ben Yates | David Hosick

9:20 a.m. – Evaluation of High School Pre-Engineering Curricula Through Missouri University of Science and Technology Student Survey Responses
Ronald Joe Stanley | Stuart Baur

9:40 a.m. – Missouri Instructor Survey Assessment of Project Lead the Way Programs
Stuart Baur | Ronald Joe Stanley

10:00 a.m. – Developing Inclusive Excellence in Engineering Education: Lessons from the Wisconsin Louis Stokes Alliance for Minority Participation Excel Program
Luis Rodriguez

The Active Classroom

Session Chair: James Rowland | *Colorado*

9:00 a.m. – Development of a Small, Robust, and Portable Circuits Training System for an Introductory Course in DC Electrical Circuits
Daniel Bullock | Edward Carl Greco, Jr.
Jim Reasoner

9:20 a.m. – Analysis of Student Performance After Implementing Active Teaching Methods in an Engineering Classroom
Cory Mettler | Nathan Ziegler

9:40 a.m. – Active Learning in the Introduction to Digital Logic Design Laboratory Course
Jing Pang

10:00 a.m. – Development of Low-Cost Laboratory Experiments for Southern Arkansas University's Engineering Program
Mahbub Ahmed | Scott McKay
Kendra Ahmed

CONCURRENT TECHNICAL SESSION II | 11:00 a.m. – Noon

Classroom Challenges & Innovations

Session Chair: Byron Garry | *Kansas A-B*

11:00 a.m. – Implementing a Hybrid-Flipped Classroom Model in an Introduction to Engineering Course
Heath Schluterman | Candace Rainwater
Leslie Massey

11:20 a.m. – Increasing Student Ratings Through Lecture Based Tutoring
Todd Easton

11:40 a.m. – Tests Given Throughout a Course as Formative Assessment Instruments Can Improve Student Learning
Robert M O'Connell

Recruitment & Retention

Session Chair: James Rowland | *Colorado*

11:00 a.m. – An Engineering Academic Success and Professional Development Class: The Influence of a Scholarship
Mary Anderson-Rowland

11:20 a.m. – Encouraging Female Participation in STEM Degrees
Kendra Ahmed | Mahbub Ahmed
Scott McKay

11:40 a.m. – Promoting Renewable Education Systems to Midwestern College Students for Engineering Education and Improved Retention Rates
Erik Mallonee | John Barkley
Ramazan Asmatulu

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MEETING PROGRAM

Thursday, September 24, 2015

1:30-5:00 p.m.	**Meeting Registration** – *Ballroom Lobby*
1:30-2:50 p.m.	**Concurrent Technical Session III** *Titles & Authors p. 11* **ABET & Assessment** – *Kansas A-B* **Improving Our Programs** – *Colorado* **NSF Broader Impacts 101** – *Oklahoma/Illinois*
2:50-3:10 p.m.	**Afternoon Break**
3:10-4:30 p.m.	**Concurrent Technical Session IV** *Titles & Authors p. 11* **Classroom Activities – Are They Effective?** – *Kansas A-B* **Innovations Using Computing Tools** – *Colorado*
6:00-7:00 p.m.	**Reception, Cash Bar & Entertainment** **String Theory Quartet** – *Ballroom Lobby*
7:00-8:30 p.m.	**Meeting Banquet Topic: My Vision for ASEE** **Speaker: Joseph Rencis, ASEE President** Introduction: Dr. Steve Watkins – *Oklahoma/Illinois*
8:30-9:30 p.m.	**Midwest Executive Meeting** – *Kansas A-B* **North Midwest Section Executive Meeting** – *Colorado* **Gulf Southwest Section Executive Meeting** – *Oklahoma/Illinois*

CONCURRENT TECHNICAL SESSION III | 1:30 p.m. – 2:50 p.m.

ABET & Assessment
Session Chair: Charles Baukal
Kansas A-B

1:30 p.m. – Standard Work in Higher Education: Creating Rubrics to Improve Student Success
Heather McCain

1:50 p.m. – Developing a Sustainable ABET Continuous Improvement Plan
Byron Garry

2:10 p.m. – Control Systems Term Projects with Multidisciplinary Teams
James Rowland

2:30 p.m. – Promoting Critical Reflection During Problem Solving: Assessing Solution Credibility
Charles E. Baukal, Jr.

Improving Our Programs
Session Chair: Susan Schneider
Colorado

1:30 p.m. – Design Teams at a Distance: A First Attempt
Christi Patton Luks | Laura Ford

1:50 p.m. – Clinical Faculty Development Program
Norman Dennis, Jr. | Ed Clausen

2:10 p.m. – Student Learning and Development in the Context of Dissertation Research
Sara Wilson

2:30 p.m. – Teaching Construction Spanish in the Context of Construction Rather than in the Context of a Foreign Language
Brian Sandford

NSF Broader Impacts 101
1:30 p.m.- 2:50 p.m.
Sara Bassmer | *Oklahoma/Illinois*

CONCURRENT TECHNICAL SESSION IV | 3:10 p.m. – 4:30 p.m.

