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CONFERENCE AT A GLANCE

Wednesday, October 23

11:00 am – 6:00 pm   Registration
                     Second Floor Prefunction Area

1:30 pm – 6:00 pm   Exhibit Setup
                     Great Hall D & E

1:30 pm – 4:30 pm   Pre-conference Workshops Session A

5:30 pm – 8:30 pm   Pre-conference Workshops Session B

Thursday, October 24

7:00 am – 5:00 pm   Registration
                     Second Floor Prefunction Area

7:00 am – 8:00 am   Focus on First-Time Attendees Breakfast Buffet
                     Great Hall C

8:00 am – 9:30 am   Plenary Session
                     Katherine Banks, Vice Chancellor and Dean of Engineering,
                     Texas A&M University
                     Great Hall A & B

9:30 am – 5:00 pm   Exhibit Hall Open
                     Great Hall D & E

9:30 am – 10:00 am  Exhibit Hall Break

10:00 am – 11:30 am  Technical Sessions (T1)

11:45 am – 1:15 pm  HP Terman and Rigas Awards Lunch
                     Sponsored by the Hewlett-Packard Company
                     Great Hall C

1:30 pm – 3:00 pm  Technical Sessions (T2)

3:00 pm – 4:00 pm  Exhibit Hall Break

4:00 pm – 5:30 pm  Technical Session (T3)

6:00 pm – 9:30 pm  Transportation to and Reception at National Cowboy & Western
                     Heritage Museum
                     Bus loading zone: between the Renaissance hotel and the
                     Cox Convention Center
Friday, October 25

7:00 am – 5:00 pm  Registration Open  Second Floor Prefunction Area

7:00 am – 8:30 am  Breakfast & Plenary Session  
Mike McCracken, Director of Online Course Development and Innovation, College of Computing, Center for 21st Century Universities (C21U), Georgia Tech  
Great Hall C

8:30 am – 10:00 am  Technical Sessions (F1)

9:00 am – 4:30 pm  Exhibit Hall Open  
Great Hall D & E

10:00 am – 10:30 am  Exhibit Hall Break

10:30 am – Noon  Technical Sessions (F2)

Noon – 1:30 pm  Luncheon  
Great Hall C

1:30 pm – 3:00 pm  Technical Sessions (F3)

3:00 pm – 4:00 pm  Focus on Exhibits and New Faculty Fellows  
Great Hall D & E

4:00 pm – 5:30 pm  Technical Sessions (F4)

6:30 pm – 9:00 pm  Reception and Awards Banquet - Ticketed Event  
Great Hall C

Saturday, October 26

7:00 am – 2:00 pm  Registration  
Second Floor Prefunction Area

7:00 am – 8:00 am  Breakfast

8:00 am – 9:30 am  Technical Sessions (S1)

9:30 am – 10:00 am  Break - Second Floor Prefunction Area

10:00 am – 11:30 am  Technical Sessions (S2)

11:30 am – 1:00 pm  Lunch  
Great Hall C

1:00 pm – 2:30 pm  Technical Sessions (S3)

2:30 pm – 3:00 pm  Break - Second Floor Prefunction Area

3:00 pm – 4:30 pm  Technical Sessions (S4)
Welcome to FIE 2013!

Oklahoma has long been known as an energy producing state, so we thought it appropriate to have “Energizing the Future” of engineering and computer science education as this year’s theme. The name of our state, Oklahoma, is a Choctaw word that means “land of the red people”. Oklahoma is home to 38 federally recognized Indian tribes and our history is enmeshed with stories of American Indian relocation and settlement, the Oklahoma land run, and the civil rights movement. So it is fitting that FIE highlight diversity and inclusion for our future. The conference also focuses on programs that bridge disciplines, such as the successful collaborations between engineering, computing and meteorology that can be seen during the evening tour of the National Weather Center, located in Norman Oklahoma. The traditional FIE topical themes of educational innovations and research in engineering and computing education are still front and center. We hope you find many opportunities to interact with your fellow conference attendees, including taking advantage of the “catalyzing conversations” sessions.

We look forward to meeting you Thursday evening at the welcoming reception, which is being held at a unique venue, the National Cowboy and Western Heritage Museum. There are many local attractions for you to enjoy during your stay, including the Oklahoma City National Memorial and Museum which memorializes the 1995 terrorist bombing of Alfred P. Murrah Federal Building; the Oklahoma City Museum of Art which is home to one of the largest collections of glass sculpture by noted artist Dale Chihuly; the Myriad Botanical Gardens featuring 17 acres of walking paths, splash fountains, and gardens, that feature plants from climates ranging from rain forests to desserts; and the Boathouse District which hosts a U.S. Olympic and Paralympic training site for rowing and canoe/kayaking and river sport adventures. All of these venues are within easy walking distance of the hotel. The Bricktown district is adjacent to the conference venue and offers a variety of restaurants and night clubs for your dining and entertainment pursuits.

The University of Oklahoma (OU) College of Engineering is pleased to host FIE 2013. We are grateful for the support of the OU administration as we prepared for the conference. We further express our sincere appreciation to our conference sponsors and exhibitors for their financial support.

We are very pleased you have joined us in Oklahoma City and wish you a hearty welcome!

Randa Shehab
Jim Sluss
Deborah Trytten
WELCOME FROM THE PROGRAM CO-CHAIRS

We are so glad you have joined us at FIE 2013! We hope that you will find your experience here enjoyable and valuable as you participate in the broad range of paper, panel, and special sessions, workshops, and social activities that have been scheduled.

This year’s conference theme is Energizing the Future, and that is just what we hope happens for those who have chosen to join us. If you are new to the conference, you will find sessions on a wide variety of topics related to engineering and computing education. If you have been to FIE before, you will discover new opportunities, catalyzing conversations, as well as some of the tried and true favorites in the special sessions and traditional sessions. The technical program is complemented by the Conference’s networking opportunities during breakfast and lunch with a big cowboy welcome at the reception – one you won’t want to miss!

Our authors deserve the credit for the continuing quality of this conference – their innovative and compelling work and their promising works-in-progress seeking your input are once again outstanding. The reviewers who volunteered their time to provide quality, constructive feedback gain our thanks.

So, may your future be energized as you enjoy your time in Oklahoma City at FIE 2013!

IEEE/Computer Society Program Co-Chair
Mats Daniels
Uppsala University

International Co-Chair, Asia
Ming Zhang
Peking University

ASEE/ERM Program Co-Chair
Teri Reed
Texas A&M University

International Co-Chair, Australasia
Mark Lee
Charles Stuart University

IEEE/Education Society Program Co-Chair
Lynne Slivovsky
Cal Poly - San Luis Obispo

International Co-Chair, Europe
Edmundo Tovar Caro
Universidad Politecnica de Madrid

Workshops, Special Sessions & Panels Chair
Susan Walden
University of Oklahoma

International Co-Chair, South America
Melany M. Ciampi
COPEC – Science and Education Research Council

Awards Chair
Manuel Castro
Spanish National Distance University
MESSAGE FROM THE FIE STEERING COMMITTEE

Welcome to Oklahoma City and the 43rd annual Frontiers in Education Conference. FIE has an outstanding global reputation as a premier conference on engineering education. It is known for its collaborative author network and papers from its proceedings record are regularly cited in bibliographies.

This year the conference continues its long tradition of offering an outstanding technical program. I am confident you will find many sessions where speakers will challenge you to think differently about education and how we facilitate learning in our classrooms. The General Chair, Technical Program Chairs, paper reviewers, and session chairs all play important roles in guaranteeing that the technical program remains current and is of high quality. Please take a moment to thank these people for their professionalism and volunteer service to engineering education when you meet them during the conference.

This year, I want to focus my welcome message on the process of organizing a conference. FIE is a mid-sized conference event led by a nine member Steering Committee of appointed representatives from the three sponsoring professional societies. This Steering Committee sets mission and vision for the conference including desired size, technical program specifications, and registration fee structure. The Steering Committee regularly reviews the structure of FIE as it considers growth potential. Have you ever thought of hosting FIE in your city and wondered what the conference requires for facilities? Currently, the conference is designed to:

- use four conference days typically beginning on a Wednesday in October or November,
- host approximately 600 registered attendees,
- support a technical program of 400 paper and special session presentations,
- provide breakfast and lunch to its participants to foster collegiality and networking,
- provide a welcome reception and formal awards banquet,
- be in a conference hotel that can provide at least 300 rooms per night for FIE guests, and
- be in a conference hotel that has at least nine presentation rooms, two ballrooms, and exhibit hall space.

And, have you ever thought of hosting FIE in your city and wondered what the workload and leadership requirements are? Currently, the conference uses a structure that includes:

- one or two local General Chairs that are responsible for leading the planning team,
- three Technical Program Co-Chairs responsible for papers sessions,
- a Special Sessions Chair responsible for workshops, panels, and special sessions,
- a number of International Co-Chairs responsible for participation in FIE from other countries,
- an Awards Chair responsible for the conference awards program,
- a paid publications service provider contracted through a request-for-proposals (RFP) bid process,
- a paid logistics service provider contracted through an RFP bid process, and
- hundreds of volunteer peer reviewers and session chairs.
As General Chair, the responsibility of managing this planning team requires significant time. Much of the day-to-day work falls to other people on the planning committee, but the big decisions are ultimately the responsibility of the General Chair working in collaboration with the Steering Committee. Bids to host FIE begin by contacting the Steering Committee Chair four years before the conference date. After informal conversation with the Steering Committee Chair, a General Chair prepares a formal bid package that outlines the transportation, hotel, and tourism opportunities of their location. The Steering Committee expects that a proposed General Chair will attend every FIE conference before and through their own event if the bid package is selected. The workload for General Chairs is lighter during the first two years but ramps up significantly in the final year before the conference because of multiple logistical decisions and technical program deadlines.

The Steering Committee encourages you to think about hosting FIE.

The Steering Committee has set a goal to have FIE locations for the rest of this decade decided by June 2014. We are half way to meeting that goal! Now is the time to seriously consider volunteering as an FIE General Chair and work with us to host FIE in your city. Here is the current schedule showing set locations in **bold** as well as open years and suggested locations through the rest of the decade:

- FIE 2014: Madrid, Spain
- FIE 2015: El Paso, Texas
- **FIE 2016**: Erie, Pennsylvania
- FIE 2017: open (southeast U.S.)
- FIE 2018: open (midwest U.S.)
- FIE 2019: open (west coast U.S.)
- FIE 2020: open (northeast U.S.)

Please note that the regional suggestions are just suggestions. The committee *always* entertains bids from prospective host sites in any location regardless of the proposed year. It should be noted, however, that current FIE policy requires FIE to be in the continental U.S. or Canada for at least five years before returning to any other international venue. If you are interested in hosting FIE as a General Chair, be sure to contact me soon so that we can have a frank conversation about requirements and the bid process.

The Steering Committee works for the Societies and the member communities. We encourage you to contact any one of us to discuss the FIE conference. We can be identified by Steering Committee ribbons on our conference badges.

**ASEE Educational Research and Methods Division Representatives**

- Beth Eschenbach, Humboldt State University, Elizabeth.Eschenbach@humboldt.edu
- Archie Holmes, University of Virginia, ah7sj@virginia.edu
- James Morgan, Texas A&M University, jmorgan@civil.tamu.edu
IEEE Computer Society Representatives

- Stephen Frezza, Gannon University, FREZZA001@gannon.edu
- Arnold Pears, Uppsala University, Arnold.Pears@it.uu.se
- Currently vacant pending appointment by the Computer Society

IEEE Education Society Representatives

- Russ Meier (Chair), Milwaukee School of Engineering, meier@msoe.edu
- James Sluss, University of Oklahoma, sluss@ou.edu
- Edmundo Tovar, Universidad Politecnica de Madrid, etovar@fi.upm.es

I hope you enjoy your conference and I look forward to meeting and talking with you in Oklahoma City!

Sincerely,

Russ Meier
Steering Committee Chair
Milwaukee School of Engineering
Milwaukee, WI, USA
meier@msoe.edu
FIE 2013 PLANNING COMMITTEE

General Co-Chair
James Sluss
University of Oklahoma

General Co-Chair
Randa Shehab
University of Oklahoma

General Co-Chair
Deborah Trytten
University of Oklahoma

Assistant to the General Chairs
Kevin Curry
University of Kansas

ASEE/ERM Program Co-Chair
Teri Reed
Texas A&M University

IEEE/Computer Society Program Co-Chair
Mats Daniels
Uppsala University

IEEE/Education Society Program Co-Chair
Lynne Slivovsky
Cal Poly State University, San Luis Obispo

Workshop, Special Sessions & Panels Chair
Susan Walden
University of Oklahoma

Exhibits Chair
Robert J. Hofinger
Purdue University

Publications Chair
Chris Dyer
Conference Catalysts, LLC

New Faculty Fellows Chair
Mark Yeary
University of Oklahoma

International Co-Chair, Asia
Ming Zhang
Peking University

International Co-Chair, Australasia
Mark Lee
Charles Sturt University

International Co-Chair, Europe
Edmundo Tovar Caro
Universidad Politecnica de Madrid

International Co-Chair, South America
Melany M. Ciampi
VP COPEC- Science and Education Research Council

Conference Historian
Ed Jones
Iowa State University

Awards Chair
Manuel Castro
Spanish National Distance University

FIE STEERING COMMITTEE

ASEE Educational Research and Methods Division Representatives
- Jim Morgan, Texas A&M University (June 2011 - June 2014)
- Archie Holmes, University of Virginia (June 2012 - June 2015)
- Elizabeth A. Eschenbach, Humboldt State University (June 2013 - June 2016)

IEEE Computer Society
- Stephen Frezza, Gannon University (June 2011 - June 2014)
- Arnold Pears, Uppsala University (June 2009 - June 2015)

IEEE Education Society
- Russ Meier, Milwaukee School of Engineering

FIE 2014 Madrid, Spain
FIE 2015 El Paso, Texas
FIE 2016 Eire, Pennsylvania

FUTURE FIE CONFERENCES

Are you interested in hosting a future FIE conference?
Leave your business card at the registration desk, and an FIE steering committee member will contact you.
The University of Oklahoma (OU) is a coeducational public research university located in Norman, Oklahoma. The university was founded in 1890 and existed for 17 years before Oklahoma became a state. OU enrolls more than 30,000 students, has more than 2,600 full-time faculty members, and has 21 colleges offering 163 majors at the baccalaureate level, 157 majors at the master’s level, 81 majors at the doctoral level, 28 majors at the doctoral professional level, and 28 graduate certificates.

The school is ranked first per capita among public universities in enrollment of National Merit Scholars and among the top ten in the graduation of Rhodes Scholars. PC Magazine and the Princeton Review rated it one of the "20 Most Wired Colleges" in 2008.

The OU College of Engineering was formed in 1909 and recorded its first graduates in the spring of 1910. It is now the largest engineering program in Oklahoma, with 1,800 undergraduate students, 450 graduate students and a 115-member faculty.

OU is also well known for its athletic programs, winning seven NCAA Division I National Football Championships, playing in four BCS national championship games since the inception of the BCS system in 1998. Its baseball team has won 2 NCAA national championships, and the women's softball team won the national championship in 2000.
CORPORATE AFFILIATES AND SPONSORSHIPS

Corporate affiliates play an important role in supporting FIE conferences. This support subsidizes the cost of the award presentations and of meal functions. We appreciate these supporters and the part they play in making the 2013 FIE conference an outstanding event.

Thursday Activities

Hewlett-Packard Frederick Emmons Terman and Harriet B. Rigas Award Luncheon

Friday Activities

NextThought Morning Break in the Exhibit Hall

FIE 2013 EXHIBITORS

The FIE vendor and association exhibits are a popular and rewarding tradition for both attendees and exhibitors. Exhibits will include materials, equipment, textbooks, software, and state-of-the-art tools applicable to engineering education. We thank the vendors for their financial support and contributions to making FIE 2013 a meaningful experience.

Exhibit Hall Hours
The exhibits will be open in the Great Hall D&E from 9:00 a.m. to 5:00 p.m. Thursday and from 9:00 a.m. to 4:30 p.m. Friday. As of September 5, the following companies had committed to exhibiting at FIE 2013:

<table>
<thead>
<tr>
<th>EXHIBITOR</th>
<th>WEBSITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digilent</td>
<td><a href="http://www.digilentinc.com">www.digilentinc.com</a></td>
</tr>
<tr>
<td>EMA Design Automation</td>
<td><a href="http://www.ema-eda.com">www.ema-eda.com</a></td>
</tr>
<tr>
<td>Emona Instruments</td>
<td><a href="http://www.qpsk.com/">http://www.qpsk.com/</a></td>
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<tr>
<td>JMP statistical discovery software from SAS</td>
<td><a href="http://www.jmp.com/">http://www.jmp.com/</a></td>
</tr>
<tr>
<td>Purdue Engineering Education</td>
<td>engineering.purdue.edu/ENE</td>
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<tr>
<td>Stratasys</td>
<td><a href="http://www.stratasys.com">www.stratasys.com</a></td>
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<tr>
<td>Utah State University Department of Engineering Education</td>
<td><a href="http://www.eed.usu.edu/">www.eed.usu.edu/</a></td>
</tr>
<tr>
<td>Virginia Tech Engineering Education</td>
<td><a href="http://www.enge.vt.edu/">http://www.enge.vt.edu/</a></td>
</tr>
<tr>
<td>Zyante</td>
<td><a href="http://www.zyante.com">www.zyante.com</a></td>
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</table>
Focus on Exhibits and New Faculty Fellows Poster Presentation
Attendees and participants will be encouraged to visit the exhibit area throughout the conference. In order to provide full exposure for the exhibits, a special "Focus on Exhibits" session is planned for the afternoon of Friday, October 25th, during which time there will be no technical sessions scheduled. The New Faculty Fellows will also display their posters at this time. Door prizes contributed by some of the exhibitors will be awarded during the Focus on Exhibits. You must be present to win.

EXHIBITOR SHOWCASE PRESENTATIONS

Thursday, October 24

<table>
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<tr>
<th>Time</th>
<th>Company</th>
<th>Room</th>
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<tr>
<td>10:00 am – 11:30 am</td>
<td>Texas Instruments</td>
<td>Meeting Room 3</td>
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Thursday, October 24

<table>
<thead>
<tr>
<th>Time</th>
<th>Company</th>
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<tbody>
<tr>
<td>1:30 pm – 3 pm</td>
<td>Zyante</td>
</tr>
</tbody>
</table>

**Topic:** Animated Interactive Learning of Programming Languages  
**Speakers:** Smita Bakshi and Frank Vahid  
**Description:** Zyante develops web-based animated interactive learning material for lower division computer science and engineering. These offerings enable students to “learn by doing” as they engage with animations, interactive tools, embedded coding environments, games and self-assessment questions. Available for $35, students can also download them for later use. 4000+ students at over 40 universities are using Zyante’s current offerings: C, C++, Java, Python, MATLAB, Embedded Systems, Data Structures & Discrete Math.

Join the founders, Smita Bakshi and Frank Vahid, at the Showcase to learn more about the material and the teaching tools. We’ll provide you with a hands-on opportunity to evaluate the material and teaching tools, including the ability to view student activity data, and to rearrange and customize the material.

Friday, October 25

<table>
<thead>
<tr>
<th>Time</th>
<th>Company</th>
<th>Room</th>
</tr>
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<tbody>
<tr>
<td>10:00 am – Noon</td>
<td>ABET</td>
<td>Meeting Room 3</td>
</tr>
</tbody>
</table>

**Topic:** Future Directions for the Computing Accreditation Criteria – A Discussion with the Computing Community  
**Speaker:** Mark Stockman, University of Cincinnati  
**Description:** The computing disciplines continue to undergo rapid change, as evidenced in part by the current cycle of model curricula efforts in the various disciplines. Driven by the same challenges, the ABET Computing Accreditation Commission (CAC) in cooperation with the ACM and IEEE Computer Society are currently considering revisions to the ABET Computing Accreditation Criteria. For ABET to be responsive to its constituencies, criteria changes must be driven by the community. As a result, CAC, ACM and the IEEE-CS are engaged in a variety of activities designed to obtain input from the community at large so as to effect appropriate evolution within the criteria. In this session, we present an update regarding some of the proposed changes to the Computing Criteria and provide an opportunity for review, comment and general input by the session participants. The results of this session will be used as an important input to the criteria change process.

<table>
<thead>
<tr>
<th>Time</th>
<th>Company</th>
<th>Room</th>
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</thead>
<tbody>
<tr>
<td>1:30 pm – 3:00 pm</td>
<td>NextThought</td>
<td>Meeting Room 3</td>
</tr>
</tbody>
</table>

**Topic:** NextThought: Frontiers in Online Social Education  
**Speaker:** Ken Parker  
**Description:** NextThought is creating the future of online education today. Their unique software melds social media with content and course management to create active learning experiences that engage students. This session will provide a product demonstration by a faculty member using NextThought in the classroom and give attendees an opportunity to interact with the next big thing in higher education.
PLENARY SESSIONS

Thursday, October 24, 8:00 – 9:30 am
Great Hall A & B

Speaker: Katherine Banks, Vice Chancellor and Dean of Engineering, Texas A&M University

Introduction by Kyle Harper, Senior Vice Provost and Director of the Institute for the American Constitutional Heritage, the University of Oklahoma

Dr. M. Katherine Banks is vice chancellor for engineering for The Texas A&M University System and dean of the Dwight Look College of Engineering at Texas A&M University.

As vice chancellor, Banks oversees coordination and collaboration among the engineering, academic and research programs at universities throughout the A&M System, as well as three state agencies: the Texas A&M Engineering Experiment Station (TEES), the Texas A&M Engineering Extension Service (TEEX) and the Texas A&M Transportation Institute (TTI). Banks also is TEES director, overseeing research administration of more than 4,400 projects and $142.5 million in sponsored research awards. As dean of the Look College and holder of the Harold J. Haynes Dean's Chair in Engineering, Banks leads one of the largest engineering schools in the country, with more than 11,000 students and nearly 400 faculty.

Banks was previously the Bowen Engineering Head for the School of Civil Engineering at Purdue University and the Jack and Kay Hockema Professor at Purdue. She received her B.S.E. from the University of Florida, M.S.E. from the University of North Carolina, and Ph.D. in civil and environmental engineering from Duke University. For her research, Banks has received funding from the National Science Foundation, the U.S. Environmental Protection Agency, the U.S. Department of Defense, the U.S. Department of Energy and NASA, as well as industry and state government. She served as director of the EPA Hazardous Substance Research Center, associate director of the NASA Center for Advanced Life Support, and co-director of the 21st Century Center for Phytoremediation Research, all headquartered at Purdue.

Banks is a Fellow of the American Society of Civil Engineers (ASCE) and is a licensed professional civil engineer in Indiana and Kansas. She has received numerous awards including the ASCE Petersen Outstanding Woman of the Year Award, ASCE Rudolph Hering Medal, Purdue Faculty Scholar Award, Sloan Foundation Mentoring Fellowship and the American Association of University Women Fellowship. She is the author or co-author of more than 150 journal articles, proceedings papers and book chapters. Banks has served as editor-in-chief for the ASCE Journal of Environmental Engineering and associate editor of the International Journal of Phytoremediation.

Friday, October 25, 7:30 – 8:30 am
Great Hall C, immediately following breakfast

Boogies, Boojums and Snarks: There are MOOC’s Under Your Bed and in Your Closet.

Speaker: Mike McCracken, Director of Online Course Development and Innovation, College of Computing, Center for 21st Century Universities (C21U), Georgia Tech

W. Michael McCracken is a Principal Research Scientist in the College of Computing at Georgia Tech. He is the Director of Online Course Development and Innovation for the Center for 21st Century Universities at Georgia Tech. In his position at C21U he is responsible for the overall development of the portfolio of Massive Open Online Courses (MOOCs) for Georgia Tech. Last year, Georgia Tech fielded 16 MOOCs and will field a minimum of 10 new MOOCs, repeat 11 of them, and extend 3 of them to full semester offerings. He is also a participant in the development of the newly announced OnLine Masters in Computer Science being developed jointly with Udacity. McCracken also teaches and conducts research in computer science and software engineering. Additionally, McCracken is on the editorial board of the Journal of Computer Science Education.
FIE 2013 WORKSHOPS

Wednesday, 1:30 – 8:30 pm (Pre-Registration is required.)

On Wednesday afternoon and evening, FIE features workshops—highly interactive sessions selected for their timeliness and value. Workshops offer a concentrated professional development experience. The wide range of workshop topics offers opportunities for everyone from new faculty members to the most experienced educators to expand their skills and knowledge.

Conference attendees must register separately for workshops. There is a $50 registration fee for each workshop. Complete abstracts for the workshops can be found in the Wednesday schedule of the program book.

GROUP MEETINGS

Wednesday, October 23
5:00 – 6:30 pm FIE Steering Committee Meeting Meeting Room 14

Thursday, October 24
10 am – Noon IEEE EDUCON Steering Committee Meeting Room 1
4:00 – 5:30 pm ASEE ERM Division Business Meeting Meeting Room 1

Friday, October 25
10 am – Noon IEEE Education Society Board of Governors meeting Meeting Room 1
4:00 – 5:30 pm ASEE ERM Division Business Meeting Meeting Room 1
This is an open meeting for all members of the community to participate in the strategic planning for ERM. We will build on the conversation begun at the ASEE meeting in June. Input from that previous meeting will be used to craft a set of goals to guide ERM activities going forward.

Saturday, October 26
8:00 – 9:30 am FIE Steering Committee Meeting Executive Session Meeting Room 1
1:00 – 3:00 pm FIE 2014 Planning Committee Meeting Meeting Room 1

NEW FACULTY FELLOW PROGRAM

Each year, FIE invites new engineering and computer science faculty to submit applications for possible selection as New Faculty Fellows. A review panel of engineering and computer science faculty from assistant, associate, and full professorship levels completes a rigorous peer review of each applicant’s conference paper, nomination letters and professional résumé. The fellowship provides a $1,000 grant for conference travel expenses.

The purpose of the program is to promote the involvement of new faculty in the Frontiers in Education Conference so they will be exposed to the "latest and greatest" in engineering educational practices and will have the opportunity to exchange information with leaders in education innovations. This year, FIE 2013 will provide registration and travel grants for the awardee to attend the conference.
Focus on New Faculty Fellows
Each fellow will present a conference paper during FIE 2013. Join them in their session and share your thoughts and ideas about the future of engineering education. Also, during the Focus on Exhibits session Friday at 3 p.m., the Fellows will display posters describing their interests and activities and previewing the full papers that they will present as part of the FIE 2013 technical sessions.

2013 New Faculty Fellow:

Joseph Ranalli
Pennsylvania State University - Hazleton
Session T3G
Assessing the Impact of Video Game Based Design Projects in a First Year Engineering Design Course
Joseph Ranalli (Pennsylvania State University - Hazleton Campus); Jacqueline Ritzko (Pennsylvania State University- Hazleton Campus)

CONFERENCE AMENITIES

Breakfast
7:00 a.m.–8:00 a.m. Thursday  Great Hall C
7:00 a.m.–8:00 a.m. Friday  Great Hall C
7:00 a.m.–8:00 a.m. Saturday  Great Hall C

Refreshment Breaks ●
Morning and afternoon breaks Thursday and Friday  Exhibit Hall – Great Hall D & E
Morning and afternoon breaks Saturday  Second Floor Prefunction East

Lunches

Frederick Emmons Terman and Harriet B. Rigas Awards Luncheon – Great Hall C
Sponsored by the Hewlett-Packard Company
11:45 a.m. –1:15 p.m. Thursday
The Frederick Emmons Terman Award is presented annually to an outstanding young electrical engineering educator by the Electrical and Computer Engineering Division of the American Society for Engineering Education. The Harriet B. Rigas Award is presented annually to an outstanding woman engineering educator in recognition of her contributions to the profession.

Luncheon – Great Hall C
Noon – 1:30 p.m. Friday

Luncheon – Great Hall C
11:30 a.m. –1:00 p.m. Saturday

Reception
6:00 p.m.–9:30 p.m. Thursday
Join your colleagues as we board busses and take the short ride to the National Cowboy and Western Heritage Museum for a reception. We will have drinks, a western-themed dinner, and plenty of time to explore the exhibits. Be sure to bring the drink tickets you received when you checked in at registration. Buses will begin boarding at 6:00 pm between the Renaissance Hotel and the Cox Convention Center on Sheridan Avenue.
New Faculty Fellows ● Exhibit Hall – Great Hall D & E
3:00 p.m.–4:00 p.m. Friday
A special session focusing on the New Faculty Fellows will be held on Friday. This session will provide an opportunity to meet this year’s New Faculty Fellows, a group of new CSET educators who were selected based on an application and a full paper being presented at this year’s conference. There will also be an opportunity to view their poster presentations at this time.

Focus on Exhibits ● Exhibit Hall – Great Hall D & E
3:00 p.m.–4:00 p.m. Friday
Visit the FIE exhibits and check out the latest textbooks, computer software, lab equipment, and other innovations while enjoying refreshments provided by our sponsor.

Awards Banquet ● Great Hall C
6:30 p.m.–9:00 p.m. Friday
This year's awards banquet features fine food, drink, and camaraderie along with presentation of special awards from FIE, the IEEE Education Society, and the IEEE Computer Society. There is a separate charge for the banquet.

The National Weather Center Tour
6:00 p.m.–9:30 p.m. Friday
Visit the National Weather Center and the Lawrence G. Rawl Engineering Practice Facility on the University of Oklahoma campus. The bus boards at 6:00 pm between the Renaissance Hotel and the Cox Convention Center on Sheridan Avenue. There is a separate charge for the tour.

FIE Registration Conference Desk ● Second Floor Prefunction East
Registration will be open during these times:
- Wednesday 11:00 a.m. – 6:00 p.m.
- Thursday 7:00 a.m. – 5:00 p.m.
- Friday 7:00 a.m. – 5:00 p.m.
- Saturday 7:00 a.m. – 2:00 p.m.

Hospitality Table ● Near Conference Registration
If you are looking for a certain kind of a restaurant, shop, golf course, or health club, stop by the hospitality table close to the registration area. Maps and brochures of area attractions will be available.

FIE Message Center ● Near Conference Registration
The conference will maintain a message board by the registration area. Messages received for conferees will be posted there. In an emergency, we will make every effort to locate you.

Catalyzing Collaborative Conversations
Conference Registration and rooms assigned Please stop by the registration desk to reserve a room for collaborative conversations with your colleagues. Pick a time, get a room, name a topic, and we will announce it by the Message Center and via Twitter #fie2013.

Social Media. Twitter hashtag #fie2013
Are you in the TwitterSphere? Tweet your comments on the conference, thoughts on the speakers, a shout-out for work that inspires you, time and topic for a Collaborative Conversation - use #fie2013 to share your insights with your colleagues and the conference committee.
2013 FIE CONFERENCE AWARDS PRESENTATIONS

Thursday, October 24............................................................ Terman/Rigas Awards Luncheon
Noon - 1:30 p.m.
   ASEE ECE Division Hewlett-Packard Frederick Emmons Terman Award
   IEEE Education Society Hewlett-Packard/Harriet B. Rigas Award

Friday, October 25............................................................. Awards Banquet
6:00 p.m. - 8:30 p.m.

   Frontiers in Education (FIE) Conference Awards
      FIE 2012 Benjamin J. Dasher Best Paper Award
      FIE 2012 Helen Plants Award
      FIE Ronald J. Schmitz Award

   IEEE Education Society
      William E. Sayle Award for Achievement in Education
      IEEE Transactions on Education Best Paper Award
      Chapter Achievement Award
      Distinguished Chapter Leadership Award
      Distinguished Member Award
      Edwin C. Jones, Jr. Meritorious Service Award
      Mac Van Valkenburg Early Career Teaching Award
      Student Leadership Award
AWARD SELECTION COMMITTEE CHAIRS

Frontiers in Education Conference
Benjamin J. Dasher Best Paper Award .............................................Jenefer Husman
Helen Plants Award .................................................................Cordelia Brown
Ronald J. Schmitz Award .........................................................Arnold Pears

ASEE Electrical and Computer Engineering Division
Hewlett-Packard Frederick Emmons Terman Award .....................

IEEE Education Society
IEEE William E. Sayle Award for Achievement in Education ..........Lyle D. Feisel
IEEE Transactions on Education Best Paper Award ......................Jeff Froyd
Chapter Achievement Award .....................................................Trond Clausen
Distinguished Chapter Leadership Award .............................Edmund Tovar
Distinguished Member Award ....................................................Ted Batchman
Edwin C. Jones, Jr. Meritorious Service Award .......................Edwin C Jones Jr
Hewlett-Packard/Harriet B. Rigas Award .................................Joanne Bechta Dugan
Mac Van Valkenburg Early Career Teaching Award ..................S. Hossein Mousavinezhad
Student Leadership Award .......................................................Emmanuel A. Gonzalez
Mung Chiang is the Arthur LeGrand Doty Professor of Electrical Engineering at Princeton University, and an affiliated faculty in the Program in Applied and Computational Mathematics and in Computer Science. His research on networking received the Alan T. Waterman Award (2013), the IEEE Kiyo Tomiyasu Award (2012), a U.S. Presidential Early Career Award for Scientists and Engineers (2008), several young investigator awards from National Science Foundation, Office of Naval Research, and Princeton, and a few paper awards including the IEEE SECON (2013) and INFOCOM Best Paper Awards (2012). A Technology Review TR35 Award recipient (2007), his inventions have resulted in a few commercial adoptions, and he serves on several networking companies’ advisory board. Supported in part by many industry research awards, he founded the Princeton EDGE Lab in 2009, which has led to multiple technology transfers as well as startup companies. He was elected an IEEE Fellow in 2012.

In 2011, Chiang created an undergraduate course: “Networks: Friends, Money, and Bytes,” which lead to an open online offering with 90,000 students during 2012-2013. The corresponding textbook, “Networked Life: 20 Questions and Answers,” adopted the “just-in-time” approach and received the PROSE Award in Engineering and Technology (2012) from the Association of American Publishers. The second textbook “Networks Illustrated: 8 Principles without Calculus” was at the top of bestsellers in Networking on Kindle upon its release, and became a series of “micro-ebooks.” In 2013 they became the first Integrated and Individualized Book-App (IIB) that adapted to individual readers. He chaired the Princeton University Committee on Classroom Design, and founded the non-profit online education platform “3 Nights and Done” (3ND).

Chiang also initiated a Network Optimization workshop series and the Smart Data-Pricing (SDP) industry forums, and co-chaired the US NITRD Workshop on Complex Engineered Networks. He has served as an associate editor of a few IEEE journals, an IEEE Communications Society Distinguished Lecturer, and Chairman of the founding steering committee of the new IEEE Transactions on Network Science and Engineering.
ASEE ECE Division Hewlett-Packard Frederick Emmons Terman Award (continued)

About the Terman Award

The Frederick Emmons Terman Award is presented annually to an outstanding young electrical engineering educator by the Electrical and Computer Engineering Division of the American Society for Engineering Education. The Terman Award, established in 1969 by the Hewlett-Packard Company, consists of $5,000, an engraved gold-plated medal, a bronze replica of the medal mounted on a walnut plaque, and a parchment certificate.

The recipient must be an electrical engineering educator who is less than 45 years old on June 1 of the year in which the award is presented and must be the principal author of an electrical engineering textbook published before June 1 of the year of his/her 40th birthday. The book must have been judged by his/her peers to be an outstanding original contribution to the field of electrical engineering. The recipient must also have displayed outstanding achievements in teaching, research, guidance of students, and other related activities.

About Frederick Emmons Terman

Frederick Emmons Terman received his A.B. degree in chemistry in 1920, the degree of engineer in electrical engineering in 1922 from Stanford University, and his Sc.D. degree in electrical engineering in 1924 from Massachusetts Institute of Technology. From 1925-1965, he served as instructor, then professor of electrical engineering, executive head of the Electrical Engineering Department, dean of the School of Engineering, provost, vice president, and finally, as acting president of Stanford University.

Among the many honors bestowed upon him were: the IEEE Medal of Honor; the first IEEE Education Medal; the ASEE’s Lamme Medal; the 1970 Herbert Hoover Medal for Distinguished Service to Stanford University; an honorary doctor’s degree by Harvard; a decoration by the British government; the Presidential Medal for merit as a result of his war work; and the 1976 National Medal of Science from President Ford at a White House ceremony.

Dr. Terman was a professor at Stanford University when William Hewlett and Dave Packard were engineering students there. It was under Dr. Terman’s guidance in graduate work on radio engineering that Mr. Hewlett built the first tunable and automatically stabilized Weinbridge oscillator. Partially through Dr. Terman’s urging, Hewlett and Packard set up their partnership in an old garage with $538 and the oscillator as their principal assets.

Dr. Terman died in December 1982. It is in appreciation of his accomplishments and guidance that Hewlett-Packard is proud to sponsor the Frederick Emmons Terman Award.
IEEE Education Society Hewlett-Packard
Harriet B. Rigas Award

For increasing the participation of underrepresented members in the computing research community by promoting research experiences for undergraduates

Nancy M. Amato is Unocal Professor and Interim Department Head of the Department of Computer Science and Engineering at Texas A&M University where she co-directs the Parasol Lab. She received undergraduate degrees in Mathematical Sciences and Economics from Stanford University in 1986, and M.S. and Ph.D. degrees in Computer Science from UC Berkeley and the University of Illinois at Urbana-Champaign in 1988 and 1995, respectively. She was an AT&T Bell Laboratories PhD Scholar, received a CAREER Award from the National Science Foundation, is a Distinguished Speaker for the ACM Distinguished Speakers Program, was a Distinguished Lecturer for the IEEE Robotics and Automation Society, and is an IEEE Fellow.

She has served as an Associate Editor for the IEEE Transactions on Robotics and Automation and of the IEEE Transactions on Parallel and Distributed Computing. She was co-Chair of the National Center for Women in Information Technology (NCWIT) Academic Alliance (2009-2011), is a member of the Computing Research Association’s Committees on the Status of Women in Computing Research (CRA-W) and Education (CRA-E), and of the ACM, IEEE, and CRA sponsored Coalition to Diversity Computing (CDC). She has directed or co-directed the CRA-W/CDC Distributed Research Experiences for Undergraduates (DREU, formally known as the DMP) for more than 10 years. DREU is a national program that matches undergraduate women and students from underrepresented groups, including ethnic minorities and persons with disabilities, with a faculty mentor for a summer research experience at the faculty member’s home institution. She received a University-level teaching award from the Texas A&M Association of Former Students and the Betty M. Unterberger Award for Outstanding Service to Honors Education at Texas A&M.

Her main areas of research focus are motion planning and robotics, computational biology and geometry, and parallel and distributed computing. She has graduated 13 PhD students, with most of them going on to careers in academia (7) and government or industry research labs (4), 15 master’s students, and has worked with more than 100 Texas A&M undergraduate researchers and non-Texas A&M student interns, with the majority being students from groups underrepresented in computing.

She currently supervises 13 PhD students, 4 masters students, and more than 10 undergraduate and high school researchers.
IEEE Education Society Hewlett-Packard Harriet B. Rigas Award (continued)

About the Rigas Award

The Harriet B. Rigas Award is presented annually to recognize outstanding faculty women who have made significant contributions to electrical/computer engineering education. The award consists of an honorarium, plaque, certificate, and Frontiers in Education Conference registration.

The recipient must be a tenured or tenure track woman faculty member in an ABET-accredited engineering program in the United States, with teaching and/or research specialization in electrical/computer engineering.

About Harriett B. Rigas

Dr. Harriett B. Rigas (1934-1989), an IEEE Fellow, was an electrical engineer with an international reputation for her hybrid computer and computer simulation research. At Washington State University between 1966 and 1984, she was eventually both full professor and chair of Electrical and Computing Engineering School. Later she chaired larger departments at the Navy’s Postgraduate School in Monterey and, at the time of her death, Michigan State University.

Her achievements in engineering research, administration, and service were widely recognized. In 1975-76, Harriett was a Program Director at the National Science Foundation and, over the years, a member of numerous panels and advisory committees at both the NSF and the national Academy of Sciences.

Professor Rigas’ success was achieved within a profession and within university administrative structures where there were very few women. Her character and courage were both evident in her strong advocacy of advancement for women. She was involved both locally and nationally in the Society of Women Engineers.
Frontiers in Education Conference
Benjamin J. Dasher Best Paper Award

Applying Philosophical Inquiry: Bringing Future Engineering Education Researchers into the Philosophy of Engineering Education by Robin Adams, Alice Pawley and Brent Jesiek
FIE 2012, T2B

Robin S. Adams is an Associate Professor in the School of Engineering Education at Purdue University. She was also a Senior Design Engineer in the semiconductor packaging industry, an Assistant Director for Research at the Center for Engineering Learning and Teaching, and the lead for the Institute for Scholarship on Engineering Education with the Center for the Advancement of Engineering Education. She received her PhD in Education, Leadership and Policy Studies and her MS in Materials Science and Engineering from the University of Washington, and a BS in Mechanical Engineering from California Polytechnic State University, San Luis Obispo. Her research seeks to empirically develop “languages for learning” in areas central to the practice of engineering – cross-disciplinarity and design – and to the practice of engineering education. A language of learning describes what it means to know, be able to do, or be as a professional and how this changes over time and through experience. It provides tools for learners to reflect upon and self-assess their own progress, teachers to design and assess learning experiences, and leaders to take action in shaping engineering education programs and policies. She conducts research in: (1) Cross-disciplinary ways of thinking, acting and being, (2) Engineering design learning trajectories and education for innovation, and (3) engineering education transformation. Dr. Adams is a recipient of a National Science Foundation CAREER award, teaching and leadership awards, best paper awards (Journal of Engineering Education, Design Studies), and publishes broadly. Her research group, XRoads, involves collaborators from a variety of disciplines to conduct research at the “crossroads” where different perspectives can connect, collide, and catalyze new ways of thinking. She also participates in many professional organizations including the American Society of Engineering Education (ASEE), American Educational Research Association (AERA), International Society of the Learning Sciences (ISLS), Design Research Society (DRS), Association for the Study of Higher Education (ASHE), and Association for Integrative Studies (AIS).

Alice L. Pawley earned her B. Eng (Chemical – Distinction) degree from McGill University in 2000, and a M.S. degree (2003) and Ph.D. degree (2007) in Industrial Engineering with a minor in women’s studies from the University of Wisconsin-Madison.

As a graduate student at UW-Madison, she worked with the Engineering Learning Center, the Wisconsin Engineering Education Laboratory, and the Center for the Integration of Research Teaching and Learning. She has served as an Assistant Professor in the School of Engineering Education and as an affiliate faculty member with the Women’s Studies Program and the Division of Environmental and Ecological Engineering at Purdue University in West Lafayette, IN from 2007 to 2012. In 2013, she was promoted to Associate Professor at Purdue. She serves on numerous advisory boards for federally funded projects across the nation, and reviews papers for the Journal of Engineering Education, the International
Prof. Pawley is a member of the American Society for Engineering Education (ASEE), the National Women’s Studies Association (NWSA), the International Network for Engineering Studies (INES), the Society of Women Engineers (SWE), and the National Organization of Gay and Lesbian Scientists and Technical Professionals (NOGLSTP); she serves as faculty advisor to the Purdue chapters of ASEE and NOGLSTP. She received a NSF CAREER award in 2010 and a Presidential Early Career Award in Science and Engineering (PECASE) from President Obama in 2012.

Brent K. Jesiek earned his B.S. in Electrical Engineering (computer engineering option) from Michigan Technological University in 1998, and a M.S. degree (2003) and Ph.D. degree (2006) in Science and Technology Studies from Virginia Polytechnic Institute and State University. He is currently an Assistant Professor in the Schools of Engineering Education and Electrical and Computer Engineering at Purdue University, and is an Associate Director of Purdue’s Global Engineering Program. Dr. Jesiek draws expertise from engineering, computing, the social sciences, and humanities to investigate the geographic, disciplinary, and historical dimensions of engineering education and professional practice. He has a strong track record of grant-funded research, and in 2012 received an NSF CAREER award to study boundary-spanning roles and competencies among early career engineers. He leads the Global Engineering Education Collaboratory (GEEC), which serves as a hub for his research. An award-winning teacher, Dr. Jesiek regularly serves as instructor for courses in Purdue’s First-Year Engineering program and Engineering Education graduate program. His professional memberships include IEEE, International Network for Engineering Studies (INES), and American Society for Engineering Education (ASEE).
Frontiers in Education Conference Benjamin J. Dasher Best Paper Award (continued)

About the Dasher Award

The Benjamin Dasher Best Paper Award is given to the best paper presented at the annual Frontiers in Education Conference, as demonstrated by technical originality, technical importance and accuracy, quality of oral presentation, and quality of the written paper appearing in the Conference Proceedings. Papers are nominated for the award by reviewers.

A committee with representation from each of the organizing societies (ERM, IEEE Ed. Soc., IEEE Comp. Soc.) is formed to review nominated papers. During the FIE meeting, the committee attends presentations of the nominated papers. The committee then makes a final recommendation to the FIE Planning Committee for the Ben Dasher Award winner based on the overall quality of both the paper and the presentation.

About Benjamin J. Dasher

Benjamin J. Dasher was born December 27, 1912 in Macon, Ga. He earned his bachelor’s and master’s degrees in electrical engineering in 1935 and 1945, respectively, and graduated with a doctorate in electrical engineering in 1952 from the Massachusetts Institute of Technology. At MIT, Dr. Dasher worked on the electronics of instrumentation of electromechanical transducers and analog-to-digital converters. He was the author of “Dasher’s method” for synthesis of resistance-capacitance two-port networks, which is found in standard textbook treatments.

While at Georgia Tech, Dr. Dasher served as a graduate assistant in 1936, then as an instructor in 1940, and became an assistant professor in 1945. While earning his PhD at MIT, he was an instructor from 1948-51. Before finishing with his PhD, he became an associate professor at Georgia Tech in 1951, was promoted to professor in 1952, and became director of the School of Electrical Engineering in 1954, where he served in that capacity until 1969. In 1968, Dr. Dasher was appointed associate dean in the College of Engineering. At Georgia Tech, Dr. Dasher served as director of network synthesis projects and transistor oscillator projects. His fields of interest included advanced network theory, electronic theory, electronic circuits, electrical engineering education, machine translation, speech analysis, and pattern recognition. He was credited for bringing undergraduate engineering education to the forefront at Georgia Tech and for increasing interactions between undergraduates and industry.

Dr. Dasher was a member of Phi Kappa Phi, ASEE, Sigma Xi, and the American Association of University Professors; he was a Fellow of both the IEEE and the Institute of Radio Engineers. He served as a regional director for IEEE and as the chair for the Atlanta section of IEEE; he was on numerous committees for IRE, AIEE, and IEEE. He served as President of the IEEE Education Group in 1970-71.

Ben Dasher organized the first Frontiers in Education Conference; it was held in Atlanta in 1971, and attracted 100 participants. There were 34 papers in six technical sessions.

Dr. Dasher died of congestive heart failure on December 13, 1971 in Houston, Texas.
Frontiers in Education Conference Helen Plants Award Best Nontraditional Session at FIE 2012

Special Session: Connecting with Community: Empathy, Experience, and Engineering with Elders, FIE 2012, Session S1A

Lynn Andrea Stein is a founding faculty member of the Franklin W. Olin College of Engineering, where she is Professor of Computer and Cognitive Science and Associate Dean for External Engagement and Initiatives. Stein's research, at Olin and over a decade on the faculty of MIT, spans the fields of artificial intelligence, programming languages, and human-computer interaction. She is a co-author of the foundational documents of the semantic web and the "mother" of a humanoid robot and an intelligent room. Stein is also active in the engineering and computer science education communities, a member of curricular advisory boards, and a frequent speaker at educational conferences on work including pioneering curricular applications of inexpensive robotics, an innovative curriculum for introductory computer science, and curricular change processes with academia. In 2009, Stein was named the founding director of Olin's Initiative for Innovation in Engineering Education.

Caitrin Lynch is a cultural anthropologist with cross-cultural expertise in labor, gender, and aging. An Associate Professor of Anthropology at Olin College of Engineering, she is also a Visiting Research Associate in the Department of Anthropology at Brandeis University. She is the author of two books, Juki Girls, Good Girls: Gender and Cultural Politics in Sri Lanka's Global Garment Industry (Cornell, 2007) and Retirement on the Line: Age, Work, and Value in an American Factory (Cornell, 2012). She is editor, with Jason Danely, of a collection of essays on aging and the life course: Transitions and Transformations: Cultural Perspectives on Aging and the Life Course (Berghahn, 2013). Lynch also is the producer of a documentary film “My Name is Julius” (directed by Titi Yu); see www.juliusfilm.com. Lynch strives to expose engineering students to critical analysis and identification of the burgeoning needs and opportunities in our aging world. One outlet for these efforts is in her interdisciplinary service-learning course (co-taught with faculty in engineering and design and created with Lynn Andrea Stein) “Engineering For Humanity: Helping Elders Age in Place through Partnerships for Healthy Living” (http://e4h.olin.edu/).
Helen Plants Award Past Recipients, Continued

'95 Burks Oakley II and Mark Yoder
'96 Alisha A. Waller, Edward R. Doering, and Mark A. Yoder
'97 Karl A. Smith, James D. Jones and Elizabeth Eschenbach
'98 Alice Agogino
'99 Melinda Piket-May and Julie L. Chang
'03 William C. Oakes
'04 Susan M. Lord, Elizabeth A. Eschenbach, Alisha A. Waller, Eileen M. Cashman, and Monica J. Bruning
'05 Ruth A. Streveler
'06 Ruth A. Streveler, Karl A. Smith, and Ronald L. Miller
'08 Maura Borrego, Lynita Newswander, and Lisa McNair
'09 Lisa C. Benson, Sherrill B. Biggers, William F. Moss, Matthew Ohland, Marisa K. Orr, and Scott D. Schiff
'10 Russell Korte and Karl A. Smith
'11 Mark Somerville, Dave Goldberg, Sherra E. Kerns, and Russell Korte
'12 Şenay Purzer and Jonathan C. Hilpert

About the Plants Award

The Helen Plants Award is given for the best special (non-traditional) session at the FIE conference, as demonstrated by originality, session content and presentation including the use of written materials and visual aids, and participation of session attendees.

About Helen Margaret Lester Plants

Helen Margaret Lester was born in Desloge, Missouri, in March 1925, the only child of Rollo Bertell and Margaret Stephens Lester.

She entered the University of Missouri as a journalism major, but soon switched to Civil Engineering. She received her BSCE in 1945. She joined West Virginia University in 1947 as a graduate student and Instructor in Mechanics, and received her MS in Civil Engineering in 1953. She was a Professor of Theoretical and Applied Mechanics and of Curriculum and Instruction in the Division of Education at WVU. She became Professor Emeritus, Mechanical and Aerospace Engineering in 1983. From 1985 to 1990 she served as Chair of Civil Engineering Technology at Indiana University-Purdue University - Fort Wayne.

Her husband Ken Plants had been a "bureaucrat" with the US Bureau of Mines in Morgantown - a chemical engineer with great expertise in cost estimation. Some of their "courting" evenings were spent manually checking the design calculations on the Star City, WV Bridge, designed by the Dean and State Bridge Engineer. While in Morgantown, Helen was active in Trinity Episcopal Church where she served as a Vestryman and Bishop's Man. For many years she was a Girl Scout leader. Helen died in Tulsa, Oklahoma in September 1999.

From the beginning of her academic career, she was a gifted teacher and a role model for the few women students at West Virginia University at that time. Later, she became an advocate of programmed and individualized instruction. She and Wally Venable wrote series of papers on these topics and several texts: Introduction to Statics, a Programmed Text, (1975), A Programmed Introduction to Dynamics (1967), and Mechanics of Materials, A Programmed Textbook (1974). She established the first doctoral program in Engineering Education at West Virginia University.

In 1975, the University of Missouri at Columbia recognized her with the Missouri Honor Award for Distinguished Service in Engineering. She became an ASEE Fellow in 1983 as a member of the first class of Fellows. She also received Distinguished Service Award, Western Electric Fund Award, and was an ASEE Vice-President (1974 – 1976).
Frontiers in Education Conference
Ronald J. Schmitz Award

For outstanding contributions to the conference series through her steering committee activities and especially her organization, coordination and management of the 2011 FIE conference in Rapid City, South Dakota

Dr. Jennifer Karlin received her undergraduate degree from Washington University in St. Louis and her Ph.D. in industrial and operations engineering from the University of Michigan, specializing in engineering management. As far as her committee could determine, she was the first person in the Industrial and Operational Engineering department to successfully defend a solely qualitative methodology dissertation. While a graduate student at the University of Michigan, she taught a senior elective and worked for the Center for Research on Learning and Teaching. Dr. Karlin is now an associate professor of industrial engineering at the South Dakota School of Mines and Technology. She teaches courses in engineering management, quality, strategy, and operational excellence in both the industrial engineering and engineering management undergraduate and technology management graduate programs. She is also the Coordinator of Faculty Development for the university.

These days, the majority of Dr. Karlin’s research is in learning organizations, holistic learner development, and impact of engineering education on economic development. In 2006, Jennifer received a National Science Foundation CAREER award to continue her study of organizational and student learning, determining the relative organizational health of colleges and departments of engineering and correlating this to changes in student intellectual development. Her work has been funded by the National Science Foundation, the United States Air Force (through a congressional earmark), and the Material Handling Industry of America (MHIA).

Dr. Karlin has been active in FIE serving as conference general co-chair for the 2011 conference and an ERM representative on the FIE steering committee. She has also served as an ERM Board Member. She received the ASEE ERM Division Distinguished Service award in 2011.
Frontiers in Education Conference Ronald J. Schmitz Award (continued)

About the Schmitz Award

The Ronald Schmitz Award is given to recognize outstanding and continued service to engineering education through contributions to the Frontiers in Education Conference.

About Ronald J. Schmitz

Ronald J. Schmitz was born near Ionia, Iowa on April 25, 1934. He attended a one-room country school through the eighth grade and then, as was not uncommon at the time, decided to forgo high school and work on his father’s farm. At age 18, he joined the United States Navy. He served as an Electricians Mate, spending much of his enlistment at sea and made a round-the-world cruise aboard the USS Saipan.

In the Navy, Ron found an interest in and an aptitude for technology and recognized the need for further education. He completed a GED program in the Navy and, when he was discharged, enrolled in electrical engineering at Iowa State University. He received all his degrees there, finishing his doctorate in 1967.

In the fall of 1967, he accepted appointment as Assistant Professor in the Department of Electrical Engineering at the South Dakota School of Mines and Technology in Rapid City. He was involved in various research activities and directed both masters and doctoral students, but his strongest interest was always in teaching. Ron was a consummate teacher, patient with students who were having difficulty but intolerant of sloth. He received the School of Mines Teaching Award in 1975 and the Western Electric Fund Award for Excellence in Teaching in 1981.

Dr. Schmitz was very active in the IEEE, especially the Education Society, and served as Secretary Treasurer of the Society. He was also active in ERM and attended, and contributed to, many Frontiers in Education Conferences. He served as general chair of FIE 1981 in Rapid City.

Ron was an avid hunter and fisherman, a devoted husband and father and a faithful friend. He served his church as Lector and Lay Minister and was active as a Boy Scout leader.

IEEE Education Society William E. Sayle II Award for Achievement in Education
Presented by name

For innovative approaches to engineering education and inspiring young people to pursue a career in engineering

Dr. Karen Panetta is a Fellow of the IEEE. Dr. Panetta received the B.S. in Computer Engineering from Boston University, and the M.S. and Ph.D. in Electrical Engineering from Northeastern University. She is the 2013 Vice-President of Communications and Public Relations for IEEE-USA. She is the Editor-in-Chief of the award winning IEEE Women in Engineering Magazine and Editor of the IEEE Boston “Reflector” Newspaper. She served as the 2011 Chair of the IEEE Boston Section. During 2009-2007, she served as the Chair for the IEEE Women in Engineering, overseeing the world’s largest professional organization supporting women in engineering and science.

She is the Associate Dean for Graduate Education and a Professor of Electrical and Computer Engineering at Tufts University. She is the Director of the Simulation Research Laboratory. Her research focuses on developing efficient algorithms for simulation, modeling, signal and image processing for security and biomedical applications.

Before joining the faculty at Tufts, Dr. Panetta was employed as a computer engineer at Digital Equipment Corporation. Her research in Simulation and Modeling has won her research team five awards from NASA for “Outstanding Contributions to NASA Research” and “Excellence in Research”. She is a NASA Langley Research Scientist “JOVE” Fellow, is a recipient of the NSF Career Award and won the 2003 Madeline and Henry Fischer Best Engineering Teacher Award. Dr. Panetta was also awarded a Mass High Tech All-Star by Mass High Tech Magazine. She is the recipient of the 2006 Boston University Outstanding Alumni Award and was a recipient of the “Be The Change” award from the Massachusetts Conference for Women. She is the 2009 Norm Augustine Award recipient from the National Academies of Engineering and Science, American Association of Engineering Societies. In 2010, the IEEE recognized Dr. Panetta by awarding her the IEEE Educational Activities Board, Major Educational Innovation Award. In 2011, she was awarded the “Women of Vision” award from the Anita Borg Institute and the IEEE Education Society Harriet B. Rigas Award for Outstanding Engineering Educator. In 2011, U.S. President Obama presented Karen with the NSF Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring. In 2013, she was awarded the E-Week New England Leadership award and the IEEE Award for Ethical Practices.

Dr. Panetta serves on the Boston University Engineering Alumni Board and is a board member for the Center for Balance by Design. She is also a member of the ACM, AAAS, AWIS, SWE, SPHE, Tau Beta Pi, ASEE and the Society for Computer Simulation. She is the faculty advisor to both the Tufts SWE and IEEE student chapters.

Believing that real world experience is critical for engineering education, Dr. Panetta maintains consulting positions in industry and brings her experience back to the classroom. She is a Design Consultant for Tycoelectronics, M/A-Com Inc. and consults for school systems and Science Museums across the United States to inspire engineering and technology education.
Dr. Panetta is dedicated to promoting women in engineering and created the nationally acclaimed “Nerd Girls” program, where undergraduate engineers use their engineering skills to solve real world problems and serve as role models for younger students. By showing youth how engineering helps society and can improve the quality of life for humans and wildlife, Karen Panetta has connected young students with the motivation for pursuing engineering careers.

The IEEE.tv video, “Nerd Girls”, which demonstrates Karen's most successful mentoring and recruiting philosophy, shows that female engineers are smart, well-rounded, talented girls. The video has won an APEX GRAND award and an Aegis Award for Best Educational Outreach video. The IEEE.tv video, “Ship the Chip” documented Karen personally mentoring 100 female students from a diversity of ethnic and socio-economic backgrounds. The participants included both physically challenged girls and girls with learning disabilities, all exploring the excitement of engineering as a team.

**About the Sayle Award and William E. Sayle II**

The William E. Sayle II Award is presented to recognize a member of the IEEE Education Society who has made significant contributions over a period of years in a field of interest of the IEEE Education Society. The award consists of a plaque, a certificate, and paid registration to the Frontiers in Education Conference.

Dr. William (Bill) E. Sayle received his BSEE and MSEE degrees from the University of Texas at Austin and his Ph.D. from the University of Washington. He joined the faculty in electrical engineering at Georgia Institute of Technology in 1970, just as Georgia Tech was beginning the transition from an undergraduate institution to a research university. He was the ECE associate chair for undergraduate affairs from 1988-2003 and, following retirement in 2003, served as director of undergraduate programs at Georgia Tech-Lorraine in France until 2007. Bill was a tireless advocate for students, putting in countless late night and weekend hours in addressing student issues, assigning teaching assistants, and meeting with prospective students and parents.

Throughout his career, Bill touched the lives of many people in the worldwide academic community. He was a leader and a pioneer in many areas. In the 1970s, he was a founding member of the IEEE Power Electronics Society, where he served in many leadership roles over the years. He was a champion of diversity and in recruiting underrepresented minorities and women to engineering and science, long before it became a national issue. He visited many high schools on behalf of the Southeastern Consortium for Minorities in Engineering, a role where he made many friends for Georgia Tech among high school administrators and students in the southern part of Georgia.

In his 30-year career at Georgia Tech, Bill received the ECE outstanding teacher award twice, as well as the Georgia Tech outstanding teacher award and outstanding service award. Bill lent his voice and efforts to Georgia Tech faculty governance throughout his career, serving as an elected member of Institute-level committees, the Academic Senate, and the Executive Board.