Classroom Activities - Are they Effective?
Session Chair: Byron Garry | *Kansas A-B*

3:10 p.m. – Flipping Forward: Improving Student Experiences in Process Calculations and Following Its Effect on Performance in Subsequent ChE Courses
Julie Jessop | Samuel Van Horne

3:30 p.m. – Applicability of Multiple Building Technologies in Building Components' Design Education
Semih G Yildirim | Stuart Baur

3:50 p.m. – Training Undergraduate Engineering Students on Biodegradable PCL Nanofibers Through Electrospinning Process
Shawn M. Hughes | Anh Pham
Kathy Huong Nguyen | Ramazan Asmatulu

4:10 p.m. – Hands-on Training the Engineering Students on Biodiesel Production Using Waste Vegetable Oils
Goutham Chinni | Israel Belachew
Ramazan Asmatulu

Innovations Using Computing Tools
Session Chair: B.J. Shrestha | *Colorado*

3:10 p.m. – Training the Engineering Students on Nanofiber-based SHM Systems
Ibrahim Alarifi | Ramazan Asmatulu
Omar Alsaiari | Abdulaziz Alharbi

3:30 p.m. – Prediction of Surface Water Supply Sources for the District of Columbia Using Neural Networks Methods
Francisco Lourenco | Nian Zhang
Sasan Haghani

3:50 p.m. – Incorporating Synopsys CAD Tools in Teaching VLSI Design
Puteri Megat Hamari

4:10 p.m. – Comparisons of Relational Databases with Big Data: A Teaching Approach
Ali Salehnia

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MEETING PROGRAM

Friday, September 25, 2015

7:30-11:30 a.m.	**Meeting Registration** – *Ballroom Lobby*
7:30-8:30 a.m.	**Campus Representatives Meeting** – *Colorado*
8:30-9:50 a.m.	**Concurrent Technical Session V** *Titles & Authors p.13* **Projects! Projects! Projects!** – *Kansas A-B* **Experiential Learning** – *Colorado*
9:50-10:10 a.m.	**Morning Break** – *Ballroom Lobby*
10:10-11:30 a.m.	**Concurrent Technical Session VI** *Titles & Authors p.13* **Technology Curriculum Enhancements** – *Kansas A-B* **The Liberal Education** – *Colorado*
11:30 a.m.-1:00 p.m.	**Lunch, Awards & Business Meeting** – *Oklahoma/Illinois*

CONCURRENT TECHNICAL SESSION V | 8:30 a.m. – 9:50 a.m.

Projects! Projects! Projects!

Session Chair: Robert O'Connell | *Kansas A-B*

8:30 a.m. – Educational Adaptation of Cargo Container Design Features
Christopher Moore | Semih G. Yildirim
Stuart Baur

8:50 a.m. – Building and Assessing a Hands-on Learning Experience for Robots in Business and Society
Timothy Burg

9:10 a.m. – Life Cycle Assessment and Sustainability Analysis of Lignin Derivative Products and Using Integrated Process Modeling, Scientific Framework and LCA
Ali Salehnia

9:30 a.m. – Analysis of an Evolving Global Engineering Education Program Between China and the US
Lisa Anneberg | SuYun Luo | Hui Zhang

Experiential Learning

Session Chair: Charles Baukal | *Colorado*

8:30 a.m. – Integration of Experiential Learning Modules in Sophomore and Junior Courses: A Pilot Study
Kendrick Aung | Jenny Zhou

8:50 a.m. – Innovative Curriculum Model Development in Robotics Education to Meet 21st Century Workforce Needs
Aleksandr Sergeyev | Nasser Alaraje
Scott Kuhl | Michael Meyer | Mark Kinney
Mark Highum

9:10 a.m. – Emulating Working in a Company in the Classroom: A Case for Hands-on Multiple Projects Oriented Course
Cristinel Ababei | Anca Miron

9:30 a.m. – A Simple, Inexpensive Venturi Experiment - Applying the Bernoulli Balance to Determine Flow and Permanent Pressure Loss
Jordan N Foley | John Thompson
Meaghan Williams | Roy Penney | Ed Clausen

CONCURRENT TECHNICAL SESSION VI | 10:10 a.m. – 11:30 a.m.

Technology Curriculum Enhancements

Session Chair: B.J. Shrestha | *Kansas A-B*

10:10 a.m. – Challenges and Opportunities in Classroom Dynamics in an Online as Opposed to an On-Site Class - A Paradigm Shift
Biyaya Shrestha

10:30 a.m. – Enhancing On-Line Electrical Engineering Undergraduate Education Through a Virtual Laboratory
Sreelatha Aihloor Subramanyam | David Beams
James Nelson

10:50 a.m. – Work in Progress: Use of Calibrated Peer Review to Improve Report Quality in an Electrical Engineering Laboratory
Susan Schneider

The Liberal Education

Session Chair: Christi Luks | *Colorado*

10:10 a.m. – Teaching Engineering Ethics
Steve E. Watkins

10:30 a.m. – Enduring Design: Examining the Relationship Between Art, Engineering, and Creativity
John Mirth | Andrew Findley

10:50 a.m. – Current State of Biotechnology and Bioethics for Engineering Education
Sarah Jurak | Ramazan Asmatulu

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CONCURRENT TECHNICAL SESSION I | 9:00 a.m. – 10:20 a.m.

Attracting and Keeping Our Students

Project Lead the Way (PLTW), Preparing for Engineering and More from Kindergarten through 12th Grade

Bill Yates,
Missouri University of Science and Technology

PLTW is a national STEM K-12 education program involving engineering, biomedical science and computer science. PLTW is based on the pedagogy of project/problem-based, hands-on teaching and learning and involves over one million students in all 50 states and Washington D.C.

Developing Inclusive Excellence in Engineering Education: Lessons From the Wisconsin Louis Stokes Alliance for Minority Participation Excel Program

Luis Rodriguez, *University of Wisconsin-Waukesha*

Efforts to broaden participation in science and engineering (STEM) are of national importance. This paper describes the development and implementation of teaching strategies for the Wisconsin Louis Stokes Alliance for Minority Participation (WiscAMP) Excel program at UW-Madison. The program involves: 1) selecting underrepresented minority (URM) students majoring in science and engineering whose first year academic performance indicates they are at risk for leaving STEM; and 2) providing an intensive 6-week immersion experience in STEM scholarship, research, academic and career exploration and advising. Collectively, program faculty members have identified a shared programmatic strategy with respect to supporting students' cultivation of a growth mindset, which has been shown to increase student persistence and performance while decreasing their vulnerability to stereotype threat (Dweck, 2006). Strategies for cultivating a growth mindset in the classroom and in the students' general attitude towards their academic activities are presented and discussed.

Evaluation of High School Pre-Engineering Curricula Through Missouri University of Science and Technology Student Survey Responses

Ronald Joe Stanley and Stuart Baur,
Missouri University of Science and Technology

Project Lead The Way (PLTW) is an example of a STEM education program that provides structured curriculum to promote college preparation in these areas. There have been several studies that show the benefits of PLTW courses for K-12 students in the preparation for high school students on statewide and national exams, high school academic performance, college level academic performance in particular areas of study, high school student engagement, and other areas. This study examines the impact of PLTW courses on Missouri S&T student career choices. Survey results from 120 current and graduated Missouri S&T (S&T) students are presented. Survey results indicated that: 1) students taking PLTW courses felt better prepared for their S&T experience in terms of hands-on experience, creative problem solving, teamwork and software experience and 2) 72.5% of the student respondents recognized engineering as their original career path and that PLTW promoted their career choices.

Missouri Instructor Survey Assessment of Project Lead the Way Programs

Stuart Baur and Ronald Joe Stanley,
Missouri University of Science and Technology

There have been several studies that show the benefits of Project Lead The Way (PLTW) courses for K-12 students in the preparation for high school students on statewide and national exams, high school academic performance, college level academic performance in particular areas of study, high school student engagement, and other areas. The challenge is how are schools being prepared to attract students to such programs and are the students excited about the curriculum. This study examines the impact of PLTW courses at the middle through high school level. Survey results from 208 instructors who attended the 2013 Missouri State PLTW Conference. Instructor observations from the survey indicated that: 1) hands-on projects promote reinforcement of PLTW course curricula, 2) PLTW courses provide useful college preparatory experiences for students and expose students to STEM related areas, and 3) school districts reasonably support PLTW courses.

The Active Classroom

Active Learning in the Introduction to Digital Logic Design Laboratory Course

Jing Pang, *California State University, Sacramento*

The introduction to digital logic design class is in general the first digital course for electrical and computer engineering undergraduate students at many universities. The related laboratory offers students hand-on experience to apply the principles of Boolean algebra and K-maps for minimizing logic expressions, to develop skills on

CONCURRENT TECHNICAL SESSION I *continued*

using digital logic chips, to understand sequential circuit operations, to perform basic finite state machine design work and to get ready for more advanced digital logic design study. In order to stimulate students in active learning inside the laboratory, this paper proposes effective technology integration with laboratory instruction including using online tools for logic circuit visualization, applying Multisim for transition to hands-on breadboard hardware experiments, running simulation in Moldelsim and prototyping the digital circuit design using Field Programmable Gate Array (FPGA) device.

Analysis of Student Performance After Implementing Active Teaching Methods in an Engineering Classroom

Cory Mettler and Nathan Ziegler,
South Dakota State University

The first part of this study compared course preparation time, material covered, and student performance between actively and traditionally taught courses. The second part, presented here, compared a new group of students in the same two courses; comparisons where made against a number of control questions developed during the first part of the study. Students' knowledge retention was also compared. Results continue to show that students were more engaged and scored higher on topics covered using active teaching methods. Students scored comparatively with previous students on control questions based on topics taught with active teaching methods. However, they scored higher on questions based on topics taught previously using traditional methods. Students who learned material from active methods scored higher in long term retention as well. Results suggest that students quickly appreciate these methods; however, extended exposure to the same techniques appears to desensitize the students and become less effective.

Development of a Small, Robust, and Portable Circuits Training System for an Introductory Course in DC Electrical Circuits

Daniel Bullock, Edward Carl Greco, Jr. and Jim Reasoner, *Arkansas Tech University*

Realizing a gap in student's ability to make connections between theoretical concepts and applied methods in an introductory DC Electric Circuits course we have developed a small, robust, and portable circuits training system. The designed system met the requirements of being self-contained, simple for student operation, robust, portable, and economically viable. In this paper we describe the details of integration of our system into an existing introductory DC Electric Circuits course and additionally, details of the planned study including implementation and assessment are discussed.

Development of Low-Cost Laboratory Experiments for Southern Arkansas University's Engineering Program

Mahbub Ahmed, Scott McKay and Kendra Ahmed,
Southern Arkansas University

The purpose of this paper is to present the preliminary work and plans related to the development of several low cost laboratory experiments in the newly established engineering program at Southern Arkansas University (SAU). SAU was recently approved to initiate a new engineering program, and the university officially started it in fall, 2014. An immediate requirement of the new engineering program is to develop two teaching labs - Solid Mechanics Lab and Thermal-fluid Science Lab. Considering the available resources and the time, the faculty decided to develop several low cost labs to meet teaching requirements. In the current work the proposed labs will be mainly used in the Thermal-fluid Science Lab. Those labs include: a conduction heat transfer experiment to demonstrate the Fourier's law; a transient conduction experiment that uses lumped capacitance method; and a hydrostatic force on a submerged surface experiment. The possibility of developing a lab using a small gas turbine that runs on alternative fuel is also discussed. The expected cost for each experimental setup is discussed.

CONCURRENT TECHNICAL SESSION II | 11:00 a.m. – Noon

Classroom Challenges and Innovations

Implementing a Hybrid-Flipped Classroom Model in an Introduction to Engineering Course

Heath Schluterman, Candace Rainwater and Leslie Massey, *University of Arkansas*

Much has been written recently about the use of the flipped classroom models in which students absorb most of the content prior to class through reading, exercises, or videos and use the class time for discussion, clarification, or problem solving. This paper discusses how this process was adapted for the Introduction to Engineering courses which almost entirely of first-year students from various high school backgrounds, students begin with large discrepancies in preparedness, study skills, and previous exposure to topics. Using a flipped classroom model with instructional videos followed by time to work problems in class allows well prepared students to not feel restricted by slower working classmates. The additional problem students not preparing before class is overcome through the use of an instructional computer lab allowing students to have access to the instructional videos, instructors, and teaching assistants during the class.