Bill was a long-time member and active volunteer in the IEEE Education Society and the Electrical and Computer Engineering Division of ASEE. He was a Fellow of both IEEE and ASEE. He was the recipient of the Education Society's 2001 Meritorious Service Award and 2004 Achievement Award and of the ECE Division's 2001 Meritorious Service Award and 2006 ECE Distinguished Educator Award. Bill was the General Chair of the 1995 Frontiers in Education (FIE) Conference, which is still remembered for its all-vegetarian menu, and received the 1996 Ronald J. Schmitz Award for outstanding service to FIE.

Much of Bill's professional career was devoted to engineering accreditation, serving at various times as member and chair of the IEEE Committee on Engineering Accreditation Activities and the IEEE Accreditation Policy Council. He participated in more than 20 visits as a program evaluator, in addition to serving as a team chair and member of the Engineering Accreditation Commission of ABET for more than five years. Bill received the IEEE Educational Activities Board Meritorious Achievement Award in Accreditation Activities in 2004.

Dr. Sayle passed away on February 2, 2008.
IEEE Transactions on Education Best Paper Award


Benjamin T. Hazen received the B.S. degree in Business Administration from Colorado Christian University, in 2004. He received the M.A. degree in Organizational Leadership from Gonzaga University, in 2006, the M.B.A. degree from California State University, Dominguez Hills, in 2007, and the Ph.D. degree in Management from Auburn University, in 2012.

He is a United States Air Force maintenance officer and has served on active duty continuously since 1999. From 1999 to 2002, he served as a Satellite and Wideband Communications Journeyman at Tinker Air Force Base, Oklahoma. He then managed the Engineering Laboratory in the Department of Astronautics at the United States Air Force Academy, Colorado, from 2002 to 2006. From 2006 to 2009, he served in a variety of aircraft maintenance positions at Travis Air Force Base, California. From 2009 to 2012, he participated in an advanced degree program and worked as a Doctoral Candidate in the Department of Aviation and Supply Chain Management at Auburn University. Currently, he serves as the Maintenance Operations Officer for the 916th Maintenance Squadron at Seymour Johnson Air Force Base, North Carolina. His primary research interest is in the area of innovation diffusion.

Yun Wu received the B.S. degree in Management Information Systems from Beijing University of Post and Telecommunications, China, in 2005. She received the M.S. degree in Management Engineering from Politecnico di Milano, Italy, in 2007.

She is currently a Doctoral student in the Department of Aviation and Supply Chain Management at Auburn University. Her research interests include IT innovation diffusion, cloud computing, healthcare information systems and pedagogy dissemination.

Chetan S. Sankar (M '81-SM '88) received the B.S. degree in Mechanical Engineering from Regional Engineering College, Trichy, India, in 1971, and the M.B.A. degree from Indian Institute of Management Calcutta, India, in 1973. He received the Ph.D. degree in Decision Sciences from the Wharton School, University of Pennsylvania, in 1981.

From 1973 to 1974, he worked as an inventory control manager at Balmer Lawrie & Co., Ltd. He was a Research Fellow at the Indian Institute of Management, Calcutta, from 1974 to 1977. He served as an Assistant Professor at Temple University, from 1981 to 1985. He then worked as a project manager at AT&T Bell Laboratories, from 1985 to 1989. In 1989, he joined the faculty at Auburn University, where he is currently the College of Business Advisory Council Professor of Information Systems, and the Director of the Geospatial Research and Applications Center at Auburn University. He has received more than three million dollars from grants sponsored by the National Science Foundation and Economic Development Administration to develop exceptional instructional
'03 Tyson S. Hall,
   James O. Hamblen, and
   Kimberly E. Newman
'04 M. Brian Blake
'04 Russell L. Pimmel
'05 Antonio J. Lopez-Martin
'06 Euan Lindsay and
   Malcolm C. Good
'07 Jason A. Day and
   James D. Foley
'08 France Bélanger,
   Tracy L. Lewis,
   George M. Kasper,
   Wanda J. Smith and
   K. Vernard Harrington
'09 Kenneth Ricks,
   Jeff Jackson, and
   William A. Stapleton
'10 Keith Holbert and
   George G. Karady
'11 Julie A. Rursch,
   Andy Luse, and
   Doug Jacobson
'12 Susan Lord,
   Richard Layton, and
   Matthew Ohland

materials that bring real-world issues into classrooms and to help communities recover from disasters effectively. He serves as the Editor-in-Chief of the Decision Sciences Journal of Innovative Education and the Managing Editor of the Journal of STEM Education: Innovations and Research. His research interests include improving instructional and pedagogy methodologies and innovative uses of information technologies to benefit the public.

Dr. Sankar has won awards for research and teaching excellence from the Society for Information Management, NEEDS, Decision Sciences Institute, American Society for Engineering Education, American Society for Mechanical Engineering, International Network for Engineering Education & Research, and the Project Management Institute.
IEEE Education Society
Chapter Achievement Award

For exemplary technical activities, membership services, societal activities to its members, and for outstanding leadership by Chapter officers

Dr Deepak Garg is currently faculty in Computer Science and Engineering Department of Thapar University, Patiala. He holds a PhD in Efficient Algorithm Design for Pattern Discovery. He has more than 100 publications to his credit. He is the Chair of Steering Committee of IEEE International Advanced Computing (IACC) Series of Annual Conference. He is also the chair of Steering Committee of IEEE International Conference in MOOC, Innovation and Technology in Education.

He is currently the Chair of IEEE Computer Society, India Council and the Chair of IEEE Education Society, India Council. He is the Chair of ACM SIGACT North India Chapter. He is teaching UG and PG courses and guiding PhD students in different areas of algorithms. He has executed few projects with funding from Indian Govt. His workshops on Advanced Algorithms and data structures are very popular. Currently his research areas are advanced algorithms, Theoretical Computer Science and Bioinformatics.

Prof. Raghu Raman currently heads the Center for Research in Advanced Technologies for Education (CREATE) at Amrita University, India. As Principal Investigator for multiple research projects totaling over $2.3m, Raghu's main research focus is in the area of computational intelligence for Intelligent and Adaptive Learning Systems, Virtual Interactive learning environments, and Diffusion of ICT Innovations.

Prior to joining Amrita, Raghu worked at NEC Research Labs, USA on the Intelligent Video surveillance technology using neural networks that was ultimately spun out into a new venture. Formerly, Raghu was the Executive Director of Product Development at IBM, where he provided product leadership and direction for engineering groups with full responsibility for operations and budget control of an annual budget of over $8m. Raghu holds an MBA from Haas School of Business, UC Berkeley and is the recipient of President's gold medal. He serves on the board of directors for Amrita Technology Business Incubator; as Member, Standing Committee, National Mission on Education through ICT (NME ICT) and is the past chair of IEEE Education Society Chapter, IEEE India Council.

Mr. Prashant R. Nair is the Vice-Chairman - Information Technology at Amrita School of Engineering, Amrita University, Coimbatore in South India. Since 2000, he has been on the faculty of Amrita University, where he also teaches at the Business School and Centre of Excellence in Cyber Security. Since 2008, he has been holding the administrative responsibility of Vice-Chairman for Accreditation & Quality Assurance for Amrita University. He has taught at academic programs in USA and Europe at University of California, San Diego and Sofia University, Bulgaria as an Erasmus Mundus fellow. His research interests include Application of ICT tools for Supply Chain Management & Education, Cyber Security and Internet Technology. He completed his B.E from Bharathiar University and MBA from Amrita School of Business, Coimbatore, which is ranked among the top 25 B-schools in India.
Om Vikas
Chair, Policy and Planning

Past Recipients
'06 Nordic Chapter
'07 Spanish Chapter
'08 Gulf Chapter
'09 Santa Clara Valley Chapter and Portugal Chapter
'10 Austria Chapter
'11 Spain Chapter
'12 Hong Kong Chapter

He has served on the program committee of over 60 international conferences including the IEEE International Conference on Technology Enhanced Education (ICTEE) 2012, IADIS WWW/Internet conference, and editorial board of 3 international journals including Computer Society of India (CSI)Transactions on ICT, a Springer Journal. He is presently holding several leadership roles in professional bodies like Student Activity Chair (SAC) of IEEE Computer Society, India Council; Executive Committee member of IEEE Madras Section and Member of National Student Committee of CSI. He is the Associate Site Director for ACM International Collegiate Programming Contest (ICPC), which is considered as the world championship of programming. Various Awards won include ASDF Award for Best Academic Administrator (2012) and CSI Academic Excellence award (2011).

Dr. Om Vikas possesses B Tech(EE), M Tech(EE), Ph.D.(CSE) all from IIT, Kanpur. Formerly Director/VC, ABVIIITM (Indian Institute of Information Technology & Management) Gwalior, Senior Director in the Department of Electronics & Information Technology (DE&IT, Govt of India), and Counselor (Science & Technology) in Indian Embassy, Tokyo, Japan. In DE&IT, he headed Technology Development for Indian Languages Mission and Computer Manpower Development Division. He served in TCS as System Engineer. He was visiting professor at IIT/K, adjunct professor at IIT/D & NSIT; Professor in charge CLASS project at NCERT, Director, IP Engineering College, Advisor to C-DAC, and on Academic Councils of various universities / Institutions. Currently he is Professor Emeritus at Mahamaya Technical University.

He has vast experience of designing curricula 1-to-12 school level (Vocational & Academic) for CBSE, and UG & PG curricula – Computer Applications, Knowledge Engineering, Industrial Informatics, Engineering Education, etc. He is invited as Expert Assessor of NBA/AICTE and NAAC/UGC for assessment & accreditation of technical programmes / institutions. He is member of Organizing Committee of World Summit on Accreditation WOSA -2014. Dr. Vikas received several awards for his outstanding contribution towards IT for masses.
IEEE Education Society
Distinguished Chapter Leadership Award

For his efforts to make Colombia the 2nd largest chapter in our Society, sponsoring many activities, and being directly involved in the development of the chapter, providing meaningful service in Colombia

Jesus Alfonso Perez Gama was a tenured professor and university master fellow at the National University of Colombia, as well as director of the Master and Systems Engineering Undergraduate Program and University Superior Council Teacher representative. Currently Alfonso is the faculty engineering dean at the Foundation of Higher Education, San Jose and is also director of the International Research Group, San Jose EIDOS. He has conducted several research projects dealing with social and economic problems for tertiary education, using mathematical and computational models and artificial intelligence, which were sponsored by Colciencias, CYTED-D (Spain - V Centenary) and the Ministry of National Education and FODESEP.

Alfonso is a graduate of the Mayor San Bartolome. He also studied Electronic Engineering at the U City University of Bogota and received a Master of Science from the University of Essex, UK and a Systems Engineering Magister from the National University and Economics Graduate Program at Universidad de los Andes, Bogota. He is IEEE Senior Life Member and a member of the New York Academy of Sciences, the International Council on Systems Engineering, the International Input Output Association, the International Institute of Software Architects, Systems Engineering Colombia Association, and the Colombia Informatics Association, which he chairs.

He has received the James Rooke Honorary Scholarship, granted by British Council; the 2012 Roberto Valenzuela IEEE Life and Achievement Award; and the City University Francisco Jose de Caldas IEEE Student Branch 50 Years with Professional Excellence recognition. Alfonso was also recognized for his A Successful Case in Superior Education: Mathematical and Computer Model for Engineering Using Propaedeutic Cycles, which was included in the Bank of Significant Experiences in Higher Education 2010 by Ministry of National Education of Colombia.
IEEE Education Society
Distinguished Member Award

For leadership and service on the Board of Governors; as chair of the Constitution and By-Laws Committee; and related professional contributions through publications, accreditation activities, and as an associate editor

Victor P. Nelson is a Professor and Assistant Chair of Electrical and Computer Engineering at Auburn University, where he has been on the faculty since 1978. His primary research interests include embedded systems and computer-aided design and testing of digital systems and application-specific integrated circuits (ASICs). He is co-author of the textbook *Digital Logic Circuit Analysis and Design* and IEEE tutorial book *Fault-Tolerant Computing*. He is past chair of the ECE Curriculum Committee and coordinator of the ECE Graduate Program, and served one year as Associate Dean for Assessment in the College of Engineering. He was a co-winner of the 2005 “Wireless Educator of the Year” award from the Global Wireless Education Consortium for his role as one of the developers of the Bachelor of Wireless Engineering program at Auburn University, which is the first of its kind in the U.S., and currently serves as the director of that program. He received the Birdsong Merit Teaching Award in 2000 and the Walker Merit Teaching Award in 2002 from the College of Engineering, and was named outstanding member of the Graduate Faculty in 2004.

He is a member of the IEEE Education Society, in which he has served as a member of the Board of Governors, chair of the Constitution and Bylaws committee, and previously as an associate editor of the *IEEE Transactions on Education*. He was a member of the IEEE Computer Society/ACM Task Force that developed the *Computer Engineering 2004* report on model computer engineering curricula. He is active in accreditation activities, having served as an ABET program evaluator and a current member of the ABET Engineering Accreditation Commission, and previously as a member and mentor coordinator of the IEEE Committee on Engineering Accreditation Activities (CEAA). He is also a member of ASEE, and previously served as chair of the ASEE ECE Division.
IEEE Education Society Edwin C. Jones, Jr. Meritorious Service Award

For his outstanding contributions and service as the Editor in Chief of the IEEE Transactions on Education

Charles Fleddermann is a Professor of Electrical and Computer Engineering and Associate Dean of the School of Engineering at the University of New Mexico (UNM) where he has been on the faculty for over 27 years. He also has served as Dean of Graduate Studies at UNM. Prof. Fleddermann earned his Ph.D. and M.S. degrees in electrical engineering from the University of Illinois at Urbana-Champaign, and a B.S. degree, also in electrical engineering, from the University of Notre Dame.

Dr. Fleddermann is a senior member of the IEEE, and is also a member of the ASEE. He has served as the Editor in Chief of IEEE Transactions on Education (ToE); previous to that he was an Associate Editor for the journal. He serves as an electrical engineering program evaluator for the Accreditation Board for Engineering and Technology (ABET).

His research interests are in engineering education, photovoltaics, plasma processing of electronic materials, optical diagnostics of plasma systems, and engineering ethics. He has taught a variety of courses at both the undergraduate and graduate levels, including on-line courses. He has developed and taught a course on professional ethics for engineers, and has been involved in research projects in the area of ethical issues in nanotechnology. He has also taught professional development seminars on ethics for engineers in New Mexico and elsewhere in the U.S. over the past few years. He is the author of two textbooks: the 4th edition of Engineering Ethics, was released in 2011; and he co-authored Introduction to Electrical and Computer Engineering, intended to help first-year students develop knowledge and strategies for success in the profession.
About the Edwin C. Jones Award

The Edwin C. Jones Meritorious Service Award is presented to recognize a member of the IEEE Education Society who has made pioneering contributions to the administrative efforts of the IEEE Education Society over a period of years. The award consists of a plaque, a certificate, and registration to the Frontiers in Education Conference.

About Edwin C. Jones

Professor Jones served as a Society officer from 1970 through 1976; this service included two years as president. He served as Editor-in-Chief of the IEEE Transactions on Education from 1982-84. Since he first became involved in the Society in the late 1960s, he has held virtually every office in the Education Society. He is still actively involved with the Education Society. Professor Jones also serves the IEEE as a member of the IEEE Committee on Engineering Accreditation Activities. Dr. Jones is University Professor and Associate Chair, emeritus, Department of Electrical and Computer Engineering, Iowa State University. Prior to joining Iowa State in 1966, he was an Assistant Professor at the University of Illinois from 1962-66. He received his PhD in 1962 from the University of Illinois; the DIC in 1956 from Imperial College of Science and Technology, University of London; and the BSEE in 1955 from West Virginia University. Dr. Jones’ honors and awards include: Fellow, Institute of Electrical and Electronics Engineers; Fellow, American Society for Engineering Education; Fellow, American Association for Advancement of Science; Fellow, Accreditation Board for Engineering and Technology; IEEE Centennial Medal, 1984; ASEE Centennial Medal, 1993.
IEEE Education Society Mac Van Valkenburg Early Career Teaching Award

For his innovative teaching approach, simultaneous emphasis on disciplinary rigor and on the societal implications of engineering in his classes, and his deep commitment to inspiring engineering students to address high-value global development problems in resource limited settings

Muhammad H. Zaman is Associate Professor of Biomedical Engineering at Boston University. He also holds appointments in the Department of Medicine and the Department of International Health at Boston University School of Medicine. Prof. Zaman is also Associate Chair of Biomedical Engineering and Associate Director of Kilachand Honors College at Boston University. Prof. Zaman got his PhD in Physical Chemistry from the University of Chicago in 2003, where he was a Burroughs-Wellcome Graduate Fellow in Interdisciplinary Sciences. After his Ph.D. he was a Herman and Margaret Post-Doctoral Fellow at MIT from 2003-2006. He was Assistant Professor of Biomedical Engineering at UT Austin from 2006-2009 and moved to BU in Fall 2009. His lab focuses on developing new experimental and computational technologies for high value healthcare problems in both the developing and developed world.

Prof. Zaman is actively involved in two areas of research. The first is developing new tools and quantitative understanding of tumor formation and tumor metastasis. The second is developing robust and affordable diagnostic technologies for the developing world. He is working on capacity building and engineering education in these countries as well. Technologies developed by Prof. Zaman and his team are in various stages of implementation in multiple African countries.

Additionally, Prof. Zaman is actively involved in bringing high quality engineering education to developing countries. He is currently involved in setting up the first biomedical engineering departments at various African Universities in Kenya, Zambia, Uganda and Ethiopia. He is also a member of the technical committee of the UN Economic Council on Africa (UNECA) and co-Director of the UNECA biomedical innovation program in Africa. He contributes regularly on issues in engineering and development as a regular op-ed columnist to various newspapers and magazines including the Huffington Post and Express Tribune (one of the leading English daily newspaper in Pakistan).

Prof. Zaman’s emphasis on excellence in teaching has been a major part of his academic career. His contribution to engineering education has been highlighted by the New York Times, NPR and a number of other organizations. Prof. Zaman has won numerous awards for his research and teaching, including BU College of Engineering Early Career Research Excellence Award, Saving Lives at Birth Innovator Award, Tewkesbury Fellowship, American Society for Engineering Education Outstanding Assistant Professor Award, BME outstanding teacher award at UT Austin, College of Engineering Outstanding Teaching by an Assistant Professor Award at UT Austin and the highest award for teaching in the entire UT System, the UT System Regents Outstanding Teaching Award. He has been invited by the National Academies of Engineering to participate in both frontiers of engineering and frontiers of engineering education as well as Japan-US Frontiers of Engineering.
IEEE Education Society
Student Leadership Award

For exemplary leadership in the execution of programs and continuous improvements of the IEEE Education Society Student Activities Committee (SAC) and excellent performance in the upgrading of the IEEE Technology in Engineering Education (formerly IEEE Multidisciplinary Engineering Education Magazine)

Subhamoy Mandal (StM’04, GSM’08) is currently a DAAD PhD Scholar with the Institute of Biological and Medical Imaging at TU München and Helmholtz Zentrum München. He received his MS (by research) from the Indian Institute of Technology Kharagpur, and B.E. in Biomedical Engineering from Manipal University, Karnataka, India. Subhamoy’s areas of interest are Medical Signal & Image Processing, Medical Imaging and DSP/GPU based algorithm design. His current research pertains to visual quality enhancement and development of novel methods for optoacoustic (photoacoustic) imaging.

Subhamoy is an active Member of IEEE, and is the Student Rep and AdCom member of its Engineering in Medicine and Biology (EMB) Society, and the 2010-13 Chair, IEEE Education Society Student Activity Committee (IEEE EduSocSAC). As the Chair of the EdSocSAC he was instrumental in designing and implementing the IEEE TechSym, a unique student only conference which is archived in IEEE Xplore DL. Further, he initiated the IEEE Direct to Student (D2S) and One World- One Education (1WoE), which has achieved notable initial success. Subhamoy was the Founding Chair, IEEE EMB Student Club of IIT Kharagpur, which was awarded the Best New Student Club/Chapter Award 2010 by IEEE EMBS Student and Member Activity Committee. He has been a Member of IEEE Ad-hoc Committee on Social Media Policy reporting directly to the IEEE Board of Directors, founding Chair of the IIT Kharagpur GOLD Affinity, and also actively volunteered with the IEEE Student Branches at IIT Kharagpur(Treasurer 2009-10) and MIT Manipal (2005-07).

Subhamoy has been closely associated with several corporate organizations including Philips, GE and Microsoft. During his internships with Philips and the master’s thesis, he has focused on developing low cost point of care technologies to address healthcare challenges of emerging economies. At GE Global Research his primary area of focus has been Magnetic Resonance Imaging (MRI) and its application in Brain Iron Quantification, leading to early diagnosis of Alzheimer’s and other neuro-degenerative diseases.

Subhamoy’s goal is to achieve success in innovating point-of-care healthcare solutions using expertise of biomedical engineering and domain knowledge of medical sciences by synchronized efforts in a collective venture. He aims to leverage the acumen and experiences gained through his own training to encourage growth of better educational and technical training facilities in emerging economies, including the Indian Subcontinent.
IEEE Education Society
Student Leadership Award

For exemplary leadership in the execution of programs and continuous improvements of the IEEE Education Society Student Activities Committee (SAC) and excellent performance in the upgrading of the IEEE Technology in Engineering Education (formerly IEEE Multidisciplinary Engineering Education Magazine)

Xinyou Zhao was born in Biyang Village, Henan Province, China in 1976. He received the B.S. degree in computer education from Xinyang Normal University, China, in 2000 and obtained the M.S. degree in Computer Science from Guilin University of Electronic Technology, China, in 2003. He was awarded a Ph.D. degree in Engineering at Graduate School of Information Systems, The University of Electro-Communications, Tokyo, Japan, in 2010.

From 2003 to 2007, he worked as a lecturer at Guilin University of Electronic Technology, Guilin, China. During May 2005 to April 2006, he was also a visiting scholar in Matsumoto Research Lab., GITI, Waseda University, Tokyo, Japan. Now he is working at ACARIC Co. Ltd as a system engineer, Tokyo, Japan. He is also a guest researcher in Advanced Research Center for Human Sciences, Waseda University, Tokorozawa, Japan. He has published more than 30 papers in national and international journals and conferences and numerous technical reports. His research interests include mobile learning, data mining with big data, intelligent tutoring system and multimedia technology.

REVIEWERS

This year, FIE 2013 had over 600 papers and presentations submitted for consideration. The FIE2013 Program Committee wishes to thank the following individuals for acting as abstract and paper reviewers. The program committee asked these individuals to help control the quality of the presentations at this year’s conference by reviewing the submissions for FIE2013. Their outstanding effort has helped maintain the high standard that has become the reputation of each FIE conference.

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SESSION CHAIRS

The conference committee would like to thank the people that have agreed to act as session chairs at the 2013 Frontiers in Education Conference. Session chairs play an important role in ensuring the conference runs smoothly and that the technical presentations are a valuable experience for both speakers and attendees. Session chairs also have served a critical role in helping with the Ben Dasher Award process.

The primary responsibilities of session chairs are to:
• Read the session’s papers in advance and recommend papers for the Ben Dasher Best Paper committee.
• Contact the authors in the session and become familiar with the authors who are presenting.
• Introduce the session and make any FIE announcements that are needed.
• Briefly introduce each speaker and paper.
• Manage audience questions, and ensure that presentations begin and end within their time slots.

The program committee would like to thank the following individuals for their efforts to help make FIE2013 both informative and successful:

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<td>S1F: Innovation and Entrepreneurship II</td>
<td>8:00 AM</td>
<td>Room 19</td>
<td>Anthony Joseph</td>
<td>Pace University</td>
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<td>S1G: First and Second Year Programs III</td>
<td>8:00 AM</td>
<td>Room 20</td>
<td>Leen-Kiat Soh</td>
<td>University of Nebraska-Lincoln</td>
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<tr>
<td>S1H: ECE VI</td>
<td>8:00 AM</td>
<td>Room 2</td>
<td>Abdel-Hameed Badawy</td>
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<td>S1I: Online Learning II</td>
<td>8:00 AM</td>
<td>Room 4</td>
<td>Dorothy Jones-Davis</td>
<td>National Science Foundation</td>
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<td>S2C: Teaming I</td>
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<td>Amy Javernick-Will</td>
<td>University of Colorado at Boulder</td>
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<td>S2D: Experiential Learning III</td>
<td>10:00 AM</td>
<td>Room 17</td>
<td>James Rowland</td>
<td>University of Kansas</td>
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<tr>
<td>S2E: Industry Partnerships</td>
<td>10:00 AM</td>
<td>Room 18</td>
<td>Xiaosong Li</td>
<td>Unitec Institute of Technology</td>
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<tr>
<td>S2F: Ethics and Moral Reasoning</td>
<td>10:00 AM</td>
<td>Room 19</td>
<td>Melany Ciampi</td>
<td>Safety, Health and Environment Research Organization</td>
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<td>S2G: First and Second Year Programs IV</td>
<td>10:00 AM</td>
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<td>São Paulo State University - UNESP</td>
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<td>S2H: pK-12 STEM IV</td>
<td>10:00 AM</td>
<td>Room 2</td>
<td>Charles Wallace</td>
<td>Michigan Technological University</td>
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<td>S2I: Interdisciplinary Programs I</td>
<td>10:00 AM</td>
<td>Room 4</td>
<td>Rose Gamble</td>
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<td>1:00 PM</td>
<td>Room 18</td>
<td>Velvet Fitzpatrick</td>
<td>Purdue University</td>
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<td>Julie Rursch</td>
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<td>Arizona State University</td>
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Web-based animated interactive learning material for lower division computer science and engineering. $35 enrollment, can replace textbooks, downloadable.

“Less text, more action.”

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Available courseware

- Programming in C
- Programming in C++
- Programming in Java
- Programming in Python
- Programming in MATLAB
- Programming Embedded Systems
- Data Structures
- Discrete Math

Contact info@zyante.com to request free access

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<th>Zyante’s advantage</th>
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<td><strong>Learn by doing</strong></td>
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<td>Interactive tools, embedded coding environment and compiler</td>
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<td><strong>Self assessment</strong></td>
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<td><strong>Low cost</strong></td>
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<td>$35 enrollment, downloadable</td>
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4200+ students at 40 schools including...

“Its offering tightly integrates explanatory text, active exercises, visual simulations, and video clips...”
-- David Arnow, CS professor at CUNY

“Zyante’s online text is miles ahead of anything that can be done with offline textbooks.”
-- Brian Linard, CS lecturer at UC Riverside
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<td>1:30 PM</td>
<td><strong>W1A:</strong> Pre-Conference Workshop: Computer Engineering Curriculum Guidelines (FREE workshop - costs covered by NSF grant)</td>
<td><strong>W1B:</strong> Pre-Conference Workshop: Modeling Software the Alloy Way</td>
<td><strong>W1C:</strong> Pre-Conference Workshop: Programming Board Game Strategies in CS2</td>
<td><strong>W1D:</strong> Pre-Conference Workshop: Why are continuous-time signals and systems courses so difficult? How can we make them more accessible?</td>
<td><strong>W1E:</strong> Pre-Conference Workshop: Using Problets for Problem-Solving Exercises in Introductory C++/Java/C# Courses</td>
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<td><strong>W2A:</strong> Pre-Conference Workshop: Inspiring Inventive Genius in Middle and High School Students with Chain-Reaction STEAM Machines™</td>
<td><strong>W2B:</strong> Pre-Conference Workshop: The Erlang Approach to Concurrent System Development</td>
<td><strong>W2C:</strong> Pre-Conference Workshop: An Online Revolution in Learning and Teaching: from e-books to MOOCs</td>
<td><strong>W2D:</strong> Pre-Conference Workshop: Teaching Service-Oriented Programming to CS and SE Undergraduate Students (FREE workshop - costs covered by NSF grant)</td>
<td><strong>W2E:</strong> Pre-Conference Workshop: Refining a Taxonomy for Engineering Education Research (FREE workshop - costs covered by NSF grant)</td>
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## SESSION GRID - THURSDAY, OCTOBER 24TH

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<td>Keynote: Katherine Banks, Vice Chancellor and Dean of Engineering, Texas A&amp;M University</td>
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<td>Mini-Workshop: Exploring Boyer's Scholarship of Application for Submissions to the IEEE Transactions on Education</td>
<td>Mini-Session: Assessing Lifelong Learning: The Role of Information Gathering and Application Skills</td>
<td>Keynote: Katherine Banks, Vice Chancellor and Dean of Engineering, Texas A&amp;M University</td>
<td>Approaches to Student-Centered Learning I</td>
<td>Student Beliefs, Motivation &amp; Persistence I</td>
<td>Software Engineering, Computing &amp; Informatics Education I</td>
<td>Innovation and Entrepreneurship I</td>
<td>First and Second Year Programs I</td>
<td>Assessment I</td>
<td>Mobile and Online Learning I</td>
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<td>Mini-Workshop: New National Science Foundation Opportunities for Improving Undergraduate Engineering Education</td>
<td>Panel: Model Collaboration for Advancing Student-Centered Engineering Education</td>
<td>Approaches to Student-Centered Learning II</td>
<td>Teaching and Engagement</td>
<td>Computing I</td>
<td>ECE I</td>
<td>First and Second Year Programs II</td>
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<td>Mini-Workshop: Catching the Wave: Big Data in the Classroom</td>
<td>Special Session: DiSrUpTiOn</td>
<td>Innovative Computing Practice I</td>
<td>Real World Influences in Experiential Learning</td>
<td>Energy Engineering Education I</td>
<td>Experiential Learning II</td>
<td>Game-Based Learning I</td>
<td>Open Educational Resources and Practices I</td>
<td>Inclusivity and Diversity I</td>
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<td>Transportation to and Reception at Western Museum</td>
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<tr>
<td>7:00 am -</td>
<td>Breakfast and Plenary Session</td>
<td>Keynote: Mike McCracken, Director of Online Course Development and Innovation, College of Computing, Center for 21st Century Universities (C2IU), Georgia Tech</td>
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<tr>
<td>8:30 am -</td>
<td>F1A: Mini-Workshop: Tools to Facilitate Development of Conceptual Understanding in the First and Second Year of Engineering</td>
<td>F1B: Panel: Building an Inclusive REU Program: A Model for Engineering Education</td>
<td>F1C: Faculty Development I</td>
<td>F1D: Teams, Communication &amp; Profession</td>
<td>F1E: Philosophy of Engineering and Engineering Education I</td>
<td>F1F: ECE II</td>
<td>F1G: Game-Based Learning II</td>
<td>F1H: Learning Theories</td>
<td>F1I: Approaches to Student-Centered Learning IV</td>
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<td>F2A: Mini-Workshop: Why are continuous-time signals and systems courses so difficult? How can we make them more accessible?</td>
<td>F2B: Special Session: True Grit: Toward a Culture of Psychological Preparedness in Engineering Education</td>
<td>F2C: Online Learning I</td>
<td>F2D: Open Educational Resources and Practices II</td>
<td>F2E: Philosophy of Engineering and Engineering Education II</td>
<td>F2F: ECE III</td>
<td>F2G: Faculty Development II</td>
<td>F2H: Design and Assessment</td>
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<td>F3A: Special Session: What is the Role of MOOCs in Engineering Education?</td>
<td>F3B: Special Session: Defining and Assessing Engineering Ethics</td>
<td>F3C: Approaches to Student-Centered Learning III</td>
<td>F3D: Student as Learner</td>
<td>F3E: Assessment Strategies</td>
<td>F3F: Learning Approaches in ECE</td>
<td>F3G: Mobile and Online Learning III</td>
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<td>F3I: Integrating Design Throughout the Curriculum</td>
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<td>Reception and Awards Banquet – Ticketed Event</td>
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<td>Special Session: The CS 2013 Computer Science Curricula Guidelines Project</td>
<td>Engineering Education in Countries of Portuguese Language</td>
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<td>pK-12 STEM III</td>
<td>Innovative Computing Practice III</td>
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SESSIONS – Wednesday, October 23rd

W1A: Pre-Conference Workshop: Computer Engineering Curriculum Guidelines (FREE workshop - costs covered by NSF grant)
1:30 - 4:30 pm
Room: 16

COMPUTER ENGINEERING CURRICULUM GUIDELINES (FREE WORKSHOP - COSTS COVERED BY NSF GRANT)
Eric Durant (Milwaukee School of Engineering & Starkey Hearing Technologies, USA)
John Impagliazzo (Hofstra University, USA)
Susan Conry (Clarkson University, USA)
Andrew McGettrick (University of Strathclyde, United Kingdom)
Mitchell A Thornton (Southern Methodist University, USA)
Timothy Wilson (Embry-Riddle Aeronautical University, USA)

Participants will learn about the revisions process and give feedback on the second draft of the updated ACM/IEEE-CS 2004 "Curriculum Guidelines for Undergraduate Degree Programs in Computer Engineering" known as CE2004. In 2011, the ACM and the IEEE-CS created the CE2004 Review Task Force (RTF) and charged it with reviewing and determining the extent to which the CE2004 document required revisions. The RTF reported on its survey of academic and industry constituents in July, 2011. It also recommended specific contemporary topics to be strengthened or added while de-emphasizing other topics that appeared to be waning from the mainstream. Additionally, the RTF recommended that the societies form a joint committee to update and edit the earlier document and to seek input and review from the computer engineering industrial and academic communities through workshops co-located at major conferences. This preconference workshop will engage the computer engineering education community in evaluating the current draft and planning revisions to the guidelines for publication in 2014.

W1B: Pre-Conference Workshop: Modeling Software the Alloy Way
1:30 - 4:30 pm
Room: 17

MODELING SOFTWARE THE ALLOY WAY
Michael Lutz (Rochester Institute of Technology, USA)

The goal of this workshop is to introduce Alloy - both the language and support tool - to faculty interested in formal methods and mathematical modeling. After a brief introduction to Alloy concepts, the tool and language will be explored by interactively developing a simple software system model. This approach mirrors the way Alloy is taught and used within RIT's undergraduate software engineering program

W1C: Pre-Conference Workshop: Programming Board Game Strategies in CS2
1:30 - 4:30 pm
Room: 18

PROGRAMMING BOARD GAME STRATEGIES IN CS2
James Heliotis (Rochester Institute of Technology, USA)
Ivona Bezakova (Rochester Institute of Technology, USA)
Sean Strout (Rochester Institute of Technology, USA)

This workshop presents freshman-level projects based on designing and programming player strategies for well-established board games. Unlike modern computerized games, board games are typically discrete, where the game state can be stored in basic data structures, and a variety of search techniques can be used to evaluate possible player moves. Such board games provide a natural context for many introductory Computer Science topics. The strategy component makes the project open-ended, motivating the students to keep improving their code. After appropriate background information is presented, to better understand how the project works from the students’ perspective, participants will act as students, brainstorm through a variety of data structures, and develop a small part of a player module.
W1D: Pre-Conference Workshop: Why are continuous-time signals and systems courses so difficult? How can we make them more accessible?
1:30 - 4:30 pm
Room: 19

WHY ARE CONTINUOUS-TIME SIGNALS AND SYSTEMS COURSES SO DIFFICULT? HOW CAN WE MAKE THEM MORE ACCESSIBLE?
Mario Simoni (Rose-Hulman Institute of Technology, USA)
Maurice Aburdene (Bucknell University, USA)
Farrah Fayyaz (Purdue University, USA)

This NSF sponsored workshop offers engineering and science faculty an engaging opportunity to explore how to improve learning in introductory continuous-time signals and systems (CTSS) courses. The two primary goals of the workshop are to provide: an interactive discussion of the sources of difficulty in CTSS courses in order to define the "problem", and a hands-on experience with laboratories that have been used at Rose-Hulman Institute of Technology and Bucknell University to improve learning in CTSS courses.

W1E: Pre-Conference Workshop: Using Problets for Problem-Solving Exercises in Introductory C++/Java/C# Courses
1:30 - 4:30 pm
Room: 20

USING PROBLETS FOR PROBLEM-SOLVING EXERCISES IN INTRODUCTORY C++/JAVA/C# COURSES
Amruth N. Kumar (Ramapo College of New Jersey, USA)

This workshop will help participants introduce problem-solving exercises into their introductory C++/Java/C# programming courses. The purpose of problem-solving exercises is two-fold: they supplement classroom instruction and complement the programming projects traditionally assigned in the course. The benefits of problem-solving exercises are many: they improve students’ comprehension of programming constructs, their self-confidence, especially that of female students, and their coding skills. In this workshop, problets (www.problets.org) will be introduced as a tool for problem-solving exercises. They parameterize problems to deter plagiarism; provide step-by-step explanation of the correct solution to each problem, which helps students learn; and adapt to the learner’s needs. They are a web-based service freely available for educational use. Problets have been rigorously evaluated, and have been adopted and used by dozens of instructors every semester since 2004. The workshop is appropriate for instructors of introductory C++/Java/C# programming courses in Computer Science or engineering. Participants are asked to bring a WiFi-enabled laptop to the workshop for hands-on experience.

W2A: Pre-Conference Workshop: Inspiring Inventive Genius in Middle and High School Students with Chain-Reaction STEAM Machines™
5:30 - 8:30 pm
Room: 20

INSPIRING INVENTIVE GENIUS IN MIDDLE AND HIGH SCHOOL STUDENTS WITH CHAIN-REACTION STEAM MACHINES™
Shawn Jordan (Arizona State University, USA)
Odesma Dalrymple (Arizona State University, USA)
Nielsen Pereira (Western Kentucky University, USA)

A STEAM Machine™ is a Rube Goldberg®-style chain reaction contraption that completes a simple task in an overly complex way. This hands-on workshop introduces participants to the project-based STEAM Machines™ program, where middle or high school students brainstorm ideas, design, and build creative inventions that solve everyday problems - like sending a text message - using chain-reaction machines. This hands-on workshop will begin with a description of the STEAM Machines™ program, and a video of a chain-reaction machine from a recent camp offering. Examples of how science, technology, engineering, arts, and math learning objectives are addressed by the curriculum (including 21st century skills) will be presented, along with the pedagogical techniques employed. Opportunities for assessment of
knowledge, skills, and attitudes of students will be discussed. Then, results of current design-based research on the STEAM Machines™ program will be presented including a discussion of its effectiveness and impact.

W2B: Pre-Conference Workshop: The Erlang Approach to Concurrent System Development
5:30 - 8:30 pm
Room: 19

THE ERLANG APPROACH TO CONCURRENT SYSTEM DEVELOPMENT
Michael Lutz (Rochester Institute of Technology, USA)

Erlang, a functional language with roots in Prolog, has been used by Erickson, Ltd., to develop robust, fault-tolerant, distributed communications switches. More recently, the symmetric multiprocessing capabilities inherent in the language have been fully incorporated into Erlang's interpretive virtual machine. The goal of this workshop is to introduce Erlang - a functional language designed for use in developing concurrent and distributed system - to computer scientists interested in the language as well as computer scientists and software engineers whose focus is software design. Participants will install the Erlang system on their notebooks, and will engage in activities along with the organizer. Both sequential and concurrent systems - small though they may be - will be developed in conjunction with the presentation.

W2C: Pre-Conference Workshop: An Online Revolution in Learning and Teaching: from e-books to MOOCs
5:30 - 8:30 pm
Room: 18

AN ONLINE REVOLUTION IN LEARNING AND TEACHING: FROM E-BOOKS TO MOOCS
Diane Rover (Iowa State University, USA)
Yaacob Astatke (Morgan State University, USA)
Smita Bakshi (Zyante, USA)
Frank Vahid (University of California, Riverside, USA)

College-level online learning took off in a big way in 2012, and is likely to impact every department and teacher in some manner. This workshop will highlight major developments in online education technology in engineering and computer science. We'll describe the latest trends in: teaching modalities like blended, flipped and online; MOOCs like Udacity, Coursera, and EdX and the impact they are having on traditional education; web-native learning material and tools like MyMathLab and Zyante; developing and/or using online teaching material for engineering and computing like interactive quizzes, animations, and simulations like Zyante tools, Hype tools, tablet capture, lecture capture; and methodologies and technology for team teaching. We'll share lessons from some experienced teachers of online and hybrid (online plus in-person) courses, and include discussion on how departments and teachers might embrace the trend. We'll also discuss methods and technology for instructors with a range of expertise to successfully collaborate to deliver impactful instructional experiences.

W2D: Pre-Conference Workshop: Teaching Service-Oriented Programming to CS and SE Undergraduate Students (FREE workshop - costs covered by NSF grant)
5:30 - 8:30 pm
Room: 17

TEACHING SERVICE-ORIENTED PROGRAMMING TO CS AND SE UNDERGRADUATE STUDENTS (FREE WORKSHOP - COSTS COVERED BY NSF GRANT)
Xumin Liu (Rochester Institute of Technology, USA)
Rajendra Raj (Rochester Institute of Technology, USA)
Tom Reichlmayr (Rochester Institute of Technology, USA)
Chunmei Liu (Howard University, USA)
Alex Pantaleev (SUNY Oswego, USA)

This workshop will introduce the participants to the fundamental concepts and techniques of a new programming paradigm, Service-Oriented Programming (SOP), which allows developing applications using services as the building blocks. SOP has gained significant popularity in industry since it greatly increases software reuse. The related topics can be incorporated into existing programming courses, such as CS2 and PLC, as well as related elective courses, such as software engineering and web services. Service-Oriented Programming (SOP) is a new programming methodology that
allows developing software applications by linking and composing existing services. It builds on top of OOP as services are usually developed in an OO fashion and then wrapped as Web services, and takes a further step to software reuse. More specifically, OOP allows one to model and implement software components as objects, while SOP allows to model and implement software systems in terms of services, which can be accessed on the Web. Presenters will introduce the problem areas and the motivation behind the SOP paradigm, the techniques of designing and implementing services, and the techniques of developing applications using services. The topics covered include service-oriented architecture, web services, service description and discovery, service invocation, service composition architecture, and core SOP protocols (e.g., WSDL, UDDI, SOAP, and XPDL).

**W2E: Pre-Conference Workshop: Refining a Taxonomy for Engineering Education Research (FREE workshop - costs covered by NSF grant)**

5:30 - 8:30 pm  
Room: 16

**REFINING A TAXONOMY FOR ENGINEERING EDUCATION RESEARCH (FREE WORKSHOP - COSTS COVERED BY NSF GRANT)**

Cynthia Finelli (University of Michigan, USA)

Engineering education research is a diverse, rapidly-evolving, international field in which scholars apply the methods of educational research to address a variety of issues pertaining to teaching and learning in engineering. As the field has grown, so has the need for a standardized terminology and an updated taxonomy to map and communicate research initiatives, and refining such a taxonomy is the focus of this workshop. Participants will engage in activities to reflect on a draft taxonomy and offer suggestions to refine it. Interested participants at any experience level are encouraged to join this dialogue.
SESSIONS - Thursday, October 24th

**T1A: Mini-Workshop: Exploring Boyer's Scholarship of Application for Submissions to the IEEE Transactions on Education**
10:00 - 11:30 am  
Room: 14

**EXPLORING BOYER'S SCHOLARSHIP OF APPLICATION FOR SUBMISSIONS TO THE IEEE TRANSACTIONS ON EDUCATION**
Jeffrey E Froyd (Texas A&M University, USA)  
Susan M. Lord (University of San Diego, USA)

A substantial percentage of the manuscripts submitted to the IEEE Transactions on Education as well as a substantial percentage of the papers that have been published fall within the scholarship of application as described by Boyer. The scholarship of application in electrical and computer engineering education might be briefly described as the scholarship of teaching practice in these disciplines. While this is a critical arena for electrical and computer engineering education, standards and criteria across the scholarly community for this area of scholarship have not been well established. Thus, this workshop at FIE 2013 offers opportunities for dialog about these issues. A starting point for the conversation will be the new review criteria that the Transactions has established for the scholarship of application. The intent of the workshop is to explore how authors interpret the new criteria, how authors might address the new criteria, and how support for authors can be fostered. Small groups will explore in greater depth the meaning of review criteria for the scholarship of application for education in electrical and computer engineering. Then, small groups with share their results with the large group for broader conversations.

**T1B: Special Session: Assessing Lifelong Learning: The Role of Information Gathering and Application Skills**
10:00 - 11:30 am  
Room: 15

**ASSESSING LIFELONG LEARNING: THE ROLE OF INFORMATION GATHERING AND APPLICATION SKILLS**
Michael Fosmire (Purdue University, USA)  
Senay Purzer (Purdue University, USA)  
Ruth Wertz (Purdue University, USA)  
Amy Van Epps (Purdue University, USA)

This special session will explore different approaches to measuring and promoting lifelong learning skills in support of fulfilling ABET student outcome criterion 3.i. “The recognition of the need for, and an ability to engage in life-long learning”[1] is multifaceted and challenging to both define and measure and is comprised of a mixture of skills, abilities, and habits, and attitudes. This session focuses on those aspects of lifelong learning associated with self-directed learning, and in particular the information gathering and application skills required for effective independent learning. As a result of this session, we will develop some shared understandings of these skills, our ability to measure them, and an agenda for future research on measuring and supporting activities related to student outcome criteria 3.i.
GREEN CONSTRUCTION IN CIVIL ENGINEERING INSTRUCTION
Kenneth Leitch (West Texas A&M University, USA)
Christopher Koop (West Texas A&M University, USA)
Miles Messer (West Texas A&M University, USA)
Andrew Payne (West Texas A&M University, USA)

Teaching sustainability in civil engineering curriculum fulfills ABET 2000 Outcome 3c and the codes of ethics of NSPE and ASCE. The US Green Building Council (USGBC) has published the Leadership in Energy and Environmental Design (LEED) criteria since 1998. LEED is an optional criteria in private construction and is mandated or encouraged by many federal, state, and local governments for public construction projects. Learning about LEED criteria will help to prepare civil engineers to understand how civil systems interact with and operate in a more complementary manner with the natural world as well as to reduce water, energy, and material usage. The authors describe the process of learning about the LEED v3 (2009) criteria to apply it to two existing buildings to build a scorecard. In the process of building the scorecard, the authors learned about sustainable construction techniques. Future guidance on applications of the LEED criteria across the undergraduate civil engineering curriculum is discussed.

ON-PROFESSIONAL COMPETENCES IN ENGINEERING EDUCATION FOR XL-CLASSES
Stefan Schröder (IMA/ZLW & IfU RWTH Aachen University, Germany)
Daniela Janssen (IMA/ZLW & IfU RWTH Aachen University, Germany)
Ingo Leisten (IMA/ZLW & IfU RWTH Aachen University, Germany)
René Vossen (IMA/ZLW & IfU RWTH Aachen University, Germany)
Ingrid Isenhardt (IMA/ZLW & IfU RWTH Aachen University, Germany)

Far reaching changes in university higher education have taken place in the last ten years. Different factors, e.g. necessity of on-professional competences in engineering education, rising or vast student numbers and new technical possibilities, have influenced the academic teaching and learning process. Therefore interdependence between requirements and didactical-educational possibilities is given. Because of changed circumstances an adaption of teaching methods and concepts is required. At the same time Bologna arrogates students to be placed in the centre of the teaching and learning process and claims on-professional competences for today's students. Especially for XL-Classes this is a specific challenge. One of the questions ensuing is how to increase learning success by the use of specific didactical methods? With a research approach connecting different proven didactical concepts and considering the previously shown conditions, the concept of the lecture "communication and organizational development" (KOE) at RWTH Aachen University has been redesigned. This lecture, organized by the Institute Cluster IMA/ZLW & IfU at RWTH Aachen University, is mainly frequented by up to nearly 1.300 students of the faculty of mechanical engineering and inherent part of the bachelor-curriculum. The following practical example prospects the multi-angulation of didactical concepts and shows up innovative educational teaching.

INCORPORATING AUGMENTED REALITY CONTENT IN ENGINEERING DESIGN GRAPHICS
Jorge Dorribo Camba (Texas A&M University, USA)
Manuel Contero (Universitat Politècnica de València, Spain)

This paper describes the development and integration of augmented reality content with traditional Engineering Design Graphics materials, and presents the results of a preliminary usability study conducted with Freshman Engineering students. The resources developed combine printed text and images with interactive three-dimensional content with the purpose of enhancing the understanding of technical graphics concepts and improving the students' visualization skills. In general, students had a very positive reaction when first presented with the materials and showed an optimistic attitude while interacting with the content. Additionally, augmented reality materials promote the development of self-directed learning skills and self-assessment.
APTITUDE DIGGING EDUCATION IN PROJECT-BASED COURSE
Yao Hu (Beijing Institute of Technology, P.R. China)
Ya Zhou (Beijing Institute of Technology, P.R. China)
Liquan Dong (Beijing Institute of Technology, P.R. China)
Ming Liu (Beijing Institute of Technology, P.R. China)
Yuejin Zhao (Beijing Institute of Technology, P.R. China)
Qun Hao (Beijing Institute of Technology, P.R. China)

Students from China are always intelligent but lack of creativity. These are somewhat stereotypes. This is partially because of the reserved or implicit culture. In an objective point of view, it is also because of the limited education resources. In the single assessment criterion education circumstance, students chase for the high marks even without knowing their interests or aptitudes. In a 12-week open experimental course, Optoelectronic Instrument Experiments (OIE), we try to encourage the students to dig their aptitudes and bring them into full play to earn more credits for the course. Self-assessment and mutual-evaluation for technical proficiency, communication skills, collaboration and leadership are carried out for the final evaluation. We also communicate with the students the speciality and skill a qualified engineer needs. We hope to help them prepare themselves for engineering-related jobs in the further.

REDESIGNING ENGINEERING COURSES BY INTRODUCING DIGITAL INK TECHNOLOGY
José V Benlloch-Dualde (Universitat Politècnica de València & ETSINF-DISCA, Spain)
Judith Gutierrez Cuba (Universidad de las Américas Puebla, Mexico)
Félix Buendía (Universitat Politècnica de València, Spain)
Aurelio López-Malo (Universidad de las Américas Puebla, Mexico)
Lenin Lemus (Universitat Politècnica de València, Spain)
Enrique Palou (Universidad de las Américas Puebla & Center for Science, Engineering and Technology Education, Mexico)
Juan-Carlos Cano (Universitat Politècnica de València, Spain)

We applied the How People Learn framework (HPLf) in two different higher education contexts. On one hand, a first-year core course on Computer Technology, taught at the Computer Engineering Degree Program at Universitat Politècnica de València, Spain. On the other hand, two Food Chemistry related courses, taught at Universidad de las Américas Puebla, Mexico, as part of food engineering undergraduate and food science graduate programs. The goal of these works was to redesign studied courses at both universities from a lecture-based format to a "challenge-based" format by using Tablet PCs and digital ink. In order to support the studied approach, different ink-enabled software tools were utilized. Class sessions were enhanced through the usage of Classroom Presenter, a pen-based interaction system that supports the sharing of digital ink on slides between instructors and students. InkSurvey also allowed teachers to pose questions, receive instantly digital ink responses, and provide real-time formative feedback. Some other tools such as PDF Annotator and Ardesia helped instructors to review coursework and assignments and provide formative feedback as well. We studied our approach over the two last academic years by observing classes at both universities, obtaining selected student achievement indicators and conducting surveys with students and instructors.

Session TID: Student Beliefs, Motivation & Persistence I
Chair: Lisa Benson (Clemson University)
10:00 - 11:30 am
Room: 17

UNDERSTANDING ENGINEERING IDENTITY THROUGH STRUCTURAL EQUATION MODELING
Allison Godwin (Clemson University, USA)
Geoff Potvin (Clemson University, USA)
Zahra Hazari (Clemson University, USA)
Robynne Lock (Clemson University, USA)

Understanding students' self-ascribed engineering identity may be one way to understand engineering choices and to help recruit new students to the engineering pipeline. In our framework, identity is composed of students' perceptions of their performance/competence, recognition, and interest in a domain. This paper outlines the creation of a model of engineering choice based on this framework. The data utilized in this analysis come from the nationally-representative Sustainability and Gender in Engineering (SaGE) survey. Distributed during the fall of 2011, the survey was completed by 6,772 college students across the United States enrolled in first-year English courses. A structural equation model was
built using previously validated constructs of mathematics, physics, and general science identities. These three constructs predict an engineering identity which, in turn, influences the choice of engineering in college. The model is a step towards a better understanding of the choice of an engineering major in college.

**STUDENT DEMOGRAPHICS AND OUTCOMES IN ELECTRICAL AND MECHANICAL ENGINEERING**

Susan M. Lord (University of San Diego, USA)
Matthew W Ohland (Purdue University, USA)
Richard Layton (Rose-Hulman Institute of Technology, USA)
Marisa K. Orr (Louisiana Tech University, USA)

Using longitudinal data from eleven institutions in the U.S., this study explores the persistence of students in the two largest engineering disciplines: Electrical (EE) and Mechanical (ME). These programs have large enrollments of students but small percentages of women. Despite these similarities, enrollment and persistence in these majors is qualitatively different. In this research, we adopt an intersectional framework. Our results show that ME attracts more White students while EE attracts more Black and Asian students. Hispanic men and women are attracted in similar numbers to EE and ME. Overall, ME has higher graduation rates than EE and women have higher rates than men in both disciplines. Transfer students of nearly all race/gender groups are more likely to persist to graduation than starters. Black and Hispanic female transfer students are particularly successful in EE and ME, which suggests enhancing the transfer pathway as a strategy to improve diversity. ME could learn from EE how to diversify its enrollment and EE could learn from ME strategies to retain its diverse students. These findings suggest that program factors affect each race-gender group differently. Therefore, the success of recruitment and retention strategies may depend on considering both the target population and the discipline.

**STUDENT PERCEPTIONS OF ANDRAGOGICAL ORIENTATION AND STUDENT LEARNING**

James Pembridge (Embry-Riddle Aeronautical University, USA)
Marie Paretti (Virginia Tech, USA)

In order to develop critical thinkers and capable problem solvers it is important to understand the needs of today's engineering student and design instruction to meet those needs. An important component in that discussion is the degree to which students perceive themselves as adults versus child learners. The issue is important for educators; particularly those who teach senior-level courses, because research on adult learners points toward different classroom methods than those used for children. In this paper, we focus on capstone design - a course often structured to simulate a professional work experience to understand student beliefs regarding their self-perceived orientation as an adult learner and how those beliefs are related to a) their self-perceived learning outcomes and b) the value they place on forms and frequency of feedback. To examine this impact, we draw on the concept of "andragogy." This study utilizes student data from a 2011 survey of capstone students. The data includes student beliefs regarding the andragogical assumptions, self-reports of their learning, and perceptions of the capstone course. The findings support Knowles' andragogical assumptions and indicate that student learning in project-based courses have the potential to have higher andragogical orientations. These findings provide insight into the characteristics of the capstone student and provide opportunities for faculty to tailor teaching to meet student needs.

**QUANTITATIVE ASSESSMENT OF STUDENT MOTIVATION TO CHARACTERIZE DIFFERENCES BETWEEN ENGINEERING MAJORS**

Adam Kirn (Clemson University, USA)
Lisa Benson (Clemson University, USA)

Student motivation is often undervalued in comparison to academic performance measures for evaluating changes in higher education. There is a need to consider the affective domain in reform, in addition to academic performance. The effect of student motivation toward short- and long-term goals on student actions is not well understood. To assess this need, two research questions are addressed: 1) What elements of a motivation instrument designed for first-year engineering students are valid for upper-level engineering students? 2) How do motivations differ for upper level students in different engineering majors? Students in their major-specific engineering courses were surveyed with the Motivation and Attitudes in Engineering (MAE) instrument, which assesses long-term goal related expectancy, and perceptions of present and future tasks/goals. Short-term task self-efficacy was assessed using items adapted from the Attitudes and Approaches to Problem Solving survey. Results based on comparisons between major, class, and grade point average (GPA) showed: 1) Higher GPA indicates significantly higher expectancies and self-efficacy 2) Bioengineers have significantly higher expectancies than mechanical engineers;and 3) Juniors have significantly
higher GPAs, expectancies, and more positive perceptions of the present than sophomores. Results indicate that students' motivations toward short- and long-term goals may influence actions toward learning.

**ENGINEERING PERSON-THING ORIENTATION: COMPARISONS BETWEEN FIRST-YEAR STUDENTS AND PRACTICING ENGINEERS WITH IMPLICATIONS FOR RETENTION AND PROFESSIONAL PLACEMENT**

Mary K. Pilotte (Purdue University, USA)
Diana Bairaktarova (University of Oklahoma, USA)

Academics, industrial leaders, and policy makers seem to agree that the United States can improve its ability to attract and retain engineering talent. Efforts aimed at addressing this need vary broadly from increasing the public's awareness of the problem, to re-framing the identity of engineering, de-emphasizing its less glamorous aspects, and orienting engineering's future toward solving the world's greatest problems facing humanity. In doing so, it is suggested that engineering would be a more appealing profession to groups that are historically under-represented. The fundamental assumption of these efforts is that an improved image of engineering as a socially engaged helper of humanity will result in greater initial and prolonged interest in engineering. Research investigating engineering as a profession has found few examples of specific engineering disciplines considered socially sensitive. This may suggest engineering is a career choice better aligned with individuals who prefer working with things rather than people. This exploratory study will utilize the Graziano, Habashi, & Woodcock (2011) Person and Thing Orientation Scale to examine how these things versus person tendencies appear in engineering college students and practicing engineers. It aims to identify potential sources of differentiation for these preferences within and across the sample populations.

**EXPLORING THE STUDENT EXPERIENCE IN LOW-COST INTRINSIC MOTIVATION COURSE CONVERSIONS**

Kathryn Trenshaw (University of Illinois at Urbana-Champaign, USA)
Renata Revelo Alonso (University of Illinois at Urbana-Champaign, USA)
Katherine Earl (University of Illinois at Urbana-Champaign, USA)
Geoffrey Herman (University of Illinois at Urbana-Champaign, USA)

The low-cost intrinsic motivation (IM) course conversion project aims to promote the adoption of education innovations, lowering the costs of these innovations by promoting students' intrinsic motivation to learn and to invest in their own education. We have piloted and scaled the IM course conversion of a large enrollment, sophomore-level engineering course. As part of a broader evaluation, we interviewed 31 students to better understand how the IM course conversion affected students' motivations to learn. During these interviews, students described their experiences in the course as a story from the beginning to the end of the semester. Interviews were transcribed and analyzed with an open coding scheme focused on motivational and affective statements. Preliminary analysis indicates that strategic choices, positive team dynamics, and productive failures in the learning process all contribute to promoting students' intrinsic motivation to learn in both pilot and full scale IM course conversions.

Session T1E: Software Engineering, Computing & Informatics Education I
Chair: Walter Schilling (Milwaukee School of Engineering)
10:00 - 11:30 am
Room: 18

**BRING BEST OF TWO WORLDS IN A SOFTWARE ENGINEERING CLASS, STUDENT OUTCOMES OF ACCREDITATION BOARD OF ENGINEERING AND TECHNOLOGY (ABET) AND INFORMATION LITERACY STANDARDS OF ASSOCIATION OF COLLEGE & RESEARCH LIBRARIES (ACRL)**

Afrin Naz (West Virginia University Institute of Technology, USA)
Michael Casto (West Virginia University Institute of Technology, USA)

In this collaborative project with librarians, the faculty members of Nelson College of Engineering, West Virginia University Institute of Technology (WVU Tech) identify the importance of information literacy (IL) in accreditation documents and then leverage accreditation guidelines from Accreditation Board of Engineering and Technology (ABET) student outcomes to integrate IL skills from standards of the Science and Technology Section (STS) of the Association of College and Research Libraries (ACRL) into an existing software engineering course. This project was sponsored by West Virginia University Information Literacy Course Enhancement Grant. We included the full range of the university libraries' resources, expertise, and services in course planning and delivery by incorporating different IL units: an
introductory talk, special workshops, library sessions and consultations with the librarian throughout the semester. As conducting researches, designing projects, and writing reports are most effective vehicles for students' learning of strategic and rigorous information retrieval and management, the class includes a group software-development project and an individual paper-writing project. We included different data collection and evaluation methods distributed throughout the semester, including Standardized Assessment of Information Literacy Skills (SAILS), a web-based tool to document IL skill levels and to pinpoint areas for improvement.

**A TAXONOMY OF EXERCISES TO SUPPORT INDIVIDUAL LEARNING PATHS IN INITIAL PROGRAMMING LEARNING**
Álvaro Santos (University of Coimbra & Polytechnic Institute of Coimbra, Portugal)
Anabela Gomes (Polytechnic Institute of Coimbra, Portugal)
António José Mendes (University of Coimbra & Universidade de Coimbra, Portugal)

Initial programming learning is known to be difficult to many students. To improve this situation it is necessary to support students learning effectively. This means that learning activities should be adapted to each student learning pace and specific needs. This is difficult considering that classes often have a large number of students. The definition of individual learning paths adaptable according to the student performance might help to improve the situation. To support the definition of learning paths it is useful to have a large set of exercises, organized according to a taxonomy that includes different dimensions and parameters relevant to the choice of appropriate exercises at any moment. To present this taxonomy is the main objective of this paper.

**AN EXPLORATORY SURVEY ON THE USE OF COMPUTATION IN UNDERGRADUATE ENGINEERING EDUCATION**
Alejandra J. Magana (Purdue University, USA)
Camilo Vieira (Purdue University, USA)
Francesca G. Polo (Purdue University, USA)
Junchao Yan (Purdue University, USA)
Xin Sun (Purdue University, USA)

Advances in computing contribute to science and engineering discovery, innovation, and education by facilitating representations, processing, storage, analysis, simulation, and visualization of unprecedented amounts of experimental and observational data to address problems that affect health, energy, environment, security, and quality of life. In spite of the emerging importance of the role of computing in engineering, a well-recognized shortage of scientists and engineers who are adequately prepared to take advantage of, or contribute to, such highly interdisciplinary, highly computational scientific challenges is evident. This exploratory study identifies how computation is integrated in the engineering disciplines at the undergraduate level. The research question is: How engineering professors integrate computation as part of their disciplinary undergraduate courses? This study reports anonymous survey responses of 41 engineering and engineering technology faculty members who identified themselves as integrating computation as part of their undergraduate courses. Results indicate that most of the faculty members used computation for the solution of complex calculations, for conducting simulations and for design purposes. Further research is required in order to identify and validate appropriated pedagogical practices to integrate computation as part of disciplinary courses.

**AN EMPIRICAL STUDY ON THE ESTIMATION OF SOFTWARE DEVELOPMENT EFFORT WITH USE CASE POINTS**
Luis Alves (Instituto Politécnico de Bragança, Portugal)
André Sousa (University of Minho, Portugal)
Pedro Ribeiro (University of Minho, Portugal)
Ricardo Machado (University of Minho, Portugal)

Empirical studies are important in software engineering to evaluate new tools, techniques, methods and technologies in a structured way before they are introduced in the industrial (real) software process. Perform empirical studies in a real context is very difficult due to various obstacles, so, we intend to create a stable environment that allows us to perform reliably empirical studies with students. This paper describes a case study with 104 students grouped in seven teams that developed a software system (Web application) for a real costumer. In this study we used a model based on Use Case Points (UCP) to estimate the resources needed to develop a software system.
METHOD FOR TEACHING PARALLELISM ON HETEROGENEOUS MANY-CORE PROCESSORS USING RESEARCH PROJECTS
Henrique Cota Freitas (Pontifícia Universidade Católica de Minas Gerais, Brazil)

Parallel programming and parallel architectures are necessary to achieve scalability and performance. It is difficult to evaluate when to teach parallelism and how to change the paradigm from serial to parallel algorithm in traditional curricula. Currently, there are efforts to introduce parallel programming since there are multi-core processors. However, there is a new chip generation called many-core processor. For instance, one processor chip can be built with 1,000 processing cores. Moreover, this type of processor is designed to achieve scalability and performance based on heterogeneous cores. How to teach parallelism to undergraduate and graduate students? Human resources are necessary to design and program parallel architectures based on this next generation of many-core processor. Therefore, the main goal of this paper is to show an experience based on research projects. The idea is to join students from different courses and levels, e.g., Computer Science, Information Systems, Computer Engineering, and Graduate in Informatics. All of them working together in order to understand all characteristics of heterogeneous many-core processors based on integrated environment composed of computer clusters and simulation. The proposed method focuses on projects convergence to teach how to extract characteristics from benchmark traces in order to simulate many-core processors.

Session TIF: Innovation and Entrepreneurship I
Chair: Gurdip Singh (Kanas State University)
10:00 - 11:30 am
Room: 19

THE VALUE OF ENTREPRENEURSHIP TO RECENT ENGINEERING GRADUATES: A QUALITATIVE PERSPECTIVE
Nathalie Duval-Couetil (Purdue University, USA)
Jacob Wheadon (Purdue University, USA)

Engineering students are increasingly being exposed to entrepreneurship education and activities as a part of their academic programs in order to equip them with the knowledge and skills increasingly valued in today’s economy. Data collected from a large sample of senior-year engineering students as part of an NSF-funded study titled “Entrepreneurship Education and its Impact on Engineering Student Outcomes: The Role of Program Characteristics and Faculty Beliefs,” suggested that these experiences increased students’ perceived self-efficacy for entrepreneurship and their intention to pursue entrepreneurial careers. This study expands on the results of previous research by conducting post-graduation interviews with recent engineering alumni who were exposed to entrepreneurship education and/or related activities. Telephone interviews were conducted with alumni who had graduated within the past 2-5 years. The study finds that engineering graduates place high value on their entrepreneurship education and the benefits that it has brought to their careers.

INCULCATING AN ENTREPRENEURIAL MINDSET IN ENGINEERING EDUCATION: PROJECT APPROACH
Firas Hassan (Ohio Northern University, USA)
Heath J. LeBlanc (Ohio Northern University, USA)
Khalid Al-Olimat (Ohio Northern University, USA)

In a competitive global economy, it is important for engineering students to develop entrepreneurial skills that include effective collaboration and communication, persisting and learning from failure, management, and solving ambiguous problems. This paper summarizes a project that aims to instill these skills as part of an entrepreneurial mindset in engineering students. The project was implemented in an introductory electric circuits class with a mixed representation of students majoring in electrical, computer, civil, and mechanical engineering. Students were organized into groups of two or three to design a temperature sensor using a negative temperature coefficient thermistor. Students groups were provided with customer specifications and were given a month to research the problem and obtain a viable solution. The groups were required to provide evidence compiled into a written product proposal that included a bill of materials, cost analysis, circuit design and simulation, testing plan, layout of the printed circuit board and packaging schematic, delivery time, and the voltage-temperature relationship of the designed circuit. After submitting the written proposal, each group was given five minutes to pitch their proposal using a poster in an effort to convince the customer that their design was the best and most cost-effective solution.
AN AGILE EMBEDDED SYSTEMS CAPSTONE COURSE
Antonio F Mondragon-Torres (Rochester Institute of Technology, USA)

The objective of this paper is to present the outcomes of an embedded systems senior design capstone course offered for Computer Engineering Technology students. This course has being taught five times using the presented format. At every offering, slight modifications have been done in an attempt to improve the student's experience and engagement. The most important intended learning outcomes for this course are: to enable team collaboration, to learn project management techniques, to develop a product from idea to implementation, and to make a professional presentation of their work to an audience. The innovative practices included in this course are: use of Agile Project Management methodologies, no paper trail all information is in electronic form, emulation of an entrepreneurial experience.

ENTREPRENEURSHIP AND ABET ACCREDITATION: HOW AND WHERE DOES IT FIT?
Nathalie Duval-Couetil (Purdue University, USA)
Liz Kisenwether (Pennsylvania State University, USA)
Joseph Tranquillo (Bucknell University, USA)
Jacob Wheadon (Purdue University, USA)

As a result of economic and workforce trends, there is a strong interest among policy makers and educational stakeholders in graduating more engineers with entrepreneurship skills and an entrepreneurial mindset. Given the role that ABET accreditation takes in shaping undergraduate engineering curriculum, wide adoption of entrepreneurship education could be driven by demonstrating the manner in which its outcomes align with accreditation mandates. This work in progress describes research taking place that is designed to develop a robust rationale for aligning entrepreneurship education with ABET Criterion 3 a-k, and to provide examples of the manner in which entrepreneurship-related outcomes can meet these criteria.

DESIGN WARS: DEVELOPING STUDENT CREATIVITY THROUGH COMPETITION
Preston Oihus (South Dakota School of Mines and Technology, USA)
Andrea Surovek (South Dakota School of Mines and Technology, USA)
Dean Jensen (South Dakota School of Mines and Technology, USA)

Design Wars was developed as a multi-disciplinary design competition in which teams of students receive the same assignment, materials, technology tools for communication and time to complete the project. The student teams were separated into two groups - the documentation team (in the "design office") and the actualization team (on the "build floor"). They were tasked with designing, constructing, and documenting an engineered solution to a complex problem on site within eight hours, with all design decisions communicated between the two groups via mobile computing. The competition was developed to challenge the students' creativity and communication skills judging was based on the elements of creativity including originality, flexibility, fluency, elaboration and aesthetics. Additionally, students were judged on their ability to document their team's decisions and alternative solutions. Because creativity in engineering is unsuccessful without functionality, the final projects were penalized if they failed in execution.

Session T1G: First and Second Year Programs I
Chair: Kurt Thoroughman (Washington University in St. Louis)
10:00 - 11:30 am
Room: 20

ENGINEER OF 2020 OUTCOMES AND THE STUDENT EXPERIENCE
Diane Rover (Iowa State University, USA)
Steve Mickelson (Iowa State University, USA)
Beth Hartmann (Iowa State University, USA)
Chris Rehmann (Iowa State University, USA)
Doug Jacobson (Iowa State University, USA)
Amy Kaleita (Iowa State University, USA)
Mack Shelley (Iowa State University, USA)
Andrew Ryder (University of North Carolina Wilmington, USA)
Mark Laingen (Illinois State University, USA)
Monica Bruning (University of Minnesota Duluth, USA)
An NSF Scholarships in STEM (S-STEM) program has provided scholarships for cohorts of undergraduate engineering students since 2009, giving specific attention to the National Academy of Engineering’s vision for the engineer of 2020 (E2020). Four E2020 outcomes are emphasized in Iowa State’s program: leadership, global awareness and understanding, systems thinking, and innovation and entrepreneurship. These outcomes, or pillars, are being integrated into curricular and co-curricular activities. The four pillar areas are introduced in a one-semester first-year seminar and reinforced in a two-semester second-year seminar. These seminars supplement the regular program of study for engineering students. In this paper, we describe the curriculum and its planned integration beyond the scholarship program. We present student feedback about their experience in the program. We also introduce relevant core competencies associated with the outcomes as judged by faculty and industry representatives.

DEVELOPMENT, IMPLEMENTATION AND ASSESSMENT OF A COMMON FIRST YEAR END-OF-SEMESTER ENGINEERING DESIGN PROJECT IN AN INTEGRATED CURRICULUM
Wilhelm Friess (University of Maine, USA)
Michael Davis (University of Maine, USA)

At the newly established University of Maine's Brunswick Engineering Program, an integrated curriculum is under development that covers the equivalent of the first two years of the B.Sc. in Mechanical, Electrical, Civil and Computer Engineering. Upon completion of the program, the students finish their degree following the traditional curriculum at the home campus. The program emphasizes a theory-simulation-experimentation approach that during the first semester is reflected in two core courses: IEN110 Integrated Engineering 1, and IEN120 Engineering Studio 1. These courses cover the equivalent of first semester courses in calculus and physics, introduction to engineering and engineering design, and engineering computation, and introduce CAD and a high level programming language (MatLAB). An end-of-semester project suitable for both courses needs to contribute to the individual course outcomes, as well as to the overall semester outcomes. The project goal is to challenge the students to, after suitably modeling the physical processes, explore the design space with the aid of the computational tools, and to then develop a design using 3D CAD that best meets the design parameters. The final design is then presented to the “client” (the faculty) both in report and presentation format (introducing the communication outcome), and subsequently is built and tested experimentally. The project assessment is carried out in four phases (project planning, critical design review, build and test day, and post test evaluation), with separate grade components at each assessment point for each of the courses. Assessment results indicate a high level of perceived learning and satisfaction from the students, and strong alignment with the overarching project goals of understanding the engineering design process, developing the capability to represent real-world engineering problems mathematically by applying appropriate simplifications, and to communicate effectively both orally and in writing.

IMPLEMENTATION OF JUST IN TIME AND REVAMPED ENGINEERING MATH COURSES TO IMPROVE RETENTION AND GRADUATION RATES
Mehdi Shadaram (University of Texas at San Antonio, USA)
Brandy Alger (University of Texas at San Antonio, USA)
Mauli Agrawal (University of Texas at San Antonio, USA)

We have created Just in Time Math (JITM) course for freshmen engineering students who show deficiency in math. The result has shifted the traditional emphasis on math prerequisite requirements for engineering classes to an emphasis on engineering motivation for math, with a “just-in-time” structuring of the new math sequence. Students still have to follow the traditional math sequences, however, the pre-requisites for some of the core engineering courses have changed from Calculus I to the newly developed Math classes. We have also incorporated engineering examples into the traditional and engineering mathematics courses. Since 2009, we have been offering cohorts of about 25 engineering freshmen every fall on a voluntary basis. The preliminary results indicate moderate improvement.

A WEB-BASED INTERACTIVE INTELLIGENT TUTORING SYSTEM FOR UNDERGRADUATE ENGINEERING DYNAMICS
Ning Fang (Utah State University, USA)
Yongqing Guo (Utah State University, USA)

A web-based interactive intelligent tutoring system was developed and assessed in an engineering dynamics course. The system consists of two learning modules to help students learn how to apply the Principle of Work and Energy to solve particle and rigid-body dynamics problems. Student learning gains were compared using a quasi-experimental research
design that involved pretests and posttests in both a control semester (n = 62) and a treatment semester (n = 44). It is shown that the ITS modules increased student learning gains by 37-43%.

**TESTING THE FLIPPED CLASSROOM WITH MODEL-ELICITING ACTIVITIES AND VIDEO LECTURES IN A MID-LEVEL UNDERGRADUATE ENGINEERING COURSE**

Jacob Bishop (Utah State University, USA)  
Matthew Verleger (Embry-Riddle Aeronautical University, USA)

This paper outlines an ongoing study of the flipped classroom with second and third-year undergraduate engineering students in a numerical methods course. The flipped classroom is a new pedagogical method, which employs asynchronous video lectures and practice problems as homework, and active, group-based problem-solving activities in the classroom. It represents the combination of learning theories once thought to be incompatible---active, problem-based learning activities founded upon constructivist ideals and instructional lectures derived from direct instruction methods founded upon behaviorist principles. Using a controlled quasi-experimental research design, we conduct a study with a full 15-week numerical methods course at Utah State University during the spring semester of 2013. Students in the experimental section completed model-eliciting activities inside the classroom and video lectures and homework outside the classroom. Students in the control section completed homework outside the classroom and group lectures inside the classroom. The two groups will be compared using scores from homework, examinations, and a sixteen-question numerical methods conceptual pre- post-test pair. The three main features that distinguish this study from previous research are: 1) This is a controlled study; 2) This study examines student performance on objective measures; 3) This study uses model-eliciting activities in the experimental classroom.

Session T1H: Assessment I  
Chair: Ashutosh Marathe (University of Pune)  
10:00 - 11:30 am  
Room: 2

**OPENANSWER, A FRAMEWORK TO SUPPORT TEACHER'S MANAGEMENT OF OPEN ANSWERS THROUGH PEER ASSESSMENT**

Andrea Sterbini (Sapienza University of Rome, Italy)  
Marco Temperini (Sapienza University of Rome, Italy)

Open-ended questions are an important means to support analysis and assessment of students; they can be of extraordinary effectiveness for the assessment of higher cognitive levels of the Bloom's Taxonomy. On the other hand, assessing open answers (textual, freely shaped, answers to a question) is a hard task. In this paper we describe an approach to open answers evaluation based on the use of peer-assessment: in a social-collaborative e-learning setting implemented by the OpenAnswer web system, the students answer questions and rate others' (and may be own) answers, while the teacher marks a subset of the answers so to allow the system inferring the rest of the marks. The aim of our system is to ease the teacher's marking burden and allow for a more extensive use of open ended questionnaires in her/his teaching activity.

**A NEW APPROACH TO ANALYZE THE CURRICULUM STRUCTURE USING THE STUDENTS' EVALUATION OF EDUCATION QUALITY INSTRUMENT**

Thomaz Edson Veloso Silva (Federal University of Ceará, Brazil)  
Francisco Herbert Lima Vasconcelos (Federal University of Ceará, Brazil)  
André Almeida (Federal University of Ceará & Wireless Telecom Research Group - GTEL, Brazil)  
Joao Cesar Moura Mota (Federal University of Ceará, Brazil)  
Wagner Andriola (Federal University of Ceará, Brazil)

There is a considerable number of engineering courses that suffer with failure rates and high withdrawal of students in their first year, especially in fundamental discipline areas like mathematics and science. In order to detect the educational quality indicators, a study was conducted to validate the application of Students' Evaluation of Educational Quality (SEEQ) instrument in an engineering course, using Factor Analysis (FA). The choice of FA to validate the instrument is that this method has been used to validate the SEEQ instrument from the students’ point of view but using this structure does not allowed us analyze the disciplines in focus, then we need to validate this same instrument into our research context according to a latent structure performed by the disciplines. We validate the application of the factor analysis by the Kaiser-Meyer-Olkin (KMO) and Bartletts’ tests that investigate the sample adequacy. After the validation of the
sample adequacy, the factor analysis validate the structure of the questionnaire, and we can state that the SEEQ instrument is valid for application in a teleinformatics engineering context to analyze the disciplines. As a final result of this procedure, we guarantee the consistency of the instrument for the application to analyze different disciplines under different criterions that can possibility a deeper analysis of the curriculum structure.

**ANALYZING THE QUALITY OF THE ENGINEERING COURSE’S MANAGEMENT USING INFORMATION PROCESSING BASED ON MULTIVARIATE STATISTICS: A CASE STUDY UNDER THE PROFESSORS’ PERSPECTIVES**

Albano Nunes (Federal University of Ceará, Brazil)
Thomaz Edson Veloso Silva (Federal University of Ceará, Brazil)
André Almeida (Federal University of Ceará & Wireless Telecom Research Group - GTEL, Brazil)
Joao Cesar Moura Mota (Federal University of Ceará, Brazil)
Wagner Andriola (Federal University of Ceará, Brazil)

Processes and evaluation methods are gaining prominence in the social and educational contexts. In this context, it is proposed to contribute to the improvement of the higher education quality, through the analysis of information obtained in six engineering courses offered by the Federal University of Ceará. The study seeks to strengthen the interface among data analysis methods typically used of engineering contexts in order to allow the analysis of the relationship between academic management processes of engineering courses and outcomes from external evaluations. This discussion aims to propose a mathematical model to support the academic management, based on multivariate analysis (MVA) and data processing, such as Principal Component Analysis (PCA). The instrument created aims to identify professors’ point of view about the management practices developed in their academic courses where they work. The application of the reliability tests revealed the suitability of the sample for the application of PCA. In the PCA application, we observed the formation of three responses’ clusters, that has been well characterized by the similarity of their factor loadings that are related to students’ academic education, academic formation processes and institutional environment. It should stand out even that the application of MVA showed strong evidence for a relationship among the methods of management in higher education, through the manifestation of latent variables in order to define a mathematical model based on MVA academic management support.

**PEER EVALUATION IN AN UNDERGRADUATE DATABASE MANAGEMENT CLASS: A QUASI-EXPERIMENTAL STUDY**

Wei-Fan Chen (Pennsylvania State University, USA)
Hei-Chia Wang (National Cheng Kung University, Taiwan)

This study is to evaluate whether peer evaluation increases student participation and thus improves learning achievement in an e-learning 2.0 environment. We first implemented an e-learning 2.0 platform and then collected data from student participants, including RSS, blogs, Wiki, and other online forums. A quasi-experimental design was used in the study. The student participants were divided into an experimental group (N=52) and a control group (N=60). The results indicated that the e-learning 2.0 platform had a positive effect on student learning process. When comparing the academic performances of the control group and the experimental group after using e-learning 2.0 for a period of time, students in the experimental group had significantly better academic results than those in the control group.

**A LONGITUDINAL STUDY OF THE EFFECTS OF A HIGH SCHOOL ROBOTICS AND COMPUTATIONAL THINKING CLASS ON ACADEMIC ACHIEVEMENT**

Pat Ko (University of Texas at Austin, USA)

While there has been a rising interest in computational thinking (CT) and a push to include it into the K-12 curriculum, there is little empirical evidence that a class that teaches CT will have any measurable long-term effects on student performance. Using robotics as an example of CT instruction, I propose to examine a high school that has had a large number of robotics students over the past six years to find evidence for the long-term benefits of CT. I will analyze school records (e.g. STEM class enrollment, STEM test scores, SAT scores) for differences between robotics and non-robotics students and compare interviews with selected students.
WEB-BASED COLLABORATION SYSTEM TO IMPROVE THE INTERACTIVITY FOR MOBILE EDUCATION THROUGH SMART DEVICES
Tao Zhang (Hitachi (China) Research & Development Corporation, P.R. China)
Shiyu Lu (Hitachi (China) Research & Development Corporation, P.R. China)
Zhenyu Zhang (Hitachi (China) Research & Development Corporation, P.R. China)
Jun Li (Hitachi (China) Research & Development Corporation, P.R. China)

Mobile education is a term that describes a relatively new way of education. Generally speaking, mobile education is aimed to facilitate teachers, students, and parents to interact with each other through mobile devices. This term gains much popularity especially in recent years with the smart devices coming into vogue. With the development of broadband networks as well as the evolution of smart devices, more and more people have come to realize that smart devices can become an effective medium for mobile education. This paper proposes an innovative approach to implement a mobile education system through web technology, which is regarded as an effective mean of overcoming cross-platform obstacles caused by the diversity of smart devices. Considering the constraints of web technology, research and development are undertaken to enhance the stability of the connection as well as the instantaneity of communication. Also, an awareness component is designed for detecting the user's environment such as location, network condition, and hardware specification in order to provide appropriate services. Our research and development lead to significant improvement in the interactivity and the usability of a web-based system.

INTERACTIVE SKETCHING IN MULTI-TOUCH DIGITAL BOOKS. A PROTOTYPE FOR TECHNICAL GRAPHICS
Jorge de la Torre Cantero (Universidad de La Laguna, Spain)
Jose L. Saorin (University of La Laguna, Spain)
Manuel Contero (Universitat Politècnica de València, Spain)
Jorge Dorribo Camba (Texas A&M University, USA)

In this paper, we present a functional prototype of an interactive multi-touch book with drawing capabilities, intended to enhance the understanding of engineering graphics concepts and improve visualization skills. Our multi-touch book combines textual elements with rich media content and interactive exercises to allow students to practice technical sketching in an environment that simulates traditional paper based drawings and tools. Additionally, finished drawings can be submitted to the instructor via email directly from the digital book, which facilitates management tasks. A comparative study of traditional and digital sketching using our prototype was conducted with a small group of participants to evaluate the effectiveness of the tool. Preliminary results show positive reactions and acceptance.

A MULTI-TOUCH APPLICATION FOR THE AUTOMATIC EVALUATION OF DIMENSIONS IN HAND-DRAWN SKETCHES
Ferran Naya (Universitat Politècnica de València, Spain)
Manuel Contero (Universitat Politècnica de València, Spain)
Jorge Dorribo Camba (Texas A&M University, USA)

Dimensioning plays an important role in the product development process. It is usually learned through sketching exercises where students add the corresponding dimensions to different parts of an engineering drawing. Nevertheless, being able to self-learn proper dimensioning methods is challenging, as a geometric figure requires a specific number of dimensions to be correctly defined. This paper presents an educational software application for multi-touch tablet devices to support dimensioning activities. Our application uses a multi-touch interface where students can create 2D parametric drawings with dimensions using freehand sketches and receive feedback from the system about the quality of their dimensioning exercises. When a student finishes a sketch, the system reports back the correct and incorrect dimensions. Multitouch gestures are also used for basic sketch manipulation (panning, zooming, and rotating), similar to the standard functionality found in modern smart phones and tablets. Preliminary experiences show that multi-touch interfaces provide an effective way to capture students' attention. Students found the system very natural, and the time required to learn how to use the application is short. They enjoyed the simplicity of the interface and valued the powerful control of the geometry.
LOW-COST AND PORTABLE LABWARE FOR COMPUTING CURRICULUM USING SCALABLE MOBILE SENSORY PLATFORM
Liang Hong (Tennessee State University, USA)
Kai Qian (Southern Polytechnic State University, USA)
Gang Quan (Florida International University, USA)
Kuosheng Ma (Southern Polytechnic State University, USA)

Mobile embedded system is an excellent candidate to provides depth, breadth, and rigorousness for meeting the emerging workforce and education needs in science, technology, and engineering. However, the high requirements of investment in resources and instructors make the mobile embedded system education impractical for universities and colleges that lack the resources and build-ups. This work-in-progress paper presents a novel low-cost and portable labware for hands-on labs and projects using Android smartphones and scalable sensory platform. It is easy-to-adopt, promotes students with authentic and creative learning, and supports wide dissemination.

SIGNIFICANT PREDICTORS OF LEARNING FROM STUDENT INTERACTIONS WITH ONLINE LEARNING OBJECTS
Lee Miller (University of Nebraska-Lincoln, USA)
Leen-Kiat Soh (University of Nebraska-Lincoln, USA)

Learning objects (LOs) are self-contained, re-usable units of learning. Previous research has shown that using LOs to supplement traditional lecture increases achievement and promotes success for college students in the disciplines of engineering and computer science. The computer-based nature for LOs allows for sophisticated tracking that can collect metadata about the individual learners. This tends to result in a tremendous amount of metadata collected on LOs. The challenge be-comes identifying the predictors of learning. Previous research tends to be focused on a single area of metadata such as the learning strategies or demographic variables. Here we report on a comprehensive regression analysis conducted on variables in four widely different areas including LO interaction data, MSLQ survey responses (that measure learning strategies), demographic information, and LO evaluation survey data. Our analysis found that a subset of the variables in each area were actually significant predictors of learning. We also found that several static variables that appeared to be significant predictors in their own right were simply reflecting the results from student motivation. These results provide valuable insights into which variables are significant predictors. Further, they also help improve LO tracking systems allowing for the design of better online learning technologies.

T2A: Mini-Workshop: New National Science Foundation Opportunities for Improving Undergraduate Engineering Education
1:30 - 3:00 pm
Room: 14

NEW NATIONAL SCIENCE FOUNDATION OPPORTUNITIES FOR IMPROVING UNDERGRADUATE ENGINEERING EDUCATION
Amy Chan Hilton (National Science Foundation, USA)
Susan Finger (NSF, USA)

The goal of this mini-workshop is to increase the participants' knowledge of current opportunities at the National Science Foundation (NSF) to support excellence in undergraduate science, technology, engineering, and mathematics (STEM) education. In particular, the discussion focuses on new and current opportunities in the Division of Undergraduate Education as well as highlight examples of project activities that support these opportunities. The mini-workshop uses a highly interactive format, using team-based games and discussion, to engage the participants and to foster the sharing of ideas, to clarify misconceptions, and to potentially initiate new ideas in engineering education innovations and research. This mini-workshop closely encourages the sharing of ideas and interaction amongst peers, and also informs participants about current NSF funding opportunities in STEM education.
MODEL COLLABORATION FOR ADVANCEING STUDENT-CENTERED ENGINEERING EDUCATION
Peter Golding (University of Texas at El Paso, USA)
Richard T. Schoephoerster (University of Texas at El Paso, USA)
Roger Gonzalez (University of Texas at El Paso, USA)
Elsa Villa (The University of Texas at El Paso, USA)
Jessica Townsend (Franklin W. Olin College of Engineering, USA)
Mark Somerville (Franklin W. Olin College of Engineering, USA)
Richard Miller (Franklin W. Olin College of Engineering, USA)
Vincent P Manno (Franklin W. Olin College of Engineering, USA)
Daniela Natera (University of Texas at El Paso, USA)
Scott Starks (University of Texas at El Paso, USA)
Isaiah Webb (University of Texas at El Paso, USA)
William Walker (University of Texas at El Paso, USA)
Robert Martello (Franklin W. Olin College of Engineering, USA)
Deyna Aragon (University of Texas at El Paso, USA)
Jonathan Stolk (Franklin W. Olin College of Engineering, USA)
Lynn Andrea Stein (Franklin W. Olin College of Engineering, USA)
Richard O'Brien (University of Texas at El Paso, USA)

The College of Engineering at the University of Texas at El Paso (UTEP) is partnering with the Franklin W. Olin College of Engineering (Olin) to establish a student-centered hands-on interactive approach to engineering education (similar to Olin's) at UTEP. The characteristics of Olin's approach to curriculum design most relevant to the UTEP BSLE Program are: 1) Frameworks and approaches for student-centered curriculum design. 2) Development of intrinsic motivation, self-direction, and autonomy through authentic project and leadership experiences. 3) Culturally and socially responsive curricula, where students creatively investigate and solve social problems through innovative technological design. The goal of the proposed collaboration is to catalyze Olin's educational innovation through a cross-campus collaboration between the two institutions by incorporating the Olin model into the first offerings of the BSLE program. Specifically, the collaboration includes faculty exchanges between the two institutions; a series of retreats for planning and assessment curriculum development; and student recruitment practices. Through the Olin-UTEP partnership a new undergraduate degree in Leadership Engineering is being developed, advancing through an Argosy Foundation Collaborative Faculty Exchange Program and with support from Bob and Diane Malone and the Halliburton Foundation.

ASSESSMENT OF A SUSTAINABILITY PROGRAM IN GRADUATE CIVIL AND ENVIRONMENTAL ENGINEERING EDUCATION
Judith Perlinger (Michigan Technological University, USA)
Kurt Paterson (James Madison University, USA)
Alex Mayer (Michigan Technological University, USA)
Veronica Griffis (Michigan Technological University, USA)
Kirsten Holles (Michigan Technological University, USA)

The engineering professions are becoming increasingly international and oriented towards a sustainability mindset. To enable graduate students in the Civil and Environmental Engineering (CEE) Department at Michigan Technological University to prepare to meet these demands, the National Science Foundation awarded the University a "Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)" grant that enabled 45 students in six CEE degree programs to receive $5,000-$10,000 scholarships in 2008-12. The Michigan Tech S-STEM Program was designed to advance a global outlook of economic and social prosperity that protects the environment through various means. A complementary goal was to advance intercultural competency. The S-STEM scholars' knowledge of and attitudes toward
sustainability and intercultural competency was assessed during the grant period. Pre-/post-intercultural competence assessment results were similar, however, through coursework, one sub-group of scholars displayed increased intercultural competence in pre/post assessment. Emergent content analysis of scholar written materials suggests that maturation in scholar perspectives, balancing engineering with community, economic, and environmental realities, occurred during the scholarship periods.

**ENGINEERS TRANSFORMING THE ENVIRONMENT FOR BETTERMENT OF LIFE**
Claudio R Brito (Science and Education Research Council, Brazil)
Melany M Ciampi (Safety, Health and Environment Research Organization & President, Brazil)
Rosa Maria Vasconcelos (University of Minho, Portugal)
Luis Amaral (University of Minho, Portugal)

Victor Barros (Science and Education Research Council & CAPES Foundation and University of Minho, Portugal)
Knowledge in Basic Sciences, Basic Sciences of Engineering and Specifics of Engineering are fundamental for the education of an engineer. However the insertion in labor market demands sometimes some practice or experience that should also be provided by the engineering schools. Taking this into account, the Engineering Education Research Team of COPEC - Science and Education Research Council has designed a program for an engineering school which main goal is to prepare engineers for the future work market, the engineer for the future. It is an interdisciplinary environmental engineering program that intends to offer students an exciting opportunity to focus their technical capabilities on evolving science that affects human quality of life in an international scale and can simultaneously help preserve and restore areas in which they work. Emerging issues challenge environmental engineers in public health, conservation and restoration of natural systems, water and wastewater treatment, pollution prevention, and more.

**MONITORING F2F INTERACTIONS THROUGH ATTENDANCE CONTROL**
Samara Ruiz (University of the Basque Country, Spain)
Maite Urretavizcaya (University of the Basque Country, Spain)
Isabel Fernández-Castro (University of the Basque Country, Spain)

This work explores the use of interactions between teachers and students as a basis to infer the students’ learning status and generate suitable feedback for them. We propose a system that lets teachers and students register the interactions face to face, so they can be capitalized for improving traditional teaching/learning. The recorded interactions will be exploited in a similar way to how teachers infer the knowledge status of their students from their interventions. In order to discover the teachers’ strategies and, specially, their necessities regarding the interactions with their students, we have run a questionnaire and verified some previously stated hypotheses. The design of the PresenceClick system is a first result. It has a double aim: to show teachers the knowledge status of their students, so that they can adapt their teaching and to show students their progresses and the one of the overall class so they can compare them. PresenceClick incorporates an Attendance module, which automatically collects the list of students attending the class with no effort from the teacher. This paper presents the results of this study, the PresenceClick architecture and the Attendance module, as an essential component to help and complete traditional F2F, blended or e-learning scenarios.

**THE APPALACHIAN COHORT FOR ENGINEERING: AN EVALUATION OF S-STEM STRATEGIES FOR SUCCESS**
David W Juedes (Ohio University, USA)
Holly Raffle (Ohio University, USA)
Valerie Young (Ohio University, USA)

The Appalachian Cohort for Engineering (ACE) at Ohio University is an NSF S-STEM funded scholarship program for students in Engineering and Computer Science that combines intensive early intervention approaches (i.e., learning communities, peer-led team learning, midterm progress reports, and purposeful selection of academic advisors) with peer advising and cohort building. The intent of this program is to help academically capable, but financially insecure students from the economically disadvantaged Appalachian counties of Ohio and surrounding states to complete important early milestones in their academic careers. The ultimate goal of this project is to build evidence-based approaches for encouraging retention and early academic milestone completion for a broad range of undergraduate students in the STEM disciplines. The research component of this project seeks to determine which services are most effective at encouraging and supporting these students to reach early academic milestones to promote long-term retention and degree completion. This component involves substantial data collection that includes observational field notes and one-on-one contact records, along with other more traditional data sources. Much of the data collection is provided by
trained peer advisors through one-on-one contact records. These records capture the following elements: personal/transitional, social, academic, financial, health and stress-coping, study sessions and tutoring, goal setting, follow up data, and academic reviews by course. In addition, field notes are collected that describe the setting, attendees, acts, and reflections on specific events that happen throughout the year. This project is in its first year of implementation. In this work-in-progress paper, we report on the design of the project, early successes and challenges, the data collection strategy, and the preliminary results of this project. In this first year, early observational results indicated that this body of students needed both social and academic support; with both being equal emphasis. Furthermore, this body of students indicated that one-on-one support and goal setting were important components of their early success.

THE NATURE OF LEARNING IN A GUIDED INQUIRY CLASSROOM
Elliot Douglas (University of Florida, USA)
Jack Vargas (University of Florida, USA)
Claudia Sotomayor (University of Florida, USA)

Active learning approaches are becoming of increasing importance within engineering education, and it has been established that an active learning environment leads to improved student outcomes. What is less known is the ways in which these classes support student learning. Our study takes place in the context of a Process Oriented Guided Inquiry Learning (POGIL) classroom. We use grounded theory to answer the research question: How do students construct knowledge in a POGIL classroom? Constructivist grounded theory was used to code student interview data and develop a theory of how student learning occurs. The resulting theory shows that the use of POGIL results in a concept-focused class, as opposed to focusing on discrete aspects of knowledge (facts). This concept-focused class provides for both conceptual understanding and improved retention of information. The findings illustrate one way to design a class for deep conceptual understanding and suggest broader implications for curriculum design.
Assessment of Team-Member Effectiveness (CATME) instrument was administered twice during the semester to evaluate teaming. A comparison of the data for the two capstone projects is presented. Results from these surveys indicate students working on the regenerative community project were more positive and consistent with the behavioral and satisfaction categories within the peer evaluation survey.

**STUDENT BELIEFS ABOUT LEARNING COMMUNICATION SKILLS**

Kelly Cross (Virginia Tech, USA)
Marie Paretti (Virginia Tech, USA)
Holly Matusovich (Virginia Tech, USA)

Communication remains an essential skill for engineering graduates in both academic and industry settings, and ABET considers it a key student learning outcome for accreditation. Despite numerous studies of effective approaches to integrating communication into disciplinary courses, few engineering courses apply those approaches. To address this gap, we have undertaken a multi-year mixed methods study to explore faculty and student beliefs about communication. Faculty beliefs have been reported elsewhere; this paper focuses on student beliefs. We analyzed five focus groups conducted with engineering students at partner schools. The focus groups sought to uncover students’ beliefs about where and how they learned communication skills within their engineering education. Focus groups were recorded and transcribed verbatim, then coded using standard open-coding procedures. The findings indicate that while students do have opportunities to practice communication in engineering courses, they may not always have optimal opportunities to learn communication in those courses. Most notably, students desired more examples and direct instruction for communication skills, including not only samples of “good” documents but also explanations about why they were good. Identifying pedagogical gaps between faculty practice and student experiences can help us develop targeted strategies to help creatively integrate these critical skills into an already packed engineering curriculum.

**PROFESSIONAL COMMUNICATION SKILLS FOR ENGINEERING PROFESSIONALS**

Aletta Nylén (Uppsala University, Sweden)
Arnold N Pears (Uppsala University, Sweden)

Verbal and written communication proficiency is an important professional skill for engineering graduates. However, developing these skills is often poorly integrated into the engineering curriculum. We present a three year integrated approach to developing professional competence in verbal and written communication which has been implemented in the IT engineering programme at a Swedish research university. In the paper we describe the educational approach, the nature of assessment items and grading rubrics that are applied in order to ensure that graduates emerge with fully fledged communications skills. An important component of the programme is the compilation of a student portfolio, in which students gather material that demonstrates progressive skills development. Associated with this portfolio is a series of student reflections, which help learners to appreciate their developing skill in professional communication. The goal of the paper is to describe a successful model for professional skills development, and to encourage a continuing dialogue on how to best equip students with communication skills for professional practice.

**CORRELATION OF LEARNING STYLES WITH TEAM PERFORMANCE AND PERCEPTION IN A CHEMICAL ENGINEERING UNIT OPERATIONS COURSE**

Elif Eda Miskioglu (The Ohio State University, USA)
David Wood (The Ohio State University, USA)

Teamwork is emphasized in high-level engineering courses to help prepare students for their chosen career. When left to self-select, students often form homogenous groups with respect to several indicators, including learning style. While homogeneous groups may occasionally be preferred for specific tasks, heterogeneous groups have shown better performance over a wider range of tasks. Qualitative data (interviews) suggest that students grasp the value of heterogeneous groups and are able to recognize the gains of such diversity. We are interested in the relationship between learning styles and team dynamics in advanced chemical engineering students taking the team-based unit operations course. We are looking to correlate team composition with respect to learning styles preferences with team performance and student perceptions of team efficacy. Students are given a learning styles questionnaire to determine preferences in the course's lecture portion. These are used to identify potential correlations between team make-up, team performance and student perceptions during the subsequent laboratory portion. Understanding variability in performance based on team composition can help elucidate the complex nature of team dynamics. Armed with such information, instructors can create the most educationally efficient teams, and students will have a better understanding of teams as they enter the workforce.
PBL IN TEACHING COMPUTING: AN OVERVIEW OF THE LAST 15 YEARS
Armanda Maria Oliveira (Federal University of Pernambuco, Brazil)
Simone Santos (Federal University of Pernambuco & Recife Center of Advanced Studies and Systems, Brazil)
Vinicius Cardoso Garcia (Federal University of Pernambuco, Brazil)

In computing courses, the teaching and learning approach normally emphasizes theoretical knowledge at the expense of practical knowledge. The major disadvantage of this approach is the lack of motivation of learners during class and their quickly forgetting the knowledge they have acquired. With a view to overcoming these difficulties, Problem Based Learning (PBL), an institutional method of teaching, has been applied to teaching computing disciplines. Despite the growth of the practice of PBL in various disciplines of Computing, there is little evidence of its specific characteristics in this area, the effectiveness of different PBL methodological approaches, or of benefits and challenges encountered. In this context, this paper presents a systematic mapping study in order to identify studies which involve best practices when using the PBL method in Computing between 1997 and 2011, answering five research questions: "What are the main characteristics of PBL that support teaching in Computing?"; "What are the criteria for applying PBL effectively in this area?"; "How is the PBL methodology applied?"; "What are the advantages and benefits of applying PBL in Computing?"; and, finally, "What are the main challenges about learning in PBL in Computing?".

WOMEN'S WAYS OF KNOWING IN INFORMATION TECHNOLOGY SPECIALTIES AT A COMMUNITY COLLEGE
Dejang Liu (College of DuPage, USA)
Margaret Mbilizi (D'Youville College, USA)
Lemuel Watson (University of South Carolina, USA)

Historically, very limited studies have focused on information technology (IT) programs in community colleges, let alone of women's participation in them. In light of the growing national debate on the need to increase female participation in Science, Technology, Engineering, and Mathematics (STEM), this study closely examines women's involvement in IT in higher education. This study builds on Belenky et al's study of women's five ways of knowing (silent knowing, subjective knowing, received knowing, procedural knowing, and constructed knowing) in the social sciences and humanities. Through analysis of women's IT pursuits at a community college, this study provides evidence not only for the five existing ways of knowing found in Belenky et al's study but also for a new way of knowing exclusive to IT: logistical knowing.

THE GOOD, THE BAD AND THE UGLY: USING VIDEOS TO REVERSE SYSTEMS ANALYSIS AND DESIGN INSTRUCTION
Imelda Smit (North West University, South Africa)
Roelien Goede (North West University, South Africa)

Systems Analysis and Design (SAD) is a second-year subject offered within the Information Technology (IT) course at the Vaal Triangle Campus of the North-West University in South Africa. The diverse environment of this campus includes students representing most ethnic groups in South Africa, adding to the complexity of classroom interaction. This is further complicated by the fact that students find the subject difficult, mostly because it includes many new concepts used in different contexts. SAD students also grapple with fuzzy issues such as fact-finding from system users and representing information obtained from models that are designed for feedback. SAD is therefore far removed from the more exact subjects like programming and mathematics that many IT students excel in. Videos explaining difficult SAD concepts were produced and made available to students on a Learning Management System (LMS). The students were motivated to come to classes prepared. During the first semester concepts were explained during formal class times. Formal explanations were not given during the second semester because students were expected to build on the knowledge that they had gained during the first semester. The success of implementing reverse instruction in the second semester is evaluated through an interpretive lens.
COMMERCIAL COMPETENCY AND COMPUTING STUDENTS: USING THE SKILLS FRAMEWORK FOR THE INFORMATION AGE IN HIGHER EDUCATION
Tom G McEwan (Edinburgh Napier University, United Kingdom)

of employability which employers expect from computing graduates, in addition to technical capability and "soft skills" (or similar terms like transferable skills). Our experience has been that viewing commercial acumen (or even commercial awareness) as simply one of the soft skills, has failed to meet the needs of local employers, who tell us they seek innovation skills and entrepreneurship. A case study illustrates a structured approach to adding commercial awareness to the computing curriculum, and, more generally, tying the learning experience more closely to the achievement of standardized competency statements. Changes to future provision are discussed following workshop discussion of a draft of this case study. This paper will be of interest to computing and engineering academics who seek to increase the commercial awareness of their students, and to those who seek to align their courses with commercial definitions of competency.

IQUIZ: INTEGRATED ASSESSMENT ENVIRONMENT TO IMPROVE MOODLE QUIZ
José Roberto Rodrigues (University of São Paulo, Brazil)
Leônidas O Brandão (University of São Paulo, Brazil)
Maurício Nascimento (University of São Paulo, Brazil)
Patrícia A Rodrigues (University of São Paulo, Brazil)
Anarosa A. F. Brandão (Universidade de São Paulo & Escola Politécnica, Brazil)
Hélène Girouet (Université Pierre et Marie Curie, France)
Odette Auzende (Université Pierre et Marie Curie, France)

Moodle is a well-known open source system to support teaching and learning through the web. It provides Quiz, a tool for learning assessment, which is also adopted by a large community along the world. Another tool that allows automatic assessment within Moodle is the iAssign package. iAssign provides means for integrating interactive Learning Modules (iLM) to Moodle, empowering it with interactive intense activities concerning specific issues implemented in iLM. However, such tools present some limitations that prevent their users to take more benefit of the question types and iLM such as (i) authoring is not a simple task; (ii) iAssign integrates iLM to Moodle without incorporating Moodle questionnaires; (iii) Quiz database for questions and questionnaires is not integrated to a repository with search and retrieving tools; (iv) in the current version of Moodle, Quiz did not allows the incorporation or exportation of assessment content that follows the IMS-QTI 2.1 (Question and Test Interoperability) specification. In this paper we address such limitations proposing a generic model and its implementation for the Moodle system.

Session T2F: ECE I
Chair: Firas Hassan (Ohio Northern University)
1:30 - 3:00 pm
Room: 19

TEACHING STRATEGY FOCUSED ON SENSORY PERCEPTION, STUDENTS’ INTEREST AND ENJOYMENT: SUCCESSFUL APPLICATION IN ELECTRICAL ENGINEERING (EE) LAB FOR NON-EE MAJORS
Sudarshan Sivaramakrishnan (University of Michigan, USA)
Alexander Ganago (University of Michigan, USA)

We report the development and successful teaching of new laboratory experiments for a large introductory course in Electrical Engineering (EE) for non-EE majors. Our goal is to create the learning environment that would engage students' senses; provide hands-on experience, to which they can easily relate; stimulate intuitive understanding of EE concepts; foster enjoyment of learning, and eventually, help them succeed in their own fields. The first experiment focuses on applications of Fourier series to the spectra of sounds of music played on a Virtual Keyboard®. In the second experiment, students solder their own filter circuit to serve has low-pass/high-pass audio filters, and then they apply their filters to an excerpt of music, with the goal of understanding effects of the filter transfer function on the audio signal through listening. Both experiments expand the conventional range of application of theory and circuits in introductory courses (usually, only standard waveforms are used, e.g. sinusoidal and square). In the scheme of the entire course, all lab projects aim to introduce realistic, practical applications that pique student interest, show students the relevance of electrical engineering, and help them transfer their newly learned skills and experience to their own fields of work and future studies.
N-FUELS AND SOPRANO: EDUCATIONAL TOOLS FOR SIMULATION, ANALYSIS AND PROCESSING OF SATELLITE NAVIGATION SIGNALS
Emanuela Falletti (Istituto Superiore Mario Boella, Italy)
Davide Margaria (Istituto Superiore Mario Boella, Italy)
Mario Nicola (Istituto Superiore Mario Boella, Italy)
Gabriella Povero (Istituto Superiore Mario Boella, Italy)
Micaela Troglia Gamba (Istituto Superiore Mario Boella, Italy)

In recent years, research activities in the field of Satellite Navigation have boosted worldwide. At the same time, it has become evident that few educational opportunities in the field were available for students and there was a need to develop dedicated tools for hands-on sessions. To partially answer this need, the NavSAS Group has developed N-FUELS and SOPRANO. N-FUELS, a MATLAB-based signal simulator, allows students to understand the physical layer of the Global Navigation Satellite Systems (GNSS) signals and to learn how to manipulate them via software. SOPRANO, a collection of ANSI C language routines, implements the whole chain of GNSS signal elaboration in post-processing and enables testing and validation of new GNSS signal processing algorithms and architectures. Both tools are used in post-graduate courses at Politecnico di Torino with a high degree of internationalization, which opens interesting points of discussion concerning the introduction of novel educational tools able to meet the demand and the learning styles of students with different educational backgrounds and cultures.

TEACHING ELECTRIC CIRCUITS USING A MODIFIED FLIPPED CLASSROOM APPROACH
Asad Azemi (Pennsylvania State University, USA)

This paper describes our initial effort to implement a flipped classroom approach to teach an Electric Circuits course. Prior to each scheduled class meeting, students are required to watch a recorded short lecture, which covers the topics in details and includes simple worked out problems. We have used Tablet PC in combination with PowerPoint, OneNote, and Camtasia as the capturing software, to produce the short-recorded lectures. We have also produced a set of narrated dynamically worked-out problems, with different difficulty levels that students are encouraged to watch. These recorded worked-out problems will complement the recorded lectures and help students with their problem solving skills. A typical lecture consists of a quick review of the concepts followed by solving more challenging problems, related to the lecture material. A more detailed discussion of this approach and the advantages and disadvantages of such a scheme are presented. The preliminary evaluations of the proposed approach by a group of students have been encouraging.

EMBEDDED SYSTEMS DESIGN CURRICULUM CONVERSION FROM QUARTERS TO SEMESTERS
Antonio F Mondragon-Torres (Rochester Institute of Technology, USA)
Jeanne Christman (Rochester Institute of Technology, USA)

In this paper we present a vision of how a sequence of three embedded systems design courses currently being taught for computer engineering technology students will be adapted from a quarter based delivery to a semester based delivery. The conversion brings the opportunity to revise the course contents, platforms used and make changes that will prepare students with a more up-to-date skill set and a robust industrial training. In this work in progress we will present some of the new ideas that will be implemented in our semester courses. After offering these courses multiple times, feedback will be gathered from students and industry, and a future study will be presented outlining the achieved outcomes as compared to our intended outcomes for curriculum continuous improvement.

COMPUTER-AIDED INSTRUCTION FOR INTRODUCTORY LINEAR CIRCUIT ANALYSIS
Brian Skromme (Arizona State University, USA)
Paul Rayes (Arizona State University, USA)
Charles Whitlatch (Arizona State University, USA)
Qiao Wang (Arizona State University, USA)
Angela Barrus (Arizona State University, USA)
John Quick (Arizona State University, USA)
Robert Atkinson (Arizona State University, USA)
Timothy Frank (South Mountain Community College, USA)

A step-based tutoring system for linear circuit analysis is being developed with the capabilities to automatically generate circuit problems with specified characteristics, including randomly generated topologies and element values. The system
further generates fully-worked, error-free solutions using the methods typically taught in such classes, and accepts a rich variety of student input such as equations, matrix equations, numerical and multiple-choice answers, re-drawn circuit diagrams, and sketches of waveforms. A randomized, controlled study was conducted using paid student volunteers to compare the effectiveness of two of our tutorials in comparison to working conventional textbook-based problems. The average learning gain was only 3/100 points for the textbook users, but 29/100 points, about 10 times higher, for the tutorial users. The effect size on the post-test scores was 1.21 pooled standard deviations (Cohen d-value) and was statistically significant. A motivational survey administered to these students yielded a 0.53 point higher rating for the software than for the textbook (on a 1-5 scale). The system is being used in Spring 2013 by over 340 students in EEE 202 at Arizona State and two community colleges. About 99% of these students rated the system as “very helpful” or “somewhat helpful.”

Session T2G: First and Second Year Programs II  
Chair: Susan Donohue (University of Virginia)  
1:30 - 3:00 pm  
Room: 20

FIRST-YEAR STUDENTS’ UNDERSTANDING OF DIRECT USER IN OPEN-ENDED PROBLEM SOLVING ACTIVITIES  
Farshid Marbouti (Purdue University, USA)  
Heidi Diefes-Dux (Purdue University, USA)

This paper presents an investigation into First-Year Engineering (FYE) students' ability to identify the direct user in open-ended client-driven problem solving activities. To guide FYE students in formulating an open-ended problem, students are asked a series of questions about the stakeholders, the direct user of the solution, and its needs. The purpose of these questions is to help students think about the problem individually by listing stakeholders including the direct user and the stakeholders' relationships to the problem and its solution prior starting to solve the problem in teams. One hundred (out of ~1600) students' responses to three open-ended problem solving activities during two successive semesters were randomly selected and analyzed. Results showed improvement in students' ability to identify the direct user over time. The majority of students' responses shifted from identifying non-users instead of direct user in the first MEA, to identifying indirect-users in the second MEA, and to identifying direct user correctly in the third MEA. This shows a clear improvement in students' ability to understand these problems over time. However, even for the third MEA, only 60% of students identified the direct user correctly, raising concerns about comprehension of the problem by about 40% of the students.

CASE STUDIES: FIRST-YEAR ENGINEERING NANOTECHNOLOGY-BASED DESIGN PROJECTS  
Kelsey J Rodgers (Purdue University, USA)  
Heidi Diefes-Dux (Purdue University, USA)  
Krishna Madhavan (Purdue University, USA)

Nanotechnology as a research field presents many new opportunities and challenges for educating the next generation of engineers. In this paper, we attempt to understand the impact of this research team's initiatives to increase engineering students' awareness and understanding of nanotechnology. This is a case study of how four student teams changed their iteratively-developed design solutions for a nanotechnology-based design project. The goal is to investigate how first-year engineering (FYE) students developed their demonstrated knowledge of nanotechnology. We found that all four teams discussed nanotechnology concepts from the beginning of their solutions. Although they had difficulty relating their nanotechnology applications to science and mathematics concepts, they had consistent ideas for the nanotechnology-specific content they wanted to focus on throughout their project. The results show that all four project cases have a clear potential connection to a field of engineering. Connecting nanotechnology to potential engineering fields may present a better content focus than science and mathematics concepts.

COMMUNITY LEARNING COMPONENT IN FIRST YEAR SEMINAR  
Lin Cheng (Trinity College, USA)

This Work in Progress paper describes current efforts to engage Liberal Art College freshman to the Engineering discipline and its impact to the broader community, through a topic-based, writing-intensive seminar course. In this particular seminar developed by the author, we aim to discuss the role of engineers in tackling challenges in the Community around the Hartford area and beyond. While students enrolled in the seminar course in this paper are mainly
"undecided" students, we believe by emphasizing technologies applied to the immediate community around our students and humanitarian applications, we can inspire students' interest in Engineering and show students how the skills they will be learning can have a positive impact on the quality of life for the surrounding community. The seminar was assessed by gathering student comments concerning each major course components.

DEVELOPMENT OF A MULTIPLE-CHOICE MATLAB THEORY AND SYNTAX EXAM
Matthew Verleger (Embry-Riddle Aeronautical University, USA)

Examinations in programming courses that require students to write code to solve a problem are an excellent method for testing how well a student has mastered language syntax, programming theory, and problem solving technique. However, if a student struggles with problem solving, it is often difficult for students to demonstrate any understanding of syntax or theory. To address this situation, faculty for a freshman engineering MATLAB-focused introductory programming course at a private southeastern STEM+Business-only university have been giving exams that are a combination of practical programming problems and multiple-choice questions. This research is focused on performing an item analysis of the questions appearing on those exams with the immediate goal being a multiple-choice exam with both topic coverage and documentation of it's ability to properly discriminate knowledge.

ENGAGING EARLY ENGINEERING STUDENTS (EEES)
Claudia Vergara (Michigan State University, USA)
Daina Briedis (Michigan State University, USA)
Jon Sticklen (Michigan State University, USA)
John Courtney (Michigan State University, USA)
Renee DeGraaf (Lansing Community College, USA)
Nathaniel Ehrlich (Michigan State University, USA)
Ruth Heckman (Lansing Community College, USA)
Colleen McDonough (Michigan State University, USA)
Louise Paquette (Lansing Community College, USA)
Mark Urban-Lurain (Michigan State University, USA)
Clifford Weil (Michigan State University, USA)
Thomas Wolff (Michigan State University, USA)

Undergraduate STEM student enrollment has declined substantially over the last decade. Specifically there has been a steady decline in retention of early engineering students working through the first half of their degree programs. Student "leavers" typically fall into two categories (i) those facing academic difficulties and (ii) those that perceive the education environment of early engineering as hostile and not engaging. The Engaging Early Engineering Students Project (EEES) is a collaborative effort between Michigan State University (MSU) and Lansing Community College (LCC). EEES functions through the integration of four component programs designed to ease the transition of high school students into engineering undergraduate programs, and, by making the transition smoother, to increase retention at the College of Engineering (COE). The programs are: (a) Peer-Assisted Learning, (b) Connector Faculty, (c) Diagnostic-driven Early Intervention and (d) Cross Course linkages.

Session T2H: Experiential Learning I
Chair: Abhijit Nagchaudhuri (University of Maryland Eastern Shore)
1:30 - 3:00 pm
Room: 2

REAL-WORLD PROBLEM SOLVING IN ENTRY-LEVEL PROGRAMMING COURSES: A CASE STUDY ON THE DEEPWATER HORIZON OIL SPILL
Mingrui Zhang (Winona State University, USA)
Chuanmin Hu (University of South Florida, USA)
Guleng Amu (Inner Mongolia Agriculture University, P.R. China)

In teaching introductory computer programming courses, problem solving with computers is an important topic and algorithm design is essential. We developed a team-based project to teach students solving real-world problem. Students are provided with six satellite images of the Deepwater Horizon oil spill in the Gulf of Mexico and asked to develop computer programs to outline oil contaminated areas. Working on the project in a team, students conducted initial analysis of the problem, identified patterns of oil slicks by visualizing satellite images, and designed algorithms to
delineate the oil slicks. The open-ended problem allowed the students to gain experiences in user interface design, use of arrays, decision-making, and repetition with hands-on experience. The project has also been adapted in teaching classes of computer science general education and digital image processing.

"WE WEREN'T INTENTIONALLY EXCLUDING THEM...JUST OLD HABITS": WOMEN, (LACK OF) INTEREST AND AN ENGINEERING STUDENT COMPETITION TEAM
Cindy Foor (University of Oklahoma, USA)
Susan Walden (University of Oklahoma, USA)
Deborah Trytten (University of Oklahoma, USA)
Randa Shehab (University of Oklahoma, USA)

Student, experiential-learning, engineering, competition teams (SELECT) provide an opportunity for engineering students to practice engineering technical and professional skills. The low representation of women in SELECT is often rationalized as a lack of interest by individual women rather than systemic processes that discourage or exclude women. We employ a qualitative-interpretive design and a cultural constructionist lens to bring into focus the interplay of individual interests, understandings of appropriate gender roles, and structural elements that contribute to a culture of inclusion or exclusion. Primary data consist of 90-minute semi-structured interviews of eight team members and one non-member. By interpreting the narrative portraits of two female students, we show the construction of a team culture where in general women are discouraged from participation based on stereotyped gender roles, by night campus attitudes, and by peers who challenge or ignore their skills, contributions, and interests. One woman persevered through the male-dominated culture because she received the encouragement and support of male peers who engaged as comrades and champions. This paper offers recommendations for institutions to demonstrate commitment to equitable access to experiential learning and to nurture student peer cultures that challenge historic gendered ideologies and rhetoric.

CONVERGENCE OF EVOLUTIONARY BIOLOGY AND SOFTWARE ENGINEERING: PUTTING PRACTICE IN ACTION
Wendy A LawrenceFowler (University of Texas-Pan American, USA)
Laura Grabowski (University of Texas-Pan American, USA)
Richard H Fowler (University of Texas-Pan American, USA)
Gabriel Yedid (Nanjing, P.R. China)

This paper presents a project in experiential learning where students put knowledge of software engineering processes into action in a multidisciplinary project combining computer science and biology. Visualization serves as a primary element to bind the concepts of the two disciplines. Students seeking to further their experience and strengthen their skills in software engineering may choose to complete their senior capstone course working on an ongoing project to construct a toolkit for visualization of phylogenies generated from Avida experimental data. Avida provides a complex computational environment in which the evolution of digital organisms is tracked and analyzed to help find answers to a wide range of research questions. Student projects involve extensions of existing analytic and visualization techniques, as well as the addition of new, often novel, techniques. Importantly, to be successful a visualization technique must be appropriate for the domain in which it is to be used, requiring students to also understand elements of biology. It is our premise that exposing computer science students to the convergence of these two disciplines will strengthen their ability to work at different levels of abstraction and develop new conceptual frameworks to address current and future challenges in hardware and software.

USING DIFFERENT METHODOLOGIES AND TECHNOLOGIES TO TRAINING SPATIAL SKILL IN ENGINEERING GRAPHIC SUBJECTS
Jorge Martin-Gutierrez (University of La Laguna, Spain)
Melchor García Dominguez (Universidad de las Palmas de Gran Canarias, Spain)
M. Carmen Mato Corrediegas (Universidad de las Palmas de Gran Canarias, Spain)
Cristina Roca (Universidad de las Palmas de Gran Canarias, Spain)

Most papers about spatial skills and their components refer to the fact that engineering, architectural and scientific jobs require a good level of spatial ability. Spatial ability has an impact on every scientific and technical field, so it's still undergoing strong development when it comes to engineering, technology, art and many other aspects of life. In the academic environment, Graphic Design teachers usually see students who have difficulties solving tasks requiring spatial reasoning and viewing abilities. The main aim of this work is the development of didactic material based on several
virtual and augmented reality formats, knowing how students behave while using them, and checking if they are useful materials to improve their spatial abilities. This work presents three different technologies: virtual reality, augmented reality, and portable document format to find out if they are suitable technologies together with suitable methodologies to improve spatial ability and from the student's perspective, their opinion of the tool and their motivation to learn more about the aspects of 3D reality. We present a pilot study that compared the results of improvement in spatial ability acquired by freshman engineering students and a survey of satisfaction and motivation of the methodology and technology used.