Increasing Student Ratings Through Lecture Based Tutoring

Todd Easton, *Kansas State University*

Lecture based tutoring is a new active learning technique. The instructor selects a student and asks the student a question. If the student cannot adequately answer the question, the teacher tutors the student to an appropriate answer. By asking each student in the class many questions during the semester, the instructor is aware of each student's progress on learning outcomes. Furthermore, the instructor can provide learning experiences for each student in the class. By changing a course from lecture based to lecture based tutoring, the student ratings of the instructor improved by a statistically significant amount.

Tests Given Throughout a Course as Formative Assessment Instruments Can Improve Student Learning

Robert M O'Connell, *University of Missouri-Columbia*

Research has shown that formative assessment can have a significant impact on student learning. Furthermore, tests administered throughout a course can be used effectively for formative assessment. However, such tests are often used for both summative and formative purposes, which can be problematic because formative assessments work best when students can take risks and make errors without fear of penalty. For the instructor to provide useful feedback, it is helpful to know the students' misconceptions and incorrect thought processes. Tests that have a summative component discourage students from taking such risks and thus deny the described feedback opportunity. The purpose of this paper is to present data from five recent offerings of a course in electric circuit theory that illustrate that when tests are used for strictly formative purposes, they can greatly enhance student learning, as measured by student performance on summative final examinations.

Recruitment and Retention

An Engineering Academic Success and Professional Development Class: The Influence of a Scholarship

Mary Anderson-Rowland, *Arizona State University*

Since 2002, workshops on academic success and professional development have been offered to engineering and computer science students who received an S-STEM and STEP scholarships from the National Science Foundation through grants to the Ira A. Fulton Schools of Engineering at Arizona State University. The most recent grants were an S-STEM grant (#1060226) for upper division native students and graduate students and a STEP grant (# 0856834) for upper division transfer students from five non-metropolitan community colleges. For the last several years, a two-credit Academic Success and Professional Development class has been required of the scholarship awardees. Class assignments were designed to help the student do well academically, socially, and professionally. This paper examines if the 32 students with a scholarship fared better than the 34 students in this class not on scholarship. Comparisons are done with overall GPA, gender, ethnicity, class evaluation, and backgrounds.

Encouraging Female Participation in STEM Degrees

Kendra Ahmed, Mahbub Ahmed and Scott McKay, *Southern Arkansas University*

Recently, more is being done to encourage high school students to enroll in STEM degrees. The STEM workforce is important and needs encouragement so that the USA

CONCURRENT TECHNICAL SESSION II *continued*

can compete globally. However, despite these programs, female participation in STEM degrees is still considerably lower than that of their male counterparts especially in engineering. Women make up almost half of the total workforce but only hold about a quarter of STEM jobs. A few of the reasons typically listed to explain this discrepancy in STEM jobs are a lack of female role models, gender stereotyping, and lack of family friendly flexibility. Despite current programs that are being used, some suggestions to help include, mentorship programs that break down gender stereotypes, STEM discovery days at universities where female high school students interact with female university STEM students, female STEM summer camps at universities, and university recruiting done by female faculty members in STEM.

Promoting Renewable Education Systems to Midwestern College Students for Engineering Education and Improved Retention Rates

Erik Mallonee and Abdulaziz Alharbi,
Wichita State University
John Barkley, *Millennium Concepts Inc.*

Energy education, especially alternative energy, is a broad field with many disciplines, including engineering, physics, chemistry, biology, mathematics, and others. One of the major challenges of energy related education is to provide students in this field with the ability to understand the fundamental concepts. Another is to be able to retain students' interest in the field, especially in the discipline of engineering, at both the college and high school levels. In the present study, a first year college student from a previous study was given the opportunity to, with guidance, improve upon a project related to the field of energy. The opportunity provided the ability to enhance the level of education and interest in engineering, as well as informing the student on the social, economic, and educational implications of the engineering field. Opportunities of this nature could help to retain students in engineering education and complete the degree on time.

CONCURRENT TECHNICAL SESSION III | 1:30 p.m. – 2:50 p.m.

ABET and Assessment

Control Systems Term Projects with Multidisciplinary Teams

James Rowland, *University of Kansas*

Improvements in multidisciplinary teaming are described for a two-phase Matlab project performed by over 300 seniors in the past 10 years in an undergraduate control systems course at the University of Kansas. Aligned with engineering education research reported in the literature, these dynamic teaming concepts provide continuous improvement for ABET Student Outcome (d). The two-semester senior capstone course that follows this course provides other teaming experiences; the controls project described in this paper serves to preconditions students for teaming principles one year earlier in their curriculum. An up-to-date survey of dynamic teaming results is presented, followed by a description of team improvements in these term projects over the past decade. The contributions of this paper are (1) a description of team accomplishments on the projects, (2) a literature survey of engineering education research on dynamic teaming, and (3) improvements in teaming for the KU projects.

Developing a Sustainable ABET Continuous Improvement Plan

Byron Garry, *South Dakota State University*

A sustainable continuous improvement process was required for use in the ABET-ETAC accreditation process for our EET program. Considering the state of assessment requirements in higher education, ABET accreditation standards, and the tools of quality and continuous improvement, our COM Department developed a three-intersecting-loop graphic that helped us to clarify the assessment, evaluation, and student learning improvement processes we will need to continue over time.

Promoting Critical Reflection During Problem Solving: Assessing Solution Credibility

Charles E Baukal, Jr., *University of Tulsa and Oral Roberts University*

Engineering students are considered novices while their instructors are experts in a given field. One of the goals of engineering education is to move students closer to being experts. Engineers are problem solvers by nature and an important skill to be learned is the ability to assess the credibility of solutions. Engineering educators can help students gain this ability by modeling solution assessment in the classroom by predicting, where possible, what the solution should look like before even solving a problem and then evaluating the result when it has been obtained. Some of the solution checks include the sign (positive or negative), the correct range and order of magnitude, the number of significant digits, and the error bars for laboratory measurements. The paper discusses problem solving, reflection, reality checks of the solution, and recommendations for how to implement solution assessment.