**ENHANCING ENGINEERING MECHANICS STATICS INSTRUCTION USING MANIPULATIVE TRUSS MODELS**
Joel Mejia (Utah State University, USA)
Wade Goodridge (Utah State University, USA)
Christopher Green (Utah State University, USA)

Enhancing a student's ability to mentally visualize and intuitively assess foundational concepts in engineering mechanics - statics can create a significant advantage for students in their pre-professional engineering courses. Concepts such as forces and moments often prove to be challenging for students lacking hands-on mechanical experience or those who are visual and kinesthetic learners. Showing students these "intangible" mechanics principles is not an easy task and usually requires proactive measures to improve learning. In an effort to improve visualization and tactile learning in a college mechanics - statics course, hands-on and visual truss models were developed based on the concept of physical manipulatives. Mathematics instructors use manipulative models to help students identify different mathematical concepts. These models not only allow the students to see and feel different objects but also to manipulate the objects to form a concrete representation of the concept. Furthermore, manipulative models help students visualize, feel, and analyze the behavior of the material being manipulated. This study examines the relationship between the use of a physical model of a truss and the students' framing of information during task interpretation to successfully attain conceptual understanding about truss analysis.

**THE CITY AS A LEARNING GAMIFIED PLATFORM**
Aldo Gordillo (Universidad Politécnica de Madrid, Spain)
Daniel Gallego (Universidad Politécnica de Madrid & Escuela Técnica Superior de Ingenieros de Telecomunicación, Spain)
Enrique Barra (Universidad Politécnica de Madrid & Agora Systems S. A., Spain)
Juan Quemada Vives (Universidad Politécnica de Madrid, Spain)

The area of mobile city guides has grown really fast in the last years based on new mobile capabilities. This growth has been fostered by the evolution of ubiquitous systems and the great penetration of smartphones in the society. In this paper, we propose a generic model to support a new way of visiting the city: instead of as a place for tourism, we see it as a place for learning in which located educational resources are available for end users. The model has been conceived as a way to encourage them to create their own educational tours, in which Learning Points Of Interest are set up to be discovered. Two main use cases are supported by the model: formal (conducted by a teacher) and informal (no educator is related to the learning experience) outdoor mobile learning. Details about the impact of the conjunction of tourism, learning and gamification dimensions in the model design, as well as about the model itself are provided. Finally, a mobile application prototype developed in the context of the FI-CONTENT European project is presented as a proof of concept of the model.

**A CONTRIBUTION TO THE QUALITY EVALUATION OF MOBILE LEARNING ENVIRONMENTS**
Nemesio Duarte Filho (University of São Paulo - ICMC/USP, Brazil)
Ellen Barbosa (University of São Paulo, Brazil)

In recent years, issues related to teaching and learning have been more and more discussed and investigated by the scientific community. Mobile learning (m-learning) environments, despite the benefits provided, are still considered as new and incipient products. Among the limitations observed in the construction and adoption of such environments, we
highlight the lack of specific quality guidelines to allow an adequate evaluation of them. In short, the planning and execution of a systematic evaluation among m-learning environments can ease their selection and adoption by apprentices, tutors and educational organizations. Motivated by this scenario, in this paper we propose a process for the quality evaluation of mobile learning environments. To validate our ideas, we have applied the proposed process in the quality evaluation of a set of m-learning environments. The promising results achieved suggest the feasibility of adopting the process for quality evaluation purposes in the m-learning domain.

**A MODEL FOR INTEGRATING LEARNING OBJECT REPOSITORY RESOURCES INTO WEB VIDEOCONFERENCE SERVICES**

Aldo Gordillo (Universidad Politécnica de Madrid, Spain)  
Enrique Barra (Universidad Politécnica de Madrid & Agora Systems S. A., Spain)  
Daniel Gallego (Universidad Politécnica de Madrid & Escuela Técnica Superior de Ingenieros de Telecomunicación, Spain)  
Juan Quemada Vives (Universidad Politécnica de Madrid, Spain)

Reusing Learning Objects saves time and reduces development costs. Hence, achieving their interoperability in multiple contexts is essential when creating a Learning Object Repository. On the other hand, novel web videoconference services are available due to technological advancements. Several benefits can be gained by integrating Learning Objects into these services. For instance, they can allow sharing, co-viewing and synchronized co-browsing of these resources at the same time that provide real time communication. However, several efforts need to be undertaken to achieve the interoperability with these systems. In this paper, we propose a model to integrate the resources of the Learning Object Repositories into web videoconference services. The experience of applying this model in a real e-Learning scenario achieving interoperability with a web videoconference service is also described.

**THE USE OF TEXT MINING TO BUILD A PEDAGOGICAL AGENT CAPABLE OF MEDIATING SYNCHRONOUS ONLINE DISCUSSIONS IN THE CONTEXT OF FOREIGN LANGUAGE LEARNING**

Isis Pinho (Federal University of Rio Grande do Sul, Brazil)  
Daniel Epstein (Federal University of Rio Grande do Sul, Brazil)  
Eliseo Reategui (Federal University of Rio Grande do Sul & Graduate Program of Computers in Education, Brazil)  
Eunice Polonia (Federal University of Rio Grande do Sul, Brazil)  
Ygor Corrêa (Federal University of Rio Grande do Sul, Brazil)

The present paper discusses the use of text mining to support the design of a pedagogical agent that mediates synchronous online discussions of academic texts by undergraduate students of English as a foreign language. The pedagogical agent proposed here has the instructional role of a tutor collaborator that participates in the chat discussion following mediation strategies grounded on sociocultural theory to assist the collective writing. Furthermore, we propose a pedagogical agent model that uses text mining techniques to identify when students deviate from the main topics that should be addressed in their discussions in a real time chat. Another important function enabled by the use of the text mining tool involves the assessment of the discussion relevance in relation to the base text, which supports the pedagogical agent decision towards a more adequate intervention. The conception of using text mining to guide the pedagogical agent in the mediation of the students’ discussions has been based on previous research that has already shown how this particular mining tool could support educators’ work in the evaluation of essays and of students’ contributions in discussion forums. Preliminary results of this study are also presented showing the agent's potential to foster students' online conversations.

**TOWARDS AN UNDERSTANDING OF ECE STUDENTS' USE OF ONLINE HOMEWORK HELP FORUMS**

Hon Jie Teo (Virginia Tech, USA)  
Aditya Johri (Virginia Tech, USA)  
Daniel S. Brogan (Virginia Tech, USA)

Online discussion forums have emerged as a popular Web application to build and support online communities for numerous engineering interest areas and practice. However, a review of engineering education literature reveals scant research on the use of online discussion forums for engineering learning beyond the classroom. This study addresses this gap in knowledge through a study of the "Homework Help" section on AllAboutCircuits.com to examine what students sought help for and for what purpose. We downloaded over 6,000 discussion messages spanning over 8 years and extracted the textual data with a Python program. Instead of analyzing the data through manual means, we utilized the Natural Language Toolkit (NLTK) to capture textual patterns and leverage a topic modeling approach, Latent Dirichlet
Allocation, to identify connected clusters of words. Linguistic Inquiry and Word Count (LIWC) analysis was also used to determine how often students use words associated with cognitive processes. We found that the homework help section of informal online discussion forums cater to students seeking help on fundamental ECE topics. Our findings also suggest that online discussion forums are supportive learning environments, as students freely engage in meaningful inquiries and social interactions with other learners.

T3A: Mini-Workshop: Catching the Wave: Big Data in the Classroom
4:00 - 5:30 pm
Room: 14

CATCHING THE WAVE: BIG DATA IN THE CLASSROOM
Carol Romanowski (Rochester Institute of Technology, USA)
Rajendra Raj (Rochester Institute of Technology, USA)

Many diverse domains—in the sciences, engineering, healthcare, and homeland security—have been grappling with the analysis of "Big Data," which has become shorthand to represent extremely large amounts of diverse types of data. A recent Gartner report predicts that around 4.4 million IT jobs globally will be created by 2015 to support Big Data, with 1.9 million of those jobs in the United States. Therefore, understanding approaches and techniques for handling and analyzing Big Data from diverse domains has become crucial for not only in computing but also engineering students. The mini-workshop will make use of active and collaborative learning exercises to introduce faculty in computer science, software engineering, and other disciplines to concepts and techniques involved in managing and analyzing Big Data. Approaches for incorporating Big Data into the engineering and computing curricula will also be presented.

T3B: Special Session: DiSrUpTiOn
4:00 - 5:30 pm
Room: 15

DISRUPTION
R Cheville (Bucknell University, USA)
Dorothy Jones-Davis (AAAS S&T Policy Fellow, National Science Foundation & Engineering Directorate, Division of Engineering Education and Centers, USA)

During the last decade STEM education has been portrayed as a crisis, opportunity, and national priority due to its importance in a changing economy, upskilling of the workforce, effect of technology, globalization, and other forces. While engineers have been partly responsible for releasing these forces into the world, we currently stand accused of not being able to adapt our education system to the inevitable disruptions caused by the changing context of education. This special session asks participants to explore the effects of disruption across the range of scales that make up the engineering education system. The goal of the special session is not maintain the current fear dynamic, but rather to focus on new opportunities that can arise from shifts in how engineering education is provided, paid for, and accessed by students. Small groups will explore hypotheses about possible disruptions to educational structures, explore the consequences that arise, and begin a dialogue on change and what the research community can do to take advantage of new opportunities.

Session T3C: Innovative Computing Practice I
Chair: Claudio Brito (Science and Education Research Council)
4:00 - 5:30 pm
Room: 16

A TEACHING METHOD FOR USING METAPHORS IN INTERACTION DESIGN
Anderson Gonçalves (Federal University of Goiás, Brazil)
Deller Ferreira (Federal University of Goiás, Brazil)

The consistent use of metaphors in the context of Human Computer Iteration (HCI) helps to reduce the cognitive load necessary for understanding the functionality of a computational interface. Students’ understanding about a good usage of metaphors in HCI improves their ability to properly critique and design computer interfaces. However, is not simple to students to learn how to use metaphors in interaction design. To teach students to develop interactive experiences by means of metaphors is not an easy task. This work proposes a teaching method for using metaphors during the design of
website, desktop, mobile or tablet interfaces and present results of a successful case study concerning the proposed teaching method. The teaching method developed is a model of collaborative learning based on King’s questioning model and Ferreira’s creative dimensions, that consists in creative tasks allied to questionnaires with structured questions and are designed to encourage interaction, group learning and to foment creativity in students.

**COMPUTER SCIENCE EDUCATION AS PART OF AN UNDERGRADUATE PROGRAM IN COMMUNITY INFORMATION SYSTEMS**

Dalit Levy (Zefat Academic College, Israel)

Social information systems have recently emerged as an empowering force for communities, organizations, and businesses. Consequently, new academic programs have been proposed around the globe, aiming at establishing a framework within which students gain experience in the socio-technical process of designing information systems in business, libraries, health, government, education and beyond. These new interdisciplinary programs often regard computer science (CS) as one of their supporting pillars and therefore include some core CS courses, aiming at educating broad-minded practitioners rather than expert programmers in the field of information systems. This paper presents some thoughts on incorporating CS education in academic programs intended for non-CS majors and proposes an approach called 'Program by Design' for the first CS course in a new undergraduate program in community information systems.

**ASSESSING THE EFFECTIVENESS OF VIDEO FEEDBACK IN THE COMPUTING FIELD**

Walter W Schilling, Jr (Milwaukee School of Engineering, USA)

Engineering students exhibit a wide array of learning styles across the perception, input, organization, processing, and understanding dimensions. To improve students performance in the classroom, many techniques have been developed to address these variances. The computer fields, however, tend to have a large percentage of students who are visual learners. These students learn best by seeing, and they can do very well in the classroom with the appropriate usage of teaching styles. However, when it comes to providing feedback to students on submitted assignments, the main method employed is the written comment, which is not conducive to visual learners. This method is most prevalent in the academic community because overall, it is the simplest form of feedback that a faculty member can provide to students. However, written feedback is often highly ineffective at improving student performance, as many students simply do not read the comments because the students feel they are not relevant to their performance. This paper presents an assessment of an alternative method for providing feedback to students: video feedback. In lieu of written feedback, students are provided feedback for software engineering exercises through the use of a short video made via video capture. The video captures in multimedia format the instructors perceptions and actions when grading a given assignment. The video includes both aural commentary as the assignment is assessed, as well as dynamic visuals of the grading process, demonstrating failures and improvements that can be made in the submitted assignment. The article describes the pedagogical foundation for the technique, specifics of the technique used, student perceptions of the technique, and an assessment of the learning gains from using such a method in a junior level class. In general, students are show to prefer the technique versus traditional grading, and an improvement in overall outcomes for the course is shown to exist as well.

**PORTABLE LAB MODULES ON CLOUD COMPUTING**

Peng Li (East Carolina University, USA)

Cloud computing is a highly scalable model for delivering information technology resources and applications, on demand, as a service, to end users through the network. In recent years, cloud computing has been adopted rapidly and extensively in industry. Notable public cloud services include Amazon Elastic Compute Cloud (EC2) and Google App Engine, among others. There is a fast growing demand for professionals with cloud computing skills. However, the demand is not being fulfilled, partially due to the inability of educational institutions to keep up with technological advancements, as well as a lack of hands-on educational material.

We have been developing portable virtual lab modules which can be used to teach basic cloud computing concepts and skills early and often. The labs run on virtual machines and can be ported between different courses and between different platforms. The virtual labs can be deployed in centralized or decentralized ways. To meet the learning outcomes, the students are expected to: 1) comprehend the fundamental concepts of cloud computing; 2) identify the building blocks of cloud computing systems; 3) understand the basic operation of open source cloud infrastructures; and 4) recognize commonly used, commercial cloud computing services and applications.
FUNCTIONAL APPROACHES TO TEACHING CONCURRENCY
Michael Lutz (Rochester Institute of Technology, USA)

Traditional approaches to addressing issues of concurrency rely on mechanisms added to standard imperative languages such as Java, such as "synchronized" methods and blocks, combined with a "wait/notify" mechanism used to block and awaken processes when a shared resource is not in an acceptable state. The problem with this approach, however, is that mutable state is potentially accessible via many paths, and each such path must be analyzed for possible race conditions, deadlocks, and safety violations. The root cause of many concurrency problems is attributable to shared, mutable state. In light of this, two approaches to mitigating concurrency problems are immutable variables and state isolation within distinct concurrent actors. Erlang, a language developed at Ericsson for distributed, fault-tolerant switches, is a language supporting both approaches. This paper reports on an experiment to include Erlang as part of an existing course on concurrent systems design. This version of the course is currently underway, and the Erlang material is being introduced as this is written. Results from the approach will be ready well before the conference, and should serve as an inspiration (or warning) to others considering such a change.

Session T3D: Real World Influences in Experiential Learning
Chair: Elif Miskioglu (The Ohio State University)
4:00 - 5:30 pm
Room: 17

USING AN EMBROIDERY MACHINE TO ACHIEVE A DEEPER UNDERSTANDING OF ELECTROMECHANICAL APPLICATIONS
Irene Rothe (Bonn-Rhine-Sieg University of Applied Sciences, Germany)
Andrea Schwandt (Bonn-Rhein-Sieg University of Applied Sciences, Germany)

Understanding the functionality of real-world machines and thinking about their improvements is a method to deepen the acquired knowledge of electrical and mechanical engineering students. The Department of Electrical Engineering, Mechanical Engineering and Technical Journalism of the Bonn-Rhine-Sieg University of Applied Sciences in Germany provides a project-based learning environment in the so-called "project weeks". Three weeks of a term are available to do some real-world projects besides the regular courses [1]. This provides a "project-based" learning environment that enables the students to connect theory and practice and to apply knowledge and skills to solve practical problems. In the winter term 2012/13 an unusual open-defined project was offered for the first time to third-semester students showing high potentials. The students were presented with an unknown embroidery machine and their task was to improve it, depending on their knowledge and abilities. This article describes a project in which an embroidery machine was used as a basis for developing better understanding of many aspects of electrical and mechanical engineering.

PEDAGOGICAL ANALYSIS AND MULTIFACETED EVALUATION OF AN ENGINEERING CO-OP PROGRAM
Suleyman Uludag (The University of Michigan - Flint, USA)
Fatih Demirci (TOBB University of Economics and Technology, Turkey)
Erdogan Dogdu (TOBB University of Economics and Technology, Turkey)
Fahri Aydos (TOBB University of Economics and Technology, Turkey)

The ever-increasing complexity and challenges of the higher education coupled with more public scrutiny for its efficacy necessitate more in depth analysis and evaluation of the educational best practices. One such practice is the cooperative (co-op) education. While co-op education has been around for more than a century, its implementation is still rarely more than nominal in higher education. Even though there are studies published to demonstrate its effectiveness, more in depth studies, both spatial and temporal, seem to be warranted to narrow the widening gap between students' jobs-first and institutions' intellectual-experience-first expectations. In this paper, we summarize the first and highly successful co-op program in Turkey at TOBB University of Economics and Technology (ETU). Our analysis include a taxonomy of different co-op programs to contextualize TOBB ETU's. Further, we touch upon the theoretical underpinnings from a variety of generally accepted foundational work. As part of the evaluation of the program, we provide a preliminary assessment of a longitudinal study as the first from Turkey and one of a very few from the non-US, international institutions. We believe that ours is the first to report an evaluation of co-op programs in terms of pre-co-op, post-co-op and graduated students separately.
SOFTWARE FOR SENIOR CITIZENS: AN EXPERIENTIAL LEARNING COURSE IN GERONTOLOGY, SOFTWARE USABILITY AND DIGITAL LITERACY
Leo Ureel, II (Michigan Technological University, USA)
Charles Wallace (Michigan Technological University, USA)

Two trends in the developed world – the marked growth in the percentage of the population identified as “elderly”, and an increased reliance on computing technology – make it imperative that the high technology designers of tomorrow understand the challenges, capabilities and context of elderly users. Our graduate course on “software for senior citizens” provides a broad background of material from humancomputer interaction, gerontology, literacy studies and cognitive and learning sciences. Students also gain first-hand experience through weekly tutoring sessions with local elderly residents. These sessions yield observations and generate contacts from which students generate research projects. This paper discusses our goals and motivations for the course, our experiences to date, and our plans for future iterations and opportunities for expansion.

INTERNAL COMBUSTION ENGINE’S THROTTLE CONTROL AS A MOTIVATIONAL THEME FOR TEACHING MICROPROCESSORS SYSTEMS LAB CLASSES
Samuel E. de Lucena (Sao Paulo State University, Brazil)

The increased fuel economy and driveability of modern internal combustion engine vehicles (ICEVs) are the result of the application of advanced digital electronics to control the operation of the internal combustion engine (ICE). Microprocessors (and microcontrollers) play a key role in the engine control, by precisely controlling the amount of both air and fuel admitted into the cylinders. Air intake is controlled by utilizing a throttle valve equipped with a motor and gear mechanism as actuator, and a sensor enabling the measurement of the angular position of the blades. This paperwork presents a lab setup that allows students to control the throttle position using a microcontroller that runs a program developed by them. A commercial throttle body has been employed, whereas a power amplifier and a microcontroller board have been hand assembled to complete the experimental setup. This setup, while based in a high-tech, microprocessor-based solution for a real-world, engine operation optimization problem, has the potential to engage students around a hands-on multidisciplinary lab activity and ignite their interest in learning fundamental and advanced topics of microprocessors systems.

USING SCRUM TO TEACH SOFTWARE ENGINEERING: A CASE STUDY
Sergio Donizetti Zorzo (Federal University of Sao Carlos, Brazil)
Leandro Ponte (Federal University of Sao Carlos, Brazil)
Daniel Lucredio (Federal University of Sao Carlos, Brazil)

The diffusion of agile methodologies in software development makes them more mature for corporative environment. However, teaching agile methodologies on the academic environment poses many difficulties and limitations. This paper describes a case study where an innovative approach for teaching software development technologies was adopted. In this approach, the entire course was designed to fit Scrum's principles, so that the students could apply them as they were learning it. Also, the course's main project was to be developed in sprints, as proposed in Scrum. After almost two years using this approach, in this paper we describe our experience and provide a critical analysis. We observed some positive points, such as the practical nature of learning by example, and a better preparation of the students regarding agile methodologies. As negative points, we highlight the impossibility of delivering complete products in earlier sprints, and some interaction and collaboration difficulties. The main conclusion of this study is that a modified version of the Scrum methodology was necessary for the approach to work in our academic scenario.
A RETROSPECTIVE STUDY OF A PERSONAL ENERGY AUDIT ASSIGNMENT IN A RENEWABLE ENERGY SOURCES COURSE
Oxana S Pantchenko (University of California at Santa Cruz, USA)
Michael Isaacson (University of California Santa Cruz, USA)
Ali Shakouri (Purdue University, USA)

A retrospective study was conducted on analyzing student performances on the personal energy audit assignment in the renewable energy sources course. We analyzed student scores from 2006, 2009, and 2012 years respectively and categorized them by declared major. In this assignment, we asked our students to calculate the amount of energy that they consume in one week of their life in college and identify the activities that consumed the largest amount of energy. We also asked them if they would consider any habit changes after completing this assignment. The goal of this assignment was to introduce non-science and engineering students to the concepts of energy, power, electricity, heat, temperature, first and second laws of thermodynamics, embedded energy and would energy consumption. In total, the scores of more than 500 students were evaluated. We found that the average of the scores increased by 19% between 2006 and 2012, and by 14% between 2009 and 2012. The paper provides analysis of the student performances on this assignment and the overall effectiveness of this assignment.

A HANDS-ON LABORATORY EXPERIMENT ON CONCENTRATING SOLAR POWER IN A RENEWABLE ENERGY SOURCES COURSE
Oxana S Pantchenko (University of California Santa Cruz, USA)
Melissa Hornstein (Hartnell College, USA)
Michael Isaacson (University of California Santa Cruz, USA)

At Hartnell Community College in Salinas, California, a renewable energy and energy efficiency course is a theory based course with several hands-on laboratory experiments. The course is designed for engineering and non-engineering students who are looking to transfer to a 4 year institution. This course does not require any advanced mathematics or physics background. In order to enhance student learning in this course, we offered an additional hands-on laboratory experiment on concentrating solar power. The laboratory kit consisted of affordable and widely available materials that included 24 telescoping mirrors, stands, steel cup, thermometer, timer, and a cup of water. We asked the students to design, assemble, and test a central receiver concentrator with the goal to boil water contained in a steel cup. Upon achieving this goal, students were then asked to calculate the efficiency, define losses, and recommend ways of increasing efficiency and therefore improving their systems through. In order to record the level of improvement, each student was given the same questionnaire before and after completing the laboratory experiment. This paper presents the results of our findings on performance improvements in further detail.

DESIGN, CONSTRUCTION, AND TESTING OF AN ELECTRIC MACHINE TESTBED FOR USE IN LABORATORY AND RESEARCH EDUCATION
Trever Hassell (Michigan Technological University, USA)
Aurenice Oliveira (Michigan Technological University, USA)
Wayne Weaver (Michigan Technological University, USA)

Research and education into various methods of improving energy efficiency for electrical devices has become increasingly important to meet future energy needs. Because of this need, an electrical machine test-bed was designed and built in collaboration with a senior design team for the purpose of furthering research and education in the area of power electronics and motor drives. Both the engineering education and research capabilities aspects of this test-bed have an important role in educating engineers with skills to quickly contribute to the power and energy related industry. This paper will discuss the design, construction, and testing of a research quality electric machine dynamometer and test-bed for use in undergraduate and graduate (UG/Grad) education, as well as for research into power electronics and motor control.
USING MATLAB’S SIMSCAPE MODELING ENVIRONMENT AS A SIMULATION TOOL IN POWER ELECTRONICS AND ELECTRICAL MACHINES COURSES
Trever Hassell (Michigan Technological University, USA)
Wayne Weaver (Michigan Technological University, USA)
Aurenice Oliveira (Michigan Technological University, USA)

In this paper the use of MATLAB, and in particular Simscape, will be discussed as a simulation tool to model multi-domain physical systems in power electronics and electrical machines courses. The overall system response (both static and dynamic) of power electronics and electrical machine circuits are demonstrated and emphasized using Simscape language. Including Simscape in the curriculum reinforces conceptual ideas presented in lectures, as it increases students’ focus on conceptual material, and their familiarity to modeling systems using MATLAB/Simulink.

ENERGY EFFICIENCY: TEACHING FOR ACCREDITATION, ETHICS, AND TECHNOLOGY
Susan J Lincke (University of Wisconsin - Parkside, USA)
Christopher Hudspeth (University of Wisconsin - Parkside, USA)

Increased energy demand in IT is growing rapidly as the world becomes more industrialized. Projections show that IT growth will continue to increase, with annual network growth at 45%. Increasing worldwide energy demands results in an increase in both costs and climate change. Using the energy efficiency topic, we address 5+ ABET learning outcomes, including ethics and local/global impact. One learning goal of this section is for students to learn what constitutes sound ethical reasoning and what does not (e.g. egoism). Another goal is to categorize the social implications of the technology into spheres of concern (local/national/global) and basic ethical theories (virtue/deontology/consequentialism). One of the best ways to teach ethics is to engage the students in identifying the ethical perspectives in use. We have created a table of justifications for energy efficiency and categorized them by ethical theory. Our main source for these reasons is Hot, Flat, and Crowded, by Thomas L. Friedman. For homework, students write a paper that includes both a technical and societal/ethical component to it.

THE USE OF A CLASSROOM RESPONSE SYSTEM TO MORE EFFECTIVELY FLIP THE CLASSROOM
Terry Lucke (University of the Sunshine Coast, Australia)
Peter Dunn (University of the Sunshine Coast, Australia)
Ulrike Keyssner (University of the Sunshine Coast, Australia)

This case study explores the use of a new, low-cost, state-of-the-art CRS (Top Hat Monocle) which allows students to use their mobile devices (phones, tablets, laptops) to respond to a variety of numerical, multiple-choice, short-answer and open-ended discussion questions posed during face-to-face workshops. In order to allow sufficient time to fully engage with the workshop activities traditional lectures were revised and the classroom lecture was flipped. Students worked through narrated lecture material (hand-e-lectures) online, prior to attending the workshops. CRS was included as part of the e-lecture content and feedback from this was incorporated into the workshops. Workshops extended the e-lecture content by including a variety of carefully designed, engaging activities (many were group activities) that used CRS questions to facilitate discussions, problem solving and case study analysis to enhance student cognition. Overall, the new flipped lecture and CRS teaching format demonstrated a substantial increase in the level of student engagement, motivation and attendance compared to previous cohorts.

DEVELOPMENT OF AN AUTOMATED MANUFACTURING COURSE WITH LAB FOR UNDERGRADUATES
Deborah S. Munro (University of Portland, USA)

Many engineering programs at universities across the country have dropped machine shop and manufacturing courses from their curriculum due to budget constraints, accreditation requirements, and concerns about student safety. At the University of Portland, we have resurrected and enhanced a hands-on advanced CAD and automated manufacturing course that introduces students to advanced solid modeling techniques in CAD, such as sweeps, lofts, and surfacing methods. In addition, students learn manual machining and vacuum forming in our machine shop, along with learning how to create tool paths for CNC machining their designed CAD parts out of wax on various three axis endmills, a 3D
printer, and a 3D laser scanner. The endmills were all refurbished and/or repaired over a period of four years to get this course up and running. A commercial software package, MasterCAM, was used in conjunction with SolidWorks as the platform from which to learn about automated manufacturing. In addition, a MakerBot 3D printer was built from a kit to give students experience with future manufacturing techniques. The 3D laser scanner was student designed and built and creates CAD surface models of parts, useful for learning about reverse engineering. The machinable wax used for machining is recycled, melted down, and formed into blocks again for reuse. This saves considerable money. Our goal has been to enhance design quality in our curriculum through experiential learning. Prior to taking this course, all mechanical engineering students are required to take a solid modeling CAD course to learn the basics. However, our experience has been that students do not conceptually understand the importance of designing for manufacture. Although emphasized in all courses, without the hands-on experience, it is difficult for students to remember to apply fillet radii to the bottom of pockets, for example. When faced with having to fit a block with sharp corners into a machined pocket with its default small corner radii, however, learning is instantaneous. The early outcomes of this course show students have learned a great deal about design for manufacturing, dimensioning, tolerancing, and manufacturing techniques from taking this course.

VIRTUAL LEARNING ENVIRONMENTS IN ENGINEERING AND STEM EDUCATION
Joe Cecil (Oklahoma State University, USA)
Parmesh Ramanathan (University of Wisconsin at Madison, USA)
Mwarumba Mwavita (Oklahoma State University, USA)

This paper discusses an innovative approach to teach engineering concepts using Virtual Reality based Learning Environments (VLEs). New learning modules have been created using Virtual Reality technology and introduced in interdisciplinary senior level and graduate level courses targeting mechanical, industrial and electrical engineering students. These Virtual Reality based learning environments have been used to teach micro systems related topics as part of overall efforts to enhance the learning experiences of students. The learning outcomes including student performance are discussed. The process undertaken to design and develop these VLEs are elaborated along with the technologies used to develop such environments. A brief discussion of next generation Internet technologies which hold the potential to impact engineering and K-12 education is also provided.

TEACHING COMPUTER PROGRAMMING: A PRACTICAL REVIEW
Luiz C Begosso (Fundação Educacional do Município de Assis & Faculdade de Tecnologia de Ourinhos, Brazil)
Priscila Silva (Fundação Educacional do Município de Assis, Brazil)

Recent developments in computer programming environments have been introduced to the academic community. Scratch is one of such environments which seek to offer innovation features as a support to teaching computer programming. This study reports on the results from a case study conducted with young students for teaching algorithms and programming.

MODELS OF ADOPTION AND BEST PRACTICES FOR MOBILE HANDS-ON LEARNING IN ELECTRICAL ENGINEERING
Yacob Astatke (Morgan State University, USA)
Mohamed Chouikha (Howard University, USA)
Kenneth Connor (Rensselaer Polytechnic Institute, USA)
Aldo A. Ferri (Georgia Institute of Technology, USA)
Bonnie Ferri (Georgia Institute of Technology, USA)
Kathleen Meehan (Virginia Tech, USA)
Dianna Newman (University at Albany/SUNY, USA)
Meghan Deyoe (University at Albany/SUNY, USA)
Deborah Walter (Rose-Hulman Institute of Technology, USA)

Pedagogical practices in electrical engineering education have been shifting away from teacher-centered learning during the past decade. An innovation that has enabled the adoption of inquiry-based and problem-based learning into the curriculum using experimentation coupled with simulation and analysis has been the development of portable oscilloscopes and other instruments that rely on tablet or laptop computers to perform some of the data processing and to act as the display. Faculty members at six institutions of higher learning have incorporated hands-on experimental activities into existing courses and/or developed new courses that take advantage of these new tools. Assessment data collected by these faculty members have demonstrated that the change towards student-centered learning facilitated by
portable electronics increased student interest in electrical engineering, built student confidence in their ability to design circuits and systems, and supported the development of a deeper understanding of the theories that the students investigate or apply in the hands-on activities. A summary of the challenges that are faced in the different implementation models and a discussion of best practices are presented.

Session T3G: Game-Based Learning I
Chair: Amir Zeid (American University of Kuwait)
4:00 - 5:30 pm
Room: 20

PLAYING ONLINE GAMES ON FACEBOOK: THE CONSCIOUS AND UNCONSCIOUS LEARNING IN DATABASE DESIGN
Hwee-Joo Kam (Ferris State University, USA)
Greg Gogolin (Ferris State University, USA)
Douglas Blakemore (Ferris State University, USA)
Gerald Emerick (Ferris State University, USA)

This study intends to examine how conscious and unconscious learning in game-based learning (GBL) enhance student's understanding in database design. Conscious learning refers to intentional learning whereas unconscious learning indicates unintentional learning. Using Facebook's online games, this study evaluates the effectiveness of GBL in enabling students to grasp the normalization concept and Entity-Relationship Diagram (ERD). Additionally, this study adopts content analysis of the semiotics approach for data analysis. The preliminary findings reveal that unconscious learning encompasses student's realization in that a purportedly simple online game is built on a complex, highly functional database. The preliminary results also uncover that conscious learning constitutes (1) student's cognitive reflection on normalization concepts during database design and (2) a better understanding of ERD resulted from the collaborative effort of database design. Drawing on these findings, this study infers that the aforementioned outcomes of unconscious learning lead to student's appreciation of conscious learning.

TEST: SERIOUS GAME FOR RADIO COMMUNICATIONS LEARNING
Andres Navarro (Universidad Icesi, Colombia)
Patricia Madrinan (Mikos Lab, Colombia)
Iván Abadía (Universidad Icesi, Colombia)
Julio Cesar Alonso (Universidad Icesi, Colombia)
Sebastian Londoño (Universidad Icesi, Colombia)
Alejandra Gonzalez (Universidad Icesi, Colombia)
Juan Pradilla (Universidad Icesi, Colombia)

The game industry has suffered an impressive explosion of popularity, becoming the largest entertainment industry in the world. Games have become a sophisticated extension of the reality and an interesting way for complementing human mind utopias. Training software allows the trainee to immerse in quasi-real controlled situations that could be measured by trainers. In this work we discuss the duality existing between the training based on a serious game and a simple game, based on state of the art technologies. Then we show a training system for telecommunications technicians based on a combination between serious games and “traditional” e-learning platform. We show results for a trial made with a group of students from different disciplines (not only engineering) in order to evaluate learning outcomes using serious games versus other learning approaches. In this paper we discuss such results and make a descriptive statistical analysis of the results.

INTRODUCING PROGRAMMING CONCEPTS THROUGH VIDEO GAME CREATION
Peggy Doerschuk (Lamar University, USA)
Valerie Juarez (Lamar University, USA)
Jiangjiang Liu (Lamar University, USA)
Daniel Vincent (Lamar University, USA)
Kathlyn Doss (Lamar University, USA)
Judith Mann (Lamar University, USA)

This paper presents adaptable materials that teach programming fundamentals via game programming with Greenfoot, a free Java based game development platform. The materials consist of five independent modules, each of which focuses
on a group of related computing fundamentals. Each module includes the shell of a game, lessons that teach programming fundamentals, hands-on exercises that apply the fundamentals to add functionality to the game, and questionnaires and content-based quizzes that can be used to assess the effectiveness of the lessons. An instructor's guide is also included. These materials were used to teach computing concepts to high school students in two different venues in summer 2011 and 2012. Formal assessments found that the students experienced a significant increase in knowledge in computing and an increased interest in computing and likelihood of taking computing courses in the future. The paper describes the motivation for this work, how it relates to other works, the teaching and assessment materials, the key concepts covered in each module, the venues in which the materials were tested, and the results. It also discusses how the instructional materials can be used in other venues and provides a link to the materials so that others may use them.

**ASSESSING THE IMPACT OF VIDEO GAME BASED DESIGN PROJECTS IN A FIRST YEAR ENGINEERING DESIGN COURSE**
Joseph Ranalli (Pennsylvania State University - Hazleton Campus, USA)
Jacqueline Ritzko (Pennsylvania State University - Hazleton Campus, USA)

Introductory engineering design courses are an opportunity to engage and encourage first-year engineering students. In one such course, we implemented a novel student design project using a commercial video game. The game, Kerbal Space Program, is a simulation of rocket travel and provides a reasonably realistic representation of rocket propulsion and orbital mechanics. Teams of students were tasked with designing a rocket that could fly to the home planet's moon and return safely. The efficacy of the project was assessed using a pre- and post-activity survey, and results are compared with those from a larger-focus research project on the effectiveness of toys in the classroom.

**EDUCATION FOR ENERGY EFFICIENCY THROUGH AN EDUCATIONAL GAME**
Leonardo Mesquita (UNESP - São Paulo State University, Brazil)
Marco Monteiro (UNESP - São Paulo State University, Brazil)
Galeno Sena (UNESP - São Paulo State University, Brazil)
Mauricio Ninomiya (UNESP - São Paulo State University, Brazil)
Charles Costa (UNESP - São Paulo State University, Brazil)

This paper presents an evaluation of a educational game for teaching the efficient use of electricity. Developed with Adobe Flash, the game is a virtual board where participants choose a car, that start the path from the same point and should reach the same final goal, from the displacement of homes defined in terms of a dice that each player plays. The car moves if the participant is able to correctly answer a question that is randomly generated by the software. The objective of the game is to answer questions related to the energy efficiency topic promoting a healthy and attractive learning from participants on the concepts related to energy efficiency such as: rational use of energy, basic concepts of form of energy generation, among others. The main objective of this paper is to evaluate the impact of the application of this virtual game in the teaching and learning of high school students. Therefore, the game was applied in the discipline of physics in a class of first year high school public school in the state of São Paulo. Initially, the class that had 43 students, was divided into 10 groups of 4 students and 1 group of 3 students. Each student group competed among themselves. The idea was that each of them could indicate a student who was the representative of this group on other until only 4 students were selected for the finals. At this stage, each student could interact with a group of up to ten students that acted as advisers. The evaluation process adopted is based on the model proposed by Savi. Then, at the end of the game the students answered a questionnaire prepared based in the model proposed by Savi. According Savi, although there are significant studies that show the importance of educational games for the process of cognitive development and for learning concepts of students, there are few papers that present forms of evaluation the potential of these resources. Thus, the evaluation criteria proposed by Savi are based on the model of training evaluation Kirkpatrick, taken as a reference to measure the efficiency of processes of continuing education courses for professionals. The authors assert that the metric of evaluation proposed to evaluate the game is based on the first level the model proposed by Kirkpatrick.
TOWARDS THE ESTABLISHMENT OF AN AGILE METHOD FOR OERS DEVELOPMENT AND DELIVERY
Maurício Massaru Arimoto (University of São Paulo, Brazil)
Ellen Barbosa (University of São Paulo, Brazil)

Open Educational Resources (OERs) have been emerged as an important mechanism for democratization of access to education. In fact, the free and open distribution of these resources contributes with the dissemination of knowledge and facilitates the access to information, benefiting the society as a whole. Similar to software, the development of OERs requires the application of appropriate methods and practices to ensure the productivity and quality of the resulting products. Agile methods seem to be an interesting approach in this perspective. However, initiatives to foster the development and delivery of quality and reliable OERs, according to agile principles and with reduced costs, are still incipient. In our work we discuss the establishment of an agile method for the development and delivery of OERs. The proposed method is based on the main characteristics, practices and principles of well-known agile methods for software. To illustrate our ideas, the method is discussed in terms of its application in the development of an OER in the FLOSS (Free / Libre and Open Source Software) domain.

A MODEL TO SUPPORT A LEARNING OBJECT REPOSITORY FOR WEB-BASED COURSES
Mauricio Nascimento (University of São Paulo, Brazil)
Leônidas O Brandão (University of São Paulo, Brazil)
Anarosa A. F. Brandão (Universidade de São Paulo & Escola Politécnica, Brazil)

The demand for digital learning content has been increasing in the last years and the advent of the Learning Objects (LO) concept has the goal of mitigating some of the difficulties related to authoring such kind of digital content, by proposing a reusable model and an open metadata standard classifications for them. Nevertheless, digital learning content authoring is often an expensive and time-consuming task that requires many distinct professional skills. One attempt to overcome it is the adoption of Learning Object Repositories (LOR), in order to smooth LO manipulation experiences for teachers and content authors. Some of its key characteristics are: to promote LO dissemination and reuse to users in a unified spot and, to serve LO through flexible searches and enforce a metadata standard classification. This paper proposes an innovative repository model to support LOR and their use in web-based courses in the context of an specific LMS, the Moodle environment. The model is flexible, enhances digital content searches and can be fully integrated with an institutional LMS. Moreover, it offers a social environment for peer evaluation and, more important, information about the student performance, resulting in an efficient evaluation of the available contents.

DEVELOPMENT OF EDUCATIONAL TECHNIQUES FOR COMPUTATIONAL-EXPERIMENTAL ANALYSIS
Nathaniel Rogers (Miami University, USA)
Kumar Singh (Miami University, USA)
Fazeel Khan (Miami University, USA)

A curriculum wide initiative to enrich course content and increase student engagement in experiential learning through the adoption of new learning modalities is underway in the Department of Mechanical and Manufacturing Engineering, Miami University, OH. The projects entail the development of online learning modules which interweave experimental and computational analysis. The modules incorporate multimedia content which has been prepared with undergraduate and graduate student participation. The ComEx website has been designed to enable easy uploading/ updating of material. The distinctive feature of the ComEx studios is the thematic linking of the content which allows them to be used for multiple classes with a progressive advancement in technical content. This paper presents details of the studio model: motivation, methodology, implementation and assessment. The learning modules can be utilized by faculty to introduce new lab derived content, which may be related to their research, into a traditional class only course format. Additional benefits of the modules include the ability to independently review specific topics in preparation of advanced courses or for a research project. Assessment of the efficacy of the modules is being performed by students surveys completed online, and by four external (faculty) reviewers. Continuous improvement of the modules is underway.
**USING LINKED OPEN DATA TO IMPROVE THE SEARCH OF OPEN EDUCATIONAL RESOURCES FOR ENGINEERING STUDENTS**

Nelson Piedra (Universidad Técnica Particular de Loja, Ecuador)
Edmundo Tovar (Universidad Politécnica de Madrid, Spain)
JanNeth Chicaiza (Universidad Técnica Particular de Loja, Ecuador)
Jorge López (Universidad Técnica Particular de Loja, Spain)

In this paper, authors apply the Linked Data Design Issues to describe and retrieve information that is semantically related to open educational resources related to the Engineering Education, that are accessible via the OCW Higher Institutions. Linked data have the potential of create bridges between OCW data silos. To assess the impact of Linked Data in OCW, the authors present an interface of faceted search for open educational content. The authors demonstrate that OCW resource metadata related to engineering open courses can be consumed and enriched using datasets hosted by the LinkedOpenData cloud.

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**Session T3I: Inclusivity and Diversity I**

**Chair:** Catherine Samuelson (University of Washington)

**4:00 - 5:30 pm**

**Room:** 4

**LATINOS AND LATINAS IN THE BORDERLANDS OF EDUCATION: RESEARCHING MINORITY POPULATIONS IN ENGINEERING**

Susan M. Lord (University of San Diego, USA)
Michelle Madsen Camacho (University of San Diego, USA)

We use the "borderlands of education" as a metaphor for studying processes of educational exclusion in engineering and the social forces that create them. Latinas in engineering education occupy intersecting borderlands. On the path to higher education, they face numerous societal obstacles resulting from a legacy of racism. As women, they are on the margins of the masculine space of engineering. Though Latinas in engineering comprise a very small group, through their voices and experiences, we illuminate broader structural problems within engineering education.

**MINORITY STUDENT INFORMED RETENTION STRATEGIES**

Stacia Leonard (University of Oklahoma, USA)
Berit Pearcy (University of Oklahoma, USA)
Randa Shehab (University of Oklahoma, USA)
Susan Walden (University of Oklahoma, USA)

Diversifying engineering programs is a major goal for almost all universities because expanding the diversity of students will broaden and enrich the knowledge and experience associated with the science, technology, engineering and mathematics community. This study looked to explore those factors that contribute to minority students' success and more precisely what contributed to their success the most so that recommendations could be made on how universities can improve their minority student retention. In order to do this, African American, Hispanic American, Asian American, and Native American undergraduate engineering students of various disciplines were interviewed using theoretically grounded qualitative methods. The transcripts were coded for patterns using NVivo qualitative analysis software and the patterns found are described in detail within this paper. These patterns gave us insight into the factors that contribute to minority students' success and therefore lead to recommendations on ways for college campuses to encourage and foster their minority students' success. The insights reported in this paper will hopefully help universities make changes that will greatly improve the success of their minority students in engineering majors.
THE ELEPHANT IN THE ROOM: FIRST-YEAR ENGINEERING STUDENTS DISCUSS DIVERSITY
Lorie Groll (Texas A&M University, USA)
Lydia Kavanaugh (University of Queensland, Australia)
Carl Reidsema (University of Queensland, Australia)
Teri Reed-Rhoads (Texas A&M University, USA)
P k Imbrie (Purdue University, USA)

This work in progress presents a developmental model representing the ability of students to negotiate shared meanings with cultural others in order to build sustainable and mutually beneficial partnerships. The goal of this research is to locate students within this continuum and provide a student-centered starting point in the ways students construct meaning around cultural differences. This paper uses a qualitative inquiry and analysis methodology with a focus on first-year engineering students at a large Midwestern public university and a similar large public university in Australia. The data collected were interviews and focus group discussions probing their experiences with cultural differences. Initial findings demonstrate that in order for students to be able to acknowledge and express their understanding of differences, they need and want models, tools and techniques to be able to communicate their thoughts about cultural differences and to negotiate bridges of mutual understanding. Student interviews in the US reflected more polarizing messages while focus groups in Australia generated more minimizing messages. Engineering educators encourage students to approach and explore both their own cultures (self-knowledge), internal dialogues and other cultures (perceived through the student’s own cultural lenses), and the language they use to describe others.

COMMON CONFIGURATIONS FOR ENGINEERING STUDENT SUPPORT CENTERS
Walter Lee, Jr. (Virginia Tech, USA)
Holly Matusovich (Virginia Tech, USA)

In response to the persistent issues of retention and diversity, many colleges offer Engineering Student Support Centers (ESSCs). However, little is known about ESSC design or how these centers function alongside the engineering curriculum and within the larger systems of engineering education. Based on the current literature, there is a need to better understand ESSC design and how such centers influence the institutional experience of undergraduate engineering students. Our research seeks to address this gap by examining ESSCs of varying structure and configuration at multiple institutions. The overall study will use a multi-case study approach, which includes interviews and open-ended surveys with center administrators and engineering students. Preliminary results from the first phase of the project reveal a variety of ESSC structures and will assist us in representing the assortment of centers in the later phases of the study.

ENGINEERING CULTURE AND LGBTQ ENGINEERS’ USE OF SOCIAL CHANGE STRATEGIES
Michael Ekoniak, III (Virginia Tech, USA)

In this paper, I describe the theoretical framework for an investigation of the ways that engineers who identify as LGBTQ navigate engineering cultures. Previous work by Cech and Waidzunas, Bilimoria and Sewart, and Riley describe strategies that LGBTQ engineers use within highly heteronormative engineering cultures. The strategies described in the previous work fall into what Cox and Gallois refer to as social mobility strategies. Because Cox and Gallois assert that these strategies ultimately prove inadequate, I call for investigation of the use of social change strategies within the context of engineering.
SESSIONS - Friday, October 25th

F1A: Mini-Workshop: Tools to Facilitate Development of Conceptual Understanding in the First and Second Year of Engineering
8:30 - 10:00 am
Room: 14

TOOLS TO FACILITATE DEVELOPMENT OF CONCEPTUAL UNDERSTANDING IN THE FIRST AND SECOND YEAR OF ENGINEERING
Jeffrey E Froyd (Texas A&M University, USA)
P K Imbrie (Purdue University, USA)
Teri Reed-Rhoads (Texas A&M University, USA)

We want our students to understand and apply key concepts in each course. However, evaluation of conceptual understanding as well other learning goals often occurs simultaneously through use of traditional problem-solving tests. Seldom do we measure pre-to-post learning gains. Creation, development, and use of instruments to evaluate conceptual understanding and facilitate pre-post assessment would likely promote constructive conversations among both engineering students and faculty members. Such instruments are often referred to as concept inventories, following a convention established by the Force Concept Inventory. What distinguishes concept inventories from typical engineering course assessment methods is focus on a small set of key constructs, focus on a specific domain of academic content, and focus on conceptual understanding or qualitative reasoning, as opposed to computational problem solving. Workshop participants will be able to (i) provide an overview of research on conceptual understanding, (ii) provide an overview of historical development of concept inventories, (iii) describe effective uses and some misuses of concept inventories, (iv) access existing concept inventories via the developing ciHUB.org platform, (v) discuss psychometric properties of existing instruments, (vi) describe how psychometric analysis can aid development of concept inventories, and (vii) become active members in a growing community of users.

F1B: Panel: Building an Inclusive REU Program: A Model for Engineering Education
8:30 - 10:00 am
Room: 15

BUILDING AN INCLUSIVE REU PROGRAM: A MODEL FOR ENGINEERING EDUCATION
Chuck Stone (Colorado School of Mines, USA)
Maureen Durkin (Colorado School of Mines, USA)
Tim Ohno (Colorado School of Mines, USA)
Idemudia "JJ" Airuoyo (Colorado School of Mines, USA)
Kory Riskey (Colorado School of Mines, USA)
Erich Meinig (Colorado School of Mines, USA)

Faculty, staff, and students from Colorado School of Mines' Renewable Energy Materials Research Science and Engineering Center (REMRSEC) will discuss several strategies that have allowed REMRSEC to host a successful Research Experiences for Undergraduates (REU) program over the past five years for more than 100 students. The REU has consistently attracted highly qualified, diverse applicants and participants from a broad range of educational institutions that include Doctoral/Research Universities, four-year liberal arts colleges, historically black colleges and universities, Ivy League schools, tribal colleges, and two-year colleges. The program has received a significant amount of national recognition and international visibility due to its strong mentoring component that spans a variety of engineering and science disciplines while engaging students in authentic research tasks. Audience members attending this panel discussion will learn how our REU has successfully connected faculty mentors and undergraduate student researchers together in experiential education activities outside the students' primary research endeavors that include extracurricular activities, field trips, hands-on laboratory investigations, interactions with other REUs, professional development opportunities, student-driven "snapshots" sessions, and weekly technical seminars.
IMPROVING STEM CLASSROOM CULTURE: DISCOURSE ANALYSIS
Yevgeniya V. Zastavker (F. W. Olin College of Engineering, USA)
Veronica Darer (Wellesley College, USA)
Alexander Kessler (F. W. Olin College of Engineering, USA)

Every classroom constructs its own culture through the interactions of all participants, students and instructors. This culture, often covert or invisible, has a direct impact on students' opportunities to learn. Therefore, it is critical that instructors understand their classrooms' interaction patterns and their effect on student learning. We suggest that discourse analysis may serve as a tool to enhance instructors' understanding of their classrooms and to serve as an intervention particularly useful for junior faculty as they are beginning their teaching career. To this end, this paper (1) describes the theoretical foundation of discourse analysis and (2) demonstrates its application, effectiveness, and applicability in STEM classrooms, particularly at the introductory level, the time when students make their first steps in negotiating 'academic literacies'.

PBL-TEST: A MODEL TO EVALUATE THE MATURITY OF TEACHING PROCESSES IN A PBL APPROACH
Simone Santos (Universidade Federal de Pernambuco, Brazil)
Caliane Figuerêdo (Universidade Federal de Pernambuco, Brazil)
Fernando Wanderley (Universidade Nova de Lisboa, Portugal)

The increasing application of student-centered teaching approaches to solve real problems, driven by the market’s demand for professionals with better skills, has prompted the use of PBL in different areas, including in Computing. However, since this represents a paradigm shift in education, its implementation is not always well understood, which adversely affects its effectiveness. Within this context, this paper puts forward a model for assessing the maturity of teaching processes under the PBL approach, the PBL-Test, with a view to identifying points for improvement. The concept of maturity is defined in terms of teaching processes adhering to PBL principles, taken from an analysis of the following authors: Savery & Duffy (1995), Barrows (2001) Peterson (1997) and Alessio (2004). With a view to validating the applicability of the model, an empirical study was conducted by applying the PBL-Test to three skills in the Computing area. Results showed that although the model has shown it needs further enhancement, it has already been possible to identify improvements in PBL teaching processes that clearly affect the effectiveness of the approach.

AN ONLINE TRAINING COURSE FOR INSTRUCTORS WISHING TO IMPLEMENT TEAM-BASED LEARNING (TBL)
O'Connell M Robert (University of Missouri, USA)
Pil Won On (University of Missouri, USA)

Due to success at adapting and implementing team-based learning (TBL) for use in sophomore-level electric circuit theory courses, an initiative is underway to encourage other faculty to use TBL in their courses, and instruct them in how to do so. The purpose of this work-in-progress paper is to describe an online training course that is being developed to assist engineering instructors in learning to use TBL as well as other forms of group-based student-centered active learning in the classroom. Currently, the course consists of five units, each of which culminates in a quiz that must be taken successfully before moving on to the next section. The content sections consist of Powerpoint slides plus detailed instructor commentary for further explanation. Also included are selected illustrative video clips taken during an exemplary classroom session.

THE PRACTICAL APPLICATIONS OF UNDERSTANDING GRADUATE TEACHING ASSISTANT MOTIVATION AND IDENTITY DEVELOPMENT
Rachel L. Kajfez (Virginia Tech, USA)
Holly Matusovich (Virginia Tech, USA)

As the field of Engineering Education continues to grow so does the number of research studies. In this ever developing field, it is important to understand the practical applications and implications of this growing body of work. This paper discusses the initial practical applications of one study designed to examine the motivation and identity development of
Graduate Teaching Assistants (GTAs). Our hope is that by sharing the initial practical applications of our work in the work-in-progress format, we can better define the appropriate applications of this particular study but also contribute to the conversation of research to practice in Engineering Education.

**INSTITUTIONAL BENEFITS POLICIES AND FAMILY FORMATION AMONG ENGINEERING FACULTY**

Joyce B. Main (Purdue University, USA)

This work in progress examines family-related benefits policies across doctoral institutions and the family formation patterns of engineering faculty. The nationally representative data come from the 2004 National Study of Postsecondary Faculty surveys of institutions and faculty. Data show that a little over half of engineering faculty members provide financial support to one or more dependents. Yet, many doctoral institutions do not provide childcare benefits or parental leave for full-time faculty and instructional staff, highlighting the need to examine the role of institutional structures and benefits policies in the career progression of engineering faculty with dependents.

**INNOVATIVE PRACTICES FOR ENGINEERING PROFESSIONAL DEVELOPMENT COURSES**

Chad Davis (University of Oklahoma, USA)
James J. Sluss, Jr. (University of Oklahoma, USA)
Thomas Landers (University of Oklahoma, USA)
Pakize Pulat (University of Oklahoma, USA)

Many universities require engineering majors to take some form of a professional development course. Generally, the goal of these courses is to prepare students for the engineering profession. Another important aspect of these courses is to provide a mechanism to satisfy accreditation criteria on student outcomes that are difficult to implement in other technical courses. At the University of Oklahoma, most engineering disciplines take the course titled: ENGR 2002 – Professional Development. Historically, this course was effective in satisfying accreditation requirements on student outcomes, but was not well received by the students. Details of the reasons for this dissatisfaction and changes made in the re-design of this course are discussed in this paper. The new version of ENGR 2002 includes many innovative practices in team-based learning and peer learning that are shared in this paper. All of the vital elements of the four projects included in the course are provided to support others who would like to implement similar projects. Course surveys, completed by 148 students, were used as the primary assessment method. Additionally, standard course evaluations were used to compare this course to other engineering courses and show improvement from the previous version of ENGR 2002. Many student comments are included in the paper to show their reaction to different aspects of the course. One student made a comment that echoed our sentiments regarding the teaching of this course for the first time in the fall 2012 semester: “from being in this class it is noticeable that people need to take it to work on public speaking skills or working with groups.” From our experience, many students grow a great deal in terms of communication effectiveness and ability to function on a multi-disciplinary team as a result of this course, and we believe these skills are essential to become a great engineer.

**PROFESSIONAL DEVELOPMENT FOR MID-CAREER WOMEN IN COMPUTER SCIENCE AND ENGINEERING**

Joanne Cohoon (University of Virginia, USA)
Feng Raoking (University of Virginia, USA)

This paper reports on self-rated career management knowledge, use, and confidence for women in computer science and engineering before and after participating in a CRA-W Cohort of Associate Professors Project (CAPP) professional development workshop. We find that months after their workshop, three years worth of participating women gave higher ratings for their knowledge and use of skills such as time management, networking, and productive mentoring relationships, as well as confidence in their promotability. These findings suggest that professional development interventions can have long lasting positive effects on mid-career women in computing, and that the type of group mentoring, role models, and community offered by CAPP can help compensate for women's reduced access to career mentoring.
PLANNING TEAMWORK TEACHING BASED ON STUDENTS' FEEDBACK IN ENGINEERING EDUCATION OF CHINA

Dan Zhang (Queen Mary University of London, United Kingdom)
Eleanor M Pritchard (Queen Mary University of London, United Kingdom)
Paula Fonseca (Queen Mary University of London, United Kingdom)
Na Yao (Queen Mary University of London, United Kingdom)
Laurie Cuthbert (Queen Mary University of London, United Kingdom)
Steve Ketteridge (Queen Mary University of London, United Kingdom)

Teamwork has been considered as one of the important learning outcomes for engineering graduates. Industry sees higher education as being where graduates should be prepared with these professional skills. Every year, a lot of engineering students graduate in China and how best to train these students to be good team players is an urgent and important need. This paper describes a planned, improved mechanism for teamwork teaching on a joint degree programme between a top Chinese university and a key British university. A previous experiment about teamwork teaching to Chinese engineering students was conducted in a Personal Development Plan (PDP) module that takes professional skills as its main objectives. This work describes an improved approach to teamwork teaching based on the experience derived from the previous practice and a summary of students' feedback about PDP that was collected from several questionnaire-based semi-structured interviews. The improved approach will be conducted in both the PDP module and a technical module - Software Engineering.

IMPROVING STUDENT WRITING THROUGH MULTIPLE PEER FEEDBACK

Michael Ekonias, III (Virginia Tech, USA)
Molly Scanlon (Nova Southeastern University, USA)
Mahnas Jean Mohammed-Aragh (Virginia Tech, USA)

It is widely recognized that effective written communication skills are essential for engineers. However, many engineering instructors are reluctant to integrate writing assignments into their curricula and writing instruction is often relegated to a technical writing service course rather than in the context of engineering courses. One way to address these concerns is to use peer feedback. Recent research by Cho & MacArthur (2010) showed that feedback from multiple peers in a psychology research methods class was more effective in improving students' writing than feedback from a single expert—typically the instructor—or a single peer reviewer. When compared with single-expert and single-peer feedback contexts, multiple-peer feedback revealed improved students' understanding of comments, included non-directive recommendations for revisions—which resulted in made more complex repair decisions (global issues like organization and focus vs. local issues like sentence structure and grammar) and new content revisions as well as improved paper quality overall. The purpose of this study is an attempt to reproduce the results from Cho & MacArthur's study in the context of a first-year engineering course. Research questions include: 1. How do different forms of feedback affect improvement in students' writing quality in an engineering course? 2. How does the form of feedback impact student perceptions of the assignment? 3. Does training on feedback best practices for writing peer review affect the quality of peer review comments? This article will outline the project and address our theoretical framework and methods. Results of the research will be presented in a future article.

AN EMPIRICAL STUDY: TEAM CHARTERS AND VIABILITY IN FRESHMEN ENGINEERING DESIGN

Veronica Conway Hughston (Pennsylvania State University, USA)

While the concept of teams has been diffused into engineering education as an instructional activity for nearly two decades, questions remain about how best to provide instruction so that it supports student teams' effectiveness without compromising technical content. Additionally, employers in industry, government, and higher education have an insatiable need for engineers proficient in work that requires multi-disciplinary teams. The issue is further compounded by the sky-rocketing cost of education—students and families want an acceptable rate of return on their tuition. Administrators must determine how to increase value-adding coursework. Engineering education and team literature is replete with theoretical and descriptive studies focused on adding separate team-building courses to the already full and expensive mandatory class lists. Students and their families do not want to pay for more credits they want more for their investment. To this end the current study looks at one facet of planning, team charter enactment, in relation to team effectiveness—operationalized as team viability within an existing freshmen design engineering course at a large Mid-Atlantic university.
DRAFTING PROGRAM EDUCATIONAL OBJECTIVES FOR UNDERGRADUATE ENGINEERING DEGREE PROGRAMS
Ramakrishnan Sundaram (Gannon University, USA)

This paper outlines the process to draft Program Educational Objectives (PEOs) appropriate for undergraduate engineering degree programs at ABET-accredited institutions of higher education. In the ECE department at our University, the existing PEOs were deemed to have language that was very similar to that used in the ABET student outcomes. Therefore, it was imperative to distinguish the PEOs from the ABET student outcomes since the PEOs must quantify the expected attainments of graduates a few years after graduation. First, PEOs must reflect the Mission Statement of the institution and serve as a yardstick of student achievement three to five years following graduation. The objectives represent the expectations of the department from its graduates. Active participation by the faculty in defining the PEOs yield clear and concise objectives and promotes ownership of the goals of the Department and ABET process. However, not all faculty members are necessarily familiar with the assessment language and the process to evaluate the PEOs. In order to ensure a meaningful contribution from all faculty members involved in defining the PEOs, this paper presents a framework to define the PEOs that (1) adhere to the Mission of the University (2) achieve consistent and measurable expectations.