Standard Work in Higher Education: Creating Rubrics to Improve Student Success

Heather McCain, *University of Kansas & Edwards Campus*

Quality requirements are not easy to define no matter what business you are in. Defining quality is manufacturing can be difficult and trying to define quality in higher education is equally, if not more, difficult. In manufacturing standard work is used to create consistency and define quality. In higher education standard work are those procedures and practices that could help create consistency and define quality. Items such as a course syllabus and course timeline are used to help students understand what to do and when to complete assignments. Although students receive the syllabus they still may not know what it takes to get a good grade on an assignment. Lecture notes may help clarify the quality requirements for assignments beyond the syllabus. Another way instructors can convey requirements is by developing rubrics. This paper suggests that rubrics can help improve student satisfaction by creating consistency and providing quality requirements.

Improving Our Programs

Design Teams At a Distance: A First Attempt

Christi Patton Luks, *Missouri University of Science and Technology*
Laura Ford, *The University of Tulsa*

In the Spring 2015 semester, Chemical Engineering professors at two universities teaching a similar junior-level course created a design project for teams formed with members from each school. The intent was that students would have an opportunity to develop some real-world skills in teamwork when part of the team is working in another office across the country or, as is frequently the case, across the globe. In this paper, the authors will describe the challenges faced by the students and by the instructors in implementing this collaboration.

CONCURRENT TECHNICAL SESSION III *continued*

Clinical Faculty Development Program

Norman Dennis, Jr. and Ed Clausen, *University of Arkansas*

With the significant increase in engineering student enrollment over the last ten years and the relatively flat number of tenure/tenure track faculty position in engineering, a significant portion of undergraduate teaching load has shifted to non-tenure track faculty. As a result of increased involvement of non-tenured faculty in teaching in the college a developmental workshop was created for the clinical faculty within the college of engineering with a vision of making clinical faculty more engaging and organized instructors. The workshop was modeled after the very successful week long ASCE ExCEEd Teaching Workshop. Participants were not only exposed to various teaching pedagogies but were actually required to incorporate them into a practice class presented to their peers and to master teachers.

Student Learning and Development in the Context of Dissertation Research

Sara Wilson, *University of Kansas*

At the University of Kansas, the Bioengineering Graduate Program has undertaken a process to develop objectives, outcomes, and measures of student learning and development in the dissertation research of PhD students. Two measures of student learning, the graduate learner outcomes dissertation rubric and peer-reviewed publication of graduates, are presented in this paper. It was found that assessing peer-reviewed publications, particularly in relationship to the year of graduation, yields information on the volume and success of a student's research productivity. It may, however, be influenced by other factors such as laboratory size. Future work will include examination of early (entrance) and intermediate measures.

Teaching Construction Spanish in the Context of Construction Rather Than in the Context of a Foreign Language

Brian Sandford, *Pittsburg State University*

In 2003, Hispanics became the largest minority population in the U.S. and construction and its related supply and support industries is a major employer of Hispanics (U.S. Census, 2015). It will continue to be more and more relevant in the construction industry to be able to communicate with the Hispanic population in their native Spanish language. In the fall of 2010, an email inquiry was sent to all construction management students at Pittsburg State University (PSU) to determine student interest in a Spanish for Construction course. A majority of positive responses resulted in the development of a Spanish for Construction course offered in the spring of 2010 in the College of Technology at PSU. Feedback provided by a pre-test/post-test language proficiency survey indicates that the course provides students with statistically significant learning gains in Spanish in the areas of listening, reading, writing, presenting, and one-on-one and group communication.

NSF Broader Impacts 101

Sara Bassmer, *Broader Impacts Network*

All proposals submitted to the National Science Foundation are evaluated on their intellectual merit and their broader impacts (BI). Dr. Sara Bassmer, Assistant Director of the Broader Impacts Network will provide an overview of the NSF BI criterion, provide examples of successful BI activities and give instruction on how to create an effective BI plan. She will also be availble to answer questions and consult with researchers on their existing BI plans.

CONCURRENT TECHNICAL SESSION IV | 3:10 p.m. – 4:30 p.m.

Classroom Activities - Are they Effective?

Applicability of Multiple Building Technologies in Building Components' Design Education

Semih G. Yildirim and Stuart Baur,
Missouri University of Science and Technology

Problem-based learning (PBL) as a part of course curriculum in architectural engineering education has already been formulized through longer retention of desired knowledge. The components of educational model are defined as learning environment, formulation of PBL, applicable building technologies and design guide. This paper aims to present applicability of multiple building technologies in "building components' design" education. Design guide is the backbone of this educational model and needs improvement in order to be used for the education of multiple building technology. Scaled model materials are evaluated due to their features and these features directly affect the students' performance in teamwork. Quantitative feedbacks received from students by survey. Model materials and the effects over PBL environment are evaluated. Teamwork creates an effective working environment for the students to accomplish the task on time. Improvements are required for peer assessment and rubric and flexibility on building types is discussed.

Flipping Forward: Improving Student Experiences in Process Calculations and Following Its Effect on Performance in Subsequent ChE Courses

Julie Jessop and Samuel Van Horne,
University of Iowa

Flipping is an appealing method to engage students for meaningful and active learning. However, students are notoriously resistant to this shift in learning culture, which puts the responsibility for learning more squarely on their shoulders. In this paper, ideas are provided to manage student expectations of the flipped course, and essential elements for increased student satisfaction and participation are presented. In addition, qualitative and quantitative assessment data are used to begin addressing the question "How does flipping affect student performance in required downstream courses?" With this information, further improvements in the flipped experience can be suggested to maximize the impact of this active learning technique.