FROM GLOBAL TO LOCAL: INVESTIGATION OF NECESSARY ENGINEERING SKILLS FOR KBE TRANSFORMATION IN QATAR IN THE CONTEXT OF GLOBAL ENGINEERING ATTRIBUTES
Reem Khair (Qatar University, Qatar)
Mahmoud Abdulwahed (Qatar University, Qatar)
Abdel Magid Hamouda (Qatar University, Qatar)
Mazen Omar Hasna (Qatar University, Qatar)

This paper provides the findings of a study on investigating the required contextual engineering skills in Qatar in light of the global engineering skills. A set of 20 attributes were identified in the literature, and surveys were implemented to measure the importance of these skills in Qatar. The targeted groups spanned from students, practicing engineers, senior industrial engineers, and academicians. The basic logic behind surveying various engineering groups was mainly to evaluate the capabilities of the current engineering labor force as well as evaluating the potential of the future engineering supply (current students). The main findings indicated the consensus of participating groups on the importance of enhancing communication skills. High perceptual gaps were identified in communication skills, business and entrepreneurship and practical skills. Remedy actions that were proposed so that the future supply of engineers is featured by required and desired level of selected skills.

SUSTAINABILITY AND THE ENGINEERING WORLDVIEW
Justin Hess (Purdue University, USA)
Johannes Strobel (Purdue University & Institute for P-12 Engineering Research and Learning, USA)

This paper explores what is included in the worldview of the modern engineer and how this compares to the concept of sustainability. Worldviews are important to humanity because they are interwoven throughout civilizations. Societies do not contain but one homogenous worldview, however, they do essentially contain a dominant worldview characterized by the collection of values, beliefs, habits, and norms. This dominant worldview forms the frame of reference for a collectivity of people, such as a nation or culture. In this paper, we attempt to articulate modern worldviews, the contemporary engineering worldview, and the sustainability worldview. We use the concept of worldviews to address the compatibility of sustainability and engineering. Our synthesis suggests that the two ideologies are misaligned and incompatible in many respects. We suggest that for sustainability to gain prominence within an engineering context, engineers and engineering educators must first become conscious of these inconsistencies. Through the philosophical synthesis presented in this paper, it is our goal to begin rethinking how we educate engineering students about engineering and sustainability.
URBAN SUSTAINABILITY - AN ENGINEERING COURSE FOR GENERAL EDUCATION - MAKING THE CASE FOR ENGINEERING TO BE ACTIVE IN GENERAL EDUCATION
Shirley Fleischmann (Grand Valley State University, USA)

This paper will address two closely related topics. The first is the design and successful delivery of an engineering course for General Education at the university level. The focus of the course is how the built environment influences the social, economic, and natural environment. Engineering decisions about the materials used to create the built environment affect structural integrity, energy performance, and the sense of place in cities. These factors, in turn, affect the quality of life for all citizens - so the topic of this course is of interest to students of all disciplines. As such it offers an opportunity to introduce non-engineering students to the way that engineers think and make decisions. The second topic is an exploration of why engineering departments are not typically major players in General Education. We in engineering have often secluded ourselves from the rest of the university. The effect of this is that students outside of engineering view the subject matter as out of reach when many of the main ideas are really central to the shared life of our nation. One way to overcome this barrier is to offer engineering courses meant for students of all academic disciplines.

RECOMMENDATIONS FOR ENGINEERING DOCTORAL EDUCATION: DESIGN OF AN INSTRUMENT TO EVALUATE CHANGE
Jiabin Zhu (Purdue University, USA)
Monica Cox (Purdue University, USA)
Sara Branch (Purdue University, USA)
Benjamin Ahn (Purdue University, USA)
Jeremi London (National Science Foundation & Purdue University, USA)

In recent years, many studies and reports have highlighted concerns and problems with engineering doctoral degree recipients. Criticisms have come from professionals in both industry and academia, as well as from current and former Ph.D. students. Given the dissatisfaction of a variety of stakeholders, there have been calls from professional societies, disciplinary bodies and federal agencies to improve doctoral granting programs across the U.S. and to educate Ph.Ds. who are equipped with skills and attributes necessary to meet the highly-competitive and rapidly changing 21st century workforce [1, 2]. Within this context, this study focuses on the perspectives of working professionals from both academia and industry. Preliminary findings were obtained from one-on-one interviews with forty engineering Ph.D. holders who are from industry and/or academia. They recommended practical measures for engineering doctoral students to obtain desired characteristics upon graduation. Using the preliminary results, the work in progress precludes the design of an instrument to evaluate on-going changes to different aspects of doctoral education. The instrument will serve as a useful tool to understand the degree and scope of changes in engineering doctoral program. Portions of the instrument informed from these recommendations are provided.

Session F1F: ECE II
Chair: Dale Carnegie (Victoria University of Wellington)
8:30 – 10:00 am
Room: 19

PHYSICS OF COMPUTING AS AN INTRODUCTION TO COMPUTER ENGINEERING
Marilyn Wolf (Georgia Institute of Technology, USA)
Saibal Mukhopadhyay (Georgia Institute of Technology, USA)

This paper describes a new required course in the Georgia Tech computer engineering curriculum, ECE 3030, Physical Foundations of Computer Systems. Traditional introductory courses take a constructive approach to logic design and computer organization. 3030, in contrast, introduces the major physical concepts underlying computation. It shows how they determine basic properties of computers such as speed and energy consumption. It also explores design trade-offs by showing how changes that improve one type of property inevitably, due to physics, cause another useful property to degrade. The course emphasizes CMOS but many of its principles apply to other logic technologies as well. Students do not directly design logic or learn assembly language—for example, delay and energy consumption are studied for inverter chains. However, they have time in the course to study in detail the basic physical phenomena that underlie design choices in digital systems. Those principles help students absorb material in later classes such as VLSI design. 3030 introduces certain topics to students much earlier in the curriculum than is traditional. We believe that an early introduction to principles is important not just for students who become logic designers but for all computer engineers.
AUTOMATIC GENERATION OF CHARACTERIZATION CIRCUITS - AN APPLICATION IN ACADEMIA
Azam Beg (United Arab Emirates University, United Arab Emirates)

Circuit characterization is an essential topic in most integrated circuit design courses in an electronic and/or computer engineering curricula. In such courses, a standard set of basic circuits (called standard cells) needs to be characterized based on different design criteria, for example, noise margin, power, performance, etc. So the students usually need to go through the manual, iterative process of creation of circuit descriptions (defined by Spice netlists) – a process that is not only time-consuming but also prone to errors. For the students to be able to conduct a large number of experiments while focusing on the design issues rather than on the tedious task of creating different circuit variants, an online tool is being proposed. The tool can be used in different courses that cover the topics of nanosized CMOS (complementary metal oxide semiconductor) digital design, VLSI (very large scale integrated) circuit design, lowpower digital circuit design, circuit reliability, etc.

ISSUES OF RECRUITMENT AND RETENTION FOR A NEW ENGINEERING PROVIDER
Dale A Carnegie (Victoria University of Wellington, New Zealand)
Craig Watterson (Victoria University of Wellington, New Zealand)

As a new provider of engineering, Victoria University of Wellington (VUW) faces a significant number of challenges in attracting and retaining quality students. As the primary funder of Universities, the New Zealand Government is providing conflicting funding directives, desiring an increase in student numbers, but penalizing poor course completion rates and banning funding on foundation or bridging courses. This paper details the development of a successful engineering programme, focusing on the modern “digital” aspects of engineering, in the face of these challenges.

INTEGRATION OF FUNDED FACULTY RESEARCH, CAPSTONE EXPERIENCES AND INDUSTRY REQUIREMENTS
Aurenice Oliveira (Michigan Technological University, USA)
Trever Hassell (Michigan Technological University, USA)
Wayne Weaver (Michigan Technological University, USA)

This paper presents a senior design strategy integrating funded faculty research and industry requirements. Students participating in this type of senior design are directly involved with all the aspects of a complete system development cycle focusing on user needs and requirements. All the aspects of the project represents higher quality and larger scale than typical senior design projects, and in this way better resemble industry projects. The case study presented herein is a practical industrial project sponsored by a faculty member – the construction of a research quality electric machine dynamometer and test-bed.

A BUILDER AND SIMULATOR PROGRAM WITH INTERACTIVE VIRTUAL ENVIRONMENTS FOR THE DISCOVERY AND DESIGN OF LOGIC DIGITAL CIRCUITS
Arturo Miguel-de-Priego (Peru)

This paper describes the features and applications of a computer program for building and simulating digital circuits with standard and custom integrated circuits, virtual environments and other useful and practical elements such as interactive tutorials and schematic circuits. By using virtual logic modules users can insert integrated circuits into breadboards, trace wires, change switches and check outputs in displays, almost like in a real life laboratory. Also students can use virtual environments to test circuits as if they were in the real world. Users can design digital applications with more components and reuse their designs to show additional examples and study more applications while saving time and money. This program supports several instructional methods. In inquiry-based learning students can be guided to experiment with integrated circuits and logic symbols in order to discover truth tables for basic logic functions and then search for patterns, principles, abstractions and applications. In project-based learning students can try solutions for virtual environments such as traffic light controller, water tanks, kinematics experiments and elevators, and then build solutions in the real world with more confidence. Earlier versions of this software have been used on many high schools and universities in Europe and Latin America.
INTEGRATION OF SCORM PACKAGES INTO WEB GAMES
Enrique Barra (Universidad Politécnica de Madrid, Spain)
Aldo Gordillo (Universidad Politécnica de Madrid, Spain)
Daniel Gallego (Universidad Politécnica de Madrid, Spain)
Juan Quemada Vives (Universidad Politécnica de Madrid, Spain)

This paper presents a model that enables the integration of SCORM packages into web games. It is based on the fact that SCORM packages are prepared to be integrated into Learning Management Systems and to communicate with them. Hence in a similar way they can also be integrated into web games. The application of this model results in the linkage between the Learning Objects inside the package and specific actions or conditions in the game. The educational content will be shown to the players when they perform these actions or the conditions are met. For example, when they need a special weapon they will have to consume the Learning Object to get it. Based on this model we have developed an open source web platform which main aim is to facilitate teachers the creation of educational games. They can select existing SCORM packages or upload their own ones and then select a game template in which the Learning Objects will be integrated. The resulting educational game will be available online. Details about the model and the developed platform are explained in this paper. Also links to the platform and an example of a generated game will be provided.

AN EDUCATIONAL SIMULATION MODEL DERIVED FROM ACADEMIC AND INDUSTRIAL EXPERIENCES
Daniela Peixoto (Federal University of Minas Gerais, Brazil)
Rodolfo Resende (Federal University of Minas Gerais, Brazil)
Clarindo Pádua (Federal University of Minas Gerais, Brazil)

Simulation games are gaining increased interest among academic researchers and practitioners where conventional teaching approaches are not adequate. In the Software Engineering field, simulation games are commonly used for enhancing the learning and understanding of complex themes such as software processes. This complexity is represented by intrinsic software development characteristics such as multiple feedback loops and the cause-effect delays. One fundamental aspect for the development of a simulation game is the definition of its simulation model. A simulation model contains some dynamic features and phenomena of the system it represents. It typically involves a set of assumptions concerning the system operation and it is used to translate the underlying system model, with given inputs, producing its behavior pattern. In this work, we describe an approach to create an educational simulation model derived from academic and industrial experiences. We focus on the systematic activities executed during its development. The created model was applied in a Software Process Improvement simulation game, named SPIAL (Software Process Improvement Animated Learning Environment). A set of important issues were identified. Our work can help developers during the creation of simulation games for educational purposes.

ADDING SOCIAL ELEMENTS TO GAME-BASED LEARNING - AN EXPLORATION
Chien-Hung Lai (Chung Yuan Christian University, Taiwan)
Yu-Chang Lin (Chung Yuan Christian University, Taiwan)
Bin-Shyan Jong (Chung Yuan Christian University, Taiwan)
Yen-Teh Hsia (Chung Yuan Christian University, Taiwan)

Game-based learning is to present the instruction by games in learning, with the main purpose of triggering learners’ motives instead of instructing the courses. Thus, increasing learning motive by game-based learning becomes a common instructional strategy to enhance learning achievement. However, it is not easy to design interesting games combined with courses. In 2011, Echeverria proposed a design to combine characteristics of games with elements of courses by matching the virtual scenarios in games with proper courses. However, in the past game-based learning, students were gathered in regular places for several times of game-based learning. Students’ learning was limited by time and space. Therefore, for students’ game-based learning at any time and in any places, based on theories of design elements of online community game Aki Järvinen, this study treats Facebook as the platform of games. The development by online community game is easier, faster and cheaper than traditional video games. In 2006, Facebook allowed API program of the third party. Therefore, by Facebook, this study provides the platform for students to learn in social lives to explore...
students’ activities in online community games. Questionnaire survey is conducted to find out if the design of non-single user game is attractive for students to participate in game-based learning.

**USING GAME-BASED LEARNING AND SIMULATIONS TO ENHANCE ENGINEERING AND MANAGEMENT EDUCATION**

Thomas Korman (California Polytechnic State University, San Luis Obispo, USA)
Hal Johnston (California Polytechnic State University, San Luis Obispo, USA)

Simulations allow students in an educational environment to experience tasks and the results of their decisions, which they will be asked to perform upon graduation. In the construction industry, many employees are hired that do not have the training or coursework at the university level that provides them access to such simulations. Simulation and gaming is not new to higher education but in the past was done in a very narrow vein and because of the complexity and development time required to produce them. Most have not been robust enough to engage students. Managing engineering and construction involves being able to make decisions that involve balancing time, cost, quality, resources, and identifying and solving a variety of issues related to the selection of equipment, labor, and tools. The skills required of today's construction engineering and management professionals are a combination of management skills and technical knowledge. This paper describes the development and implementation of Construction Industry Simulation (COINS) designed and developed at California Polytechnic State University, San Luis Obispo (Cal Poly) to prepare construction engineering and management students for the real world.

**MAKING IN-CLASS COMPETITIONS DESIRABLE FOR MARGINALIZED GROUPS**

Amy McGovern (University of Oklahoma, USA)
Deborah Trytten (University of Oklahoma, USA)

Inspired by research that indicates that direct competition is not always comfortable for female students, we redesigned an existing class competition to permit students to choose whether they wished to participate in either direct or indirect competition. We pilot tested it in the Spring of 2013 in a undergraduate/graduate class on introductory artificial intelligence at the University of Oklahoma. Although the results for female students are inconclusive due to their small number, we observed that international students embraced the indirect competitions. This suggests that allowing the option of indirect competition may also appeal other groups of students who can be marginalized in engineering. Our results indicate the international students prefer the less risky option of indirect competition.

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**Session F1H: Learning Theories**

*Chair: Dazhi Yang (Boise State)*

*8:30 - 10:00 am*

*Room: 2*

**EVALUATION OF COMPUTER MODULES TO TEACH METACOGNITION AND MOTIVATION STRATEGIES**

Michele H Miller (Michigan Technological University, USA)
James De Clerck (Michigan Technological University, USA)
William Endres (Michigan Technological University, USA)
Laura Roberts (Michigan Technological University, USA)
Kevin Hale (Michigan Technological University, USA)
Sheryl Sorby (The Ohio State University, USA)

Two e-learning modules are being developed to improve self-regulation and lifelong learning readiness. More than 150 mechanical engineering students completed first versions of the two modules in 2012. An evaluation of the module results suggests that students are learning the module content and tend to enjoy taking the modules. The modules were also tested as an intervention for improving lifelong readiness as measured by the SDLRS. Comparing scores of the SDLRS taken before and after the modules showed a statistically significant gain (p<0.1). Comparisons were also made between the 2nd and 3rd year classes and between women and men. Suggestions for improvements to the modules have been identified.
ON MENTORING RELATIONSHIPS: HOW TO BECOME A GOOD MENTOR
Waddah Akili (Geotechnical Engineering, USA)

Mentoring is not a new concept. Many of us have benefited from a trusted mentor. Perhaps we called them a friend, family member, or an advisor, whose opinions and experiences we trusted. They created an intangible bond with us through their experiences, opinions, and the time they took to give us advice and counsel. As professional engineers, many of us have the same opportunity—by getting involved in two aspects that are vitally important to the engineering profession. The first is to make an incredibly positive impact on the life of a young, aspiring professional or student. The second is to help solidify the role of engineering in a fast paced, diverse landscape. How best to start? Begin by assessing what we have to offer as mentors. The main role of a mentor is to stimulate students or young professionals to think in new and creative ways. One of the biggest values to bring to mentoring is a broad perspective—and how that perspective can be of value to students. From author's experiences, a key issue in "starting where they are" relates to our own preconceived notions about students and their abilities to evolve into the field of engineering. It is all too easy to consider general educational trends that indicate a woeful lack of most students' preparation in math and science. The logical extension of such thinking is: they don't have what it takes to succeed in engineering. Let us not waste our time and resources. In light of this, do we simply give up? Or do we rally our resources to help students do better? There is only one real option - how do we meet students where they are in their educational preparation, and how do we help them develop their core competencies so they could one day become engineers? The proposed paper takes a practical look at the challenges and rewards of experienced engineering educators becoming mentors for students or young practicing engineers. The author recommends an approach to mentoring that is deep in self-evaluation, one that considers the intellectual, social, and professional development needs of students and young professionals, and the need for taking little steps—one step at a time—that makes a big difference. Such an approach to mentoring will help encourage students, particularly underrepresented groups, to pursue careers in engineering. The relationship between the mentor and the student may last for many years after student's graduation. Often it is difficult to define, in a clear manner, what mentoring is and how a professor can become a good mentor. The proposed paper describes some attributes of mentoring and sketches out how a faculty member might become a good mentor to students.

THE EFFECTS OF TEACHING MATERIAL REMEDIATION WITH ARCS-STRATEGIES FOR PROGRAMMING EDUCATION
Hidekuni Tsukamoto (Osaka University of Arts, Japan)
Yasuhiro Takemura (Osaka University of Arts, Japan)
Hideo Nagumo (Niigata Seiryo University, Japan)
Akito Monden (Nara Institute of Science and Technology, Japan)
Ken-ichi Matsumoto (Nara Institute of Science and Technology, Japan)

In this paper, a method for improving the teaching materials of programming education is introduced, and the evaluation of the effects of using the strategy is presented. By using this method, the teachers of programming education will be able to assess and improve their teaching materials irrespective of their knowledge and experience of their teaching materials already used. In this method, the teaching materials were improved based on the statistical analysis of the motivation of students. Specifically, the motivation of students was measured for each lower category of ARCS motivation model with the authors' original questionnaire. The lower category in a particular lesson that showed a statistically significant decrease from the previous lesson was identified, and the improvement strategies for the lower category were selected from the list of motivation strategies in the ARCS model. The teaching materials of programming education were then improved based on the strategy. In this research, five lower categories of particular lessons in a programming course were identified, and the teaching materials were improved. The improved teaching materials were used in the following programming course, and the effects of the improvements were seen in three lower categories out of the identified five lower categories.

A FRAMEWORK TO EXAMINE FIDELITY OF IMPLEMENTATION OF A HYBRID INSTRUCTIONAL MODEL FOR COMPUTER ENGINEERING COURSES
Jia-Ling Lin (University of Minnesota Twin Cities, USA)
Andy S. Peng (Lockheed Martin & University of Minnesota - Stout, USA)

This paper describes a framework adopted to examine the fidelity level of the implemented curriculum in a computer engineering course. The framework allows education researchers to analyze how an applied hybrid instructional model impacts student learning methodically. This study helps to gain insights into how instructors’ pedagogical and content
knowledge has shaped the curriculum implementation. Factors that influence the intended, implemented, and learned curriculum are discussed.

**STUDYING METACOGNITION IN NATURAL SETTINGS**

Rachel McCord (Virginia Tech, USA)
Holly Matusovich (Virginia Tech, USA)

The purpose of this paper is to provide significant evidence from the literature for the use of emerging methods to study engineering students' use of metacognitive strategies when studying. We will review current research methods used to study metacognition and provide evidence that observational methods are an appropriate methodological choice when attempting to study the actual metacognitive strategies students engage in when in naturalistic settings.

**EVALUATING THE EFFECTIVENESS OF FLIPPED CLASSROOMS FOR TEACHING CS1**

Ashish Amresh (Arizona State University, USA)
Adam R Carberry (Arizona State University, USA)
John Femiani (Arizona State University, USA)

An alternative to the traditional classroom structure that has seen increased use in higher education is the flipped classroom. Flipping the classroom switches when assignments (e.g. homework) and knowledge transfer (e.g. lecture) occur. Flipped classrooms are getting popular in secondary and post-secondary teaching institutions as evidenced by the marked increase in the study, use, and application of the flipped pedagogy as it applies to learning and retention. The majority of the courses that have undergone this change use applied learning strategies and include a significant "learning-by-doing" component. The research in this area is skewed towards such courses and in general there are many considerations that educators ought to account for if they were to move to this form of teaching. Introductory courses in computer programming can appear to have all the elements needed to move to a flipped environment however, initial observations from our research identify possible pitfalls with the assumption. In this work in progress the authors discuss early results and observations of implementing a flipped classroom to teach an introductory programming course (CS1) to engineering, engineering technology, and software engineering undergraduates.

**IMPROVING STUDENT LEARNING USING AN IN-CLASS MATERIAL PROCESSING DESIGN PROJECT**

Joseph Domblesky (Marquette University, USA)
James Rice (Marquette University, USA)
Jay Goldberg (Marquette University, USA)
Mark Nagurka (Marquette University, USA)

At Marquette University, hybrid project-based learning has been implemented in an undergraduate mechanical engineering course on materials processing and forming using a team-based approach. The goals of the project are to 1) introduce more active and student-centered activities to improve student engagement and mastery of core concepts, 2) increase students' confidence in their ability to apply what they learned in the course to solving real-world problems, 3) enable students to gain experience using engineering software as part of the learning process and in applications contexts. While use of process modeling software in materials processing and manufacturing courses is not entirely new, the project has students actively developing a model around a realistic process, rather than passive users running "canned" models and reviewing the output. This paper presents details of the project and discusses preliminary results regarding its impact on student learning and confidence related to application of the course concepts. Recommendations for improving and expanding this in-class project are presented, along with a description of the assessment methods used to measure the impact on students.
A PBL APPROACH TO PROCESS MANAGEMENT APPLIED TO SOFTWARE ENGINEERING EDUCATION
Simone Santos (Universidade Federal de Pernambuco, Brazil)
Ana Claudia Andrade (Universidade Federal de Pernambuco, Brazil)
Ariane Rodrigues (Universidade de Pernambuco, Brazil)

Given the demand in the area of Software Engineering for solutions that actually contribute to modern organizations, the search for qualified professionals who have considerable practical experience has been growing day-by-day. Set against this background is the learning process of traditional teaching, in which the student is largely a mere recipient of information, including concepts and theoretical foundations, and is seldom given practice in problem solving. Therefore with a view to minimizing this problem, teaching and learning methods such as the Problem Based Learning (PBL) have emerged in higher education as an approach to foster changes in teaching and learning processes, which are aligned to the new requirements of the labor market and redefine the roles of those involved in educational processes. To evaluate these processes, a case study on skills training to teach Usability Testing is discussed, and important results presented that show the applicability of the proposed approach for teaching Software Engineering.

SHOULD THE FIRST COURSE IN COMPUTATIONAL PROBLEM SOLVING AND PROGRAMMING BE STUDENT-CENTERED OR TEACHER-CENTERED?
Cem Sahin (Drexel University, USA)
Pramod Abichandani (Drexel University, USA)

Computational problem solving and programming are foundational skills for engineers. The first undergraduate level course that covers these topics is critical to laying these foundations. As instructors strive to incorporate the spirit of inquiry in their courses, an important question that comes forth is whether the teaching methodology should be student-centered or teacher-centered. This paper adds helpful information in the ongoing debate on this question. The paper reports on the student performance results obtained by teaching two sections (cohorts) of an introductory Computation Lab course sequence. This course sequence aims to teach new engineering students MATLAB scripting and programming in the context of technical problem-solving using mathematical models. Cohort A was taught using a traditional teacher-centered approach, while Cohort B employed an open-ended student-centered approach. Our results indicate that the teacher-centered approach has the potential of creating polarized grade distributions with relatively more A grades in the class compared to the student centered approach. On the other hand, the student-centered approach provided a smoother grade distribution, indicating that a higher number of students demonstrate noticeable progress as compared to the teacher-centered approach.

DEVELOPING MODULES FOR AN INVERTED CLASSROOM PROJECT IN COST ESTIMATING
Stuart Kellogg (South Dakota School of Mines and Technology, USA)

The need to serve increasingly diverse learning communities requires a curriculum that not only recognizes alternative modes of thinking but also helps students develop the complex thinking skills required by industry. Classroom inversion or "flipping" can provide a useful framework for this new paradigm by pre-engaging students with the material. The classroom lecture can then be replaced with collaborative problem solving exercises or model eliciting activities. While the most common methods used for pre-engagement include streamed lectures or podcasts, these techniques are subject to some of the same concerns associated with passive lectures or assigned readings. In this paper we present an approach for classroom inversion that is based on three premises: pre-engagement occurs through online interactive modules, classroom lectures are replaced with group problem solving activities, and homework assignments incorporate open ended problems or model eliciting activities. Examples of online interactive modules in accounting and cost estimating are presented. We follow with a discussion of the resultant transformation of the classroom learning environment along with some samples incorporating open-ended problem solving exercises. Preliminary assessments indicating gains in student learning along with future directions and implications for a broader approach to innovation and entrepreneurship is discussed.
F2A: Mini-Workshop: Why are continuous-time signals and systems courses so difficult? How can we make them more accessible?
10:30 am - 12:00 pm
Room: 14

WHY ARE CONTINUOUS-TIME SIGNALS AND SYSTEMS COURSES SO DIFFICULT? HOW CAN WE MAKE THEM MORE ACCESSIBLE?
Mario Simoni (Rose-Hulman Institute of Technology, USA)
Maurice Aburdene (Bucknell University, USA)
Farrah Fayyaz (Purdue University, USA)

The introductory continuous-time signals and systems (CTSS) course is widely considered one of the most difficult courses in electrical and computer engineering (ECE) curricula. This workshop will be an interactive discussion about sources of difficulty and what can be done to help improve student learning and understanding. In the first part of the workshop, discussion will be sparked and encouraged through presentation of historical data and directed questions. The goal will be to advance a continually developing understanding of the problem. In the second part of the workshop, attendees will learn about hands-on activities that are being done at Bucknell and Rose-Hulman to help address what the authors think some of the issues are. Attendees will have an opportunity to attempt one of these activities and provide feedback based on the previous discussion about learning difficulties.

F2B: Special Session: True Grit: Toward a Culture of Psychological Preparedness in Engineering Education
10:30 am - 12:00 pm
Room: 15

TRUE GRIT: TOWARD A CULTURE OF PSYCHOLOGICAL PREPAREDNESS IN ENGINEERING EDUCATION
Jesse Pappas (James Madison University, USA)
Olga Pierrakos (James Madison University, USA)
Eric Pappas (James Madison University, USA)
Kurt Paterson (James Madison University, USA)

The rigors of engineering education present each student with a unique set of academic and psychological challenges. Established interventional strategies are typically focused on enhancing academic - rather than psychological - preparedness, potentially leaving many students vulnerable to various demotivating factors. Participants in this special session will collaborate to develop a nucleus of ideas to inform the future development of psychological preparedness strategies - interventions specifically designed to facilitate productive processes such as self-efficacy, self-discipline, resilience, and motivation.

Session F2C: Online Learning I
Chair: Theodore Manikas (Southern Methodist University)
10:30 am - 12:00 pm
Room: 16

MONITORING THE VIDEO USE FOR LEARNING SUPPORT
Itana Stiubiener (Universidade Federal do ABC - UFABC, Brazil)
Regina Melo Silveira (University of São Paulo, Brazil)
Reinaldo Matushima (University of São Paulo, Brazil)
Wilson Ruggiero (University of Sao Paulo, Brazil)

In this paper we present a tool we developed and an experiment we realized with 2 classes of engineering courses and computer related to network computer subjects, totaling 140 students. In our experiment we divided our students in two groups: half of them attended a video explanation and half of them had the same explanation but only in a traditional classroom format, with a professor teaching the same subject that was explained in the video. This video was offered in a distance learning environment in which we developed an interface to interact with students, applying them a questionnaire about the subject they were watching, observing if they have had any kind of commentary or any interaction with other students, in the LMS system or in a social network environment. At the beginning of the discipline we asked students to realize a learning profile test using a tool we developed and we will also present in this paper some
preliminary conclusions we achieved by the observation of some relationship between students profile and their performance in the discipline, to both groups: with the one that watched the video and with the other that had not watched the video explanation.

**PROGRAMMING TUTORS, PRACTICED CONCEPTS, AND DEMOGRAPHICS**

Amruth N. Kumar (Ramapo College of New Jersey, USA)
Lisa C. Kaczmarczyk (Independent Consultant, USA)

A study was conducted to find out who needed online problem-solving tutors and who benefited from using them. In particular, the study focused on whether there were any significant differences between male and female students and between traditionally represented and under-represented racial groups. Data collected by two Computer Science tutors over multiple semesters was analyzed. The only significant differences found between sexes and racial groups were when female students practiced significantly more concepts because they had solved significantly fewer problems during pre-test, or when they demonstrated greater pre-post increase in score because they had scored significantly less on the pre-test. In both the cases, the tutors helped female students overcome differences in prior preparation vis-a-vis male students. No difference was found between the sexes or racial groups on the number of practice problems solved per practiced concept. Finally, students needed and benefited from the tutors in the same proportion, regardless of sex or racial group.

**AN INSTRUCTIONAL PRACTICE BASED ON HANDWRITTEN ANSWER SHEETS WITH A COURSE MANAGEMENT SYSTEM**

Yuji Tokiwa (Hosei University, Japan)
Makoto Miyazaki (Hosei University, Japan)
Yuki Yamada (Kanematsu Electronics Ltd., Japan)
Etsushi Sato (Fuji Xerox Co., Ltd., Japan)

Since the start of the 21st century, information technology (IT) was introduced in many universities to support effective instruction. One solution intended to support STEM classes took the form of a classroom management system, such as DyKnow Vision, which was different from a course management system (CMS), such as Moodle. This may be because HTML editors on web-based CMSs do not easily allow both instructors and students to produce freehand scientific information such as equations, charts, and illustrations. However, classroom management systems require special devices such as Tablet PCs and force instructors to perform complex system operations. Moreover, in some cases these systems are not necessarily designed to accumulate learning activities for ABET or e-Portfolio. To support both writing by hand and the accumulation of learning activities in a class, the system proposed here, developed on the basis of the key concept of "No special devices in a class,” makes use of sheets of paper and digitizes the papers after the class so that they can be stored in a CMS. A multifunctional peripheral with a digital watermark enables this educational setting. Our demonstration experiment for three classes functioned well. This paper presents a system overview and the preliminary results.

**RETHINKING REMOTE LABORATORIES: WIDGETS AND SMART DEVICES**

Miguel Latorre (Spanish University for Distance Education - UNED, Spain)
German Carro Fernandez (Spanish University for Distance Education - UNED, Spain)
Elio Sancristobal (Spanish University for Distance Education - UNED, Spain)
Alberto Pesquera Martin (Spanish University for Distance Education - UNED, Spain)
Manuel Castro (Spanish University for Distance Education - UNED, Spain)

Until the last decades, students of distance learning universities had to go to traditional and physical laboratories to acquire practical knowledge and skills. Currently, thanks to the advances in communication and computer networks and the evolution of programming languages, new eLearning tools have emerged that enable the usage of learning methodologies such as blended learning and distance learning. One of them is the remote Web laboratory. A remote Web laboratory is an application which allows students to work with real hardware or instruments. To do this, students only need a computer with an Internet connection. However, emerging technologies and other hardware such as mobile devices, cloud computing and the Internet of Things, require the design of different models to support innovative learning experiences. For this reason, remote labs are being reconsidered to smart device paradigm. Physically, the considered smart device is made of the junction of a controller (computer server) connected to physical equipment on the one hand, and to the Internet on the other hand. This paper describes the process to translate a "traditional” remote Web lab into a set of smart devices which are able to work together in the cloud and the Internet of Things.
PACKING AND REUSING VIRTUAL WEB LABORATORIES AS SHARABLE CONTENT OBJECT IN WIDE RANGE OF EDUCATIONAL FIELDS
Irene Bellver Serrano (Spanish University for Distance Education - UNED, Spain)
Elio Sanristobal (Spanish University for Distance Education - UNED, Spain)
Gabriel Díaz (Spanish University for Distance Education - UNED, Spain)
Salvador Ros (Spanish University for Distance Education - UNED, Spain)
Juan Vicente Míguez Camiña (Spanish University for Distance Education - UNED, Spain)
Nuria Oliva (Spanish University for Distance Education - UNED, Spain)
Antonio Colmenar (Spanish University for Distance Education - UNED, Spain)
Roberto Hernandez (Spanish University for Distance Education - UNED, Spain)
Manuel Castro (Spanish University for Distance Education - UNED, Spain)

One of the key issues in the education field is the acquisition of skills. This practical knowledge was usually acquired through traditional labs or standalone simulation programs. The World Wide Web and the advance in web programming language have allowed teachers to create online learning applications, such as virtual web laboratories which can be displayed by Web browser, at any time and everywhere. Currently, a large amount of virtual Web labs can be found in the World Wide Web, and these are able to cover a wide range of educational fields such as physic, chemistry, electronic, medicine, mathematics and languages. This paper describes the process of searching of these laboratories and their packing in Sharable Content Object, following the e-learning standard called SCORM.

AREA: A SOCIAL CURATION PLATFORM FOR OPEN EDUCATIONAL RESOURCES AND LESSON PLANS
Manuel Caeiro (University of Vigo, Spain)
Roberto Pérez-Rodriguez (University of Vigo, Spain)
Javier García-Alonso (University of Vigo, Spain)
Mario Manso Vazquez (University of Vigo, Spain)
Martin Llamas-Nistal (University of Vigo, Spain)

Content curation has emerged as a topic of interest in the last few years in the Internet. It aims at discovering and ordering interesting resources from the web, and sharing them with others. From the profile and past behaviour of users, new resources that may be of interest can be recommended to them. This paper discusses AREA, a content curation platform targeted at teachers, where they can aggregate into shareboards the resources that they find in the web. Those resources can be used in educational activities, which are the building blocks for composing sequences of activities, that are in turn the cornerstones of guides (lesson plans). The educational experiences that result from the use of guides are also contemplated in the platform. The key original feature of AREA is that it extends the concept of content curation, so that, not only contents, but also activities, sequences, guides, and experiences, in addition to other resources such as persons, events and tools, are first-class curable elements in the platform. Therefore, shareboards of teachers can include any of those elements; and all of them can be shared, commented, rated, and also recommended to other teachers.

DISTRIBUTED VERSION CONTROL FOR CURRICULAR CONTENT MANAGEMENT
Srikesh Mandela (Cisco, USA)
Kevin Gary (Arizona State University, USA)

Educators have at their disposal many digital content sources, from textbook publishers to open courseware repositories to specialized collections to shared resources from a network of peers. It is rare one needs to go create new lecture materials, instead one can download and adapt to fit their needs. The proliferation of such resources is expected to result in great productivity for educators, particularly those in higher education where time demands relegate content development to the back-burner. But are we seeing such productivity? Are courseware repositories spawning heavy reuse? Or are issues integrating content to courses causing a loss in productivity and greater frustration? These are the questions being investigated by the Distributed Version Control for Curricular Content Management project. This work-in-progress project has conducted a local faculty survey of curricular content development and used the results to drive the initial implementation of a distributed version control tool for curricular content management.
COEXISTENCE OF CLOUD TECHNOLOGY AND IT INFRASTRUCTURE IN HIGHER EDUCATION
Laurynas Riliskis (Luleå University of Technology, Sweden)
Evgeny Osipov (Luleå University of Technology, Sweden)

Early 2012 Luleå University of Technology started a project on adopting cloud technology for implementing in the university's IT-infrastructure. This work-in-progress article describes the results of its pre-study phase aiming at understanding the feasibility of integrating and/or migrating main IT-infrastructure components into an IaaS system and opening ways for making university's resources more accessible to a wider public. Numbers of logistical, technical and education related challenges make such transition far from being trivial. The article focuses on the educational aspect of the pre-study. Specifically, work flows in education process of several courses in different disciplines in natural and engineering sciences were analyzed from the student and teacher perspectives. In the article a schematic of a sustainable IT infrastructure adjusted to the needs of higher education will be drafted. Further, technical readiness and challenges of using cloud technology for university scale IT-infrastructure are discussed.

WHO ELSE COULD PARTICIPATE IN MY LESSON PLANS?
Agustín Cañas-Rodríguez (University of Vigo, Spain)
Victor Alonso-Roris (University of Vigo, Spain)
Juan M. Santos-Gago (University of Vigo, Spain)
Luis Anido-Rifon (University of Vigo, Spain)
Manuel Fernández Iglesias (University of Vigo, Spain)
Manuel Caeiro (University of Vigo, Spain)

This paper introduces the iTEC SDE (Scenario Development Environment), a recommendation system to assist teachers in the creation of lesson plans. A key functionality of the SDE is the recommendation of people. Basically, taking into account new pedagogical approaches, this system manages information about potential lesson plan contributors and provides recommendations on the best available persons to participate in specific learning activities. The SDE has been developed as a multi-criteria recommender focused on supporting learning activities in particular technological and educational contexts. In this way, it manages information about the devices and applications available in the classroom and the features of the students, such as educational level, language, age, location, etc. The final goal of this system is to support teachers creating lesson plans in which they can develop new pedagogical approaches involving new technologies and external resources, such as people from outside the school. Eventually, this will contribute to engage students and improve learning.

Session F2E: Philosophy of Engineering and Engineering Education II
Chair: Dorothy Jones-Davis (National Science Foundation)
10:30 am - 12:00 pm
Room: 18

SHOULD MAKERS BE THE ENGINEERS OF THE FUTURE?
Shawn Jordan (Arizona State University, USA)
Micah Lande (Arizona State University, USA)

Engineers participate in the Maker movement. Some Makers do not pursue formal engineering education but both the engineering field and their own vocational advancement could readily benefit. We seek to understand Makers and how they are inclusive or exclusive of what can be expected from engineers. From the Engineer of 2020 list of characteristics (National Academy of Engineering, 2004), we highlight practical ingenuity, creativity and lifelong learning for likely opportunities to leverage the Maker experience. The mission of this research is to develop a theory, inductively grounded in data and deductively built on literature, illuminating the knowledge, skills, and attitudes of Makers, describing their pathways in formal engineering education to better inform future innovations in order to improve the practical ingenuity and lifelong learning of our future engineers. Artifact elicitation interviews, based on the method of photo elicitation and critical incident technique interviews will be administered to participants. Results from the inductive and deductive analyses will be triangulated to generate a preliminary theory of Maker knowledge, skills, attitudes, and pathways. This theory, inductively grounded in data and deductively connected to literature, will describe aspects of Makers, along with how their pathways intersect with formal engineering education experiences.
KNOWLEDGE-GENERATION EPISTEMOLOGY AND THE FOUNDATIONS OF ENGINEERING
Stephen Frezza (Gannon University, USA)
David Nordquest (Gannon University, USA)
Richard Moodey (Gannon University, USA)

This paper suggests that the purpose (goal) and manner (method) of knowledge application and generation usefully distinguishes engineering and scientific knowledge. This method could be significantly useful in distinguishing the scientific and engineering components of engineering education, as well as underscored the centrality of social context to engineering work, and engineering values. This paper presents a brief exploration of the epistemology of knowledge, specifically distinguishing the development of scientific knowledge from the development of engineering knowledge. It outlines a pragmatic theory of knowledge which provides a means by which to reliably distinguish, particularly in a learning environment, the critical terms of 'science', 'engineering science' and 'engineering.'

CONTEMPLATIONS ON RESULTS FROM INVESTIGATING THE PERSONAL EPISTEMOLOGY OF COMPUTING
Roger McDermott (Robert Gordon University, United Kingdom)
Iain Pirie (Robert Gordon University, United Kingdom)
Åsa Cajander (Uppsala University, Sweden)
Mats Daniels (Uppsala University, Sweden)
Cary Laxer (Rose-Hulman Institute of Technology, USA)

"Personal Epistemology" is the analysis of the ways in which an individual perceives what constitutes knowledge, its boundaries, how it is justified, and how it is related to learning. While investigation of metacognitive strategies used by students is now an established research topic within Computer Science and Information Technology education, the study of personal epistemology is relatively undeveloped. This is so despite there being significant epistemological issues associated with learning the subject itself, such as those concerned with the way in which programming exercises change from convergent to divergent problems, or the process by which software project management problems very quickly become ill-defined. In this paper, we describe a preliminary investigation into the personal epistemology of two cohorts of computing students. We review some models of personal epistemological development and describe an empirical study in which we investigated the dimensions of epistemological beliefs of two cohorts of computing students. The results show that there appears to be a wide range of epistemological belief amongst computing students. Finally, we make some observations about the importance of personal epistemology for learning in Computer Science and outline further work in this area.

LIBERATING ENGINEERING EDUCATION: ENGINEERING EDUCATION AND PRAGMATISM
Mani Mina (Iowa State University, USA)

This paper will examine the following: The liberating essence of engineering education is the practical/pragmatic elements of engineering. This paper reviews research and activities in pedagogical development of engineering curriculum throughout the last century and especially after the 2nd world war. The paper reviews distinct directions and curriculum trends that dominated engineering education and will raise the main question: "What makes engineering special and different from sciences and mathematics?" The paper builds the supports for reasoning based on findings in the main trends of engineer development to prove that the practical aspects of the engineering fields are the essence that uniquely distinguished the engineering education. Consequently, the pragmatic essence of the engineering (that needs to be reflected in the engineering education) has been (and must be) the unique identifier and the liberating element of the engineering curricula. The idea of liberation is meant as a guiding concept to help educators reflect on pragmatic essence of engineering when balancing between mathematical rigor, scientific basics, and the engineering systems level thinking, as well as common knowledge and methodologies.

FINDING AND FACING THE FRONTIERS AT FIE CONFERENCES
James Rowland (University of Kansas, USA)

Each year since the founding in 1971, Frontiers in Education Conference participants have sought the newest innovations and concepts in engineering education, i.e., the true frontiers at the cutting-edge of the profession. While those frontiers have obviously changed over the past 42 years, the primary objective of identifying and addressing them has remained at the forefront. This WIP paper describes what was perceived as the main frontiers in each of four periods corresponding to the four decades since the first conference by examining papers from two sample conferences in each decade. In
addition to a careful analysis of selected FIE Proceedings, results of a brief survey of long-time FIE leaders and more recent participants are presented as further evidence on identifying the recognized frontiers for each period. Changes during the intervening years of the conference included more formal presentations, required reviews before accepting papers, and references to clearly show the relevance of each paper within the body of knowledge. Currently, papers are categorized as innovative practice, research-to-practice, or research; an emphasis on STEM research nationally has created engineering education departments within universities. Faculty and staff from these departments regularly present their research results at FIE Conferences. The overall goal for conference organizers and program chairs is to make certain not only that accepted papers point to existing frontiers as the major focus of the FIE Conference each year but also include invited speakers, sessions, panels, and keynote addresses that focus on other emerging frontiers.

Session F2F: ECE III
Chair: Aurenice Oliveira (Michigan Technological University)
10:30 am - 12:00 pm
Room: 19

AN EXEMPLARY DESIGN FRAMEWORK: A SMALL-SCALE PROTOTYPE OF HOME AREA NETWORK IN A SMART GRID
Wookwon Lee (Gannon University, USA)

In this paper, with a specific application to a Smart Grid system in mind, we present a small-scale prototype system of wireless networks and design details of the prototype system. From the perspective of undergraduate engineering education and learning, we describe how the project team of undergraduate students has overcome technical obstacles and challenges in successfully completing the prototype system. For an outcome of this project, we also derive a set of laboratory experiments for integration into a laboratory-based course for improvement in learning effectiveness and overall undergraduate engineering education.

BOOLE-WEBLAB-DEUSTO: INTEGRATION OF A REMOTE LAB IN A TOOL FOR DIGITAL CIRCUITS DESIGN
Javier Garcia-Zubia (University of Deusto, Spain)
Luis Rodriguez-Gil (University of Deusto, Spain)
Pablo Orduña (University of Deusto, Spain)
Ignacio Angulo (University of Deusto, Spain)
Olga Dziabenko (University of Deusto, Spain)

This paper describes the integration of a remote lab in a tool for educational digital circuits. Boole-Deusto is an educational software tool featuring truth tables, Karnaugh maps, Boolean expressions, finite-state machines and digital circuits. After creating the design through Boole-Deusto, the user can implement the circuit in a remote lab (WebLab-Deusto) with only a few mouse clicks. The user does not need the technical knowledge, time, hardware equipment and specialized software that would normally be required. These conveniences benefit teachers and students alike, especially those involved in basic courses in digital electronics, both at the university and high school levels.

SYSTEM DESIGN: A NOVEL, PROJECT-BASED COURSE CONNECTING THE DOTS OF THE ELECTRICAL ENGINEERING CURRICULUM
Sami Khorbotly (Ohio Northern University, USA)
Khalid Al-Olimat (Ohio Northern University, USA)
Srinivasa Vemuru (Ohio Northern University, USA)

The four year curriculum of the Electrical Engineering program includes a fairly diverse set of classes covering topics including electronics, electromagnetics, signal processing, power & energy, digital systems, as well as communication and control systems. While these topics constitute the core components in the technical education of a future electrical engineer, a major missing component is the holistic, system understanding of these individual topics. This paper describes a class addressing the integration of the technical topics in addition to defining the overall architecture, the modularity of complex systems, as well as the interfaces between the different components to satisfy design requirements. The new class is a project-based, one credit-hour class with a single weekly meeting in a laboratory environment. The paper describes the assigned projects as well as their proposed solutions. The paper also includes assessment data including student feedback from the first class offering. Assessment shows a great student enthusiasm
towards the class. It also shows that the class improved the student’s conceptual knowledge, knowledge retention, and problem solving skills.

**AN APPROACH FOR TEACHING LOGIC PROGRAMMING BASED ON REAL-WORLD APPLICATIONS**
Alexsandro Soares (Federal University of Uberlândia, Brazil)
Carlos Lopes (Federal University of Uberlândia, Brazil)
Paula Souza (Federal University of Uberlândia, Brazil)
Sérgio Peres (Federal University of Uberlândia, Brazil)

In this paper the authors describe their approach towards motivating students in the learning of logic programming is given. The focus here of the authors is on real world applications. Nowadays, where internet applications are still a hot topic, the development of projects related to internet applications are quite strongly motivated. Unfortunately, many of the resources used in logic programming that help us to explore the development of programs for internet purposes are not so freely available. The authors therefore had to develop much of the material used in order to be understood by first year university students, who were in fact the target group. Preliminary results showed an augmented interest in the learning of such concepts and as a result an increase in the pass rate was achieved.

**ENHANCING MICROELECTRONICS EDUCATION USING ONLINE SEMICONDUCTOR TECHNOLOGY CAD LABORATORY**
Chinmay Maiti (IIT Kharagpur, India)
Ananda Maiti (Vellore Institute of Technology, Australia)

Currently semiconductor devices, VLSI circuit design and fabrication are specialized fields in electrical engineering curricula. Due to the high cost of microelectronic fabrication laboratories, teaching microelectronics is very much driven by the availability of resources and is mainly being taught at universities where a fabrication facility is available. As such, microelectronics engineering education is in transition. New thoughts are being given to topics such as what constitutes microelectronics process design fundamentals, how to shrink the gap between industrial and academic perspectives on process design and how to help students gain more experience and knowledge. This paper proposes and discusses an efficient teaching methodology for micro- and nano-electronics education. A Technology CAD (TCAD) course integrated with an online simulation laboratory at undergraduate/graduate level. The aims of the course are the development of theoretical and practical skills in semiconductor manufacturing using virtual wafer fabrication. It is expected that the students shall have increased affinity towards semiconductor fabrication, improved their academic skills, abilities and knowledge. The impact of the proposed teaching method on the learning process will be presented.

**INSIGHTS FOR CURRICULUM DESIGN FROM DESIGN RESEARCH**
Arun Srinivasa (Texas A&M University, Qatar)
Jeffrey E Froyd (Texas A&M University, USA)
Ramanathan Guha (Google, Inc., USA)

The paper considers how research in product/process design methodologies can be used to design engineering curricula. Following the Function-Behavior-Structure (FBS) framework for product design, we show how the curriculum design task can be separated into functionality of the curriculum, student behaviors and course structures. We then describe possible ways in which such a design could help us explore the possibilities of designing different types of curricula with the same functionality so that we could develop flexible, fault tolerant, scalable curricula that evolves with changing circumstances. These requirements are not generally included as curriculum design criteria and an approach that highlights the role of "robustness" would be useful.
USING BACKWARDS DESIGN PROCESS FOR THE DESIGN AND IMPLEMENTATION OF COMPUTER SCIENCE (CS) PRINCIPLES: A CASE STUDY OF A COLOMBIAN ELEMENTARY AND SECONDARY TEACHER DEVELOPMENT PROGRAM
Camilo Vieira (Purdue University, USA)
Alejandra J. Magana (Purdue University, USA)

This paper describes the outcomes of a three-day teacher professional development workshop aimed at introducing concepts, principles and practices of computational thinking. The guiding research question for this study was: How teachers implement the backwards design process embodying elements of CS Principles (i.e., computational thinking big ideas and computational thinking practices) in the context of their classrooms? The participants of this study included 15 elementary, high school and college level teachers who are also graduate students from a master program in engineering. As part of the workshop participants developed a learning activity that included a set of learning objectives, the design of computational thinking related activities considering appropriate pedagogical strategies, and the integration of mechanisms to evaluate students' performance. Here we describe (a) how participants embodied the CS Principles in the design of learning activities to be integrated into their classrooms, (b) how they used the backwards design process as a tool to implement elements of the CS Principles and (c) what is teachers' performance in integrating CS Principles to the design of learning activities as evidenced by their peer evaluations. Finally, we propose the use of backwards design process together with the CS Principles as a framework for the design of computing learning activities and the development of teacher professional development programs in computing education.

UNDERSTANDING THE MOTIVATION OF INSTRUCTORS TO GET INVOLVED IN SERVICE-LEARNING ENVIRONMENTS
John Mendoza-Garcia (Purdue University, USA)
William Oakes (Purdue University, USA)
Carla Zoltowski (Purdue University, USA)
Monica Cardella (Purdue University, USA)

Professional associations of engineering have recommended Service Learning environments to cultivate professional engineering skills. However, a report from ASEE published in 2012 showed that faculty did not consider these learning environments to be important. This study aims to address this gap through understanding the motivation of instructors of Service-Learning programs in engineering. The results can be used to propose strategies to attract faculty toward these effective engineering learning environments.

INSTRUCTIONAL MODULE DEVELOPMENT (IMOD) SYSTEM: BUILDING FACULTY EXPERTISE IN OUTCOME-BASED COURSE DESIGN
Odesma Dalrymple (Arizona State University – Polytechnic Campus, USA)
Srividya K Bansal (Arizona State University – Polytechnic Campus, USA)
Kavitha Elamparithi (Arizona State University – Polytechnic Campus, USA)
Husna Gafoor (Arizona State University – Polytechnic Campus, USA)
Adam Lay (Arizona State University – Polytechnic Campus, USA)
Sai Shetty (Arizona State University – Polytechnic Campus, USA)

A well-designed and constructed course plan or curriculum is an integral part of the foundation of effective STEM instruction. This paper presents a framework for outcome-based course design process and its translation into a semantic web-based tool; i.e., the IMODTM system. This system guides STEM educators through the complex task of curriculum design, ensures tight alignment between various components of a course (i.e., learning objectives, content, assessments, and pedagogy), and provides relevant information about research-based pedagogical and assessment strategies. The theoretical framework is presented, along with descriptions and screenshots of the implementation of key features.

IMA-TOOL: A TOOL FOR MODELING AND AUTOMATIC GENERATION OF EDUCATIONAL CONTENT
Vanessa Araujo Borges (University of São Paulo, Brazil)
Ellen Barbosa (University of São Paulo, Brazil)

In this paper we discuss the establishment and application of IMATool - a web-based tool for the modeling and automatic generation of educational content. The tool is based on IMA-CID, an approach for modeling educational content, capable of addressing conceptual, instructional and didactic issues altogether, in an integrated way. IMA-CID
and IMATool have been applied in the development of an educational module for software testing. The preliminary results indicate the effectiveness of such mechanisms for modeling and generating content.

Session F2H: Design and Assessment
Chair: Deborah Munro (University of Portland)
10:30 am - 12:00 pm
Room: 2

DATA BASE DEVELOPMENT FOR SCHOOL-RELATED RESEARCH
Mariana Tafur (Purdue University, USA)
Heidi Diefes-Dux (Purdue University, USA)

During 2008, the Institute for P-12 Engineering Research and Learning (INSPIRE) began a research project that started with 19 teachers and more than 200 students who were educated, interviewed, and assessed for STEM learning. This longitudinal study grew fast, gathering numerous pieces of data from 168 teachers and more than 3,000 students during the five-year treatment. This information growth led to a need for data management improvement. However, there are few database structures available for gathering school-related research. This paper presents lessons learned during the process of database construction and improvement for supporting project data consolidation. The process of construction and development included structural changes to provide an organization commensurate with schools' clusters, domains, and strata, all of which occur organically in the school setting. The database construction also included program development for uploading and cleaning large amounts of information; application analysis for defining an appropriate tool; and improvements for user information visualization. The analysis of lessons learned includes a discussion of major changes within the database and benefits of creating program codes within this tool. The discussion ends addressing the implications of having a structured and automatized yet flexible database tool designed for school settings.

ASSESSING THE IMPACT OF SERVICE-LEARNING ON FIRST-YEAR ENGINEERING STUDENTS' UNDERSTANDING OF HUMAN-CENTERED DESIGN
Roy B Melton (Purdue University, USA)
Monica Cardella (Purdue University, USA)
William Oakes (Purdue University, USA)
Carla Zoltowski (Purdue University, USA)

This paper represents an update of a three stage research project that culminates in investigating the impact of the service-learning pedagogy on students understanding of human-centered design. The first two stages of the project were disseminated in previously published papers where we discussed the discovery of distinct ways in which students experience human-centered design, along with another published paper discussing the development of an assessment task that would expose and capture students' understanding of human-centered design.

A PILOT STUDY: DOCUMENTING ENGINEERING SCHOOL SYSTEMS THAT SUPPORT HIGH STUDENT RETENTION
Brian Yoder (American Society for Engineering Education, USA)

The American Society for Engineering Education (ASEE) has engaged with the engineering education community to define and pilot the current best approaches for systematically collecting and analyzing student success data. Out of these efforts, ASEE has developed a survey that provides reliable, broad-based data for national retention and time-to-graduation benchmarks. ASEE plans to build on its retention and time-to-graduation survey and work collaboratively with engineering schools using a design-based implementation research approach [1] and plans to document engineering school systems that support high student retention, with a pilot that focuses on schools that excel at retaining engineering students who are from the regular majority (i.e., schools that admit students through less selective admission requirements but are able to retain those students at high rates).
OUT OF THEIR WORLD: USING ALIEN-CENTERED DESIGN FOR TEACHING EMPATHY IN UNDERGRADUATE DESIGN COURSES
Shawn Jordan (Arizona State University – Polytechnic Campus, USA)
Monica Cardella (Purdue University, USA)
Micah Lande (Arizona State University – Polytechnic Campus, USA)
Hadi Ali (Purdue University, USA)

Designing for others is a paramount focus of teaching user-centered engineering design. This paper presents a novel engineering design brief presented to undergraduate engineering students to design for extra-terrestrials scheduled to visit their collegiate campus. Through this alien-centered design approach, students are pushed to develop empathy for a group of users quite different from themselves and to conceive and design within such an given context. A detailed plan of action is described for both cases with detailed deliverables aligned to course learning objectives. Examples of the interactions students make with their extra-terrestrial users are listed and examples of student work and final deliverables are highlighted. Reflections from the end of project are also included from students and instructors alike. The work presented here may serve as a building block to these types of successful engineering design projects in the classroom.

PREPARING FUTURE ENGINEERING STUDENTS THROUGH MATH COMPETITION IN INLAND AREA
Ziliang Zhou (California Baptist University, USA)

MATHCOUNTS is a national program aimed at enhancing problem solving skills for middle schools students through a series of math competitions at the local, state and national levels. Currently in its 30th year, MATHCOUNTS is one of the country's largest and most successful education partnerships involving volunteers, educators, industry sponsors and students. As an extracurricular activity, MATHCOUNTS recognize and reward students for pursuing a deeper understanding of math concepts and their applications in science, technology, and engineering (STEM) fields. In this paper, I shall describes the effort made by the College of Engineering of California Baptist University in organizing the annual MATHCOUNTS Chapter competition for Inland Empire area and encouraging engineering careers among the local middle school students. After initial background introduction of the MATHCOUNTS program, the paper will focus on the growth of the MATHCOUNTS program in Inland Empire area during the last five years, the detail aspects of organizing this important competition, and the linkage between the competition and the career choices among the students involved in the competition. The long term goal of organizing this competition is to further promote and improve K-12 STEM education so that more students will choose engineering as their future careers and more students will be better prepared for the engineering careers they choose.

AN INITIAL COMPARISON OF THE LEARNING PROPENSITIES OF 10 THROUGH 12 STUDENTS FOR DATA ANALYTICS EDUCATION
Jamie Kennedy (Drexel University, USA)
Pramod Abichandani (Drexel University, USA)
Adam Fontecchio (Drexel University, USA)

The main focus of this ongoing effort is to compare the learning propensities of 10 through 12 students for data analytics education. Towards this end, a Microsoft Excel based university-level environmental engineering module was taught in a high school classroom with students in grades 10 through 12. The module focused on understanding the current trends and challenges in environmental pollution management and policy. Students were required to procure, analyze, and visualize data in order to propose an environmental policy that was aimed at reducing pollution. Initial data collected from the assessment of the student work alludes to the fact that despite being taught the same material by the same professor and teaching assistant, the success of the students, as measured by their final grades, varies substantially with their academic year. The underclassmen in high school did not display the academic maturity and comprehension that was displayed by the high school seniors. On the other hand, seniors demonstrated a strong propensity to learn and perform well.
EMBEDDING DESIGN AND SERVICE-LEARNING INTO THE K-12 COMPUTER SCIENCE CLASSROOM
Mindy Hart (Purdue University, USA)
William Oakes (Purdue University, USA)

In the pre-university setting, computer science course assignments are often project-based, but seldom do they include real-life problems in real time. Many assignments are strictly dictated by what textbooks suggest as valuable learning experiences, as long as they can be completed in just a few class periods. The number of students taking a computer science course continues to dwindle, as does the number of teachers certified to teach computer science. Building on two case studies of EPICS High in computer science classrooms, this paper will open discussion and explore novel ways of engaging computer science teachers and students through compelling community-based service-learning projects using engineering design concepts. As it is EPICS High’s mission to be a leader in developing, disseminating, and supporting service-learning models that engage high school students in engineering and computing-based design projects that meet the needs of their communities, EPICS High intends to build relationships with computer science teachers to learn the best way this model can be implemented in their courses and help these teachers pilot an EPICS project that connects with their community.

AN INNOVATIVE APPROACH TO SECONDARY MATHEMATICS FOR ENGINEERING AND SCIENCE
Joshua Coriell (Cyber Innovation Center, USA)
Krystal Corbett (Cyber Innovation Center, USA)

The purpose of this paper is to provide a framework for NICERC's Advanced Math for Engineering and Science (AMES) curriculum that will lead to a series of studies on various aspects of the curriculum. Included in the paper is a description of the content, an explanation for the integration of AMES with other curricula, and a description of the professional development for AMES. AMES is a high school curriculum aimed at integrating multiple disciplines in order to provide context for the mathematics concepts used daily by engineers and scientists. This paper begins by discussing the structure of AMES. The structure is based on an analytic geometry approach to concepts taught in high school and post-secondary institutions combined with a multidisciplinary approach providing the context. Additionally, the paper outlines a broad description of the content in AMES and how multiple disciplines such as history, physics, and American government are incorporated into various lessons. This paper then demonstrates how other curricula are interwoven into AMES. Lastly, the paper includes a description of the professional development component of AMES. This section discusses how the professional development engages teachers prior to implementing the course.

F3A: Special Session: What is the Role of MOOCs in Engineering Education?
1:30 - 3:00 pm
Room: 14

WHAT IS THE ROLE OF MOOCS IN ENGINEERING EDUCATION?
Susan Finger (National Science Foundation, USA)
Amy Chan Hilton (National Science Foundation, USA)
Jeremi London (National Science Foundation, USA)
Cynthia Young (University of Central Florida, USA)

MOOCs (Massive Open Online Courses) are a recent phenomenon that, some believe, will transform higher education. With their low cost and potential to reach a large number of students, MOOCs have the potential to broaden access to education at all levels. The capabilities of the technology and its widespread distribution make interactive online learning possible at any time, in any place, at any pace. Unfortunately, however, MOOCs have infiltrated higher education at such a rapid pace that there has been little time for large groups of educators to have meaningful discussions about how MOOCs can be leveraged to support student learning. This special session is designed to meet this need. There are two main goals of this interactive session. The first is to bring together a panel of diverse experts and engineering educators to provide an opportunity for them to exchange ideas about the potential of MOOCs to transform engineering education. A second goal is to build a community of engineering educators interested in MOOCs, and identify a set of research questions regarding MOOCs and student learning. In light of these goals, the intended audience for this session is engineering faculty interested in learning about and using MOOCs.
F3B: Special Session: Defining and Assessing Engineering Ethics  
1:30 - 3:00 pm  
Room: 15

DEFINING AND ASSESSING ENGINEERING ETHICS  
Carla Zoltowski (Purdue University, USA)  
William Oakes (Purdue University, USA)  
Patrice Buzzanell (Purdue University, USA)

The motivation of the special session was to allow engineering educators and researchers to experience two different instruments intended to assess ethical reasoning—one which measures general moral reasoning, and one that is situated in the engineering context—so they can identify the knowledge, skills, and attitudes that are specific to engineering. This will inform how we teach and assess engineering ethics, and equip educators with tools for using these instruments as part of the student learning. The special session format will allow for discussion and debate on the relevance of the approach and appropriateness for our own classrooms.

Session F3C: Approaches to Student-Centered Learning III  
Chair: Asad Azemi (Pennsylvania State University)  
1:30 - 3:00 pm  
Room: 16

ILL-STRUCTURED PROBLEM SOLVING IN A WORKPLACE SIMULATION ENVIRONMENT: CHALLENGES OF THE LEARNING EXPERIENCE AND SKILLS DEVELOPED  
Marija Božić (Autonomous University of Barcelona, Spain)  
Svetlana Čizmić (University of Belgrade, Serbia)  
Dragana Šumarac Pavlović (University of Belgrade, Serbia)  
Jelena Ćertić (University of Belgrade, Serbia)  
M. Teresa Escalas Tramullas (Autonomous University of Barcelona, Spain)

Engineering workplace problems are complex and ill-structured. Students should be faced with this kind of problems during their studies in order to be better prepared for the workplace. However, there is still little evidence on the strategies to support students’ learning during workplace problem solving. The general objective of our on-going research is to identify teaching strategies that would best support students in solving ill-structured problems while preparing them to step into the work environment after graduating from the conventional engineering curricula. To this end we designed the professional practice course for final year Information and Communication Technology (ICT) engineering students. Educational principles applied include problem and project based learning, workplace simulation and experiential learning. In this paper we describe the research design that centers on determining the challenges that students perceive during different phases of ill-structured problem solving process, with relationship to their learning styles and skills development.

INFORMATION AND COMMUNICATION TECHNOLOGIES LITERACY FROM ENGINEERING STUDENTS AT THE UNIVERSITY OF BUENOS AIRES  
Osvaldo Clua (Universidad de Buenos Aires, Argentina)  
Maria Feldgen (Universidad de Buenos Aires, Argentina)

A survey concerning literacy in Information and Communication Technology (ICT) was held at the School of Engineers of the University of Buenos Aires. The overall aim was to state if ICT literacy can be considered as an existing background among our student population. In addition we wanted to identify possible environments where students and faculty can interact and learning is possible. Building such environments is highly dependent on previous experience of students to ICT and its breadth of use. In this work we detail the survey results, draw some conclusions and outline some considerations on how to deal with ICT in the classroom.
"UNMUDDYING" COURSE CONTENT USING MUDDIEST POINT REFLECTIONS
Adam R Carberry (Arizona State University, USA)
Stephen Krause (Arizona State University, USA)
Casey J. Ankeny (Arizona State University, USA)
Cindy Waters (North Carolina A&T State University, USA)

Class instruction is a living and ever-evolving process aimed at providing students with a quality education. Instructors are responsible for analyzing their courses to ensure that delivery of information is effective. Changes made are usually based on student assessments; however, our reactions to assessments are flawed without student insight. One method to obtain student feedback is through muddiest point reflections. This activity asks students to reflect on what was just taught allowing students the opportunity to share what was "muddy". This mixed-methods study provides vignettes from faculty members on their use of muddiest point reflections and an assessment of what value students associate with such an intervention. Faculty members who have used this approach say it drives change within their classes. The analysis of student value beliefs revealed muddiest point reflections as an intervention that positively impacts interest, attainment, and utility value without negative cost. The appeal of muddiest points was also evident with 77% of students hoping to see muddiest point reflections in another class and 93% agreeing to recommend their course experience to a friend. These findings suggest that students agree more than disagree that muddiest point reflections are a valuable addition to their educational experience.

LEARNING FROM INDUSTRY BY USING AN INQUIRY BASED LEARNING APPROACH
Xiaosong Li (Unitec Institute of Technology, New Zealand)

Inquiry based and constructivist activities can motivate students to take charge of their own learning, understand multiple perspectives and develop high level reasoning skills. This paper describes a case study of six year teaching practice in one of our Master courses. The course requires the students to acquire critically analysis, evaluation and research skills. The course also requires the students to acquire the techniques and technologies related to many aspects of an enterprise website. There are only 32 hours for class meetings so the students have to work by themselves in most of the time. The best way to achieve the course requirements is to use the constructivist activities, let the students individually or collaboratively to work with the relevant partners and build the required knowledge and skills gradually. An assignment was developed which requires the students to investigate different aspects of an enterprise website. To complete this assignment, the students need to use an inquiry based learning approach. The practice is evaluated by using a set of survey data, a set of data observed from the marking reports and the industry feedbacks. The practice is effective, while the practice is improving; the students' abilities of planning, investigating, analyzing, communicating and reflecting are improving as well. The students' contributions are valuable to the industry. The paper also includes a discussion which links the teaching practice with the relevant theories.

SCAFFOLDING STUDENTS IN A COMPLEX LEARNING ENVIRONMENT
Maria Feldgen (Universidad de Buenos Aires, Argentina)
Osvaldo Clua (Universidad de Buenos Aires, Argentina)

The design of distributed systems is a rather complex and difficult task. Distributed systems are complex systems that can be characterized as wicked problems because they involve an intricate combination of changing relationships between their various components. Research shows that it takes a lot of deliberate practice to move from the mindset of a novice to the mindset of an expert. To start cultivating experts design mindset we designed a cognitive support system consisting of a suite of mechanisms characterized by mentorship and social interactions around a real-world project. In a problem-based learning environment with cased-based reasoning, students have to follow a systematic approach using a common system of activities of "ritualized" activity structures. The systematic approach is based on the Rational Unified Process, CATs (Classroom Assessment Techniques) with rubrics, and scaffolding: questions prompts, peer-review, expert modeling, and self-reflection. This paper describes the challenges faced by novices and instructors in wicked problems design tasks in the context of developing a prototype and its framework and middleware for a complex distributed application while learning distributed systems concepts. It also outlines our interactive learning environment to scaffold the design and developing process improving student's problem-solving skills and time on-task to reduce frustration.
USING A COMPETENCY-BASED INSTRUCTIONAL APPROACH IN THERMODYNAMICS
Brent Nelson (Northern Arizona University, USA)

Many engineering classes are highly sequential, causing students that fail to grasp initial topics to struggle as courses progress. Despite instructor exhortations to master fundamental subjects, students often continue to struggle instead of investing the time to review. Because students do not proactively re-learn initial content, a competency-based approach was implemented in a highly sequential thermodynamics course. In the approach, students scoring below 80% on the first exam were required to pass an online review quiz in order to take subsequent exams. Only 3 out of 135 students were unable to take the second exam, but all were able to pass by the time of the third exam. Significant increases (p<0.01) were achieved in both the average course grade and average grade on the third (final) exam as compared to the previous offering of the course, with the average grade on the final exam rising from 66.5% to 74.0% and the overall course grade rising from 76.2% to 83.2%. The competency-based structure forced students to review fundamental material that is necessary both later within a course and in subsequent courses, and seems to particularly benefit the poorer performing students. This may have impacts on student retention and persistence.

SHARED NOTE-TAKING USING ELECTRONIC ENHANCED GUIDED NOTES: PEER-REVIEW ACTIVITY, PERFORMANCE, AND SELF-REGULATED LEARNING SKILLS
Harry Santoso (Utah State University, Indonesia)
Oenardi Lawanto (Utah State University, USA)

Literature suggests that note-taking activity helps students in their learning process and successfully increases performance. Previous studies also have suggested that collaborative learning facilitates students to learn from different views of interpreting information. Although many studies have revealed positive correlations between collaborative learning and student performance, few studies have been conducted to investigate peer-review activity, students' performance, and self-regulated learning skills while engaged in shared note-taking using electronic enhanced guided notes. The main research question of the current study was to investigate how students' review frequency of peers' enhanced guided notes and learning performance reflected on their self-regulated learning skills. With regards to this question, we specifically explored differences among students according to their peer-review activity and performance and how the differences reflected on their self-regulated learning skills. Our findings revealed four groups of students based on those differentiation factors. Data analysis showed that while sixty percent of participants were willing to review their peers' enhanced guided notes regularly, sixty-eight percent of participants performed very well on the exams. Results also suggest that willingness to review peers' guided notes positively correlated with planning and cognitive strategies. Implications of the use of shared note-taking in an engineering classroom will be discussed.

ASSESSING STUDENT KNOWLEDGE TRANSFER DURING GROUP WORK
Courtney Faber (Clemson University, USA)
Randolph Hutchison (Furman University, USA)
Lisa Benson (Clemson University, USA)
Adam Kirn (Clemson University, USA)
John DesJardins (Clemson University, USA)

Successful group work requires that students transfer relevant prior knowledge to solve problems. This paper establishes a method to assess dynamic knowledge transfer in a group setting through analysis of a group project in a biomechanics class. Transcripts of student-student and student-instructor interactions were coded for evidence of target tools (students identifying relevant problem features), source tools (students activating prior knowledge), answers (stopping points), external inputs (resources and prompts from individuals or the instructor), and workbench explanations (student explanations of connections between source tools and target tools). Knowledge transfer was identified when a source tool and a target tool were coded within a phrase. The frequencies of codes were quantified to provide an overall picture of knowledge transfer for each group member throughout the project. Analysis for one group (a sophomore and junior bioengineering student, and a freshman engineering student) revealed that the junior was the largest contributor in the group, followed by the sophomore and freshman. The group mentioned source tools most frequently, followed by
external inputs and target tools. The analysis provided evidence of knowledge transfer within the group through their identification of target tools and use of prior knowledge to explain their observations.

**COMPARING LEARNING STYLES QUESTIONNAIRES**

Mauricio Dziedzic (Universidade Positivo, Brazil)
Rebecca Dziedzic (University of Toronto, Canada)
Fernanda Oliveira (Universidade Positivo, Brazil)
Paulo Janissek (Universidade Positivo, Brazil)

The study reported herein considered three questionnaires available for assessing learning styles, viz., Kolb, Honey-Alonso, and Felder-Solomon. The questionnaires were implemented in a spreadsheet with automated results, and distributed to subjects of both genders, and varying age, and academic background. The aim of the work was to determine which questionnaire, if any, would be preferred by respondents. The respondents were asked to answer all three questionnaires, examine the results and indicate their satisfaction by grading each result, using a scale between 0 and 10. While the results given by each questionnaire do not allow a complete comparison, partial agreement was possible to identify. Answers provided by 52 respondents have been processed, which show that, while there is no statistically significant difference among the preference of respondents regarding the three options, a slight preference for the Felder-Solomon questionnaire is discernible.

**LEARNING IN STYLE: CORRELATION OF LEARNING STYLES WITH PROBLEM COMPREHENSION AND PERCEPTIONS IN AN INTRODUCTORY CHEMICAL ENGINEERING COURSE**

Elif Eda Miskioglu (The Ohio State University, USA)
David Wood (The Ohio State University, USA)

Learning styles are emphasized as being preferences for how an individual learns and indicators of how studying should be approached, rather than indicators of success. This has not, however, prevented researchers from exploring whether student performance can be dependent on matching question type to learning style. In a study of medical students, Cook et al. failed to establish such a correlation. However, small sample size and the inherently high inclination of the sample population to succeed were likely high contributing factors. Further, preferences are adaptable by education, and this study was conducted with advanced students. We are interested in the correlations between learning style preferences, task perception, and student performance in the context of an introductory chemical engineering material balances course. Assignments have a natural degree of learning style bias, and we are looking to see if student preferences correlate with their performance and perceptions when these biases are considered. Results will provide evidence regarding whether learning styles can affect student performance, as well as identify naturally occurring biases in chemical engineering problems that are translatable to other fields. A better understanding of student background and learning preferences is invaluable in developing improved curriculum, especially in the ever-changing modern classroom.

**IDENTIFYING MISCONCEPTIONS HELD ABOUT THE ENGINEERING DESIGN PROCESS**

Susan Donohue (University of Virginia, USA)

The primary goal of the research presented in this work-in-progress paper is to identify misconceptions held about the engineering design process. Identification is the first step in the development of a concept inventory, an instrument for assessing misconceptions. While there are several methods for assessing misconceptions, concept inventories are an excellent method for assessing a group of students. The distractor questions identify misconceptions and possible causes for them. Misconceptions coded from student responses to incomplete scenarios of the engineering design process include the idea that engineering is solution driven instead of problem/client need driven and that engineering is merely fabrication. Future work will develop, test, and validate a concept inventory for engineering design with questions based on identifying these misconceptions as well as misconceptions identified through follow-up work.
THE EFFECTS OF DIRECT OBSERVATION ON STUDENT RESPONSES IN THE RENEWABLE ENERGY REU PROGRAM AT COLORADO SCHOOL OF MINES
Scott Strong (Colorado School of Mines, USA)

The Cornell Office for Research on Evaluation (CORE) Systems Evaluation Protocol (SEP) is a guide to evaluation, emphasizing systems modeling principles, facilitating the creation of evaluation plans with clear, specific and measurable outcomes. In 2011, CORE SEP techniques were applied to the Renewable Energy Materials Research Science and Engineering Center (REMRSEC) National Science Foundation (NSF) funded Research Experience for Undergraduate (REU) site and revealed two very different pathways leading to the critical outcome of students obtaining post-baccalaureate jobs in technical fields related to renewable energies. While the experiences within a student's research group defined a clear evaluation pathway, a second pathway characterizing student attitudes shaped by the REU community at-large also emerged. This created an interesting question on the effects direct observation has on evaluation data. In response the REMRSEC REU SEP evaluation plan saw different implementations from 2011 to 2012. While both employed similar measures, the 2012 evaluators intervened only digitally. In this paper we summarize the REMRSEC REU and its CORE SEP evaluation plan. We conclude with comparison of the two evaluation implementations and speculate on how evaluator role affects the gathered data. Lastly, we discuss plans to hybridize previous implementations into the 2013 cycle.

MORE GRAPH COMPARISON TECHNIQUES ON MIND MAPS TO PROVIDE STUDENTS WITH FEEDBACK
Peter A Jamieson (Miami University, USA)

One of the limiting aspects in education research is the techniques available for determining if a student has learned something. In this work, the goal is to extend our exploration of how mind maps can be automatically analyzed using their graph properties to reflect student learning. In particular, a set of student mind maps are created three times during a class in both 2011 and 2012 on digital system design using a common technical vocabulary. These mind maps are analyzed by extracting graph metrics by comparison with a criterion mind map, which is an expert created mind map. The metrics are derived from traditional graph metrics (average degree and graph density), three sets of difference metrics analyzed with a internally created tool, and a graph metric invented for comparing proteins. The results of this exploratory analysis is that five of the six metrics can be used to evaluate if a student is learning and connecting the vocabulary in a given subject over time. Additionally, these five metrics are correlated to one another. This result is promising, but we emphasize that these metrics do not correlate directly to class performance based on student grades over the course, and therefore, the current goal for this measurement technique is to be used to provide the student with automated feedback on their mind maps as related to the technical vocabulary of a course. This work extends our original work in by increasing the number of graph metrics that are used to automatically analyze student maps to a criterion map. The idea is to find a number of graph metrics that can then be combined to help analyze a students mind map and provide them with useful feedback. Even though our results show that there are 5 metrics that correlate to one another and each metric can be used to observe student improvement, each of these metrics differs in how the metric can be interpreted and related to the process of learning. Therefore, our goal is to find a number of these metrics so that they can be combined to provide the student with a variety of feedback results to help them understand their errors in terms of the structure of their mind map.
The assessment of learning outcomes is a key concept in the European Credit Transfer and Accumulation System (ECTS) since credits are awarded when the assessment shows the competences which were aimed at have been developed at an appropriate level. This paper describes a study which was first part of the Bologna Experts Team-Spain project and then developed as an independent study. It was carried out with the overall goal to gain experience in the assessment of learning outcomes. More specifically it aimed at 1) designing procedures for the assessment of learning outcomes related to these compulsory generic competences; 2) testing some basic psychometric features that an assessment device with some consequences for the subjects being evaluated needs to prove; 3) testing different procedures of standard setting, and 4) using assessment results as orienting feedback to students and their tutors. The process of development of tests to carry out the assessment of learning outcomes is described as well as some basic features regarding their reliability and validity. First conclusions on the comparison of the results achieved at two academic levels are also presented.

**A SYSTEMS APPROACH TO MANAGING LEARNING BASED ON BLOOM´S REVISED TAXONOMY TO SUPPORT STUDENT ASSESSMENT IN PBL**
Ariane Rodrigues (University of Pernambuco, Brazil)
Simone Santos (Federal University of Pernambuco & Recife Center of Advanced Studies and Systems, Brazil)

The dynamism and intensity of the adoption of practical learning problems (PBL) provide adverse effects contrary to traditional learning approaches. The difficulty in defining clear educational objectives aligned to appropriate forms of assessment is also a recurring challenge in the management of learning environments. As a response to this state of affairs, this paper presents an approach to a system for managing learning based on PBL that makes use of Bloom's revised taxonomy to support planning and assessment activities. The model was implemented using prototypes with low-fidelity screens and its applicability with regard to the conduct of teaching using PBL was found to be valid.

**TOWARDS AN ADAPTIVE SYSTEM FOR THE EVALUATION OF NETWORK SERVICES**
Antonio Robles-Gómez (Spanish University for Distance Education - UNED, Spain)
Salvador Ros (Spanish University for Distance Education - UNED, Spain)
Roberto Hernandez (Spanish University for Distance Education - UNED, Spain)
Llanos Tobarra (Spanish University for Distance Education - UNED Spain)
Agustin Caminero (Spanish University for Distance Education - UNED, Spain)
Rafael Pastor Vargas (Spanish University for Distance Education - UNED, Spain)
Miguel Rodriguez-Artacho (Spanish University for Distance Education - UNED, Spain)
Manuel Castro (Spanish University for Distance Education - UNED, Spain)
Elio Sancristobal (Spanish University for Distance Education - UNED, Spain)
Mohamed Tawfik (Spanish University for Distance Education - UNED, Spain)

This paper presents a new educational system to automatically adapt the evaluation activities to the students' needs in the context of Higher Engineering Education. As an example, a subject focused on the configuration of network services has been chosen to implement our proposal. Therefore, the system will be able to guide each student through the learning process based on his/her particular knowledge-level. In addition to this, specific techniques are needed to dynamically evolve the system depending on the students' progress. In our case, this is analyzed by using data mining techniques. Finally, we show survey results, which illustrate the ease of use and usefulness of the system.
ONCE AGAIN AROUND THE DOUBLE TRIANGLE: A MULTI-RATER ASSESSMENT OF CAPSTONE DESIGN SKILLS

Daniel Knight (University of Colorado Boulder, USA)
Daria Kotys-Schwartz (University of Colorado Boulder, USA)

The Senior Capstone Design Course serves as an opportunity to develop crucial skills in professionalism and design that are necessary for succeeding in industry post-graduation. This study delves into the effectiveness of a senior Mechanical Engineering Capstone Design Course for the development of professional and technical skills including: project management, design, engineering methods, communication and teamwork. A triangulated assessment was performed to evaluate the development of student skills using a survey administered during the middle and end of the Senior Capstone Design Course. This survey was administered to the students, team Faculty Advisors and team Industry Mentors. After analysis, it was found that teams made a significant gain pre to post in engineering methods, project management, and design skills. Communication skills remained at an acceptable level while teamwork skills dropped significantly in the second semester due to difficulties resolving interpersonal conflicts.

Session F3F: Learning Approaches in ECE
Chair: Robert O’Connell (University of Missouri-Columbia)
1:30 - 3:00 pm
Room: 19

TEACHING COMPUTER NETWORKS: A PRACTICAL APPROACH USING VIRTUALIZATION TOOLS
Paulo Gurgel (University of São Paulo, Brazil)
Ellen Barbosa (University of São Paulo, Brazil)
Kalinka Branco (University of São Paulo, Brazil)

Virtualization tools, useful softwares that enables tests and evaluation of functionalities, have been used in computer network classes to provide an environment for practice experiments. Although some papers describe these tools and their technical benefits, they do not provide quantitative information about its effectiveness. This paper presents a proposal for systematic use of this category of tools in computer classes and a evaluation of the Netkit tool use in computer network classes. It will be shown how tutorial sections have been developed to these courses, the receptivity from the students through surveys and a statistical analysis of how much students grades can be improved by applying such tutorials. Finally, it will be possible to conclude that, in fact, the use of such tools is strongly advised.

PEER-LED TEAM LEARNING: ADJUNCT TO LECTURES IN AN ELECTRICAL ENGINEERING COURSE FOR NON-MAJORS
Jack Mottley (University of Rochester, USA)
Vicki Roth (University of Rochester, USA)

Peer-Led Team Learning (PLTL) is a recognized model for teaching and learning in which students who have done well in a course return in later semesters to serve as Peer Leaders to facilitate small learning groups. At our university (a small, private, research-intensive university) this technique is adopted in Workshops, in which Peer Leaders meet weekly with small groups of students and guide them through sets of exercises designed by the instructor(s) of the course. Peer Leaders receive instruction and support in pedagogy and group dynamics in a course jointly taught by a Learning Specialist from the Center for Excellence in Teaching and Learning (CETL) and the instructor of the course. Workshops were originally developed in Organic Chemistry, and have been adapted to many other courses, ranging from Biology, Earth Sciences, Physics, and Optics, to Economics and Business. This presentation will report on the use of Workshops for several years in an Electrical and Computer Engineering (ECE) course intended for non-ECE majors. Only one section of the course is offered each year, so direct comparison of grades or other numeric outcomes between "treatment" and "non-treatment" groups is not possible. The course also changes a bit from year to year as some topics receive greater or lesser emphasis depending on the needs of the students and their background. The materials used in the Workshop sessions are also revised a little from year to year, along with the ways different Workshop Leaders present and handle them. We will discuss the processes and pitfalls for initiating the use of Workshops in this and other courses, present examples of Workshop problems and questions currently in use, and discuss the value of the Workshops to students, Peer Leaders, and faculty as told to us in surveys, course journals, and reflective sessions held after the course.
CONCEPT MAPS: AN AUTOMATED SUPPORT FOR MONITORING THE LEARNING PROCESS
Davidson Cury (Universidade Federal do Espírito Santo, Brazil)
Crediné Silva de Menezes (Federal University of Rio Grande do Sul, Brazil)
Rosane Aragon (Federal University of Rio Grande do Sul, Brazil)

It is vital for a constructivist teacher to monitor the apprenticeship of each student in order to facilitate the definition of the next steps in the development of a discipline. This is a very time consuming and it requires a theoretical framework to support the observations of the teacher. This monitoring would benefit from certain automated tools to expedite parts of the process. Different pedagogical approaches say that the use of concept maps can help students in the processes of signification of new contents or in the resignification of those already learned. The epistemological position of Piaget states that the development of a student's logical-mathematical structures is related to the learning of concepts, forming in this way a conceptual system. In the construction of concept maps we create, ultimately, what Piaget calls “significant implications” that evolve according to the semantic nature of the conceptual relations that we create. We propose here an environment for the automatic identification of the significant implications, using a family of software agents guided by an ontology. The analysis of maps will be made based on Piagetian theory. A prototype is under development and will be used to support the analysis of maps produced.

ENHANCING STUDENT MOTIVATION IN TARGETED UNDERGRADUATE EDUCATION
Kemal M Bayrakceken (Turkish Air Force Academy, Turkey)
Ersan Oguz (Turkish Air Force Academy, Turkey)
Aydemir Arisoy (Turkish Air Force Academy, Turkey)

Future aims of an undergraduate student are likely to evolve during the education timeline. While new knowledge and experiences emerge into students mind, the way of thinking and decision making matures, hence builds up student’s mental and academic perspective. This whole progress embodies a natural motivation as a result of ongoing “change”. However, a targeted undergraduate education may suffer from the deficiency of this natural motivation where the students are partially aware of the future awaiting them. Military academies are good examples of targeted education, since the students have substantial amount of knowledge about their career alternatives. It is up to the instructor to overcome the negative effects of this situation. The instructor, being acquainted with the practical aspects of the courses, can build solid connections between conceptual knowledge and real-world applications where possible. For instance, it is natural that Air Force Academy students are best motivated with flight and related activities. Hence, using flying platforms, flight dynamics and similar content in experimental studies and in-class demonstrations will play a vital role in motivating students for academic study. In this sense, a four rotor aerial experimentation platform is designed, built and utilized for courses and laboratories. Here learning objectives/outcomes of in-class demonstrations are emphasized rather than technical details which are given in previously published articles. The method is evaluated by student surveys and instructor observations.

A SEMI-AUTONOMOUS EMBEDDED SYSTEMS COURSE
John Oliver (Cal Polytechnic State University, USA)
Lynne Slivovsky (Cal Polytechnic State University, USA)
Bridget Benson (Cal Polytechnic State University, USA)
Jim Harris (Cal Polytechnic State University, USA)

Educational research has shown that students learn with deeper understanding and retain that understanding for a greater duration when they learn in an environment of inquiry. In order to foster an environment of inquiry in an embedded systems course, we have redesigned the course to give students more and more autonomy with course material as the course progresses. In this paper, we describe the design and preliminary assessment of a semi-autonomous embedded systems course in the computer engineering program at Cal Poly, San Luis Obispo. Preliminary assessment data indicate that the course appears to provide an environment of inquiry for students, but further assessment is required to determine if the semi-autonomous nature of the course increased student understanding and retention of course material.
CAN UTILIZING SOCIAL MEDIA AND VISUAL PROGRAMMING INCREASE RETENTION OF MINORITIES IN PROGRAMMING CLASSES?
Khallai Taylor (Triton College, USA)

This paper discusses how Social Digital Literacy is being used in CS1 to teach critical and computational thinking by delivering content to students through the use of social media. Social Digital Literacy (SDL) is the way in which people use social media to enhance their social network, effectively increase their knowledge base, while communicating clearly and professionally through the use of social media. The increased popularity of social media amongst college students makes it an opportune time to consider a new form of literacy based on how technology is used by students, the devices that students interact with on a daily basis and the mainstream acceptance of social media in daily life. In order to retain students in computing classes, students are taught in an efficacious manner how to capitalize on the technology that they use on a daily basis. By increasing their SDL proficiency to become a more informed student, a well versed employee and consciously aware of what they post to social media. The expectation is that the approach being used can be implemented in any introductory programming course.

Session F3G: Mobile and Online Learning III
Chair: Mahesh Banavar (Arizona State University)
1:30 - 3:00 pm
Room: 20

HEALTH MONITORING LABORATORIES BY INTERFACING PHYSIOLOGICAL SENSORS TO MOBILE ANDROID DEVICES
Deepta Rajan (Arizona State University, USA)
Andreas Spanias (Arizona State University, USA)
Suhas Ranganath (Arizona State University, USA)
Mahesh Banavar (Arizona State University, USA)
Photini Spanias (Arizona State University, USA)

The recent sensing capabilities of mobile devices along with their interactivity and popularity in the student community can be used to create a unique learning environment in engineering education. Android Java-DSP (AJDSP) is a mobile educational application that interfaces with sensors and enables simulation and visualization of signal processing concepts. In this paper, we present the work done towards building non-invasive physiological signal monitoring tools in AJDSP through hardware interfaces to both external sensors and on-board device sensors. Examples of laboratory exercises that can be introduced in classes are presented. The proposed software tools can be used to provide intuitive understanding in wireless sensing and feature extraction to demonstrate the application of DSP to health monitoring systems. The effectiveness of the software modules in enhancing student understanding is demonstrated with the help of preliminary assessments.

UPDATE 2013 ON THE ICollaborate MSE PROJECT
Kathleen Kitto (Western Washington University, USA)
Debra Jusak (Western Washington University, USA)

The primary goals of the iCollaborate Materials Science and Engineering (MSE) project are to improve student learning outcomes, engagement, and completion rates in introductory materials engineering courses. This extensive research project is multidimensional and includes several interrelated components, all of which are founded upon best practices from STEM education research. There are several individual elements within the project that operate simultaneously or sequentially and unite to form a novel teaching and learning system. The detailed analysis of pre-course knowledge and mis-perceptions showed a surprising lack of pre-conceptual knowledge and revealed several important student mis-perceptions. This paper focuses on components of the iCollaborate project that were researched, analyzed, or developed during the Fall 2011 through Winter 2013 timeframe. First, a summary of the pre-course assessment findings is given in this paper. Second, an overview of the suite of MSE iPod applications and newly developed web applications for iCollaborate is presented. Finally, an overview of the supporting web site for the project, which is currently under development, is described. The paper concludes with a description of the remaining objectives for the iCollaborate project and future research directions. The National Science Foundation is supporting the project (NSF CCLI/TUES #941012).
THE EFFECTIVENESS OF BRIEF, SPACED PRACTICE ON STUDENT DIFFICULTIES WITH BASIC AND ESSENTIAL ENGINEERING SKILLS

Brendon Mikula (The Ohio State University, USA)
Andrew F Heckler (The Ohio State University, USA)

Through extensive testing and interviews of sophomore, junior, and senior engineering students in a Materials Science Engineering course at The Ohio State University, we found that these students struggle with many skills necessary for their coursework. Often these “essential skills” were prerequisite to the course and little to no instruction time was spent on them. Online training was developed to attempt to improve these skills. Students participated in the training several times over the term, with each assignment taking 10-20 minutes and consisting of 10 questions. Students were allowed unlimited attempts on each assignment and were required to achieve mastery (80% or better) for full credit. Training covered a wide range of topics: interpreting log plots and log scales, using metric prefixes for various conversions, estimating typical values of common material properties, employing dimensional analysis, and operating equations when given variables in mixed units. Unlike the success achieved by the log plots training, most of the topics saw little and insufficient improvement as a result of training, despite the basic nature of the skills. Future improvements to the training will focus on determining which factors will help to convince students of the importance of mastering these prerequisite skills.

STUDENT ACCURACY IN READING LOGARITHMIC PLOTS: THE PROBLEM AND HOW TO FIX IT

Andrew F Heckler (The Ohio State University, USA)
Brendon Mikula (The Ohio State University, USA)
Rebecca Rosenblatt (Illinois State University, USA)

Through extensive student testing and interviews, we found that the majority of university sophomore, junior, and senior engineering students in a standard introductory materials science engineering course have a variety of difficulties reading correct values from simple logarithmic graphs. For example, students often unknowingly interpreted the log scale as linear and were confused about the order of magnitude of a value in the negative exponent region. To address these issues, we used the results of our findings to develop and implement a set of online “essential skills” tasks to help students achieve a core level of mastery and fluency in reading log plots, a basic and critical skill for engineers. The online tasks were administered as for-credit homework assigned several times throughout the semester, and students spent 10-20 minutes on each assignment. Results of post-tests indicate that with this minimal practice, students were able to dramatically improve their accuracy in reading log plots compared to a control group with no log plot practice. Furthermore, testing one month after training demonstrated that student continued to retain the learned skill. Future development will focus on making these essentials skills task broadly available online and further improving effectiveness and usability.

INQUIRY-BASED LEARNING ENVIRONMENT USING INTELLIGENT TUTORING SYSTEM

Daniel Epstein (Federal University of Rio Grande do Sul, Brazil)
Isis Pinho (Federal University of Rio Grande do Sul, Brazil)
Otavio Acosta (Federal University of Rio Grande do Sul, Brazil)
Eliseo Reategui (Federal University of Rio Grande do Sul, Brazil)

The present study aims to discuss the development of a collaborative inquiry-based learning environment with the support of an intelligent tutoring system for general education. Following an inquiry-based learning approach, the learner-centered activities involve students making questions about a given theme based on a subject proposed by teachers. Here the collaborative nature of interaction is seen as a fertile space for learning since it enables the mobilization, interpretation and coordination of contributions to achieve a common goal. Students may require instruction and feedback to help them exploit the learning environment to its full potential. To provide the necessary assistance, an intelligent tutoring system is proposed. Intelligent tutoring systems are computer programs capable of providing immediate and customized instruction or feedback to students, without the need of human intervention. In our proposal, a text mining tool provides key concepts about the interaction of the student within the environment. This information can be used by a recommender system, which searches for related material in the Internet and in other specific learning repositories. The relevance of the learning environment proposed here lies on its capacity to give assistance through a recommender system, promoting a richer interactive learning.
EXPLAINING SEMICONDUCTOR DEVICE PHYSICS WITH A FUSION OF LECTURES AND VIDEOS
Kathleen Meehan (Virginia Tech, USA)

Concepts that describe the operation of semiconductor devices tend to be some of the most difficult for students to grasp. Hands-on experimentation can be used to demonstrate the concepts discussed in lectures or course readings and to stimulate student interest through visual applications of the concepts. However, such activities can be impractical to integrate into the classroom. Thus, multimedia tutorials have been developed on some of the concepts to support student learning and to address why a solid foundation in semiconductor device physics is critical to their development as electrical or computer engineers. Each tutorial includes a review of the theory that is demonstrated in the experiment, which is then presented. Reinforcement of their learning occurs immediately in the form of a brief video from an expert (not necessarily the course instructor) with his or her explanation. Assessment on student learning has been initiated using an assessment tool developed to evaluate hands-on learning at Georgia Tech.

DEVELOPMENT OF A CONCEPT INVENTORY FOR MICROELECTRONICS COURSES
David H Hoe (University of Texas at Tyler, USA)

This paper describes our initial attempts at developing a concept inventory for a microelectronics course. The methodology for selecting the core concepts to be tested and the development of the questions are described. Results of the assessment data indicate some areas where student conceptual understanding is weak. The proposed method to improve the concept inventory is also detailed.

ONLINE LABORATORIES AS A CLOUD SERVICE DEVELOPED BY STUDENTS
Rafael Pastor Vargas (Spanish University for Distance Education - UNED, Spain)
Roberto Hernandez (Spanish University for Distance Education - UNED, Spain)
Salvador Ros (Spanish University for Distance Education - UNED, Spain)
Agustín Caminero (Spanish University for Distance Education - UNED, Spain)
Daniel Sanchez (Spanish University for Distance Education - UNED, Spain)
Antonio Robles-Gómez (Spanish University for Distance Education - UNED, Spain)
Llanos Tobarra (Spanish University for Distance Education - UNED, Spain)
Manuel Castro (Spanish University for Distance Education - UNED, Spain)
Gabriel Diaz (Spanish University for Distance Education - UNED, Spain)
Elio Sancristobal (Spanish University for Distance Education - UNED, Spain)
Mohamed Tawfik (Spanish University for Distance Education - UNED, Spain)

On-line laboratories (virtual or remote) are widely used in experimental engineering subjects as part of the learning process. In order to develop these laboratories, a development framework called RELATED (Remote Laboratories exTendED) is used by the Communications and Control System Department of the Spanish University for Distance Education of Spain (UNED). This framework defines a structured and methodological development procedure, allowing the students the generation of their own laboratories. Once the laboratory is developed (based in its components), students have to configure their own computing resources in order to make their labs available. However, several problems must be faced by students in the “deployment” of their labs: network configuration, hardware availability, and so on. So, in order to solve these problems, an automatic system based on cloud providers is defined to allow students having their own cloud network/resources for their developed labs. This system simplifies the lab deployment and avoids common errors/mistakes in the development of laboratories with RELATED.
REAL-TIME FM RADIO FOR TEACHING DSP AND COMMUNICATION SYSTEMS
Joseph P. Hoffbeck (University of Portland, USA)
Mark Sugiyama (University of Portland, USA)

In digital signal processing (DSP) and communication systems courses much of the material is theoretical. There are
some students who are more motivated to learn if they can see a connection to the real world, but unfortunately many
real-world communication and DSP systems are very complex, and including them as part of a course is difficult or
impossible. The FM radio, however, is a relatively simple system that is in some ways ideal as a real-world example
because it includes both analog and digital signals. The analog signals transmit the audio and the digital Radio Data
System (RDS) signal transmits auxiliary information such as the name of the artist, song, current time, etc. This paper
describes an FM radio with RDS decoder based on an inexpensive FM module and an affordable DSP board. The system
runs in real-time, demodulates FM radio, plays the music through speakers, displays the name of the song and artist, and
allows access to the internal signals. This real-time receiver can be used in demonstrations in a lecture course or as the
basis for a series of laboratory experiments.

ENGAGING A VARIETY OF STUDENTS IN DIGITAL DESIGN WITH COMPETITION
Danial J Neebel (Loras College, USA)
Alex Wong (Digilent Inc., USA)
Clark Merkel (Loras College, USA)

This paper highlights the successes of contestants enrolled in an Introduction to Engineering class that took on the task of
designing and building a robot to solve a problem with little or no background in electronics or programming. The
semester long project started with developing a problem statement and from there timeline followed the Digilent Design
Contest. Students had deadlines and formats for design documentation required by Digilent for the contest. While some
students were attracted to the challenge of creating and implementing a design of their very own, other students are
excited to compare their design against projects from students at other institutions. These competitions are designed to
feed the excitement of the students and also fuel creativity.

MOTIVATING AND PREPARING FIRST-YEAR STUDENTS IN COMPUTER AND ENGINEERING SCIENCE
Håkan Jonsson (Luleå University of Technology, Sweden)

During recent years the interest in Engineering Studies has declined at universities both in the United States and in many
Western European countries including Sweden. In addition, among those students that do enroll, an increasing number
drop-out. This paper presents an attempt to mitigate these worrying problems in the form of a new kind of introductory
course for first-year engineering students studying on a 5-year long Master of Science program in Computer Science and
Engineering. The course is novel in that it takes a holistic approach to motivate and prepare students for their further
studies. Core subjects and useful tools are mixed together into an intense 10-week course with 12 separate course
modules on different topics, often running in parallel. The course has a total of 21 individual examinations to take, tasks
to carry out, and deadlines to meet. The examinations and tasks are chosen among those common in our School of
Engineering. Evaluations show that, although demanding for the students, the course works well and fulfills its goals.

Session F3I: Integrating Design Throughout the Curriculum
Chair: Aurenice Oliveira (Michigan Technological University)
1:30 - 3:00 pm
Room: 4

EVOLUTION OF A FIRST YEAR PROJECT BASED DESIGN COURSE
Allen Hoffman (Worcester Polytechnic Institute, USA)

First year project based design courses may face several obstacles. The students have very limited experience in design,
construction and realization of prototypes, and in testing and evaluation of their designs. Most first year introduction to
engineering courses cover a wide variety of important topics, but lack a strong emphasis on design. Originally our
Introduction to Engineering course was similar to those offered at other institutions. In 2004 the format and focus of this
course was transformed into a project based design course for first year students. This paper discusses the changes that
have been implemented over the past nine years, to the point where this first year course now contains most of the
elements of more advanced design courses at our institution.
STEM EXPLORE, DISCOVER, APPLY - ELECTIVE COURSES THAT USE THE ENGINEERING DESIGN PROCESS TO FOSTER EXCITEMENT FOR STEM IN MIDDLE SCHOOL STUDENTS
Krystal Corbett (Cyber Innovation Center, USA)
Joshua Coriell (Cyber Innovation Center, USA)

Engaging students early in meaningful STEM experiences will help them maintain a level of interest in STEM fields later in life. However, the key is developing meaningful courses in STEM for K-12 students. These students not only need to have a "fun" experience, but a meaningful one, where they connect with, and develop deep understanding of the material being presented. STEM Explore, Discover, Apply (STEM EDA) is being created by the Cyber Innovation Center, a 501c not-for-profit as a middle school elective course. STEM EDA is designed as a three course progression through topics that foster excitement for STEM. The curriculum is designed to enhance the core science and math classes taken in middle school. STEM EDA begins by exploring STEM concepts (STEM Explore, 6th grade) then transition to discovering fundamental concepts (STEM Discover, 7th grade), followed by the application of the concepts (STEM Apply, 8th grade). This work in progress will outline the framework for STEM EDA, including the various modules of the courses. Additionally, this paper will discuss how the engineering design process is integrated into the modules, how other disciplines are highlighted, and showcase a specific module in this innovative middle school elective curriculum.

SPARKING CREATIVITY IN COMPUTER SCIENCE FOR INTERDISCIPLINARY STUDENTS
Renita M Murimi (Oklahoma Baptist University, USA)

A class on Technologies for Creative Learning was designed to investigate the answers to a well-researched question: “What learning mechanisms spark creativity?” The class was offered for the first time at Oklahoma Baptist University during the Winter 2013 semester, and was structured to introduce computer science concepts to an interdisciplinary group of students. A key enabler of most learning mechanisms today is technology, and this class explored the use of various platforms in the design and functionality of learning through technology, using computer science as the learning objective. This work addresses the implications of programming and robotics to foster creativity in computer science and discusses the outcomes of the class.

INCREASING STUDENT INTEREST IN STEM VIA THE KENSINGTON KINETIC SCULPTURE DERBY
Donald Fehlinger, Jr. (Drexel University, USA)
Jessica Ward (Drexel University, USA)
Adam Fontecchio (Drexel University, USA)

According to the Help Wanted: The Role of Foreign Workers in the Innovation Economy Report, "It is critical for our economic future that we…educate and train more US workers in STEM fields..." This paper will explore a project associated with the National Science Foundation STEM GK-12 Program at Drexel University titled “Catalyzing STEM Education via the NAE Grand Challenges” (http://www.engineeringchallenges.org) that serves to address the above-described need. Specifically, the Drexel NSF STEM GK-12 program pairs ten College of Engineering graduate students (Fellows) with ten School District of Philadelphia high school teachers to help introduce engineering concepts to high school students through the context of the National Academy of Engineering (NAE) Grand Challenges. This work in progress explores a high school vehicle design project as part of the Kensington Kinetic Sculpture Derby (KKSD) facilitated by a fellow/teacher partnership at Central High School, an urban school in Philadelphia comprised of 40% underrepresented groups in the STEM fields. A unique feature of the project is that students from the IB Design Technology course were grouped in an interdisciplinary team with other students from World History and Sculpture classes to develop a vehicle based on the structure of a bicycle.

CURRICULUM INTEGRATION FOR THE ECE UNDERGRADUATE CORE COURSES IN ELECTRONICS
Qing Zheng (Gannon University, USA)
Pengtao Lin (Gannon University, USA)
Fong Mak (Gannon University, USA)
Ramakrishnan Sundaram (Gannon University, USA)
Lin Zhao (Gannon University, USA)

This paper discusses the work in progress to restructure the Electronics curriculum in the Department of Electrical and Computer Engineering (ECE) in order to improve the system integration learning experience gained by the undergraduate students. The goals of restructuring the ECE Electronics curriculum are as follows: a) train and prepare students to design and analyze complex electronic systems first at the subsystem and system level before teaching and
learning electronics at the component level; and b) strengthen the infrastructure for the system integration learning experience with other courses such as power electronics through the use of integrated projects developed for the Electronics curriculum. To realize these goals, the curriculum of Electronics I and Electronics II are redesigned. Electronics I is designed to focus on the design and analysis of electronic circuits, devices, and processes at the system and subsystem level. Electronics II is designed to focus on the study, operation, and analysis of electronic circuits, devices, and processes at the component level. Centralized projects are selected as platforms to allow students to develop the skills in designing and analyzing electronic systems. The students' performance and survey show that the Electronics curriculum restructure has a positive impact on students' learning.

FIRST-YEAR / SENIOR YEAR DESIGN DATA: PRELIMINARY RESULTS FROM ONGOING RESEARCH ON POST-SECONDARY DESIGN STUDENT ACTIVITIES
Nina Phanthanousy (Raytheon & Embry-Riddle Aeronautical University, USA)
Yosef Allam (Embry-Riddle Aeronautical University, USA)

The College of Engineering at Embry-Riddle Aeronautical University requires its students to take a semester long engineering profession and project-based design course as first-year students and a capstone project-based design course over the span of two semesters as seniors. There is a desire to ascertain the actual and normalized time, process progression, and traffic patterns of engineering student design project teams navigating a design process and gauge these metrics across engineering majors and against faculty impressions and expectations, with an eventual goal of gauging against professional practice as well. Once student design activity application is analyzed with respect to faculty and professional expectations, pedagogical and curricular content adjustments can be made as necessary to align these project-based, experiential learning activities with perceived practice. The analysis of student progress compared to faculty and professional perspectives will provide an opportunity to dissect and reinforce the foundation of engineering design education at the University.

F4A: Mini-Workshop: Hands-On Activities with Portable Electronics
4:00 - 5:30 pm
Room: 14

HANDS-ON ACTIVITIES WITH PORTABLE ELECTRONICS
Kathleen Meehan (Virginia Tech, USA)
Mario Simoni (Rose-Hulman Institute of Technology, USA)
Alex Wong (Digilent Inc., USA)

Advances in technology have made possible the development of low-cost portable electronic instrumentation. Such instrumentation opens the door to new possibilities for hands-on pedagogy related to analog circuits and physics education. This workshop will introduce attendees to the Digilent Analog Discovery platform and pedagogies that have been developed for it. Attendees will see examples of and have opportunities to try activities that have been developed for undergraduate electrical engineering and high-school physics courses. All attendees will be given a memory stick that contains pedagogical materials and an opportunity to receive an Analog Discovery system free of charge.

F4B: Panel: Effective Recruiting for Diversity
4:00 - 5:30 pm
Room: 15

EFFECTIVE RECRUITING FOR DIVERSITY
Joanne Cohoon (University of Virginia, USA)
James Cohoon (University of Virginia, USA)
Seth Reichelson (Lake Brantley High School, USA)
Selwyn Lawrence (South Lakes High School, USA)

Women of all colors are underrepresented in most technical disciplines. For example, electrical engineering college graduates have comprised only about ten percent women for many years, and computing graduates only about eighteen percent women, down from about thirty-five percent in the mid-1980s. Gender stereotypes and stereotypes about creators of technology contribute to this underrepresentation. Nevertheless, these prevailing conditions can be overcome to a substantial degree by actively recruiting diverse female students. This panel session will provide an introduction to the reasons for active recruiting, methods for successful active recruiting, examples of effective applications of the
recommended methods, and resources to help participants as they attempt to actively recruit underrepresented students to their courses. The panel's focus will be on computing disciplines, but the information applies to other technical disciplines as well.

Session F4C: Student Beliefs, Motivation & Persistence II
Chair: Jia-Ling Lin (University of Minnesota Twin Cities)
4:00 - 5:30 pm
Room: 16

PASTORAL CARE AND STUDENT SUPPORT: DEVELOPING A METHOD OF RETENTION
Craig Watterson (Victoria University of Wellington, New Zealand)
Dale A Carnegie (Victoria University of Wellington, New Zealand)

The transition from High School to first year Engineering at University can be very difficult for many students. Victoria University of Wellington, New Zealand (VUW), developed an early warning system for student grade performance: Big Sister, and a system of Pastoral Care within the School of Engineering and Computer Science. This paper will discuss how Big Sister supports the identification of at risk students and how this system is integrated into the delivery of effective Pastoral Care. Importantly, this paper will also discuss the information gained from student interviews by the Pastoral Care staff member. In particular, we discuss the findings in relation to student self-efficacy and success and how this is being used to improve the first year teaching and learning environment.

STUDENT PERCEPTIONS OF CHEATING IN ONLINE AND TRADITIONAL CLASSES
Stephen W Turner (University of Michigan - Flint, USA)
Suleyman Uludag (University of Michigan - Flint, USA)

With classroom instruction undergoing a massive transformation to incorporate online learning techniques at unprecedented levels, technological advances have facilitated a range of mechanisms that improve teaching and learning. At the same time, these technological advances have also facilitated different forms of cheating in classes. Although the impact and implications of cheating have often been studied, we feel that this problem experiences constant evolution, and the dynamics of cheating, especially in online courses, needs more examination to be fully grasped. The study presented here surveyed computer science, computer information systems, and engineering college students, with the goal of gaining a greater understanding of their perceptions, beliefs, and attitudes about the many dimensions of academic integrity violations. Results of this survey, coupled with statistical analysis and some conclusions, are presented. The impact of our popular Virtual Lab (VLAB) facility is also examined in this context, and it is found to make a positive difference in student attitudes about cheating in classes.

PERCEPTIONS AND INFLUENCERS AFFECTING ENGINEERING AND COMPUTER SCIENCE STUDENT PERSISTENCE
Kaitlyn Bunker (Michigan Technological University, USA)
Laura Brown (Michigan Technological University, USA)
Leonard J. Bohmann (Michigan Technological University, USA)
Gretchen Hein (Michigan Technological University, USA)
Nilufer Onder (Michigan Technological University, USA)
Raven Rebb (Michigan Technological University, USA)

In the 2012-2013 academic year, a survey to investigate why engineering and computer science students persist in their major was conducted at Michigan Technological University. This paper discusses the results of the survey and ties the findings to the literature. It focuses on: (1) who influenced students' decisions on picking a major or on changing a major (for example, friends, family, academic advisors, faculty, upper-division or graduate students, co-workers, and supervisors), and how did they affect students' persistence and (2) what is the impact of role models on student persistence. The analysis compares students who reported not having considered changing majors to students who considered switching to another major. The findings show that the students who did not consider changing majors reported having a stronger support system including faculty, academic advisors, and engineers who serve as role models. The data suggest that university faculty and staff need to reach out to the students who are deliberating about their initial choice of major and support the decision making process.
THE DYNAMIC IMAGE OF THE ENGINEER
John Pritchard (Iowa State University, USA)
Mani Mina (Iowa State University, USA)

In this work, engineering students are asked what engineering is and what it means to be an engineer. Their responses suggest that there may be an inconsistent development of the image of an engineer as the student progresses within their engineering program, and a lack of philosophical discussion that leads to a deeper understanding of their field. Additionally, non-engineering students are given the same questions, providing an interesting perspective. The survey questions are presented and an analysis of the results is provided with suggested approaches to improve the observed issues.

COMPARING THE ATTITUDES TOWARDS ENGINEERING OF HONORS STUDENTS AND ENGINEERING STUDENTS AT A LIBERAL ARTS UNIVERSITY
Rick Olson (University of San Diego, USA)
Truc T. Ngo (University of San Diego, USA)
Susan M. Lord (University of San Diego, USA)

In Fall 2012, 53 honors students and 53 engineering students (including seven students in both honors and engineering) completed a survey designed to solicit their attitudes towards engineering and their ability to succeed in engineering. Preliminary analysis of five factors shows that the attitudes of engineers and honors students were similar in many respects. The main areas of difference were that honors liberal arts students had lower confidence in their ability to succeed in science and math and all non-engineers showed lower aptitude for engineering. Non-engineering women showed slightly less affinity for solving open-ended problems. All students expressed similar attitudes about the creativity of engineers and their contributions to solving society's problems.

Session F4D: Innovative Computing Practice II
Chair: Irene Rothe (Bonn-Rhine-Sieg University)
4:00 - 5:30 pm
Room: 17

CARRY-ON EFFECT IN EXTREME APPRENTICESHIP
Hansi Keijonen (University of Helsinki, Finland)
Jaakko Kurhila (University of Helsinki, Finland)
Arto Vihavainen (University of Helsinki, Finland)

We argue that the first undergraduate courses are the most important ones on the student's path towards becoming a computer scientist. Therefore, during 2010-2012, we have exercised extensive effort in order to improve the first-semester Computer Science (CS) courses. We have been able to use a learning-by-doing approach called the Extreme Apprenticeship (XA) method accompanied by personal advising even for courses with hundreds of students. We claim that when high demands are met with sufficient support, students learn valuable programming skills that become a foundation that carries them in their further CS courses. In this paper, we analyze how the effects of a three-year effort of renovating our introductory programming courses propagate to further studies. Compared to the control cohorts of 2007-2009, we observe a carry-on-effect caused by the XA method in student success that is visible in the per-student average accumulation of credits after 7 and 13 months after the start of studies. In addition, we can see the effect propagating to mandatory subsequent courses, even without the XA method.

A SUCCESSFUL GRADUATE CLOUD COMPUTING CLASS WITH HANDS-ON LABS
Melody Moh (San Jose State University, USA)
Rafael Alvarez-Horine (San Jose State University, USA)

Modern web-based services increasingly have a cloud-based component, which only in recent years has been studied in an academic manner. Many cloud-computing courses focus on fundamental concepts that, while universal to cloud computing understanding, may not provide students with enough background to actually deploy an application to the cloud. To that end we present a cloud computing class that through the use of labs, presentations, and research projects, integrates practical hands-on experiences with academic research. The labs not only deploy to multiple public cloud environments, but also walk students through the process of creating, configuring, and maintaining their own private clouds. We maintain that this juxtaposition of practice and theory leads to not only better learning outcomes in the
classroom in the form of refereed publications and further study, but also leads to practical skills which better prepare students for joining the workforce.

**BRAIN-BASED PROGRAMMING**
Barbara Sabitzer (Alpen-Adria-Universität Klagenfurt, Austria)
Sandra Strutzmann (Alpen-Adria-Universität Klagenfurt, Austria)

Learning languages can be hard. As the yearly results of the course "Introduction to structured and object-based programming" at our university show, learning the first programming language might be even harder. Many students complain about the difficulty of the course and fail in the exam. With the desire to support the students and enhance the learning outcomes we initiated the project "Brain-based Programming". The basic question is: "How can learning to program be made easier?" The answer may come from the interdisciplinary field of neurodidactics that offers many general suggestions for improving teaching and designing teaching material. But concrete examples for computer science education are scarce, and empirical research is still missing. This was the impetus for the project "Brain-based Programming" that aims at (1) creating and evaluating a brain-based script for beginners in Java programming and at (2) implementing and evaluating brain-based teaching methods in the programming course. In the pilot phase we conducted a didactic experiment in one of seven parallel groups and combined brain-based teaching methods and exercises. The results demonstrate the success of the experiment and support the hypothesis that learning is more effective when it considers how the brain learns and follows neurodidactical principles.

**MULTIPLE INTELLIGENCE APPROACH AND COMPETENCIES APPLIED TO COMPUTER SCIENCE 1**
Alejandro Adorjan (Universidad ORT Uruguay, Uruguay)
Inés Friss de Kereki (Universidad ORT Uruguay, Uruguay)

In order to contribute to the improvement of Computer Science 1 (CS1) course's results we designed a set of activities based on competencies and multiple intelligence approach. Hypothetically, we propose that including this kind of activities helps to obtain better results in the course. A preliminary experimentation was done in 2012. This year, the course included a low number of freshmen students. The initial results show a positive difference in student's results, particularly in freshmen students and no differences in students who are taking the course for the second or third time.

**INTEGRATING HIGHLY-CAPABLE COROBOTS INTO A COMPUTING CURRICULUM**
Zack Butler (Rochester Institute of Technology, USA)
Rajendra Raj (Rochester Institute of Technology, USA)
Minseok Kwon (Rochester Institute of Technology, USA)

Robots are typically used at the college level either as a pedagogic platform for introductory programming or for more advanced courses in robotics. With robots becoming cheaper and more plentiful, personal interactions with them will become more commonplace. This project therefore takes the position that undergraduate computing students need the opportunity to explore core computing concepts in a robotics context. Specifically, we will give students the ability to work alongside teams of highly capable and easily programmable corobots, a term used to identify robots that work side by side with humans, rather than being completely autonomous and isolated. A modular approach is used to incorporate corobotics into various computer science (CS) courses such as first-year computing, networking, and data management, thus permitting the students to see these corobots in multiple contexts. This work-in-progress paper describes the corobotics infrastructure that has been developed, and outlines how this infrastructure can be used to support diverse courses in the CS curriculum.
EEG-BASED COMPARISONS OF PERFORMANCE ON A MENTAL ROTATION TASK BETWEEN LEARNING STYLES AND GENDER
Elizabeth Hames (Texas Tech University, USA)
Mary Baker (Texas Tech University, USA)

Retention and diversity are central issues in engineering schools. Students' learning styles may hinder understanding of course material if presented in an incompatible way. While learning styles assessments are informative in determining the students' preferences in how they learn, there have been few studies that correlate student learning styles with cognitive and intellectual abilities. The goal of this study was to determine the relationship between students' learning styles, as determined by the Felder-Solomon Inventory of Learning Styles (ILS), and their cognitive abilities. This study uses functional electroencephalography (EEG) to evaluate the areas of neural activation in the brain while engineering students are performing a mental rotation task. Learning style preferences and mental rotation scores are correlated with the EEG activation. Learning styles differences were observed, primarily across gender. Most of these differences were in EEG patterns as opposed to actual task performance, indicating that individuals of different gender and learning style preference might be engaging different parts of the brain on a task while exhibiting similar performance on the task.

DETECTION AND ASSISTANCE TO STUDENTS WHO SHOW FRUSTRATION IN LEARNING OF ALGORITHMS
Edécio Iepsen (Universidade Federal do Rio Grande do Sul, Brazil)
Magda Bercht (Universidade Federal do Rio Grande do Sul, Brazil)
Eliseo Reategui (Universidade Federal do Rio Grande do Sul, Brazil)

This paper presents a research work on the detection of students who show signs of frustration in learning activities in the area of algorithms, to then assist them with proactive support actions. Our motivation for the development of this work comes from students' difficulty in learning the concepts and techniques for building algorithms, which constitutes one of the main factors for the high dropout rates of computing courses. With the intent of giving a contribution to the reduction of such evasion, this research highlights the importance of considering students' affective states, trying to motivate them to study and work out their difficulties, with the assistance of computer systems. For research validation purposes, a tool was built to: a) infer the student's affective state of frustration while solving exercises of algorithms b) detect signs associated with frustration, to provide resources to support student learning. Case studies were conducted with students of algorithms at the Faculty of Technology Senac Pelotas, in 2011 and 2012. The rules generated by the data mining software used to identify students' affective state of frustration, as well as an analysis of students' performance are presented in this article.