Hands-on Training the Engineering Students on Biodiesel Production Using Waste Vegetable Oils

Ramazan Asmatulu, *Wichita State University*

Energy is playing a vital role in human life and mainly produced from the fossil fuels worldwide. Due to the extensive usage of energy obtained from fossil fuels, alternative sources of energy should be sought for the future demands. Biodiesel can be one of the alternative energy sources to replace the fossil fuels because of the lower emissions and lower harmful exhaust gases. Biodiesel can be directly used or blended with other diesel products to manage some of the pollution and emission problems. In today's conditions, the optimum blend of biodiesel to the diesel seems to be about 10 wt. % (or B10). The emissions and particulates can be adjusted after appropriate blends of biodiesel into the petroleum-based diesel. During the present study, the undergraduate engineering students were trained on biodiesel production using a waste vegetable oil. The major goals of this study were to extract the biodiesel from the waste vegetable oil, improve biodiesel properties and train the undergraduate engineering students on the renewable energy systems for their future careers.

Training Undergraduate Engineering Students on Biodegradable PCL Nanofibers Through Electrospinning Process

Shawn Hughes and Ramazan Asmatulu,
Wichita State University

Nanotechnology has a great potential to revolutionize the industrial and scientific realm of knowledge. Electrospinning is one of the most effective techniques to fabricate nanotechnology products, such as nanofibers, nanomembranes, nanofilms and nanocomposites for different industrial applications. In the present study, an electrospinning technique was used to fabricate nanofibers using polycaprolactone (PCL) after dissolving in acidic acid (HC2H3O2) and acetonitrile (C2H3N) at a 50:50 wt% ratio. The produced PCL nanofibers can be used in different industrial and research applications, including scaffolding, energy storage and conversion, drug delivery, bio and nanosensors, filtration, and so on. During the experiments, two undergraduate students in the Department of Mechanical Engineering were trained to produce these PCL nanofibers. It is believed that these hands-on experiences will motivate students to do more advanced studies in the engineering fields.

CONCURRENT TECHNICAL SESSION IV *continued*

Innovations Using Computing Tools

Comparisons of Relational Databases with Big Data: A Teaching Approach

Ali Salehnia, *South Dakota State University*

Biotechnology provides a wealth of products which improve the lives of many individuals. Some improve the quality of life of the person while the others extend their lives. Another biology oriented research area is synthetic biology, which is a sub-category of biotechnology. Products from synthetic muscle tissue and medications to biofuels are the subjects of research today. Each product developed has to be evaluated as to whether it can be produced sustainably and economically while taking into consideration the effect on the environment and protection of human rights. With the introduction of new products and technologies, bioethics is evolving, which means the educational community has to be up to date with the current bioethical issues and accepted practice in order to prepare the engineering students to be involved in research as a student and in industry. The present study will investigate current research in biotechnology and synthetic biology, and identify ethical issues and current accepted practices associated with them. It will also touch on how these issues are handled globally.

Incorporating Synopsys CAD Tools in Teaching VLSI Design

Puteri Megat Hamari,
Minnesota State University Mankato

VLSI Design is a course for graduate and undergraduate students at the Minnesota State University, Mankato, to introduce students to the theory, concepts and practice of VLSI design. For Spring 2015, the course syllabus was changed with the integration of industrial-standard VLSI CAD using Synopsys. Previously, simulations were limited and performed with open source software. With Synopsys, students used methodology similar to the process used in industry to design complex circuits. This paper describes the experience of an instructor in teaching VLSI Design and how the instructor has successfully integrated the teaching of CMOS theory, process technology and complex logic design through the use of Synopsys tools. Topics covered in this paper include course outline, the use of CAD session to teach design skills, the ability of students to use basic circuit blocks to build larger designs and how the methodology of teaching evolved with the use of Synopsys.

Prediction of Surface Water Supply Sources for the District of Columbia Using Neural Networks Methods

Francisco Lourenco, Nian Zhang and Sasan Haghani, *The University of the District of Columbia*

Water availability for municipal and industrial use, irrigation, navigation support, hydropower, and environmental flows is a significant concern in regions throughout the United States. Hence, there is a need to develop analytical tools to assess and help in the long-term planning of the availability of water supply sources. In this paper, we study the long-term prediction of surface water resources at the Potomac Watershed in the District of Columbia. A predictive model, based on recurrent neural networks, trained with the Levenberg-Marquardt backpropagation learning algorithm is proposed to forecast the runoff discharge using the past runoff discharge and gage height. Using this computational intelligence modeling tool, the impact of discharge and gage height to the long-run discharge forecast accuracy was studied. Our experimental results indicate that the proposed learning algorithm can successfully train the recurrent neural network for the runoff prediction.

Training the Engineering Students on Nanofiber-based SHM Systems

Ibrahim Alarifi, Ramazan Asmatulu, Omar Alsaiari and Abdulaziz Alharbi, *Wichita State University*

The undergraduate engineering students were trained on the structural health monitoring (SHM) systems for the detections of aircraft composite damages using carbonized electrospun polyacrylonitrile (PAN) fibers. The carbonization process was conducted in two different steps: i) oxidation at 270 degrees C in a furnace for 1 hr, and ii) carbonization in an Argon atmosphere at 750, 850, and 950oC for additional 1 hr. The PAN nanofibers were placed on the pre-preg carbon fiber composites with 0, 45, -45 and 90 degrees stacking sequences, and co-cured in a vacuum oven. The extracted carbon fiber composites associated with the carbonized PAN nanofibers were used as a strain sensor during the loading and unloading of the carbon fiber composites panels. The electrical resistivity values of the nanofibers were changed at different strain conditions. The surface hydrophobicity of the carbonized samples were also measured and the test results were evaluated in detail. During this study, the undergraduate engineering students were involved in the tests to give them hands-on experience in understanding the new technology and stimulate their desire for pursuing advanced studies in engineering fields.

CONCURRENT TECHNICAL SESSION V | 8:30 a.m. – 9:50 a.m.

Projects! Projects! Projects!