STUDENTS' COLLABORATIVE NOTE-TAKING ACTIVITIES WHILE USING ELECTRONIC AND PAPER-BASED ENHANCED GUIDED NOTES: VIEWED FROM METACOGNITIVE AND SOCIAL NETWORK PERSPECTIVES
Oenardi Lawanto (Utah State University, USA)
Harry Santoso (Utah State University, USA)

Previous studies suggested that the implementation of note-taking strategies impacted students' learning process and performance. Research also suggested that collaborative learning facilitates students to learn from different views of interpreting information. The objective of this study was to investigate students' metacognitive skills and social networks while using electronic and paper-based enhanced guided notes. Students' worked in groups of three or four to complete the EGN. The impact of the collaborative note-taking activities on the students' collaboration processes was examined using social network analysis. Our findings revealed that students' cognitive and metacognitive strategies between electronic and paper-based EGN groups were relatively similar. Our data analysis of students' social networks revealed two clusters of students, high and low groups that represented the level of students' connectivity in a collaborations network. The findings suggested that the high group outperformed students in the low group in the use of cognitive, monitoring, and regulating strategies. Implications of the use of collaborative note-taking in engineering classroom will be discussed.
COGNITIVE PATHWAYS TO ENGINEERING
Jonathan Hilpert (Georgia Southern University, USA)
Jennifer Hyppolite (Georgia Southern University, USA)

We collected qualitative data to examine how engineering students’ previous experiences, present academic course work, and future goals create cognitive pathways to a career in engineering. Using future time perspective theory as our literature base, we conceptualize cognitive pathways as relationships or links between reconstructed-past, present-active, and imagined-future events that lead to a career in engineering. Our goal is to begin to develop evidence for cognitive linkages between past, present, and future that motivate students to pursue careers in engineering. To gather the data, 21 students were interviewed after they completed a timeline of their lives, consisting of their developmental experiences, present academic work, and their imagined future. We used purposive sampling to recruit participants who are strong engineering students to provide preliminary evidence for what ideal cognitive pathways might look like. The data are being collected as part of a funded “seed” project to conduct exploratory work that can ultimately lead to a well-designed larger project. Here, we present some preliminary results of our analysis, including example case study of a participant timeline. The results are primarily descriptive, and provide a glimpse into our analytic techniques and mixed method approach to the data.

PREVENTING PERSISTENT MISCONCEPTIONS WITH FIRST-YEAR ENGINEERING STUDENTS
Dazhi Yang (Boise State University, USA)
Ronald Miller (Colorado School of Mines, USA)

Previous studies on student misconceptions of science and engineering concepts focused on repairing and correcting misconceptions after they have formed. However, it may be too difficult or too late to correct and repair such misconceptions by the time misconceptions have been formed or identified in engineering students. This work-in-progress focuses on a different approach towards treating persistent misconceptions, switching from correcting and repairing persistent misconceptions to preventing those misconceptions from forming.

CREATING AN INTRINSIC-MOTIVATION-DRIVEN COURSE DESIGN METHOD
Geoffrey Herman (University of Illinois at Urbana-Champaign, USA)
Kathryn Trenshaw (University of Illinois at Urbana-Champaign, USA)
David E. Goldberg (University of Illinois at Urbana-Champaign, USA)
Jonathan Stolk (Olin College, USA)
Mark Somerville (Olin College, USA)

The low-cost intrinsic motivation (IM) course conversion project is an effort to create a new system of course design that focuses on creating scalable and sustainable courses that emphasize promoting students' IM to learn. Unlike many course design methods such as idea-based learning, project- or problem-driven learning, or "flipped" classrooms, which first ask, "How do we help students learn X better," we ask "how do we foster intrinsically-motivated learners who want to learn X?" While this course design method still uses theories of cognition to design course structures, it uses motivational constructs such as purpose, autonomy, relatedness, and competence as the primary design considerations of a course. Secondly, the course design method considers and documents the financial, time, political, and psychological costs of course design. In this paper, we present a preliminary attempt to formalize this IM-driven course design method as well as a system for evaluating the short- and long-term costs of implementing a specific course design.

EXPECTATIONS AND REALITIES FOR COMMUNITY COLLEGE ENGINEERING TRANSFERS AT A LARGE UNIVERSITY
Mary Anderson-Rowland (Arizona State University, USA)

This study identifies factors that worry potential and new upper division transfer students in engineering. To determine the actual expectations and realities of transfer students, we surveyed 120 transfer students enrolled in an Academic Success Class. The top six expectations were reality over which the transfer students had little control, but there were
other factors for which they had some control: GPA shock, faster paced classes, feeling like freshmen all over again, and not knowing where to find resources. For half of the students, the fifth most prevalent reality was that the Transfer Center helped in their transfer. Other realities included more assigned homework and that almost all easy non-engineering classes have been taken. We also examined gender differences. This data will inform potential and new transfer students and to help them plan for success. Even though much of this knowledge may be well known, a new transfer often does not believe that the challenges will affect him. By using the results of this study, at this university, the facts are more believable. We encourage others working with transfer students to become familiar with the expectations and realities of their own transfer students in order to help them be successful.

THE EFFECT OF MATRICULATION PRACTICES AND FIRST-YEAR ENGINEERING COURSES ON ENGINEERING MAJOR SELECTION
Catherine E. Brawner (Research Triangle Educational Consultants, USA)
Matthew W Ohland (Purdue University, USA)
Marisa K. Orr (Louisiana Tech University, USA)
Xingyu Chen (Purdue University, USA)

Sixty-one sophomores were interviewed at six large public institutions to learn why they chose their institution and their engineering major. The institutions were categorized as either requiring a first year engineering (FYE) program or allowing students to matriculate directly into a major. At these institutions, the first-year experience either required a common introduction to engineering course, required introduction to engineering courses that were not common to all majors or included an optional introduction to engineering course. The impact of the matriculation mode on selection of the institution and the presence or absence of a required first year course are studied. We find that cost of attendance is far more important than matriculation mode for most students choosing their institutions. Required and optional first-year courses, when taken, do tend to help students either affirm their prior choice of major or select an engineering major that suits their interests.

A COMPREHENSIVE FRAMEWORK FOR SIGNIFICANTLY INCREASING THE NUMBER OF HIGHLY TRAINED ENGINEERS: A MODEL ACADEMIC SUCCESS AND PROFESSIONAL DEVELOPMENT (ASAP) CLASS - LESSONS LEARNED AND STRATEGIES MOVING FORWARD
Armando Rodriguez (Arizona State University, USA)
Mary Anderson-Rowland (Arizona State University, USA)

This paper describes a comprehensive academic success and professional development (ASAP) framework that has been developed within Arizona State University’s (ASU’s) Ira Fulton School of Engineering over the past decade. Centered around an ASAP class offered each semester, with need-based scholarships serving as incentives/facilitators, the success of the program has been tremendous – with retention and graduation rates for participating scholars exceeding their counterparts at ASU and at other universities across the nation. Program activities, lessons learned and strategies moving forward are discussed within the paper.

ACCELERATING ENGINEERING DEGREE COMPLETION FOR MILITARY VETERANS
David L Soldan (Kansas State University, USA)
Don M. Gruenbacher (Kansas State University, USA)
Noel N Schulz (Kansas State University, USA)
Blythe Vogt (Kansas State University, USA)
Rekha Natarajan (Kansas State University, USA)
William Hageman (Kansas State University, USA)

This paper addresses an accelerated track for military veterans into bachelor’s degrees in engineering. It is an update on a project that was first reported at FIE 2011. An initial thorough evaluation of the veterans’ training, experiences, and expertise has been conducted with the option of granting academic credit where appropriate. Therefore, it is important to have contact with the military veteran prior to their arriving on campus to begin their schooling. Current policies give little credit for military experience or training. The development of on-line pre and post assessments and subject based tutorials are being used to accelerate the veteran’s entry into the traditional math sequence. Veterans may have a base of technical knowledge acquired through the technical nature of their service posts. Assigning them to introductory level courses with traditional freshman and sophomore students does not respect their technical expertise nor challenge their capabilities and accustomed pace.
THE TIES PROGRAM: A TRANSFER INITIATIVE FOR ENGINEERING STUDENTS
Jill Auerbach (Georgia Institute of Technology, USA)
Douglas B Williams (Georgia Institute of Technology, USA)

Strategies to recruit and retain underrepresented students in the STEM fields are as diverse as the students they seek to engage. The community college pipeline is well recognized as a source for both nontraditional and underrepresented students for engineering programs. The Transfer Initiative for Engineering Scholars (TIES) addresses the unique needs of this cohort who transfer as juniors from the community college environment. TIES is currently in the fourth year of receiving funding from NSF’s S-STEM program and providing financial support to eligible students in an environment committed to smooth transitions, multiple options for student support services, community building with peers and faculty, leadership development, and mentor relationships. Many of the support activities build upon previously existing retention programs, but new components, such as leadership seminars, community building, and industry mentoring, were developed specifically for TIES participants. Among the several components of the program, those that contribute to a supportive community environment were seen by the students as extremely important for a successful transition to Georgia Tech’s undergraduate electrical engineering and computer engineering programs.

INVESTIGATING HOW SERVICE-LEARNING ALUMNI CONSTRUCT THEIR ENGINEERING SELVES
James Huff (Purdue University & Harding University, USA)
Carla Zoltowski (Purdue University, USA)
William Oakes (Purdue University, USA)
Brent Jesiek (Purdue University, USA)

Prior research has demonstrated that traditional academic pathways tend to provide engineering students with a predominantly technical sense of professional identity. We respond to this research by investigating how a non-traditional pathway, marked by a large service-learning program, engenders a sense of engineering identity. We approach this investigation using a thematic analysis and are currently developing themes related to how alumni/ae of this program construct their engineering selves. We are currently in the early stages of analysis and will present the elaborated themes at the conference.

Session F4G: Inclusivity and Diversity II
Chair: Deborah Munro (University of Portland)
4:00 - 5:30 pm
Room: 20

LESBIAN, GAY, BISEXUAL, AND TRANSGENDER STUDENTS IN ENGINEERING: CLIMATE AND PERCEPTIONS
Kathryn Trenshaw (University of Illinois at Urbana-Champaign, USA)
Ashley Hetrick (University of Illinois at Urbana-Champaign, USA)
Ramona Oswald (University of Illinois at Urbana-Champaign, USA)
Sharra Vostral (University of Illinois at Urbana-Champaign, USA)
Michael C. Loui (University of Illinois at Urbana-Champaign, USA)

Few studies of the climate in engineering for lesbian, gay, bisexual and transgender (LGBT) students have been conducted. According to these studies, LGBT students are often forced to cope with hostile climates in engineering. To address the question of how LGBT students experience the climate in engineering, we interviewed a total of 16 students at two institutions in the Midwest. We analyzed the interview transcripts using open coding based on a combination of Meyer’s Minority Stress Theory and Tinto’s Theory of Student Departure. Preliminary results indicate that LGBT students experience more situations of exclusion within engineering than in other areas of their campuses. Based on their experiences, students advocate increased visibility for LGBT students in engineering and a mentoring program to provide support from engineering faculty and graduate students who also identify as LGBT.
PROVIDING A HOLISTIC EDUCATIONAL ENVIRONMENT FOR THE WHOLE FAMILY
Luis Anido-Rifon (University of Vigo, Spain)  
Manuel Fernández Iglesias (Universidad de Vigo, Spain)  
Carlos Rivas-Costa (University of Vigo, Spain)  
Sonia Valladares-Rodriguez (University of Vigo, Spain)  
Miguel Gómez-Carballa (University of Vigo, Spain)

This paper describes a multi-device Learning Management System based on Moodle with alternative interfaces providing accessibility for people with disabilities. The software architecture built over Moodle is described as well as the interface created to offer access through a TV. An initial user focus group has been used to test and get feedback for further developments of the system.

ONLINE COURSE ADVISING: DIFFERENCES IN STUDENT RESPONSE BY GENDER AND ETHNICITY
Rui Pan (Purdue University, USA)  
Matthew D. Pistilli (Purdue University, USA)  
Joyce B. Main (Purdue University, USA)

Previous research suggests that effective academic advising can lead to better academic outcomes among undergraduate students. This study examines patterns between the use of an online advising tool, Course Signals, and course performance among students in engineering and technology. The number of advising interventions distributed through Course Signals tends to be positively associated with improved student course performance, particularly among female students. Findings suggest that online advising has the potential to be an effective method to improve student academic performance.

FIRST-YEAR ENGINEERING STUDENTS WITH DYSLEXIA: COMPARISON OF SPATIAL VISUALIZATION PERFORMANCE AND ATTITUDES
Velvet Fitzpatrick (Purdue University, USA)  
Teri Reed-Rhoads (Texas A&M University, USA)  
Jeffrey Gilger (University of California, Merced, USA)  
Sean Brophy (Purdue University, USA)  
P k Imbrie (Purdue University, USA)

Student diversity in higher education tends to focus on gender, ethnicity/race, and socio-economic status. However, these factors do not address cognitive diversity. Cognitive diversity, within the context of this study, refers to the varying ability of brain functions such as reasoning and memory, excluding persons with a developmental disability. Students with learning disabilities (LD), specifically dyslexia, contribute to this cognitive diversity. This study aims to initiate scholarly research on academic success factors for First-Year Engineering (FYE) students with dyslexia. FYE student performances on the Purdue Spatial Visualization Test-Rotations (PSVT-R) and Student Attitudinal Success Instrument (SASI) have been found to be predictors of academic success in engineering. A preliminary analysis of entering FYE student performance on the PSVT-R and SASI is conducted for three populations: students with dyslexia, students with a LD, and students without a LD. The anticipated findings will support the inclusion of cognitive ability, with an emphasis on LD and dyslexia, in FYE engineering diversity programs.

FACTORS INFLUENCING PARTICIPANTS' SELECTION OF INDIVIDUAL REU SITES
David Ross Economy (Clemson University, USA)  
Julie Martin (Clemson University, USA)  
Marian Kennedy (Clemson University, USA)

This study seeks to elucidate factors influencing undergraduate engineering student intent to participate in research assistantships offered through National Science Foundation (NSF) research experiences for undergraduates (REU) site programs. Understanding participant decision criteria could increase targeting of specific student populations, improve program outcomes, and increase efficiency of site directors. This ongoing study builds off previous work by the NSF [1] on REU programs to answer the following questions: (1) are participant selection criteria uniform for all STEM REU programs or do they vary by program primary discipline, (2) do additional factors not previously considered, such as geography and other offers they receive, significantly impact REU selection, and (3) do factors significantly vary by each successive student cohort. To collect data, a survey was sent to REU participants through nine participating National Science Foundation (NSF) site administrators. Geographic distributions of applications were classified based on
distance and spread with respect to hometown and indicated applicant divisions. Initial results showed that twenty five percent of these participants were offered multiple positions and seven percent of respondents declined another offer before accepting their current position.

**CONTEXT AND CONSISTENCY IN STUDENTS' APPROACHES TO SOLVING PROBLEMS IN ENGINEERING STATICS**

Jeffrey L. Newcomer (Western Washington University, USA)

This paper examines students' responses to conceptually identical equilibrium and equivalence concept questions given in slightly different contexts, two as part of a final exam requiring explanation and the other two as part of a concept inventory. Since equivalence questions are essentially equilibrium questions from a different perspective, students were asked to apply the same concepts from two different perspectives and in two different contexts. Ideally student responses would be independent of context, but examination of students' answer selections and explanations indicates that approximately 2 in 3 students are consistent in their answers for equilibrium or equivalence questions in different contexts, but only approximately 1 in 3 students is consistent for both types of questions in both contexts. This paper builds off of previous studies of students' responses to Engineering Statics concept questions, explains the questions and methodology used in the study, and presents the results of the study.

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**Session F4H: ECE V**

**Chair: Joseph Hoffbeck (University of Portland)**

4:00 - 5:30 pm

**Room: 2**

**WHEN A TESTBED DOES MORE THAN TESTING - THE INTERNET-SCALE EVENT ATTACK AND GENERATION ENVIRONMENT (ISEAGE) - PROVIDING LEARNING AND SYNTHESIZING EXPERIENCES FOR CYBER SECURITY STUDENTS**

Julie Rursch (Iowa State University, USA)

Doug Jacobson (Iowa State University, USA)

The importance of laboratory exercises for students is recognized unilaterally by engineering and technology programs. As engineering educators whose academic focus is information assurance and cyber security, we believe students in cyber security need the same type of access to hands on opportunities as their counter parts in hardware design or circuit design. Students should be able to configure and run their own networks, as well as explore the vulnerabilities, exploits, and remediations needed in a cyber security professional's tool kit. Further, they need exposure to working in the complexity of the Internet. While some might argue that simulation software could be a solution, it often lacks realism. In this paper we show how our institution goes beyond the providing the standard, formalized laboratory activities for our cyber security students by developing a unique, highly configurable testbed called Internet-Scale Event and Attack Generation Environment (ISEAGE - pronounced "ice age") that allows us to imitate the Internet. ISEAGE provides a controlled environment that allows real attacks to be played out against the students' networks and demonstrates to them real world security concepts.

**INTEGRATING CONTROL CONCEPTS IN AN EMBEDDED SYSTEMS DESIGN COURSE**

Manuel Jimenez (University of Puerto Rico at Mayaguez, Puerto Rico)

Gerson Beauchamp (University of Puerto Rico at Mayaguez, Puerto Rico)

Reinaldo Mulero (University of Puerto Rico-Mayaguez, Puerto Rico)

Maria Gonzalez Gil (University of Puerto Rico- Mayaguez, USA)

This paper describes a project experience in a microprocessor interfacing course, where computer engineering (CE) and electrical engineering (EE) students were joined to develop a project designing and implementing a Digital Controller for a Three Degree of Freedom Helicopter (3DOFH). This is a highly non-linear problem brought in by the EE students from the Process Instrumentation and Control Laboratory (PICL). Besides serving as the course project for the students, the motivation for taking such a project was to create a base platform using embedded microprocessors where control students could acquire signal conditioning and embedded software design skills in a more realistic platform than that provided by virtual instrument environments. This paper describes the course setting, design approach, and experience gained by the students, establishing a collaboration modality that could be emulated to bring multidisciplinary projects into traditional courses.
INNOVATE ENGINEERING OUTREACH: A SPECIAL APPLICATION OF THE XBOX 360 KINECT SENSOR
Tanner Blair (University of Oklahoma, USA)
Chad Davis (University of Oklahoma, USA)

In November of 2010, Microsoft released the Kinect sensor for the Xbox 360 video game console. This device—similar to a webcam—allows an individual to interact with an Xbox 360 or a computer in threedimensional space using an infrared depth-finding camera and a standard RGB camera. As of January of 2012, over 24 million units have been sold. Using a combination of custom and open-source software, we were able to develop a means for students to visualize and interact with the data allowing us to introduce the concepts and skills used in the field of Electrical and Computer Engineering. The unique technological application, visual appeal of the output, and the widespread ubiquity of the device make this an ideal platform for raising interest in the field of Electrical and Computer Engineering among high school students.

A NOVEL APPROACH TO TEACHING AMPLITUDE AND PHASE DISTORTION CONCEPTS USING TIME DOMAIN METHODS
Paul B Crilly (United States Coast Guard Academy, USA)
Richard J Hartnett (United States Coast Guard Academy, USA)

We present an alternative method to teach amplitude and phase distortion concepts using time domain methods. Typically, these concepts are taught using relatively expensive network analyzers. Here we show how a transcendental waveform, generated using relatively inexpensive waveform generators, and observed using standard lab oscilloscopes, can be used to illustrate amplitude and phase distortion, enabling the student to better understand systems whose magnitude responses are not flat, or whose phase responses may not be linear. Our methods allow students the opportunity to gain more insight into the characteristics of high fidelity (audio) systems.

JUST BECAUSE WE TEACH IT DOES NOT MEAN THEY USE IT: CASE OF PROGRAMMING SKILLS
Branimir Pejcinovic (Portland State University, USA)
Melinda Holtzman (Portland State University, USA)
Malgorzata Chrzanowska-Jeske (Portland State University, USA)
Phillip K Wong (Portland State University, USA)

We are assessing the effect of our new freshman electrical engineering course sequence on follow-on courses. One of our assessments is a survey distributed to sophomores in electrical circuits and juniors in microelectronics courses. Roughly one half of freshman year is spent on programming in MATLAB and C, and problem solving using these programming tools. Our observation is that students consider programming important and have reasonably good confidence (self-efficacy) that they can solve problems using MATLAB and C. However, when asked about frequency of use for these tools students report using them somewhere between once a week and once a month. There is a significant number of students who report almost no usage at all. Results are consistent across sophomore and junior years with a slight up-tick in frequency of use for juniors. We are hypothesizing that students do not view MATLAB and C as tools for problem solving but as yet another item to acquire in their studies. Our plan is to change instruction in sophomore courses so that more problem-solving which requires programming will be introduced. The existing survey will be used to measure future improvement.

Session F4I: pK-12 STEM II
Chair: Mindy Hart (Purdue University)
4:00 - 5:30 pm
Room: 4

DEVELOPING THE CELLBOT LEARNING FRAMEWORK (CLF) - AN INTERDISCIPLINARY MODEL FOR INTEGRATING MOBILE COMPUTING WITH ROBOTICS TO INNOVATE STEM EDUCATION AND OUTREACH
Ankur Chattopadhyay (Adams State University, USA)
George Sellman (Adams State University, USA)

Mobile computing and robotics have been used as two separate approaches to engage university and pre-university students in STEM education. We are in the process of developing an innovative learning model that combines these two approaches into an integrated framework, where students would learn to make robots and control them via Android.
By creating these cellbots, students will learn Android app programming and robot building together. Through CLF, we strive to engage both university and pre-university students in a creative environment that enables joint learning of programming logic and engineering concepts. CLF will also serve as an interdisciplinary tool to interface science with engineering. It will further pave the way for building diverse student communities by bonding different learners. The overall goal is to enhance STEM curriculum and outreach activities for recruiting more STEM majors. As part of implementing CLF, we are developing a STEM workshop for high school students, which will consist of hands-on activities on working with BERO (Be The Robot) and designing cellbots. Our future plans comprise of deploying CLF in introductory STEM courses to promote the diverse and interdisciplinary nature of STEM disciplines.

ENGINEERING THE HUMAN HEART IN THE SIXTH GRADE CLASSROOM
Christina Foster (Arizona State University, USA)
Tirupalavanam Ganesh (Arizona State University, USA)

A Framework for K-12 Science Education has been released that provides further support of K-12 engineering education by framing requirements for K-12 engineering standards for the science classroom. This study uses the engineering themes from the framework to evaluate how an engineering learning experience affects student achievement in science and engineering in the context of a science classroom. An engineering design challenge, Engineering an Artificial Heart, was developed for a pre-existing science instructional lesson, the human heart, for its use in a 6th grade science classroom with 32 students. Students' achievement of learning objectives for science and engineering concepts were measured using content assessments, student artifacts, and semi-structured interviews. Preliminary analysis shows positive learning gains for science learning objectives and evidence of performance for the engineering learning objectives.

MASTERY GOAL STRUCTURES FOR A FOURTH GRADE SCIENCE CLASSROOM
Christina Foster (Arizona State University, USA)
Christine Mendoza (Arizona State University, USA)
Jenefer Husman (ASU, USA)

This study investigates the influence of modeling instruction for a solar engineering design challenge on students' achievement goal orientations. Two classrooms received five weeks of modeling instruction using whiteboarding strategies. Students' goal orientations were measured before and after the learning experience using the goal orientation sub scale of the self-report questionnaire, Patterns of Adaptive Learning (PALS). Preliminary analysis revealed that students' performance approach and avoid goals increased, but saw no improvement in the students' mastery goals. This study provided insight to the possible ways in which modeling instruction may be enhancing negative performance goals within the context of a high-stakes environment. Discussion highlights the importance of motivational supports for creating a classroom environment that supports mastery learning.

EXPOSURE MATTERS: UNDERSTANDING THE EXPERIENCES OF RURAL CULTURES
Matthew Boynton (Virginia Tech, USA)
Cheryl Carrico (Virginia Tech, USA)
Marie Paretti (Virginia Tech, USA)
Holly Matusovich (Virginia Tech, USA)
Adam Taylor (Auckland University of Technology, New Zealand)

Engineering has been shown to be an important field of study and practice for economic and technological development, as well as an opportunity for students to improve their standard of living and their communities. Engineering also has the potential to provide a powerful career path in places that suffer disproportionate economic losses from shifts in the global economy, particularly as the growth of mobile communication technologies enable virtual work and local business development in areas formerly considered "remote" or "inaccessible." Despite these opportunities, little investigative work to date has been done on recruitment of engineering students from rural cultures that are typically underrepresented in the field. To address this gap, this paper explores two such cultures: the Central Appalachians in the United States of America and the Maori in New Zealand. We present a review of the current situation in each region, along with preliminary findings from a study of Appalachian students, to identify both similarities and differences between the two peoples that can be used to enhance recruitment efforts and provide a global context for understanding the experiences of rural cultures.
DEVELOPMENT OF INTERACTIVE 3D TANGIBLE MODELS AS TEACHING AIDS TO IMPROVE STUDENTS' SPATIAL ABILITY IN STEM EDUCATION

Oai Ha (Utah State University, USA)
Ning Fang (Utah State University & College of Engineering, USA)

Spatial abilities have been reported to be critical for success in Science, Technology, Engineering, and Mathematics (STEM) education. Research findings prove that spatial abilities can be improved significantly through training. This project develops 3D tangible models (TMs) and their corresponding computer graphics (CGs) as teaching aids to improve students' spatial abilities. The TMs and their CGs work together in a real-time, interactive manner. The TMs use a sensor board containing an attitude heading reference system to track and send their real-time 3D orientation on three axes to a computer. A program renders the 3D graphic models of these TMs on the computer screen and updates their 3D orientations. By manipulating the TMs and observing corresponding CGs on computer screens in real time, students will experience the displays of the same objects which undergo rotations in space from infinite viewing angles, resolving visual ambiguities. The system offers potential advantages over static pictures by explicitly rendering dynamic rotations of 3D figures over space, rather than requiring students to "mentally" figure out those rotations. The models in this development project will be used in an experiment to evaluate how they affect students' spatial abilities.

A COMPARISON OF SINGLE AND MIXED GENDER ENGINEERING ENRICHMENT PROGRAMS FOR ELEMENTARY STUDENTS

Linda S. Hirsch (New Jersey Institute of Technology, USA)
Suzanne Berliner Heyman (New Jersey Institute of Technology, USA)
Rosa Cano (New Jersey Institute of Technology, USA)
John Carpinelli (NJIT, USA)
Howard Kimmel (New Jersey Institute of Technology, USA)
Steven Romero (New Jersey Institute of Technology, USA)

The Center for Pre-College Programs at New Jersey Institute of Technology sponsors summer enrichment programs designed to increase students' interest in the fields of science, technology, engineering and mathematics (STEM). Such programs are instrumental in informing students about careers in STEM, helping ensure they receive the academic background to prepare for these careers in college. One program was designed specifically for young girls to help increase the number of women interested in engineering and other technological careers. Although there is much debate about the relative effectiveness of female-only programs, previous research comparing aspects of our program to equivalent mixed-gender programs found it to be particularly effective in influencing girls' perceptions of engineers and attitudes toward engineering as a career. The addition of equivalent male-only programs prompted further research comparing changes in students' perceptions of engineers and attitudes toward engineering, as well as increases in learning and content knowledge. The female-only, male-only and mixed-gender programs were identical in content. In addition to objective measures of effectiveness, teachers were interviewed to collect qualitative data about the students' interaction and the climate in the classroom. Results show differential effects among the programs in terms of perceptions, attitudes, learning, classroom climate and student interactions.
S1A: Special Session: The CS 2013 Computer Science Curricula Guidelines Project
8:00 - 9:30 am
Room: 14

THE CS 2013 COMPUTER SCIENCE CURRICULA GUIDELINES PROJECT
Steve Roach (Exelis, USA)
Mehran Sahami (Stanford, USA)
Richard LeBlanc (Seattle University, USA)
Remzi Seker (University of Arkansas at Little Rock, USA)

The ACM/IEEE-Computer Society CS2013 Computer Science Curricula task force is working to update the previous curricular guidelines published in 2008 and 2001. The CS2013 guidelines are scheduled to be published in the latter half of 2013. This special session is devoted to exploring the guidelines with an emphasis on migrating current curricula to curricula aligned with the new guidelines. A number of significant changes from the 2008 and 2001 guidelines have been made, including the addition of new knowledge areas (including Parallel and Distributed Computing and Security and Information Assurance) as well as the reorganization and refactoring of previous areas to create a Systems Fundamentals area and a Software Development Fundamentals area. These changes are intended to identify significant changes in the computing field over the past decade, look forward to future changes, provide greater flexibility in the design and implementation of Computer Science curricula, provide stronger guidance with respect to student outcomes, and provide diverse examples of fielded curricula.

S1B: Panel: Engineering Education in Countries of Portuguese Language
8:00 - 9:30 am
Room: 14

ENGINEERING EDUCATION IN COUNTRIES OF PORTUGUESE LANGUAGE
Melany M Ciampi (Safety, Health and Environment Research Organization & President, Brazil)
Claudio R Brito (Science and Education Research Council, Brazil)
Rosa Maria Vasconcelos (Minho University, Portugal)
Luis Amaral (University of Minho, Portugal)

The Portuguese-speaking countries are home to more than 240 million people located across the globe but having cultural similarities and a shared history. The CPLP (Community of Portuguese Language Countries) nations have a combined area of about 10,742,000 square kilometers (4,148,000 sq. mi), which is larger than Canada. The proposal of this paper is to show and discuss with some details how engineering education is developed in countries of Portuguese languages due to the peculiarities in the historic development of the countries.

Session S1C: pK-12 STEM III
Chair: Andres Navarro (Universidad Icesi)
8:00 - 9:30 am
Room: 16

STEM LITERACY AND TEXTBOOK BIASES IN K-12
Gisele Ragusa (University of Southern California, USA)

Textbooks are a common source of science information in K-12 science education. Science literacy is a major challenge of students in K-12 and this dramatically affects students’ achievement. Biases in textbooks negatively influence students’ interest and achievement in science and engineering. This study explores types of biases in K-12 science texts. These biases primarily relate to gender, race and ethnicity. Textbook biases negatively affect students’ views of science as a field, as a career and as a college major. Achievement may also be affected by such biases. Accordingly, this research study explores the biases in K-12 science textbooks. The textbooks were analyzed using a multidimensional rubric and accompanying scoring checklist. Results of these analyses revealed dramatic biases in textbooks particularly for early elementary and high school texts. Both print and photographic biases were noted in the textbooks. In particular,
the books that focused on biological sciences were found to contain significant biases especially related to gender. These biases may influence how students feel about careers in science, technology, engineering and mathematics (STEM) areas and therefore may impact future workforces in STEM fields.

**PROJECT BASED CLEAN TECH CURRICULUM FOR HIGH SCHOOL**
John Skardon (California State University-Monterey Bay & Open Innovation Networks, USA)

United States renewable energy businesses require well trained high school and college students to fill key positions as technicians, engineers, and other high paying jobs. Project based learning programs offer a way to train students in these emerging fields with realistic, intensive student-designed and built projects. This paper reviews the challenges and some of the lessons learned in developing a four year high school curriculum in renewable energy and clean technology. A primary challenge in developing this kind of program is the time and complexity of gathering relevant technical material in this field and adapting it for high school students. Related to this challenge is the selection of projects that the students pursue. We’ve learned that these two challenges require a content area expert and substantial technical support to insure that student design projects are age and skill appropriate, safe for the class, but also keep students engaged. One key learning from this program has been the successful introduction of novel, table-top scale "minisystems" that emulate full scale projects such as electric vehicles. These minisystems are also low-cost enough so that a typical class can to assign one minisystem to a two person team. The renewable energy focus also enables the discussion of key environmental and economic challenges. Student designed and built thermal storage units mimic residential-scale systems. Energy arbitrage, the differential in peak and low demand prices for electricity, helps the students understand why and when these systems can be economical to operate. Other projects in biofuels also facilitate discussion about the sustainability of using food or other renewable natural resources for energy. Each course contains six to eight projects. Projects topics are developed through an interactive brainstorming session including leading teachers in the State, representatives from prominent local industry. The project topics are further refined to focus on a key problem area. This curriculum this currently in the pilot phase at numerous high schools in the Southeast.

**COMPUTER SCIENCE WIDENING THE STEM EDUCATION SPECTRUM**
Christopher Morack (Tennessee Technological University, USA)
William Eberle (Tennessee Tech University, USA)

Science, Technology, Engineering and Mathematics (STEM) education is slowly becoming an important part of American culture. STEM educators try to promote 'hands on' science, where students can actually interact with and see the results of their work. Unfortunately, not all paths of education for STEM related fields can have exciting, interactive teaching methods. At the Millard Oakley STEM Center, we have taken advantage of the interactive experience in our planetarium show. In this paper, we take an in-depth look at the Definiti Theater System and the software that runs it, Digital Sky 2. This software package is created by Sky-Skan and is considered to be the standard for many new planetariums across the country and beyond. We take the software in new directions by building new elements through the Sky-Skan scripting engine and by also exploring its 3D engine for creating a novel experience. The primary purpose of this paper is to provide a roadmap of observations and enhancements for other educators that wish to improve the learning experience of students and visitors to their planetarium.

**BROADENED PERCEPTIONS OF ENGINEERING IN TENTH GRADE STUDENTS THROUGH A BIOWALL DESIGN PROJECT**
Weston L Aenchbacher (Drexel University, USA)
Sin Park (Drexel University, USA)
Stephanie Dunda (Science Leadership Academy, Philadelphia, PA, USA)
Timothy Best (Science Leadership Academy, Philadelphia, PA, USA)

Vertical garden and green wall structures have been introduced to the K-12 environment as vehicles for learning as part of a larger green construction trend. This paper considers the design and construction of a biowall as a case study for green engineering design projects in the K-12 setting. The research, conducted in participation with 123 10th-grade public school students, investigates further learning opportunities posed by a biowall design-build project. We claim that the highly visible plant component of the wall makes the project more accessible to students that would have been immediately averse to a “rigid” engineering project, allowing for increased perceptions of competency in engineering through willing practice. Further, we claim that the large-group organizational structure of the project, with students working in multiple specialist sub-groups to complete a larger project, increases students' perceptions that good
communication skills are required in engineering. This article provides methods employed and qualitative and quantitative results.

**HANDS-ON ELECTRICITY: AN ACTIVE LEARNING OPPORTUNITY FOR HIGH-SCHOOL PHYSICS**
Mario Simoni (Rose-Hulman Institute of Technology, USA)
Glen Cook (Terre Haute North High School, USA)
Stephen Beeler (Terre Haute South High School, USA)

This paper describes a STEM outreach program for 9-12 grade physics courses. The goal of the program is to provide students with hands-on technologically relevant learning activities for concepts in electricity and magnetism. The three parts of this program include providing schools with the appropriate technology, training the teachers, and developing relevant and sufficiently detailed lesson plans. This program began in the summer of 2011. Being at the beginning of a work in progress, very few results are available so this paper describes the program itself and some of the lesson plans.

**SESSION S1D: INNOVATIVE COMPUTING PRACTICE III**
Chair: Daniel Krutz (Rochester Institute Of Technology)
8:00 - 9:30 am
Room: 17

**USING LEGO MINDSTORMS TO ENGAGE STUDENTS ON ALGORITHM DESIGN**
Ainhoa Álvarez (University of the Basque Country, Spain)
Mikel Larrañaga (University of the Basque Country, Spain)

Students on Basic Programming courses often have difficulties with program design tasks. This problem mainly arises from their lack of program solving skills. To overcome this lack, students' need to practice. Manipulating real entities can be a useful and motivating strategy to engage students in such endeavor. In this context, several authors have used LEGO Mindstorms robots to help students on basic programming courses. In this paper, we present the results obtained from an experience conducted on a Basic Programming course using those robots to motivate students and to involve them in algorithm design.

**EDUCATING INNOVATORS OF FUTURE INTERNET OF THINGS**
Evgeny Osipov (Luleå University of Technology, Sweden)
Laurynas Riliskis (Luleå University of Technology, Sweden)

The concept of "Internet-of-Things" will undoubtedly emerge as the technology of the future. Educating specialists ready to bring the concept to the reality remains challenging in the scope of traditional university courses. The main challenge is how to enable students to think outside the boundaries of the particular discipline and therefore to enable the innovative thinking. This article describes an experiment with teaching Internet-of-Things as a common red thread across three courses which ran in parallel during fall semester 2012 at Luleå University of Technology in Sweden. We discuss the teaching methodology, the technology blocks which laid the ground for our teaching philosophy as well as the experiences and lessons learned.

**WRITING GROUPS IN COMPUTER SCIENCE RESEARCH LABS**
Adam Doupe (University of California, Santa Barbara, USA)
Janet L. Kayfetz (University of California, Santa Barbara & Columbia University, USA)

Researchers must excel at writing to effectively engage the scientific community. Clear and engaging writing advances new knowledge and increases the impact of a researcher's work. As developing researchers, it is essential that graduate students learn to write clearly and effectively so that their work is accessible to their peers and colleagues. An essential part of graduate school education should include the teaching of formal writing skills. In most graduate programs, students learn formal writing skills from two sources, their advisors or a writing class. We identify a third source: the graduate student peer group. In this paper, we describe how we leveraged the existing collaborative research dynamic among students in a graduate research lab and created a writing group, similar in spirit to the concept of a reading group. We describe the inspiration, implementation, and impact of a writing group in a real-world research lab. We show how the writing group started organically after a PhD student took a graduate writing class in the Computer Science Department and thereafter initiated the writing group in his research lab. We also describe how a writing group can be implemented in other research labs to improve the writing of graduate students worldwide.
TEACHING WEB ENGINEERING USING A PROJECT COMPONENT
Daniel Krutz (Rochester Institute of Technology, USA)
Andrew Meneely (Rochester Institute of Technology, USA)

Web applications are an intricate part of the world today. Everything from banking to checking our Facebook status may now be done through the use of web applications. Today’s students need to balance numerous concerns in order to create a web application that is robust, on time and on budget. At the Department of Software Engineering at the Rochester Institute of Technology, we created a course called Web Engineering. As part of this course, we developed an innovative project component which focused on students following software engineering principles such as elicitation, requirements generation, testing and deployment.

INCORPORATING SERVICE-ORIENTED PROGRAMMING TECHNIQUES INTO UNDERGRADUATE CS AND SE CURRICULA
Xumin Liu (Rochester Institute of Technology, USA)
Rajendra Raj (Rochester Institute of Technology, USA)
Tom Reichlmayr (Rochester Institute of Technology, USA)
Chunmei Liu (Howard University, USA)
Alex Pantaleev (SUNY Oswego, USA)

Service-Oriented Programming (SOP) has emerged as a new programming paradigm that allows the wrapping of existing software as web services, thus permitting the development of new software applications by using existing web services as building blocks. SOP has attracted great attention from industry as it dramatically increases software reuse. Despite the growing demand for an SOP-trained workforce, SOP has not been adequately covered in coursework for undergraduate students in Computer Science (CS) and Software Engineering (SE). This project addresses this curricular shortcoming via the design and creation of SOP materials for undergraduate CS and SE. The concept of course modules—self-contained units of instruction that can be incorporated into several existing courses—is used to make these materials accessible at multiple educational institutions. This paper describes an exemplification and visualization framework that supports the teaching of SOP, along with three course modules that can be folded into typical courses currently offered to CS or SE undergraduates.

Session S1E: Distance Education I
Chair: James Rowland (University of Kansas)
8:00 - 9:30 am
Room: 18

GENERIC INTEGRATION OF REMOTE LABORATORIES IN LEARNING AND CONTENT MANAGEMENT SYSTEMS THROUGH FEDERATION PROTOCOLS
Pablo Orduña (DeustoTech - University of Deusto, Spain)
Sergio Botero Uribe (EAFIT, Colombia)
Nicolas Hock Isaza (Massachusetts Institute of Technology, USA)
Elio Sancristobal (Spanish University for Distance Education - UNED, Spain)
Mikel Emaldi (DeustoTech - University of Deusto, Spain)
Alberto Pesquera Martin (Spanish University for Distance Education - UNED, Spain)
Kimberley DeLong (Massachusetts Institute of Technology, USA)
Philip Bailey (Massachusetts Institute of Technology, USA)
Diego López-de-Ipiña (DeustoTech - University of Deusto, Spain)
Manuel Castro (Spanish University for Distance Education - UNED, Spain)
Javier Garcia-Zubia (DeustoTech - University of Deusto, Spain)

Educational remote laboratories are a software and hardware tool that allows students to remotely access real equipment located in universities as if they were in a hands-on-lab session. Their integration in Content and Learning Management Systems (CMSs or LMSs) has been an active research topic for years, supporting mainly ad hoc solutions. A notable exception has been the use of federation protocols—commonly used for sharing laboratories from one university to other—for actually sharing laboratories from a remote laboratory system to a C/LMS. This approach opened new doors in the simplification of the process, since it did not require the remote laboratories to make any type of change. The focus of this contribution is to provide a solution to decrease the number of functionalities required for creating an integration by
providing a software component that reuses them. This component -open sourced- has been implemented and two remote laboratory management systems are already supported. In the C/LMS side, all the LMSs supporting IMS LTI are supported, and HTTP APIs are provided for being supported by other systems. The contribution describes its support in 3 systems which do not support IMS LTI.

**EMBEDDED AND REAL-TIME SYSTEMS CLASSES IN TRADITIONAL AND DISTANCE EDUCATION FORMAT**

Mitchell A Thornton (Southern Methodist University, USA)
Theodore Manikas (Southern Methodist University, USA)
Phil Laplante (Pennsylvania State University, USA)

Embedded Systems design courses are important components in software, computer, and electrical engineering programs and curricula. We describe topics for inclusion in these courses and associated hands-on experiences as required portions of the courses including example development systems based upon two popular microcontrollers. We also describe the challenges of offering these courses in distance format and provide examples of how the hands-on component may be included for distance students.

**STUDENT ENGAGEMENT IN GEOGRAPHICALLY DISTRIBUTED CLASSROOMS THROUGH LOCALIZED SOLUTIONS**

Kai Pan Mark (City University of Hong Kong, Hong Kong)
Crusher Wong (City University of Hong Kong, Hong Kong)

Engaging students across geographically distributed teaching and learning activities can be a challenge in contemporary higher institutions. Often, technical constraints, e.g., hardware and software availability, network connectivity and support availability, affect the quality of teaching and learning activities in remote sites. Student participation in the remote sites decreases if the quality of activities is appalling. This paper reports the approaches taken by the faculty and support staff to overcome the challenges in student engagement in a joint graduate research level course on Information Systems geographically distributed in multiple sites in Hong Kong and China. A combination of Web LiveCast and local Voice over IP (VoIP) messaging tools have been deployed on existing thin client hardware to deliver the “quick and dirty” solution. The solution was proved to be effective in improving student engagement, in terms of improved quality in teaching and learning activities, minimal interruption to the students and teachers by preserving the “natural” way of conducting teaching and learning activities, in the remote site without additional resources input on existing solutions.

**ENHANCED RECOMMENDATIONS FOR E-LEARNING AUTHORING TOOLS BASED ON A PROACTIVE CONTEXT-AWARE RECOMMENDER**

Daniel Gallego (Universidad Politécnica de Madrid, Spain)
Enrique Barra (Universidad Politécnica de Madrid, Spain)
Aldo Gordillo (Universidad Politécnica de Madrid, Spain)
Gabriel Huecas (Universidad Politécnica de Madrid, Spain)

Authoring tools are powerful systems in the area of e-Learning that make easier for teachers to create new learning objects by reusing or editing existing educational resources coming from learning repositories or content providers. However, due to the overwhelming number of resources these tools can access, sometimes it is difficult for teachers to find the most suitable resources taking into account their needs in terms of content (e.g. topic) or pedagogical aspects (e.g. target level associated to their students). Recommender systems can take an important role trying to mitigate this problem. In this paper we propose a new model to generate proactive context-aware recommendations on resources during the creation process of a new learning object that a teacher carries out by using an authoring tool. The common use cases covered by the model for having recommendations in online authoring tools are explained. Furthermore, details about the recommender model proposed and advantages of applying it to e-Learning traditional authoring tools are presented.
IMPROVING STUDENT OUTCOMES IN DISTANCE LEARNING MATHEMATICS CLASSES
Christopher Golubski (University of Texas at Austin, USA)
Cesar Navarrete (University of Texas at Austin, USA)
Elisa Azua (University of Texas at Austin, USA)

Participation in online courses has significantly increased in recent times. Student performance in online mathematics classes lag behind their counterparts in other subject areas. We hypothesize that one of the main reasons for this is the lack of technological tools for effective communication of mathematics via the Internet. We propose to test our hypothesis by implementing new technologies and evaluate the difference in course performance and attrition rates between the students who use these technologies and a control group.

INFLUENCE OF ENTREPRENEURIAL APTITUDE ON TECHNOLOGY ENTREPRENEURSHIP COURSE PERFORMANCE
Anthony Joseph (Pace University, USA)

In a computing technology entrepreneurship course offered in fall 2011, students were separated into teams of three and four students and taught the concepts and skills of teamwork, innovation, and entrepreneurship. They applied these concepts and skills to an open-ended project for a niche market financial or healthcare information technology product. Each team produced a product supported by a business plan and PowerPoint presentation as the project deliverable. The course was supported by mentors for the teams and guest lecturers. In spring 2011, a Data Mining course was offered where no direct instruction in teamwork, innovation, and entrepreneurship was provided, but the student teams were assigned a similar open-ended project. The objective of this exploratory study is to evaluate students and teams' relative increase in entrepreneurial aptitude. The two courses' performances were determined by the project quality and course grades (average in-class and final examinations) supplemented by a post survey of student perceptions of course related gains and changes in attitudes. As expected, the quality of the team projects produced and the correlation analysis of the examination grades in the Technology Entrepreneurship course showed relative improvement over those produced in the Data Mining course.

INNOVATION-DIRECTED EXPERIENTIAL LEARNING USING SERVICE BLUEPRINTS
Jayashree Ramanathan (The Ohio State University, USA)
Rajiv Ramnath (The Ohio State University, USA)
Michael J. Herold (The Ohio State University, USA)
Benjamin J. R. Wierwille (The Ohio State University, USA)

An analysis of hiring patterns showed emerging trends: the complexity of information technology (IT) is shifting from development to post-deployment and integration needed for services. Given the complexity of deployed service systems, generated big data, and the national dialogue on educating engineers, we asked ourselves related questions. Do our graduate students have evaluation skills needed to work at the most advanced level of Bloom’s taxonomy? Can they learn to frame and solve the problems within complex industry environments while applying the current research? How do we structure a graduate curriculum and an environment that provides experiences in innovation within the constraints of the academic calendar? Here we present an interdisciplinary curriculum comprised of three components: a service interaction blueprint for framing the industry problem, agile principles focusing on aspects of the solution, and Christensen’s theory-building to frame the next iteration of research. The environment for industry problems was created through an National Science Funded Industry & University Cooperative Research Center. The feedback from a pilot graduate-level class is positive and provides insights for further research. We show through feedback discussions that it is possible to have translational activity at the industryuniversity enterprise
INVENTS: IMPROVING RETENTION AMONG STEM MAJORS THROUGH A LIVING LEARNING COMMUNITY
Catherine Amelink (Virginia Tech, USA)
Bevlee Watford (Virginia Tech, USA)
Susan Arnold-Christian (Virginia Tech, USA)
Christina Seimetz (Virginia Tech, USA)

Studies have identified institutional or programmatic interventions that can be implemented to address lack of fit and related individual variables that may impact success and retention in engineering programs, especially among underrepresented groups in science, technology, engineering, and math (STEM) fields. One such intervention is a living-learning community (LLCs). LLCs can create a critical mass that increases the supportive peer interactions taking place among women and other underrepresented groups and can also alleviate negative stereotypes. Informed by best practices in the literature, inVenTs is a new interdisciplinary residential community offered to engineering, science, and business undergraduates that is designed to encourage the development of innovative and entrepreneurial thinking skills while at the same time offering programming that is linked to retention and success, especially among students from underrepresented groups. Linked to the activities being offered in this residential community, our research is examining what curricular and co-curricular initiatives have been shown to retain underrepresented minorities and at the same time develop students’ ability to be innovative. Results related to this research will share the best practices identified and resources that can help educators in teaching innovation, while at the same time encouraging retention and success among undergraduates.

AN INNOVATIVE CLASSROOM THAT PRODUCES INNOVATIVE STUDENTS
Weixun Cao (Arixin Electronics Inc., P.R. China)
Hong Gao (Association of Neimenggu Children’s Science and Technology Education, P.R. China)
Shengri Chen (Shanghai Qibao High School, P.R. China)
Danhui Ying (Shanghai Xunyang Middle School, P.R. China)
Yingping Chen (Nanhu Primary School, P.R. China)
Zhiqiang Xu (Arixin Electronics Inc., P.R. China)

"BitLab" is an innovative classroom that integrates scientific history, sensor technology with quick prototyping and public speaking in a team-based interactive learning environment. In order to inspire the students' spirit of innovation, everything in this classroom is built by small "Bit". Electronic sensor-based "BitLab Bricks" enable the students to conceive their own innovative design, which covers daily life applications. A prototype is then built using geometric shapes. In the end, each team writes up a description of their "product" and gives a presentation on its features and functionalities. The interactive learning platform is delivered through team-based "BitLab Curriculum". The status and impact of BitLab in Chinese schools are presented.

INNOVATION IN GRADUATE PROJECTS: LEARNING TO IDENTIFY CRITICAL FUNCTIONS
Vimal Viswanathan (Georgia Institute of Technology, USA)
Peter Ngo (Georgia Institute of Technology, USA)
Cameron Turner (Colorado School of Mines, USA)
Julie Linsey (Georgia Institute of Technology, USA)

Design-by-analogy is considered to be a powerful tool for engineering design. The difficulty of finding suitable analogies for solving a given design problem gives rise to the current efforts on computational tools for analogy-based design. For deriving information from an analogy database, critical functionality of a design problem can be a potential criterion. The study described in this paper investigates whether novice designers can identify the critical function of a design problem in three scenarios: when they are asked to report the important functions of the problem, when they are directly asked to report the critical function and when they are asked to use design-by-analogy. It is observed that student designers have a hard time identifying the critical functions when they are directly asked to or when they are asked to list important functions. However, they use critical functions as search criteria in their analogical mapping process. This shows that during analogical reasoning, designers tend to think in terms of critical functions and they are valid search criteria for deriving analogies from a computational database. This insight is highly valuable for the current efforts to develop computational tools for analogical reasoning.
Session SIG: First and Second Year Programs III
Chair: Leen-Kiat Soh (University of Nebraska-Lincoln)
8:00 - 9:30 am
Room: 20

**IMPROVING LEARNING OF COMPUTATIONAL THINKING USING CREATIVE THINKING EXERCISES IN CS-1 COMPUTER SCIENCE COURSES**

Lee Miller (University of Nebraska-Lincoln, USA)
Leen-Kiat Soh (University of Nebraska-Lincoln, USA)
Elizabeth Ingraham (University of Nebraska-Lincoln, USA)
Duane F Shell (University of Nebraska-Lincoln, USA)
Stephen Ramsay (University of Nebraska-Lincoln, USA)
Melissa Patterson Hazley (University of Nebraska-Lincoln, USA)
Vlad Chiriacescu (University of Nebraska-Lincoln, USA)

Promoting computational thinking is one of the top priorities in CS education as well as in other STEM and non-STEM disciplines. Our innovative NSF-funded IC2Think project blends computational thinking with creative thinking so that students leverage their creative thinking skills to "unlock" their understanding of computational thinking. In Fall 2012, we deployed creative exercises designed to engage Epstein’s creative competencies (Surrounding, Capturing, Challenging and Broadening) in introductory level CS courses targeting four different groups (CS, engineering, combined CS/physical sciences, and humanities majors). Students combined hands-on problem solving with guided analysis and reflection to connect their creative activities to CS topics such as conditionals and arrays and to real-world CS applications. Evaluation results (approximately 150 students) found that creative thinking exercise completion had a linear "dosage" effect. As students completed more exercises [0/1 - 4], they increased their long-term retention [a computational thinking test], F(3, 98) = 4.76, p =.004, partial Eta2 = .127 and course grades, F(3, 109) = 4.32, p =.006, partial Eta2 = .106. These findings support our belief that the addition of creative thinking exercises to CSCE courses improves the learning of computational knowledge and skills.

**AN ANALYSIS OF A PRE-ENGINEERING PROGRAM MODEL USED TO PREDICT A STUDENT'S PERSISTENCE TO GRADUATION**

Reginald J Perry (FAMU-FSU College of Engineering, USA)

This paper presents the evolution and implementation of the pre-engineering program at the joint Florida A&M University-Florida State University College of Engineering. The program was initiated in 2004. It was revised several times between 2004 and 2009. These revisions were made to accommodate unexpected or unattended consequences in the program’s implementation. The current program consists of five courses taken by engineering students including First-Year Engineering Laboratory, Calculus I, Calculus II, General Chemistry I, and General Physics I. Chemical engineering students replace General Physics I with General Chemistry II. Between 2004 and 2008, almost 2000 first-time in college (FTIC) engineering students participated in the program. The analysis suggests that students who successfully complete the pre-engineering program graduate from the college with a degree in engineering at a very high rate. Additionally, it appears there are no statistically significant differences in graduation rates among pre-engineering program completers with respect to home institution, gender, and race/ethnicity.

**INTEGRATING COHORTS TO IMPROVE STUDENT CAREER SELF-EFFICACY**

Lesley Strawderman (Mississippi State University, USA)
Katherine King (Mississippi State University, USA)

Past research on student efficacy shows that students felt more confident in their selection of career field when they were able to "try it on for size." Students have a desire to get their hands dirty and try using engineering tools early in the curriculum. Additionally, students often report a great deal of uncertainty about the curriculum and their ability to be successful in their academic and future careers. In this paper, we describe the integration of a discipline’s introductory course within the rest of the discipline's curriculum. Student reported self-efficacy in the introductory engineering course was measured before and after the course activity was completed. Four questions were used to assess efficacy on a 5-point Likert scale. The largest increase in score was seen on the final efficacy question (Mpre4=3.59, Mpost4=3.87). The average efficacy for all students and all questions was 4.04 (sd=1.01). Inferential results based on student classification, gender, prior work experience, and perceptions of the mentoring activity are discussed. Finally, implications and suggestions for the use of cohort integration in engineering programs are discussed.
ASSESSING STUDENT INFORMATION LITERACY SKILLS AND THE EFFECTIVENESS OF AN EVOLVING FACULTY-LIBRARIAN COLLABORATION IN A FIRST YEAR DESIGN COURSE
Laura Hanlan (Worcester Polytechnic Institute, USA)
Allen Hoffman (Worcester Polytechnic Institute, USA)
Rebecca Ziino (Worcester Polytechnic Institute, USA)

Engineering students need research skills to effectively complete research and design projects. Information literacy education during the first year of college positions future engineers to complete projects both during their college years and when they move into their careers. This study provides evidence that faculty-librarian collaboration is an effective method to train students in these critical skills, and proposes an efficient model that can be adapted to other courses. This work-in-progress, in the third year of a four year analysis, assesses and develops a method of sustainable faculty-librarian collaboration that improves information literacy outcomes in a first-year, project-based engineering design course at Worcester Polytechnic Institute (WPI). To assess the effectiveness of information literacy instruction methods, citation analysis of group project bibliographies, faculty feedback, and student opinion survey data will be used. Preliminary citation data and faculty feedback suggest that increased librarian contact with students, development of resource guides, and design of grading rubrics to incorporate reference list requirements improve student projects and information literacy outcomes. The end result of this four year study will be a recommendation of a sustainable and effective faculty-librarian collaboration that improves information literacy outcomes among students and can be easily adapted to other courses.

TEACHING WITH UNFAMILIAR PEDAGOGY FOR ENGINEERING DESIGN INSTRUCTORS
Omowunmi Isaacs Sodeye (Arizona State University, USA)
Micah Lande (Arizona State University, USA)

In recent years, there has been an increase in the degree of attention paid to the teaching of engineering design. This increase is the result of engineering institutions' response to calls for reform in the way engineering graduates are trained. Many engineering programs have responded by adding more practical courses to their curriculum. Unlike traditional engineering courses, teaching engineering design involves using active teaching pedagogy. However, many engineering educators are not familiar with active teaching pedagogy and tend to have reservations when asked to implement in the classroom. This reservation makes the study of the type of concerns faculty may have implementing active teaching strategies relevant. Hence, understanding concerns regarding the teaching of engineering design is necessary if faculty members are to meet the mandate of helping the students develop the needed non-technical workplace skills. Many studies that examined teachers' concerns about their teaching, especially at K-12 education systems, but few studies have been done in undergraduate engineering education. The purpose of this paper is to investigate the concerns that faculty members have about teaching a freshman engineering design course, especially related to implementing an unfamiliar pedagogy for them. The instructors who taught the course were interviewed and comparative analysis of the semi-structured interview transcripts was studied for common themes. Observed themes were mapped unto Hall's Concerns-Based Adoption Model for understanding concern related to adoption of innovation. Emergent themes from this analysis were deemed specific to the teaching engineering design. Studying of engineering educators concerns teaching design mapped well unto Hall's Concerns-Based Adoption Model for adoption innovation. Results showed all the instructors have had some experience with using students engagement strategies in their classroom. However, despite their experience, these instructors still have concerns about teaching design, especially regarding their ability to interpret the effectiveness of the active teaching strategies.

Session S1H: ECE VI
Chair: Abdel-Hameed Badawy (Arkansas Tech University)
8:00 - 9:30 am
Room: 2

DEVELOPING EXPERIMENTAL PLATFORMS USING COMMON SOFTWARE TOOLS FOR ENHANCING TECHNICAL SKILLS OF ELECTRONICS ENGINEERING STUDENTS IN MICROCONTROLLERS
Sangmeshwar Shankarrao Kendre (TSSM's PVPIT, University of Pune, India)
Pallavi Mulmule (TSSM's PVPIT, University of Pune, India)
Suresh Shirbahadurkar (TSSM's PVPIT, University of Pune, India)
An innovative laboratory methodology for simulation of microcontroller based virtual kits is presented. Microcontrollers are widely applied in the field of industry to solve engineering control problems. Today's embedded world uses variety of microcontrollers as heart of processing. These simulation softwares are used to study the functionality of circuit. Students have blindness when they first contact the experiments because of the complexity of the circuit, so this usually leads to the damage to the experiment device. Therefore, it is necessary to make the students to know the theory, models and adjustable parameters of the experiments before the practical experiments. The mixed software stimulation platform based on Proteus, LabVIEW, MATLAB and Arduino was designed for this purpose.

A FULL-FEATURED REMOTE LABORATORY FOR HANDS-ON ENGINEERING EDUCATION
Timothy Pearson (Raptor Engineering & Northern Illinois University, USA)

This work-in-progress paper briefly describes the uLab, a new method and framework for remote hardware design laboratories, which uses Linux and FOSS to provide real-time design and debug services to students over standard RDP channels. A secure, encrypted, plugin-based remote laboratory framework allows customization of programming and debug/test services to match physical laboratory resources. Industry standard technologies such as LDAP and Kerberos are utilized to ensure scalability, security, and ease of management. Emphasis is placed on direct access to real hardware, with the normal array of simulation tools and design software also being provided. In contrast with many of the remote laboratories currently in existence, this system places strong emphasis on direct, long-duration access to real, physical hardware for non-trivial design and evaluation tasks. In order to achieve this goal, secure, network-enabled hardware "pods" were created from inexpensive COTS components, and a blend of new and existing open-source software was used to connect with the overall laboratory framework. Hardware-design software and tools, including the software for physical hardware access, are preloaded and made available within the desktop session, allowing students to log in and start working almost immediately.

POWER ELECTRONICS EDUCATION USING THE INTEGRATED CIRCUIT CONSISTENT EDUCATION SYSTEM AND TCAD
Keisuke Konishi (Hiroshima Institute of Technology, Japan)
Takeshi Tanaka (Hiroshima Institute of Technology, Japan)
Tetsushi Koide (Hiroshima University, Japan)

By the remarkable progress of integrated circuit technology in recent years, the integrated circuits are improved in high speed, high performance and high integration. In this study, we perform a device evaluation from trial device production (a computer simulation) using technology CAD (TCAD) in an integrated circuit consistent education system, which consists of a series of processes: system design, semiconductor process, trial device production, and device evaluation. By changing the device parameters (kinds of material, film thickness, impurities density) of the semiconductor process, the simulation can more closely approximate the electrical property of the desired target performance. By integrating the simulation technology using TCAD with each piece of knowledge mastered by the integrated circuit consistent education system, which is currently under development, we are able to construct an education system that can be mastered not only for an integrated circuit for information processing but also for the semiconductor process and the global perspective of the device structure in a power device. Furthermore, the possibility of applicability to a new device structure and process development is shown by means of a simulation using TCAD in virtual processing conditions.