Building and Assessing a Hands-on Learning Experience for Robots in Business and Society

Timothy Burg, *Kansas State University*

An undergraduate course is being developed for non-engineering majors to address the need for general competencies in ethics, science, and technology. Robotics is a field of science that is rapidly transforming our lives. Participants in the course will learn the history, mechanics and software, and applications of robots and learn to analyze the ethical, social, and economic concerns. The unique feature of the proposed course is that the participants will use hands-on assignments with a Lego® Mindstorm kit (interlocking plastic bricks, gears, computer) to explore these issues. For example, students will use the Legos to build a face for a robot that expresses emotions as an exercise to more deeply consider the use of robots as surrogates for human interaction. The course will be monitored and updated using formative and summative assessments including a modified "Views on Science-Technology-Society" (VOSTS) tool. Trial use of the VOSTS tool is described.

Analysis of an Evolving Global Engineering Education Program Between China and the US

Lisa Anneberg, *Lawrence Technological University*
SuYun Luo and Hui Zhang, *Shanghai University of Engineering Science, P.R. China*

Our paper analyzes specific aspects of a Global Engineering program that has been evolving since 2003. Lawrence Technological University in Southfield, MI [LTU] and Shanghai University of Engineering Science [SUES] have and have had other global programs with other universities. For instance, LTU has an ongoing program with Wenzhou University [WU] in China. However, WU is interested only in two classes. SUES has an ongoing program with St. Cloud State University in St. Cloud, MN [SCSU]. This program comprises special seminars at both SCSU and SUES. But the LTU/SUES partnership is enduring, expanding and evolving, and now comprises over twenty courses in four SUES degree programs. The focus of this paper is an overview of the growth and specific evolving mechanisms, as well as lessons learned from participating administrators and professors. Some statistics about the program will be analyzed as well. A conclusion and time-specific mission statement is provided.

Educational Adaptation of Cargo Container Design Features

Christopher Moore, Semih G. Yildirim and Stuart Baur, *Missouri University of Science and Technology*

Cargo container homes have become increasingly popular around the world in the last 30 years. Because cargo containers are modular in design, they can be used to create efficient, cheap homes. Repurposing cargo containers into homes is a sustainable construction practice due to the majority of the structure coming from recycled materials. Many design parameters of cargo container homes parallel those of standard home construction methodologies (cold formed steel framing/light wood framing) and from a structural standpoint, cargo containers are an effective building material. This paper aims to discuss the design parameters of cargo container home construction and an educational application of the concept. Problem-based learning (PBL) methodology was applied in order to create a discussion group. Building types were handed-out, scaled model and poster presentation were prepared by teams according to defined design parameters. Educational activity is evaluated by survey and critical points are determined to improve.

Life Cycle Assessment and Sustainability Analysis of Lignin Derivative Products and Using Integrated Process Modeling, Scientific Framework and LCA

Ali Salehnia, *South Dakota State University*

This proposal aims to develop a novel scientific model framework to assess the life cycle sustainability of lignin derived chemicals and compare the life cycle profiles of both current state of the art processes and DakotaBioCon lignin process based on final products. In this work we try to develop and implement a project to determine the Economic, environmental, and social dimensions of sustainability. We will assess the sustainability of a project and product. In this proposal, the central concept is life cycle assessment for sustainability and conflicts in system definition, allocation, treatment of time, aggregation, etc. will be discussed in integration of LCA, LCC and SLCA. We will develop and implement this project using a modified Dijkstra's algorithm along with dynamic programming. The resulting values will be input for new processes. The final value of each route determines the maximum value associated with each route and process.

CONCURRENT TECHNICAL SESSION V *continued*

Experiential Learning

A Simple, Inexpensive Venturi Experiment - Applying the Bernoulli Balance to Determine Flow and Permanent Pressure Loss

Jordan N Foley, John Thompson, Meaghan Williams, Roy Penney and Ed Clausen, *University of Arkansas*

Experiments were conducted using a simple, easily built and inexpensive venturi meter. Three modified Bernoulli balances were used to determine mass flows and permanent pressure loss for the flowmeter. The mass flow rate from the Bernoulli balance calculation gave a mass flow rate about 88% of the experimental flow rate, yielding a discharge coefficient of 0.88. Small, well-constructed venturi meters have discharge coefficients about 0.98. Since this homemade flowmeter likely not well constructed, the low discharge coefficient is reasonable. The permanent pressure loss was correlated using a minor loss coefficient applied to the velocity head in the venturi throat. The minor loss coefficient was 0.29, which compares with the minor loss coefficient of a well-designed venturi meter of about 0.1. This inexpensive flowmeter is ideal for teaching the use of the Bernoulli Balance to model fluid systems.

Emulating Working in a Company in the Classroom: A Case for Hands-on Multiple Projects Oriented Course

Cristinel Ababei, *Marquette University*
Anca Miron, *University of Wisconsin Oshkosh*

We describe the design, implementation, and outcomes of an advanced engineering course emulating the working environment of a company. Shifting from a traditional teaching style to an approach where students must be completely involved in project-related research, implementation, preparation of deliverables, and presentation of results helps to: 1) foster self-learning, 2) engage students more and enable them to be pro-active and competition-aware, and 3) enable a smoother transition from full-time student to full-time employee. We used anonymous questionnaires as the primary methodology of data collection along with ratings of the projects in terms of extent of challenge/complexity and type of work (individual vs. team-work). The questionnaires assessed the following dimensions satisfaction, fairness, knowledge acquired, challenge, feedback, and validation. Students are more satisfied with their learning experience when they work in teams on more complex projects split into smaller subprojects rather than working individually on projects, irrespective of their complexity.

Innovative Curriculum Model Development in Robotics Education to Meet 21st Century Workforce Needs

Aleksandr Sergeyev, Nasser Alaraje, Scott Kuhl and Michael Meyer, *Michigan Technological University*
Mark Kinney, *Bay College*
Mark Highum, Bay de *Noc Community College*

Recently, educators have worked to improve STEM education at all levels, but challenges remain. Capitalizing on the appeal of robotics is one strategy proposed to increase STEM interest. The interdisciplinary nature of robots, which involve motors, sensors, and programs, make robotics a useful STEM pedagogical tool. There is also a significant need for industrial certification programs in robotics. Robots are increasingly used across industry sectors to improve production throughputs while maintaining product quality. The benefits of robotics, however, depend on workers with up-to-date knowledge and skills to maintain and use existing robots, enhance future technologies, and educate users. It is critical that education efforts respond to the demand for robotics specialists by offering courses and professional certification in robotics and automation. This paper introduces a new approach for Industrial Robotics in electrical engineering technology (EET) programs at Michigan Tech and Bay de Noc Community College.

Integration of Experiential Learning Modules in Sophomore and Junior Courses: A Pilot Study

Kendrick Aung, *Mechanical Engineering & Lamar University*, Jenny Zhou, *Lamar University*

Evidence from past literature suggests that experiential learning activities can be highly beneficial to undergraduate engineering students when introduced early in their undergraduate studies. Learning modules based on experiential learning model have been developed and integrated into two core undergraduate courses (one sophomore and one junior) of mechanical engineering. Using the experiential learning model of Kolb, each learning module contains concrete engineering experience, theory, computer-based modeling and simulations, and hands-on laboratory exercises. The main goal is to provide experiential learning experiences based on real-world engineering problem solving, engineering design process, and engineering design skills. The first module was tested in the sophomore course, engineering dynamics, in the summer 2014 semester as a pilot study. The second module for a junior course, engineering analysis, was tested in the fall 2014 semester. Some of the results from these pilot studies are presented in this paper.

CONCURRENT TECHNICAL SESSION VI | 10:10 a.m. – 11:30 a.m.

Technology Curriculum Enhancements

Challenges and Opportunities in Classroom Dynamics in an Online as Opposed to an On-Site Class – A Paradigm Shift

Bijaya Shrestha,
Missouri University of Science and Technology

Online class as an emerging mode of education delivery has brought forth new opportunities and challenges on the face of traditional sit-in class. The opportunities are more obvious than the challenges. Compared to our old school format, the lack of a real human being standing in front of the class is the real game changer. The work reported in this article examines these issues.

Enhancing On-Line Electrical Engineering Undergraduate Education Through a Virtual Laboratory

Sreelatha Aihloor Subramanyam, David Beams and James Nelson, *The University of Texas at Tyler*

On-line education is utilized extensively and has been found to be effective in a multitude of subject areas, including engineering education. However, for on-line education to be fully effective in engineering education, a means must be developed to provide on-line students with laboratory experiences that achieve the same learning outcomes as face-to-face laboratories. To address this need, a pilot computer program, Project VELVET (Virtual Electronics Laboratory for Visualized Education and Training), for a virtual electronics laboratory is being developed. VELVET operates on Windows-based computers in a real-time environment. It presents to its user a virtual breadboard into which components may be inserted. A dc power supply and a signal generator are available to supply energy and signals to circuits, and measurements may be made with a virtual millimeters and a virtual oscilloscope. The algorithm and sample screen images of the program are presented in this paper.

Work in Progress: Use of Calibrated Peer Review to Improve Report Quality in an Electrical Engineering Laboratory

Susan Schneider, *Marquette University*

This paper discusses the use of a writing exercise in an electrical engineering undergraduate laboratory class in which some of the attributes of the Calibrated Peer Review (CPR) process are practiced. An example of a CPR assignment for an electrical engineering undergraduate laboratory is provided to show how an instructor can potentially modify existing assignments for use with CPR. The results of a "practice CPR" assignment are used to highlight which areas of the CPR assignment preparation need to be given close attention in order to achieve meaningful reviews.

The Liberal Education

Current State of Biotechnology and Bioethics for Engineering Education

Sarah Jurak and Ramazan Asmatulu,
Wichita State University

Biotechnology provides a wealth of products which improve the lives of many individuals. Some improve the quality of life of the person while the others extend their lives. Another biology oriented research area is synthetic biology, which is a sub-category of biotechnology. Products from synthetic muscle tissue and medications to biofuels are the subjects of research today. Each product developed has to be evaluated as to whether it can be produced sustainably and economically while taking into consideration the effect on the environment and protection of human rights. With the introduction of new products and technologies, bioethics is evolving, which means the educational community has to be up to date with the current bioethical issues and accepted practice in order to prepare the engineering students to be involved in research as a student and in industry. The present study will investigate current research in biotechnology and synthetic biology, and identify ethical issues and current accepted practices associated with them. It will also touch on how these issues are handled globally.

Enduring Design: Examining the Relationship Between Art, Engineering, and Creativity

John Mirth and Andrew Findley,
Rose-Hulman Institute of Technology

This paper describes the development of an arts and humanities course entitled "Enduring Design: The Art of Engineering." The course was co-developed by faculty members in the humanities and engineering departments. The intent of the course was to help students better appreciate the importance of the arts and humanities by

CONCURRENT TECHNICAL SESSION VI *continued*

creating an art course that provides a bridge between engineering and an appreciation of the arts. While the course had a variety of outcomes, the focus of this paper is on the effect of the course on student creativity. Results suggest that enrollment in the course increased the ability of students to recommend improvements in both the form and function of common objects. Further study is required to verify this preliminary outcome.

Teaching Engineering Ethics

Steve E. Watkins,
Missouri University of Science and Technology

Instruction in engineering ethics is an important aspect of professional development. For universities, it is an element of program assessment and is considered for accreditation. For engineering students, it addresses relationships in professional life and is a topic for professional licensure. A common instructional objective is for students to have an ability to continue developing their ethical knowledge and judgment. Topical content typically includes an introduction to principles of applied ethics with supporting examples of related engineering situations. This paper discusses the organization of the ethics component in a senior seminar course. Key topics are ethics principles in the context of the engineering profession, codes of ethics as developed by professional societies, and ethical judgment in case studies.

NOTES

NOTES

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