JAVA TOOLS FOR TEACHING OFDM PRINCIPLES IN UNDERGRADUATE COURSES
Sai Zhang (Arizona State University, USA)
Mahesh Banavar (Arizona State University, USA)
Andreas Spanias ((Arizona State University, USA)
Cihan Tepedelenlioglu (Arizona State University, USA)
Xue Zhang (Arizona State University, USA)

In this paper, we describe a new set of software functions and associated exercises that can be used for teaching Orthogonal Frequency Division Multiplexing (OFDM) concepts in undergraduate DSP and communications courses. These tools can be used to simulate, visualize, and analyze the performance and behavior of OFDM systems by considering different input signals and communication channels. OFDM is a compelling paradigm for us because of its utility in WiFi and LTE. It is also a good demonstration of the FFT usage in an actual communication system. We have developed the proposed set of functions as a part of the Java-DSP (J-DSP) visual programming environment. The functions can be used in DSP and communication undergraduate courses, in order to demonstrate to students the
application of DSP concepts in a communication system, as well as concepts such as FIR filter design, properties of the DFT matrix, random signals, and circular effects.

**DEVELOPING A NEW ADVANCED MICROCONTROLLERS COURSE AS A PART OF EMBEDDED SYSTEMS CURRICULUM**
Vignesh Subbian (University of Cincinnati, USA)
Fred Beyette Jr (University of Cincinnati, USA)

This paper presents our experiences in developing a new advanced microcontrollers course within the Department of Electrical Engineering and Computing Systems at the University of Cincinnati (UC). This course was developed and offered for the first time in Spring 2013 to undergraduate seniors and first-year graduate students in electrical and computer engineering. It is also open to interested students in other relevant science and engineering programs. The course aims at providing advanced skills in designing and developing microcontroller-based embedded systems. It adopts an instruction model that integrates active learning techniques with in-class lectures and laboratory projects. The paper elaborates on the course structure and schedule, pedagogical techniques used in the course, and student feedback results. It also explains how this course fits in to the existing embedded systems curriculum at UC.

**ENGAGING STUDENTS FOR SUCCESS IN CALCULUS WITH ONLINE LEARNING FORUMS**
Angela Minichiello (Utah State University, USA)
Christine Hailey (Utah State University, USA)

It is said that we face an engineering "talent crisis" [1]; the United States is failing to keep pace in educating a highly skilled and diverse engineering workforce. Emphasis is currently placed on recruitment and retention of underrepresented minorities. Newer distance-delivered programs seek participation of non-traditional and geographically underrepresented students. With expansion of educational offerings in engineering, one issue that emerges is student attrition during the first two years. It is suggested [2–4] that success in first year calculus reliably predicts persistence in engineering. To increase retention, new strategies are needed. Effective interventions may have the most impact if employed within the first year calculus sequence. Pedagogies that support traditional classroom learning as well as hybrid instruction and distance education offer the greatest transformative potential. This work-in-progress paper describes research underway to evaluate the use of online learning forums during first year calculus. A freely available, wiki-based online learning forum is employed during a mixed-methods study. The study is conducted within sequential calculus courses distance-delivered across two academic years. Quantitative and qualitative data are used to evaluate the effect of forum use on student achievement, engagement and attitudes. A usage model is developed to disseminate within the STEM education community.

**COMPUTER SELF-EFFICACY, COGNITIVE, AND METACOGNITIVE STRATEGIES OF HIGH SCHOOL STUDENTS WHILE ENGAGED IN INTERACTIVE LEARNING MODULES**
Harry Santoso (Utah State University, USA)
Oenardi Lawanto (Utah State University, USA)
Russ Weeks (Logan High School, USA)
Stephanie Kawamura (InTech Collegiate High School, USA)
Jens Trautvein (InTech Collegiate High School, USA)

Along with the rapid development of computer and Internet technologies, efforts have been conducted to include design, development, and evaluation of computer applications for learning activities. Although extensive research has defined the use of computer applications in various disciplines, few studies have systematically investigated students' self-regulated learning skills while learning with an interactive learning module specifically in computer science education. The purposes of this study are to investigate high school students' computer self-efficacy, cognitive, and metacognitive strategies while students learn with the interactive learning modules and performing a mixed-methods study. Data collection included students' self-reports and traces of student activity. The quantitative analyses applicable to this study included descriptive and non-parametric statistics. Qualitative data were gathered from interactive learning module screen-captured videos and interview transcripts to support findings from quantitative data. The outcome of this study
will inform policy makers, educators, researchers, developers, and others of the importance of a self-regulated learning perspective when designing instruction using an interactive learning module.

**STUDENT PERCEPTIONS OF DIFFERENCES IN VISUAL COMMUNICATION MODE FOR AN ONLINE COURSE IN ENGINEERING**

Suma Bhat (University of Illinois, USA)
Geoffrey Herman (University of Illinois, USA)

Online courses have the promise of extending the horizons of today's academic landscape with their cost-effective and convenient model. Despite their promise, there remain several challenges that hinder learning, one of which is lack of instructor presence. This study aims at understanding the effect of instructor presence on student satisfaction in an online setting of a course in engineering. We conducted an experiment to assess students' perceptions of two presentation modes of an online lecture created with the same instructor— with the instructor appearing in window, created using an off-the-shelf screen-capture software and with the instructor overlaid in the slides created using recent visual communication technology that overlays the video of the instructor without any background images or outline boxes. We focus on comparing - overall student satisfaction after watching the two modes, the perceived non-verbal immediacy factors of the instructor and the preference of video mode. Preliminary results suggest a preference of the mode with the instructor overlaid. The effect sizes of the differences in overall satisfaction between the experimental groups and their perceived levels of non-verbal immediacy factors when viewing the online lecture in the two modes are encouraging enough to pursue more longitudinal studies with the set-up.

**ASSESSMENT OF ONLINE PARTICIPATION THROUGH SOCIAL NETWORK MEASURES: A HLM APPROACH**

Hon Jie Teo (Virginia Tech, USA)
Aditya Johri (Virginia Tech, USA)
Vinod Lohani (Virginia Tech, USA)

In this research, we bring attention to one of the largest electrical and computer engineering (ECE) online discussion forums AllAboutCircuits.com. There are close to two hundred thousand learners contributing more than a million messages to this forum for over more than a decade. The massive archives of educational data raise an important question for engineering educators: How do we assess online participation? In this work-in-progress, we propose a multilevel approach to assess online participation based on social network measures and Hierarchical Linear Modeling (HLM) techniques. Specifically, we consider the employment of HLM to model the association between online participation and measures of social capital. Predictors of social capital are established, at both the individual and group levels, to examine the association between these predictors and learners' participation frequencies. We discuss our choice of HLM as a modeling approach over ordinary least squares (OLS) regression methods. We then describe how data is collected from the site of study, AllAboutCircuits.com, and how the modeling approach is conceptualized and used for assessment purposes. The importance of this work lies not only on sheer participation figures - it derives from the argument that online discussion fosters productive collaborative learning and individual reflection.

**INSTRUCTIONAL STRATEGIES FOR TEACHING SCIENCE ONLINE**

Dazhi Yang (Boise State, USA)

This paper (work in progress) reports the design and initial implementation of a complete online statistics course. It focuses on applications and adaptations of effective instructional strategies based on current research and best practice of teaching quantitative oriented courses (math, statistics, and engineering) online. The online statistics course was an introductory course and covered common statistical concepts and their applications in educational research for graduate students in educational technology. The course was equivalent to an undergraduate level statistics class for students majoring in science, technology, math, and engineering (STEM). Thus the implications of this project in terms of effective instructional strategies and online course design are relevant to a board audience including course designers, instructors, and students in science and engineering.
THE LORD OF PHD: FELLOWSHIP OF THE DISSERTATION; A GUIDE TO THE ENGINEERING PHD
Stephanie Cutler (Embry-Riddle Aeronautical University, USA)
James Pembridge (Embry-Riddle Aeronautical University, USA)
Matthew Verleger (Embry-Riddle Aeronautical University, USA)
Lauren Thomas (Virginia Tech, USA)

Allegories have been to represent ideas, concepts, and processes, primarily in classical literature. In engineering education, allegories have been used to describe the different roles within academia. Here, we focus specifically on the path of a doctoral student in engineering working towards earning their degree and completing a dissertation. The path will be discussed as an allegory to "The Lord of the Rings" by J.R.R. Tolkien. This allegory explores the milestones, characters, barriers, and support doctoral students will meet along their journey. The session will utilize identity-trajectory to guide discussion and encourage attendees to explore and share their experiences. The session is aimed at providing guidelines to students progressing through a doctoral degree and to assist graduate advisors in supporting their students on this journey.

INTEGRATE BY DESIGN: BRINGING SCIENCE, MATH, AND TECHNOLOGY TOGETHER THROUGH THE ENGINEERING DESIGN PROCESS
Susan Donohue (University of Virginia, USA)
Larry Richards (University of Virginia, USA)

The primary goal of this mini-workshop is to assist participants in developing engineering- and art-based design projects that reinforce concepts in mathematics and science, thus providing an integrative environment for learning. The emerging STEAM (STEM + art, which is also a design discipline) approach emphasizes a hands-on, project-based, interdisciplinary approach to the study of science, technology, engineering, and math (STEM). To emphasize the importance of using engineering design principles to integrate learning in science and math and gain technological literacy, we refer to this approach as STEAMd. This mini-workshop will be of interest to those involved in P-16 engineering education and in developing a philosophy of engineering education that stresses an integrative approach to instruction and practice grounded in design, the fundamental process of engineering.

MANAGEMENT OF DISTRIBUTED COLLABORATIVE LEARNING ENVIRONMENTS BASED ON A CONCEPT MAP PARADIGM AND NATURAL INTERFACES
Gustavo Salvador-Herranz (Universidad CEU Cardenal Herrera, Spain)
Manuel Contero (Universitat Politècnica de València, Spain)
Jorge Dorribo Camba (Texas A&M University, USA)

Collaborative learning is an effective educational method that plays an essential role in theories such as Constructivism and Knowledge Building. Studies have shown that collaborative work in small groups significantly improves learning when supported by concept maps. Although useful in collaborative environments, most applications available for the development of concept maps are designed for personal or small tablet computers, which can limit student communication in a team. In addition, the use of these applications usually requires learning or training periods, which can also interfere with the learning process. In this paper, we present a software tool for generating concept maps and
constructing learning spaces under both local and distributed collaboration scenarios. Our system uses a natural interface with multi-touch and multi-user capabilities. It was specifically designed for tabletop systems, which provide a large horizontal interactive surface suitable for collaboration and face-to-face communication. The tool is also available in other platforms, which makes it useful in a variety of classroom orchestration settings. Finally we present the results of a preliminary usability study of our tool in a real educational environment.

**EXPERIENCING DISRUPTIVE BEHAVIOR IN A TEAM USING "MOLES"**
Daniel Krutz (Rochester Institute Of Technology, USA)
James Vallino (Rochester Institute of Technology, USA)

The ability to work on a team is a paramount skill for every engineer. The capability to understand, identify and work through team problems will significantly enhance the engineer's ability to deliver a high quality product on time and within budget. Far too often, however, the experience of working as a team, with its challenges, is overlooked in the student's education. The Department of Software Engineering at Rochester Institute of Technology introduced an activity in their Freshman Seminar course to help students work in a team-based environment. The specific focus was interacting with problematic team members. This team activity involved student "moles" covertly being inserted to act in a disruptive fashion. At the end of the activity, the teams reassembled to discuss the task the team had been assigned to do. The instructor revealed the role of the "moles" at this point, and the teams discussed the effect their behaviors had on team effectiveness and the strategies used to deal with the disruptive behaviors. The students have praised the activity, finding it to be different, exciting and educational. This paper describes the "mole" activity, our observations of the results, and provides suggestions for future use in coursework.

**EVALUATING THE EFFECTIVENESS OF A COOPERATIVE LEARNING APPROACH IN ENGINEERING EDUCATION IN CHINA**
Dan Zhang (Queen Mary University of London, United Kingdom)
Laurie Cuthbert (Queen Mary University of London, United Kingdom)
Eleanor M Pritchard (Queen Mary University of London, United Kingdom)
Steve Ketteridge (Queen Mary, University of London, United Kingdom)

The need for teamwork skills has been recognised as one of the key requirements for engineering graduates by industries world-wide, including in China. A pilot on teamwork training was conducted in a joint degree programme between a leading British university and a top Chinese university in 2011. This paper attempts to evaluate the effectiveness of this cooperative learning practice in Chinese engineering students and to identify the gap between the declarative knowledge and the skill-based outcomes. This evaluation focuses on the open-ended and qualitative items in students' expectations agreements, team function evaluation forms, peer ratings, and questionnaires. The data collected were analysed using descriptive statistics, with class observation and informal interview responses also being discussed. This qualitative study provides a good supplement to the previous quantitative findings and contributes to understanding by displaying how students perceived a Cooperative Learning practice in a mainland Chinese context, and how they reacted to the experience. It also provides an insight into the underlying cultural considerations behind the team behaviour. Instructors can design and improve team tasks for Chinese students based on these findings.

**INTEGRATING COMMUNICATION SKILLS IN DATA STRUCTURES AND ALGORITHMS COURSES**
William Eberle (Tennessee Tech University, USA)
John Karro (Miami University, USA)
Neal Lerner (Northeastern University, USA)
Matthias Stallmann (NC State University, USA)

While the improvement of computer science students' communication skills has frequently been called for in the literature, employers continue to feel that recent graduates are not equipped with the writing, speaking, and teaming skills essential in the 21st century workplace. One problem with previous approaches is that they often teach communication skills in dedicated courses rather than integrating them into technical classes across the curriculum. In this paper, we report on a multi-institutional faculty team's efforts to integrate communication skills into mid-level data structures and algorithms courses as part of a larger NSF-funded project to enact integrated reform throughout computer science/software engineering curricula. We present an outline of assignments designed to develop communication skills (writing, speaking, reading, listening, and teaming) intertwined with technical skills, and discuss our preliminary efforts to assess these efforts. Our work reflects a general approach to incorporate communication activities within the computer science curricula and to help students learn and communicate technical content in academic and professional settings.
LET'S DO IT OR DEAL WITH IT: TEAMWORK IN PROJECT-BASED LEARNING

Ya Zhou (Beijing Institute of Technology, P.R. China)
Yao Hu (Beijing Institute of Technology, P.R. China)
Liquan Dong (Beijing Institute of Technology, P.R. China)
Ming Liu (Beijing Institute of Technology, P.R. China)
Yuejin Zhao (Beijing Institute of Technology, P.R. China)
Qun Hao (Beijing Institute of Technology, P.R. China)

Project-based course is based on teamwork and most of work is done and presented as a team. Team grouping rule is one of the most important issues. In project-based experimental course Optoelectronic Instrument Experiments (OIE), several different rules were attempted, each of which produced complaints by some students. After several trials of different grouping rule, we realized that there is no perfect rule which can satisfy everyone. Instead of changing the rule, trying to find a way to persuade the students to accept and support their group willingly might be a better solution. In this semester, the project teams are entirely determined by lot and several teamwork inspirational approaches are introduced to inspire team spirit in the course. Our purpose is to find a way to make student learn the interpersonal skill of working in team. Let's do it, not just deal with it inactively.

Session S2D: Experiential Learning III
Chair: James Rowland (University of Kansas)
10:00 - 11:30 am
Room: 17

EXPLORES: AN INTEGRATED LEARNING ENVIRONMENT TO PRODUCE INDUSTRY READY GRADUATES
Samuel Huang (University of Cincinnati, USA)
Sam Anand (University of Cincinnati, USA)
Murali Sundaram (University of Cincinnati, USA)
Manish Kumar (University of Toledo, USA)

To maintain competitive advantages in today’s global market, US companies are challenging higher education institutions to bridge competency gaps between industry workforce needs and what is provided by engineering education programs. To meet this challenge, the Mechanical Engineering program at the University of Cincinnati proposes the EXPLORES (Experiential and Problem-based Learning within Opportunities for Real-world Engineering Settings) model where students from freshman year onwards are exposed to real-world industrial problems that have a direct bearing on fundamental engineering concepts. The EXPLORES model is implemented in a learner-centered, knowledge-centered, assessment-centered, and community-centered student learning environment. Although inclusion of real-world industrial problems into engineering curriculum is not a new invention, the EXPLORES model is unique in the following aspects: (1) the problems span multiple courses so students need to have the ability to synthesize knowledge acquired from different courses in order to develop complete solutions; (2) industry partners are an integral part of the education process by providing problem design, periodic feedback, and expert solution; and (3) an on-line virtual company framework is used to facilitate information sharing and motivate student learning.

TEACHING BUSINESS ANALYTICS
Li Yang (University of Tennessee at Chattanooga, USA)
Xumin Liu (Rochester Institute of Technology, USA)

It is essential to prepare students with knowledge and skills in area of business analytics (BA) which will help business to process data, find patterns and relations, develop insights from past transactions, and make prediction. We develop hands-on labs to teach business analytics to students in Computer Science, Information Technology, and Software Engineering disciplines. Our hands-on labs can be adopted in courses such as database systems, data warehousing, data mining, etc. We use enterprise BA tools including MS SQL Server Business Intelligence and Cognos 10 platforms, which are essential to increase student interests, improve student learning, and enhance student confidence. Our hands-on labs contain three parts with one is built upon another: 1) Data integration; 2) Data Warehouse; and 3) Business analytics.
AUTHENTIC LEARNING OF MOBILE SECURITY WITH CASE STUDIES
Minzhe Guo (University of Cincinnati, USA)
Prabir Bhattacharya (University of Cincinnati, USA)
Kai Qian (Southern Polytechnic State University, USA)
Li Yang (University of Tennessee at Chattanooga, USA)

This work-in-progress paper presents an approach to authentic learning of mobile security through real-world-scenario case studies. Five sets of case studies are being developed to cover the state-of-the-art of mobile security knowledge and practices. Some of the developed case studies are being implemented in related courses and the preliminary feedback is positive.

DEVELOPING A REMOTE RELEASE MECHANISM IN SUPPORT OF UNMANNED AERIAL SYSTEMS: A COMPARISON OF TWO SEPARATE APPROACHES IN FRESHMAN ENGINEERING DESIGN
I Dabipi (University of Maryland Eastern Shore, USA)

As restrictions on operating small unmanned aerial systems (sUAS) in the United States national airspace system (NAS) have compounded, university researchers in this discipline have had to react by developing increasingly more novel ways to collect remote sensing data. Current restrictions by the Federal Aviation Administration (FAA) require universities to apply for a Certificate of Authorization (COA) to operate any remote control device for the purposes of research. Previously, many universities operated under Advisory Circular (AC) 91-57 (for model aircraft operators). University research does not fall under this circular and therefore, alternative methods of gathering aerial images in support of the universities remote sensing projects needed to be explored. The freshman engineering design course at the University of Maryland Eastern Shore is a multidisciplinary and collaborative effort between the Engineering Program and Aviation Sciences Program faculty. Introductory engineering design process theory is taught by engineering faculty while students engage in an experiential exercise in problem solving with the Aviation faculty serving the role of a client with a specific problem that needs to be remedied. This paper outlines the freshmen engineering design process from the introduction of the initial problem statement, mid-term review and final product delivery of a remote release system for a non-powered glider sensor system. The aviation faculty serving as the client is involved with the class from initial team selection to evaluation of the final product and student's presentation abilities. A brief review of the current restrictions on sUAS operations on campuses will be discussed. Students were asked to design a remote release system that would support the deployment of the client's glider platform from an existing kite lifting device. The freshman design class was divided into two groups and asked to design systems that would meet the clients design criteria. The authors present an in-depth comparison of design approaches, execution and lessons learned. Group leadership dynamics are considered.

A COMMUNITY COLLEGE BLENDED LEARNING CLASSROOM EXPERIENCE THROUGH ARTIFICIAL INTELLIGENCE IN GAMES
Titus Barik (North Carolina State University, USA)
Michael Everett (Wayne Community College & SAS Institute, USA)
Rogelio E. Cardona-Rivera (North Carolina State University, USA)
David L. Roberts (North Carolina State University, USA)
Ed Gehringer (North Carolina State University, USA)

We report on the experience of teaching an industry-validated course on Artificial Intelligence in Computer Games within the Simulation and Game Design department at a two-year community college during a 16-week semester. The course format used a blended learning just-in-time teaching approach, which included active learning programming exercises and one-on-one student interactions. Moskal's Attitudes Toward Computer Science survey showed a positive and significant increase in students in both interest (W(10) = 25, p = 0.011) and professional (W(10) = 49.5, p = 0.037) constructs. The Felder-Soloman Index of Learning Styles (n = 14) failed to identify any statistically significant differences in learning styles when compared to a four-year CS1 class. In the final class evaluation, 8 out of 13 students (62%) strongly or very strongly preferred the blended learning approach. We validated this course through four semi-structured interviews with game companies. The interview results suggest that companies are strongly favorable to the
course content and structure. The results of this work serve as a template that community colleges can adopt for their curriculum.

**AN AGILE TRANSLATION PROCESS FOR COMPLEX INNOVATIONS: AN INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH CENTER CASE STUDY**

Jayashree Ramanathan (The Ohio State University, USA)  
Rajiv Ramnath (The Ohio State University, USA)  
Michael J. Herold (The Ohio State University, USA)  
Benjamin J. R. Wierwille (The Ohio State University, USA)

An analysis of hiring patterns showed emerging trends: the complexity of information technology (IT) is shifting from development to post-deployment and integration needed for services. Given the complexity of deployed service systems, generated big data, and the national dialogue on educating engineers, we asked ourselves related questions. Do our graduate students have evaluation skills needed to work at the most advanced level of Bloom's taxonomy? Can they learn to frame and solve the problems within complex industry environments while applying the current research? How do we structure a graduate curriculum and an environment that provides experiences in innovation within the constraints of the academic calendar? Here we present an interdisciplinary curriculum comprised of three components: a service interaction blueprint for framing the industry problem, agile principles focusing on aspects of the solution, and Christensen's theory-building to frame the next iteration of research. The environment for industry problems was created through an National Science Funded Industry & University Cooperative Research Center. The feedback from a pilot graduate-level class is positive and provides insights for further research. We show through feedback discussions that it is possible to have translational activity at the industry-university enterprise boundary resourced in by advanced experiential learning.

**BRINGING ADJUNCT ENGINEERING FACULTY INTO THE CLASSROOM: OPPORTUNITIES FOR ENHANCING THE PRACTICE**

Waddah Akili (Geotechnical Engineering, USA)

This paper examines the status quo of adjunct faculty in engineering institutions and argues that adjuncts could enrich an academic engineering program by bringing in their practical experience and by introducing relevant applications and design venues to the classroom. Adjunct faculty members do also help in setting up linkages with the industrial sector, which often leads to: employment opportunities for graduates, co-op activities, and potential development of collaborative research programs. Nevertheless, the present status of most adjunct faculty is tenuous, subject to shifting enrollment, and considered as a temporary arrangement, or until a "full-time" faculty is appointed. Unfortunately adjuncts, often with proven records of excellent teaching, are marginalized by the academic systems in place today and their efforts and contributions to the academic process are undervalued. If fair treatment, and proper recognition are accorded to adjuncts; then, their morale, loyalty to the institution, and their teaching effectiveness would improve markedly. Next, the paper reports on a success story of an adjunct, a practitioner with excellent credentials, who "teamed-up" with a "full-time" faculty, in an attempt to bring-in the "practice" to 4th year students in a geotechnical/foundation engineering class. The success achieved in meeting stated objectives, i.e., including students' exposure to the "practice", was attributed, in large measure, to the proper coordination that preceded course delivery. The paper sheds light on this experience, and focuses on the contributions and effectiveness of the adjunct in: course planning, delivery of "practice-related" material, organizing instructional activities, as well as adjunct's ability and effort in engaging students, in and outside the classroom. The positive outcome of this experience has lead other faculty members to follow the same path, i.e., by searching for practitioners-as adjunct faculty- to assist in bringing the practice into the classroom, in partnership with "full-time" faculty. The paper stresses the need to search for qualified adjuncts, provide them with the tools to develop and improve their teaching skills, affirm their value to the department by recognizing the contributions these individuals make, and provide the opportunities to bring them fully into the learning community.
INVESTIGATING THE ATTRIBUTES AND EXPECTATIONS OF ENGINEERING PH.D.S WORKING IN INDUSTRY
Benjamin Ahn (Purdue University, USA)
Monica Cox (Purdue University, USA)
Jeremi London (National Science Foundation & Purdue University, USA)
Jiabin Zhu (Purdue University, USA)

Many engineering Ph.D.s are finding career opportunities in industry. Despite the increase in number of Ph.D. engineers working in industry, there is little research on what it takes to be a successful engineering Ph.D. in industry. This study explores the characteristics, and expectations of engineering Ph.D.s by interviewing ten engineering Ph.D.s working in industry. These preliminary findings reveal that responsibilities of engineering Ph.D.s in industry include more than research and development. Among other things, engineering Ph.D.s that work in this sector are expected to communicate effectively and teach others. The characteristics that engineering Ph.D.s need to possess to be successful in industry are also discussed.

Session S2F: Ethics and Moral Reasoning
Chair: Melany Ciampi (Safety, Health and Environment Research Organization)
10:00 - 11:30 am
Room: 19

GRADING BY EXPERIENCE POINTS: AN EXAMPLE FROM COMPUTER ETHICS
Ed Gehringer (North Carolina State University, USA)
Barry Peddycord III (North Carolina State University, USA)

In most of education, courses are graded based on percentages—a certain percentage is required for each letter grade. Students often see this as a negative, in which they can only lose points, not gain points, and put their class average at risk with each new assignment. This contrasts with the world of online gaming, where they gain “experience points” from each new activity, and their score monotonically increases toward a desired goal. In Fall 2012, the lead author switched to grading by experience points in his Ethics in Computing class. Students earned points for a variety of activities, mainly performing ethical analyses of various issues related to computing, and participating in debates on ethics-related topics. The students appreciated the ability to earn extra points by performing extra activities. But they were less likely to complete analyses after signing up to do them than were students in a traditionally graded class. At semester’s end, the number of peer reviews increased, as students strove to top off their point total. The grade distribution was bimodal, with clusters at both ends (A+ and F). Students’ greatest concern was rapid grading turnaround, so they would know where they stood in the class at all times.

A QUALITATIVE STUDY EXPLORING STUDENTS' ENGINEERING ETHICAL REFLECTIONS AND THEIR USE IN INSTRUMENT VALIDATION
Carla Zoltowski (Purdue University, USA)
Patrice Buzzanell (Purdue University, USA)
William Oakes (Purdue University, USA)
Megan Kenny (Purdue University, USA)

The development of ethical awareness and ethical reasoning is a critical part of engineering education. Appropriate assessments are needed to determine if the educational interventions are effective in developing these skills. Although there are measures to assess general moral reasoning (e.g., DIT2), they do not take into consideration the peculiarities of handling ethical situations in engineering rather than ethical situations in general. In addition, because most undergraduates learn to apply ethical reasoning to engineering through design courses that are taught in teams, it is important to understand the team ethical climate. To address this need, our research team is developing instruments to assess both individual moral reasoning and team ethical climate in an engineering context. As part of the validation efforts, we have conducted individual interviews and team observations to triangulate data from other sources and aid in data interpretation. In this work-in-progress research paper we present an overview of the instruments and our qualitative study design including our interview protocol and analysis approach. At the FIE conference, we will present initial findings from the analyses and discuss how these results are being used to validate and/or modify both the individual engineering ethical reasoning and team climate instruments being developed.
ETHICS IN ENGINEERING EDUCATION: A LITERATURE REVIEW
Jehan Abu Hamad (Qatar University, Qatar)
Maram Hasanain (Qatar University, Qatar)
Mahmoud Abdulwahed (Qatar University, Qatar)
Rashid Alammari (Qatar University, Qatar)

Engineering Ethics is an important topic to be developed in engineering education curriculum. Despite its importance, ethics is not much investigated in engineering education as compared to other disciplines, in particular medicine or biology education. In this paper, a comprehensive review on engineering ethics is provided. The review covers three main topics: 1) Attributes of ethical engineers, 2) Content, logistics and pedagogy of engineering ethics, and 3) Assessment of engineering ethics. A particular focus is given to the Defining Issues Test (DIT) and the Engineering and Science Issues Test (ESIT) that is considered a promising instrument to assess moral judgment development of science and engineering students. Final remarks and future works will conclude the paper.

USING SCAFFOLDED, INTEGRATED, AND REFLEXIVE ANALYSIS (SIRA) OF CASES IN A CYBER-ENABLED LEARNING INFRASTRUCTURE TO DEVELOP MORAL REASONING IN ENGINEERING STUDENTS
Lorraine Kisselburgh (Purdue University, USA)
Carla Zoltowski (Purdue University, USA)
Jonathan Beever (Purdue University, USA)
Justin Hess (Purdue University, USA)
Matthew Krane (Purdue University, USA)
Andrew Brightman (Purdue University, USA)

Each year thousands of new engineers join the workforce and face novel issues raised by radical technological advances. Concurrently, changing societal responses to new technologies introduce novel conflicts in research and development that challenge the scope of established professional codes of ethics. These issues create a critical demand for new approaches for developing moral reasoning for ethical decision-making. Our multidisciplinary team of engineering, communication, and ethics educators has developed and tested a novel pedagogical framework of Scaffolded, Integrated, and Reflexive Analysis (SIRA) of ethics cases to enhance development of moral reasoning that extends beyond case-based analyses. Implemented as a series of two-week cyber-enabled learning modules, with cases from several engineering disciplines, this theory-based, data-driven, cyber-enabled framework for ethics education has applicability across a broad spectrum of disciplines and provides engineering educators with limited ethics training a tested framework and set of resources and modules to adapt and use in their own disciplines. In this paper, we discuss our work in progress on the SIRA framework, its implementation, and our assessment of changes in moral reasoning and student satisfaction when utilizing this model.

Session S2G: First and Second Year Programs IV
Chair: Aleardo Manacero (São Paulo State University - UNESP)
10:00 - 11:30 am
Room: 20

DEVELOPMENT OF A CLASSIFICATION SCHEME FOR "INTRODUCTION TO ENGINEERING" COURSES
Kenneth Reid (Ohio Northern University, USA)
David Reeping (Ohio Northern University, USA)
Tyler Hertenstein (Ohio Northern University, USA)
Graham Fennell (Ohio Northern University, USA)
Elizabeth Spingola (Ohio Northern University, USA)

"Introduction to Engineering" courses are often designed from scratch and can become a grab-bag of unrelated topics. They are often designed by instructors to cover what they feel is important. Therefore, while they may be prerequisites to second-year courses, first-year engineering programs are not necessarily integrated into the curriculum. Further, since they are often designed with little consideration for existing models, overall outcomes and content may vary widely. The results include an issue of course developers "reinventing the wheel" as successful models are not adequately disseminated. Results of multiple methods of investigation are presented. An analysis of syllabi for Introduction to Engineering courses identified course learning objectives, and these objectives were grouped to establish an initial classification scheme. A workshop in which objectives were discussed was held at a national conference and a separate
draft classification scheme was proposed. A concurrent effort uses a Delphi procedure to define and categorize expected outcomes in first-year courses. Survey data from the Delphi study has been collected toward a single, final classification scheme. This paper will present results of the first two components of the study and the initial high level classification scheme identified as the Delphi analysis begins.

**A SURVEY ON THE MATHEMATICAL EMPHASIS IN BRAZILIAN COMPUTER SCIENCE CURRICULA**
Pedro Paulo Vezza Campos (University of São Paulo, Brazil)
Jackson Souza (University of São Paulo, Brazil)
Giuliano Olguin (University of Campinas, Brazil)

A recurring question raised by professors and undergraduate students involves the distribution of basic and practical - or professional - courses. Some authors defend a curriculum with more basic courses in order to create a solid background. Moreover, there is a growth of academic exchange programs all around the world, which requires a common learning base. The goal of this paper is to analyze the amount of the courses related to Mathematics in different CS undergraduate curricula. In this work are analyzed the lecture hour load dedicated to Mathematics courses on eleven Brazilian CS undergraduate programs. To allow this comparison, it was established a definition of what was considered a lecture hour of Mathematics. For a reference point, such programs were compared with two reference curricula in the area: The Brazilian Computer Society (SBC) and the Computer Science Curriculum 2008 made by the IEEE Computer Society and ACM joint task force. The curricula presented in the official sites of the selected universities in 2012 were analyzed and it was possible to conclude that more than half of the programs don't achieve the minimum amount of Mathematics study hours necessary during undergraduate studies according to IEEE/ACM's reference curriculum.

**UNDERGRADUATE AND GRADUATE TEACHING ASSISTANTS' PERCEPTIONS OF THEIR RESPONSIBILITIES - FACTORS THAT HELP OR HINDER**
Alena Moon (Purdue University, USA)
Hyunyi Jung (Purdue University, USA)
Farshid Marbouti (Purdue University, USA)
Kelsey J Rodgers (Purdue University, USA)
Heidi Diefes-Dux (Purdue University, USA)

Effective teaching assistants (TAs) are crucial for effective student learning. This is especially true in science, technology, engineering, and mathematics (STEM) programs, where TAs are enabling large programs to transition to more student-centered learning environments. To ensure that TAs are able to support these types of learning environments, their perspectives of training, their abilities, and other work related aspects must be understood. In this paper a survey that was created based on interviews conducted with eight TAs is discussed. The survey has four primary categories of content that are critical for understanding TAs' perspectives: (1) background, (2) motivation, (3) training, and (4) grading and feedback. This research team is first utilizing this survey at Purdue University to test for validity and reliability of the instrument, as well as identifying ways to improve the experiences and effectiveness of the First-Year Engineering Program's TAs' support system, training, hiring process, and any other relevant components of the infrastructure. The more generalizable goal of this research is to further develop this survey to be used by any STEM program as a diagnostic tool for identifying opportunities to enhance the TA support systems and therefore improve student learning.

**ENGINEERING VIRTUAL STUDIO: ONLINE CONTEXT AND COMMUNITY FOR UNDERCLASSMEN ENGINEERS**
Kurt Thoroughman (Washington University in St. Louis, USA)
Alessandra Hruschka (Washington University in St Louis, USA)
Kathryn Ruzicka (Washington University in St. Louis, USA)
Patricia Widder (Washington University in St. Louis, USA)

Myopia on foundations early in undergraduate work is pandemic throughout STEM undergraduate training. This "sink or swim" foundational approach begets attrition and reduced motivation, engagement, and performance for those rugged students who stay in the major. Current approaches to alleviating this myopia, including integrative curricula and extracurricula, provide some context and community, but require great faculty and staff effort, and often requires onerous changes to the base curriculum, while leaving students stranded segueing into the sophomore year. Here we introduce and report on an initial pilot of an online alternative. Our one-credit, pass/fail course, Engineering Virtual Studio (EVS), provides explicit connections between foundational courses and real-world products and problems. The
course also fosters both scholarly and pre-professional identity building as constant processes. We report on the course
design, work in progress in our pilot year, and opportunity for improvement.

**DEVELOPMENT OF A FLASH DRIVE DESIGN PROJECT FOR ENGINEERING GRAPHICS AND DESIGN**

Paul Schreuders (Texas A&M University, USA)
Jeffrey Otey (Texas A&M University, USA)

A major challenge in engineering design graphics classes has been the development of semester-long projects, which
supports curricular goals while maintaining student interest. In this paper, we will describe a project to develop flash
drive casings. The project scenario was structured as a request by a client to design a themed set of flash drive casings
and a presentation case suitable for use as a gift to outstanding employees and high value clients. Each student rapid
prototyped one flash drive casing of his or her own design. The project was implemented as a series of team and
individual assignments spread over the semester, with the product of those assignments returned to the instructors in
memo format.

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**Session S2H: pK-12 STEM IV**
Chair: Charles Wallace (Michigan Technological University)
10:00 - 11:30 am
Room: 2

**ENHANCED STEM LEARNING WITH ONLINE LABS: EMPIRICAL STUDY COMPARING PHYSICAL LABS,
TABLETS AND DESKTOPS**

Prema Nedungadi (Amrita University, India)
Raghu Raman (Amrita University, India)
Mark McGregor (Amrita University, India)

India's educational challenge includes a large school going population, shortage of science teachers and lack of science
labs in many schools. To counter this challenge, the Online Labs (OLabs) pedagogy is designed as a complete learning
environment with tutorials, theory, procedure, animations, videos and simulations while the assessment includes
conceptual, experimental, procedural and reporting skills. We discuss two separate empirical studies using OLabs to
study the performance gains, student attitudes and preferences while using physical labs, desktops and tablets. The first
study was at a school that compared students who learnt individually with OLabs on desktops, to students who learnt
with the traditional teacher led physical labs. The second study was at a science camp and compared OLabs on desktops
to OLabs that were context adapted for android tablets. There were significant differences between the physical labs and
the self study mode using OLabs on desktops, but no significant differences between OLabs on desktops compared to
OLabs on tablets.

**OUTCOMES OF A THREE-YEAR IN-SERVICE SECONDARY TEACHER TRAINING PROGRAM IN
ENGINEERING DESIGN**

James F. Young (Rice University, USA)
Deborah Jensen (Spring Independent School District & Rice University, USA)

We have developed and implemented a comprehensive, three-year professional development program for in-service
secondary teachers to prepare them to teach engineering design and problem solving, and to use design-based teaching
approaches in their science curriculum. The program used a constructionist, immersion pedagogy and a three-phase
learning cycle. The program consisted of intensive summer workshops followed by monthly one-day workshops, school
visits, and support activities during the academic year. This paper describes the program philosophy and activities, and
presents outcome results using both qualitative and quantitative data. Pre- and post-test results indicate the workshop
pedagogy and program structure were successful in meeting the goals and desired outcomes of the program.
YOUNG PEOPLE’S PERCEPTIONS OF COMPUTING CAREERS
Tom G McEwan (Edinburgh Napier University, United Kingdom)

Recruitment into computing-related undergraduate degree courses is challenging in several countries. This is despite employers reporting skills shortages, and the sector generally offering better salaries than for graduates of more popular courses. This paper describes a study (n=111) of the interest of 16 and 17 year olds in taking Computing-related degrees, particularly those that lead to user experience (UX) careers, where there is both a local and global skills shortage. The picture that emerges is of surprisingly pronounced and entrenched attitudes, which are worthy of a more detailed study. Only one of eight typical computing job roles (Tester) was familiar while the term UX was almost unknown. The females in this study expressed antipathy even towards finding out about computing careers. An unexpected additional finding is the commonplace, and apparently inappropriate, use of Myers-Briggs-style questionnaires in offering careers advice on computing to local school children. This paper will be of interest to those who seek to progress professionalism in the field of computing and to recruit (particularly female) school leavers into computing degrees.

TEACHING COMPUTER PROGRAMMING BASED ON PATTERNS WITH ACTIVITIES AND COLLABORATIVE GAMES USING CONCRETE MATERIALS FOR HIGH SCHOOL STUDENTS
Alexis Leal (Federal University of Goiás, Brazil)
Deller Ferreira (Federal University of Goiás, Brazil)

The courses in computing, especially those focused on software development, require many skills of novice students of computer programming. Due to the fact that computer science is a new area for most of novice students, they demonstrate great difficulty in initial courses in this area. They do not have specific skills in computer programming. This work presents the results obtained from the application of a teaching method, for computer programming students of the integrated high school mode, that combines patterns-based programming and games. The games uses concrete materials and collaborative activities based on sports in non-formal spaces. The results show improvements in students’ motivation and in programming abilities. The method proposed in this work takes advantage of analogies between programming logic and games using concrete materials in order to develop programming skills.

THE DIGITAL CULTURE DEGREE: A COMPETENCY-BASED INTERDISCIPLINARY PROGRAM SPANNING ENGINEERING AND THE ARTS
Thanassis Rikakis (Carnegie Mellon University, USA)
David Tinapple (Arizona State University, USA)
Loren Olson (Arizona State University, USA)

This paper describes the Digital Culture BA degree: an engineering-arts undergraduate curriculum that combines competency-based education (CBE) and knowledge-oriented education (KOE) structures and related Pull-Push approaches. The degree has been offered for three years at Arizona State University, has 200 enrolled students and is continuing to grow. The degree embeds nine knowledge-oriented concentrations, each offered by a relevant participating department, within an interdisciplinary CBE context. The CBE part of the degree provides customized access to 40 interdisciplinary digital culture courses from 12 different academic units by connecting these courses through a set of core competencies. Access to courses is not determined by fixed prerequisites but rather by having one of several possible combinations of lower level competencies. This flexible curriculum is attractive to students, promotes integrative collaborative learning that inspires innovation, and prepares the type of engineering-arts experts and complex problem solvers that are currently needed in creative industries. This type of degree also presents several important challenges for educators and administrators. To address these challenges we developed project based assessment approaches, custom web-based software for advising a very diverse student body, as well as online tools for facilitating peer critique and feedback in large creative classrooms.
DEVELOPING AN INTERDISCIPLINARY HEALTH INFORMATICS SECURITY AND PRIVACY PROGRAM
Xiaohong Yuan (North Carolina A&T State University, USA)
Jinsheng Xu (North Carolina A&T State University, USA)
Hong Wang (North Carolina A&T State University, USA)
Kossi Edoh (North Carolina A&T State University, USA)

Health informatics is one of the nation’s largest growing industries. To protect health information systems, it is extremely important for health informatics professionals to be well educated and trained in information assurance, and to understand the many concerns of security, privacy, integrity and reliability. To meet this demand, we are creating a new, interdisciplinary curriculum model of Bachelor of Science in Computer Science (BSCS) concentration in Health Informatics Security and Privacy (HISP) at North Carolina Agriculture and Technical State University (NC A&T). To establish this BSCS concentration in HISP, we developed a new course on health information systems in the Department of Computer Science, a new course on Mathematics for Health Informatics in the Department of Mathematics, and modified an existing course in the Department of Management to include topics on business practices relating to health information technology. We also developed three course modules on health informatics security and privacy and are integrating these course modules into the existing information assurance courses in the Department of Computer Science. This paper describes the new curriculum, the new courses, and the three course modules we have developed.

AIRSPACES: AIR-PROPELLED INSTRUMENTED ROBOTIC SENSORY PLATFORM(S) FOR ASSATEAGUE COASTLINE ENVIRONMENTAL STUDIES - A MULTIDISCIPLINARY EXPERIENTIAL LEARNING AND RESEARCH PROJECT AT A MINORITY SERVING LAND GRANT INSTITUTION
Abhijit Nagchaudhuri (University of Maryland Eastern Shore, USA)
Madhumi Mitra (University of Maryland Eastern Shore, USA)
Lei Zhang (University of Maryland Eastern Shore, USA)

AIRSPACES (Air-propelled Instrumented Robotic Sensory Platform(s) for Assateague Coastline Environmental Studies) project funded by the Maryland Space Grant Consortium (MDSGC) provides a model platform to involve a multidisciplinary team of Science, Technology, Engineering, Agriculture, and Mathematics (STEAM) students in a challenging experiential learning and research endeavor that promotes active learning in field and laboratory settings. The overarching goal of the project is to develop an autonomous surface vessel to collect and map selected water quality variables, geo-located with GPS sensors in lakes and ponds on campus, as well as Assateague and other nearby coastal bays for further scientific analysis. The project has been adapted for undergraduate students; however, outreach efforts by engineers and scientists at NASA Wallops Flight Facility have provided an overview of expanded scope of the goals and objectives that may be addressed in a professional setting.

INTEGRATING DESIGN AND BRIDGING ACTIVITIES OF THE ENGINEERING AND THE DESIGN COLLEGE: MERGING LANGUAGE CULTURES, CREATIVITIES, AND PERSPECTIVES
Mani Mina (Iowa State University, USA)
David Ringholtz (Iowa State University, USA)

This paper describes a unique and an innovative pedagogical experiment conducted between engineering and design faculty. The goal of the experiment is to create innovative bridges between student design and creative activities and projects that would converge and unify two different approaches: Engineering and Industrial Design. In this class, third and fourth year students from Material Engineering, and Electrical and Computer engineering Engineering are teamed up with the students from the graduate level Industrial design Design studio. Together the teams are assigned to a major industry sponsored design project. This paper discusses the class concept, execution, outcomes, reflections, surprises, and will provides discussions on designing, implementing, and modifying such classes. The paper describes the goal of the experiment, the implementation, and the unique findings of the experiment. In particular, this paper focuses on early results of this pedagogical experiment.
INTEGRATING INTERNATIONAL STUDENTS' CONTESTS WITH SOFTWARE ENGINEERING COURSES: LESSONS LEARNED AND BEST PRACTICES
Amir Zeid (American University of Kuwait, Kuwait)

There are many general computer contests targeting undergraduate and graduate students. The prizes vary from cash, trip, fame, conference participation and others. Contests can be class, school, national, regional or global. This workshop aims to share the knowledge and experience of different educational institutes of integrating students' contests with academic software engineering courses. The main goal is to identify, discuss and promote best practices to properly benefit from such integration.

INDIVIDUAL SUSTAINABILITY: PRELIMINARY RESEARCH
Eric Pappas (James Madison University, USA)

All societal change begins with the individual. One cannot do for a community what one cannot do for one's self. The topic of Individual Sustainability is a controversial one, as students often appear to be unable to align their demonstrated behaviors with their admirable values related to sustainability. Individual behavior creates the foundation for action in social, economic, and environmental sustainability, and potentially guides our ability to work with one another to make life-affirming decisions. In short, it is a matter of aligning our day-to-day behaviors with our well-stated values that will result in greater sustainable community action. The general objective of this research is to help students align their behaviors with their values. This change is a necessary precursor to demonstrating sustainable community behavior. We believe that creating a "cognitive dissonance" between an individual's values and behaviors tends to encourage her to balance more effectively the self-knowledge that motivates intentional personal development towards more sustainable behavior. While most students indicated they believed their behaviors consistently reflected their values, the students' broad range of responses and survey responses revealed behaviors quite in conflict with their values.

ASSOCIATIONS OF STUDENTS' CREATIVITY, MOTIVATION, AND SELF-REGULATION WITH LEARNING AND ACHIEVEMENT IN COLLEGE COMPUTER SCIENCE COURSES
Duane F Shell (University of Nebraska-Lincoln, USA)
Melissa Patterson Hazley (University of Nebraska-Lincoln, USA)
Leen-Kiat Soh (University of Nebraska-Lincoln, USA)
Elizabeth Ingraham (University of Nebraska-Lincoln, USA)
Stephen Ramsay (University of Nebraska-Lincoln, USA)

The need for more post-secondary students to major and graduate in STEM fields is widely recognized. Students' motivation and strategic self-regulation have been identified as playing crucial roles in their success in STEM classes. But, how students' strategy use, self-regulation, knowledge building, and engagement impact different learning outcomes is not well understood. Our goal in this study was to investigate how motivation, strategic self-regulation, and creative competency were associated with course achievement and long-term learning of computational thinking knowledge and skills in introductory computer science courses. Student grades and long-term retention were positively associated with self-regulated strategy use and knowledge building, and negatively associated with lack of regulation. Grades were associated with higher study effort and knowledge retention was associated with higher study time. For motivation, higher learning- and task-approach goal orientations, endogenous instrumentality, and positive affect and lower learning- , task-, and performance-avoid goal orientations, exogenous instrumentality and negative affect were associated with higher grades and knowledge retention and also with strategic self-regulation and engagement. Implicit intelligence beliefs were associated with strategic self-regulation, but not grades or knowledge retention. Creative competency was associated with knowledge retention, but not grades, and with higher strategic self-regulation. Implications for STEM education are discussed.
AN EVALUATION OF FRESHMAN ENGINEERING PERSISTENCE USING EXPECTANCY-VALUE THEORY
Cynthia McGrath (James Madison University, USA)
Kyle Gipson (James Madison University, USA)
Olga Pierrakos (James Madison University, USA)
Robert Nagel (James Madison University, USA)
Jesse Pappas (James Madison University, USA)
Mackenzie Peterson (James Madison University, USA)

As we engage in an increasingly complex and quickly progressing world, the development of science, technology, engineering, and mathematics (STEM) students will be increasingly important to the continuation of the United States’ competitiveness. However, the overall number of STEM students earning a degree will not be able to meet the increasing demand for practicing professionals especially within historically underrepresented groups such as women and minorities. One way to tackle this problem is to increase the retention of STEM students by studying the processes that influence persistence to completion of a STEM degree. Retention is critically important to the field of engineering as over 10% of all engineering majors will switch to other STEM degrees and even more will not persist within STEM fields at all. The focus of this paper is to utilize Expectancy-Value Theory to determine how freshman engineering students (both those who persisted within the major and those who switched out of the major) perceive engineering. Research was conducted at a predominately undergraduate liberal arts institution with a medium sized engineering program. Interview data was examined for 11 entering freshman who stayed with the engineering program (persisters) and 10 entering freshman who switched to different majors (switchers).

FIRST-GENERATION ENGINEERING TRANSFER STUDENTS: A QUALITATIVE STUDY OF SOCIAL AND CULTURAL CAPITAL
Catherine Mobley (Clemson University, USA)
Catherine E. Brawner (Research Triangle Educational Consultants, USA)
Erin Shealy (Clemson University, USA)

We present the preliminary results of interviews of 18 first-generation engineering transfer students at two institutions. We employ a unique method for categorizing students according to generation status and then examine whether their experiences differ from one another. We then describe the different experiences of transfer students based on parental education status, with a focus on negotiating the transfer process, involvement in extra-curricular activities, the use of study strategies, and assistance received from families. Our early results suggest that it is useful to make finer distinctions between the various levels of parental education (i.e., use three rather than two categories). support for navigating the complex transfer and higher education pathways.

A NEW VISION: CHANGED ENGINEERING OUTCOME EXPECTATIONS THROUGH EWB-USA
Kaitlin Litchfield (University of Colorado at Boulder, USA)
Amy Javernick-Will (University of Colorado at Boulder, USA)

With the growing demands for additional and diverse engineers, the atypical gender balance experienced by Engineers Without Borders-USA (EWB-USA) is a unique engineering education research setting. Exploring the gender balance of this organization could assist the field's efforts in better recruiting and retaining female engineers. In this work-in-progress study, a social cognitive career theory framework is used to explore the engineering outcome expectations of engineers both involved and not involved with the organization. Qualitative methods were used to gather outcome expectations of male, female, professional, and student engineers, and initial case-based and thematic coding was performed. Preliminary results suggest that EWB-USA members have unique engineering outcome expectations that are often influenced by their organizational involvement. This study may identify ways in which the larger engineering field can replicate similar alternative expectations, particularly to aid the recruitment and retention of a more gender balanced engineering population.
EXPECTATIONS OF COMPUTING AND OTHER STEM STUDENTS: A COMPARISON FOR DIFFERENT CLASS LEVELS, OR (CSE /= STEM - CSE)(COURSE LEVEL)
Abdel-Hameed A Badawy (University of Maryland, College Park & Arkansas Tech University, USA)
Karl R.B. Schmitt (University of Maryland, USA)
Sabrina Kramer (University of Maryland, USA)
Katie Hrapczynski (University of Maryland, USA)
Elise Larsen (University of Maryland, USA)
Andrea Andrew (University of Maryland, USA)
Artesa Taylor (University of Maryland, USA)
Mara Doughtery (American University, USA)
Mathew Miller (Auburn University, USA)
Breanne Robertson (Wesleyan University, USA)
Alexis Williams (University of Maryland, USA)
Spencer Benson (University of Maryland, USA)

Students begin each new course with a set of expectations. These expectations are formed from their experiences in their major, class level, culture, skills, etc. However, faculty and the students are often not on the same page with respect to expectations even though faculty provide students with course syllabi. It is crucial for faculty to understand students’ expectations to maximize students’ learning, satisfaction, and success. Furthermore, it would promote classroom transparency. There would be no hidden unstated expectations; disappointments during the course can potentially be minimized. We present the results of a survey focused on understanding student expectations. Specifically, we focus on examining the differences in expectations of the students of Computer Science and Engineering (CSE) courses and non-computing STEM courses. We present our analysis and observations of the results using aggregate data for all students at all class levels. We observe various differences and similarities among the STEM fields. Identifying differences is crucial since many non-computing STEM majors are enrolled in computing courses, especially in the lower level courses. We provide a detailed comparison among sophomore and senior level courses in computing, biology and chemistry courses. We also compare sophomore and senior CSE courses. Finally, we discuss the importance of paying attention to all students’ needs and expectations. Armed with this knowledge, faculty members can increase transparency in the classroom, student satisfaction, and possibly student retention.

TEACHING TEACHING SOFTWARE MAINTENANCE WITH OPEN SOURCE SOFTWARE: EXPERIENCES AND LESSONS
Swapna S. Gokhale (University of Connecticut, USA)

Software Engineering (SE) careers are overwhelmingly devoted to the maintenance and evolution of existing, large software systems, where the key challenge is code comprehension especially in the face of inadequate documentation and support. SE courses must thus prepare students to meet this challenge. Open Source Software (OSS) furnishes a valuable source of realistic, sizeable projects for inculcating the appreciation and skills involved in code comprehension and evolution. This paper describes experiences and lessons learnt in using OSS projects to teach an introductory, sophomore/junior-level SE course with an emphasis on comprehension, maintenance, and evolution. Students’ reactions and undertakings, acquired through participant observation and homework assignments, suggest that OSS can meaningfully illustrate comprehension and evolution difficulties. Finally, it describes the characteristics of OSS projects that are conducive to highlighting maintenance challenges.

MATHEMATIZATION IN TEACHING PUMPING LEMMAS
Thérèse Smith (University of Connecticut, USA)
Robert McCartney (University of Connecticut, USA)

Theory of Computation provides students of the computing disciplines with understanding that some problems are not solvable, and that there is a range of complexities of problems, in terms of significant resources, including but not limited to time and memory. Theory of Computation acquaints students with reasoning processes by which they can know (for
some cases) the complexity class of a given problem, and by which they can, for some problems they might find in the future, determine the complexity. People formulate these reasoning processes in symbols, and use logic with quantifiers an example of this is the application of the pumping lemma for regular languages. We categorized the errors students made in applying the pumping lemma for regular languages, to develop an understanding of the possible misconceptions, in turn, to improve teaching.

**ASSESSING INDIVIDUAL PERFORMANCE IN AGILE UNDERGRADUATE SOFTWARE ENGINEERING TEAMS**
Rose Gamble (University of Tulsa, USA)
Matt Hale (University of Tulsa, USA)

The Agile Software Development (ASD) process is at the forefront of rapid product development driven by changing customer requirements and a trusted, self-organizing development team. Scrum has become a viable model of ASD focusing on determining immediate deliverables and structuring short timelines, called Sprints, for designing, implementing, and providing them for testing by the customer. While these practices are being adopted by organizations, there is significant difficulty in scaling them to the classroom. Once in place, it is a complex task to evaluate individual student performance based solely on the product outcome and Sprint grade. Thus, there is limited opportunity to catch performance problems that may lead to missing deliverable deadlines or decreasing team trust. In this paper, we impose ASD using Scrum on a senior software projects course in Computer Science. Using a collaborative environment that embeds a social network, project management modules, and event capture system, we perform broad data and event capture and analysis to investigate metrics that are relevant to assessing individual performance aspects related to functioning on an Agile team for software development. Our results suggest that predictive data is available after each Sprint to ascertain individual performance attributes and their relationship to product outcomes.

**EXPLORING STUDENT REPRESENTATIONAL APPROACHES IN SOLVING RECHARGABLE BATTERY DESIGN PROBLEMS**
Oluwatosin O. Alabi (Purdue University, USA)
Alejandra J. Magana (Purdue University, USA)
Edwin Garcia (Purdue University, USA)

Research in how people learn and solve problems suggest that formulating effective solutions to design problems involves effective problem representation in addition to the application of conceptual knowledge and inquiry strategies. This study investigates students' use of computational tools to represent knowledge to inform their problem-solving processes. The research question is: What is the interplay between students' representational artifacts and students' solution processes in solving problems using computational tools? Specifically, how are representational artifacts informing students' strategies to develop and articulate solution procedures? Participants of this study were drawn from a population of 24 graduate students from a materials science engineering course titled Introduction to Rechargeable Batteries. In this case study, our experiment was developed such that two groups of participants were required to employ different computational resources: one group used a computer simulation tool while the other used a written analytical solution. Results indicate that students' use of computer simulation tools contributes further to the internalization of connecting the representational media, as they are present as abstract models for students to reason with and express their understanding without the need to reproduce them.

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**Session S3E: Engineering in International Contexts I**
**Chair: Velvet Fitzpatrick (Purdue University)**
1:00 - 2:30 pm
Room: 18

**HEALTH CLINIC INFRASTRUCTURE DESIGN ACROSS CULTURES IN A HIGH SCHOOL BIOLOGY COURSE**
Camilla Nix (Drexel University, USA)
Jared Coyle (Drexel University, USA)
Stuart Surrey (Philadelphia High School for Girls, USA)
Adam Fontecchio (Drexel University, USA)

A design project is a great way to engage and interest students about engineering subjects. This paper describes an engineering design project intended for use within the high school classroom that transcends global boundaries. The
main goal of the project is to give students a better understanding of engineering, and introduce students to the concept of engineering design. Students assume the roles of engineers, first designing, and then building a small model of a health center. This paper describes the design project, as conducted in East Africa, which has a similar component implemented within the United States. Project implementation in East Africa occurred over a two-week period, while the project is designed to last for a longer period in the United States. Survey results and classroom observation from the East African component reveal project efficacy in the areas of student engineering awareness, engineering interest, engineering efficacy, and cross-cultural sharing.

SOCIAL ENGINEERING PROGRAM - MBA LEVEL: DESIGNED FOR GLOBAL EDUCATION DEMAND
Melany M Ciampi (Safety, Health and Environment Research Organization, Brazil)
Claudio R Brito (Science and Education Research Council, Brazil)
Luis Amaral (Computer Graphics Center, Portugal)
Rosa Maria Vasconcelos (University of Minho, Portugal)
Victor Barros (Science and Education Research Council, Portugal)

Following the new trend in education, more focused on a global perspective, COPEC - Science and Education Research Council is offering an MBA, online, in Social Engineering for all Countries of CPLP - Portuguese Language Countries Community. The goal is to cover these countries’ engineers, which are also seeking for opportunities, as the majority are countries of growing economy based on their very rich resources. The idea of an online program is the possibility of reaching a broader audience and at the same time of enriching the experience of offering and implementing a program that can disseminate ideas and concepts, which fits the needs of the target audience. The Education Research Team of COPEC is convinced that Engineers with proper knowledge and skills can take action in order to solve social problems, as engineers are problem solvers.

A COMPARATIVE STUDY OF MOTIVATION AND LEARNING STRATEGIES BETWEEN AMERICAN AND CHINESE UNDERGRADUATE ENGINEERING STUDENTS
Ning Fang (Utah State University, USA)
Xiuli Zhao (Beijing Forestry University, P.R. China)

This paper presents the results of a comparative study of motivation and learning strategies between American and Chinese undergraduate engineering students. A total of 109 sophomore engineering students from two American and Chinese universities responded to a Motivated Strategies for Learning Questionnaire (MSLQ) survey. The survey includes six motivation scales (totaling 31 items) and nine learning strategy scales (totaling 50 items). Descriptive statistics and independent sample t-tests are performed to analyze students' responses to each MSLQ scale. The results show that statistically significant differences exist in three motivation scales and six learning strategy scales between American and Chinese students surveyed. Overall, American students exceed Chinese students in motivation, but fall behind in learning strategies.

A COMPARATIVE STUDY OF LEARNING STYLE PREFERENCES BETWEEN AMERICAN AND CHINESE UNDERGRADUATE ENGINEERING STUDENTS
Ning Fang (Utah State University, USA)
Xiuli Zhao (Beijing Forestry University, P.R. China)

This paper presents the results of a comparative study of learning style preferences between American and Chinese undergraduate engineering students. A total of 132 sophomore engineering students from two American and Chinese universities responded to an Index of Learning Styles (ILS) survey. The survey is a 44-item, self-scoring questionnaire that assesses learning style preferences on four pairs of dimensions of the Felder-Silverman model: active/reflective, sensing/intuitive, visual/verbal, and sequential/global. Descriptive statistics and independent sample t-tests are performed to analyze students’ responses to the survey. The results show that statistically significant differences exist in four dimensions (reflective, sensing, visual, and verbal) between American and Chinese students. Overall, American students show higher preferences in all four of these dimensions than do Chinese students.
DEVELOPMENT OF A SMART BUILDING WIRELESS SENSORS NETWORK: COOPERATION BETWEEN UNIVERSITY OF WASHINGTON TACOMA AND BRAZILIAN UNIVERSITIES

Orlando Rocha Baiocchi (University of Washington Tacoma, USA)
Fabricio Braga Soares de Carvalho (Federal University of Paraiba – UFPB, Brazil)
George Mobus (University of Washington Tacoma, USA)
Rodrigo Moreira Bacurau (State University of Campinas - UNICAMP, Brazil)
Sérgio Aurélio Ferreira Soares (Federal University of the Vale of San Francisco - UNIVASF, Brazil)

The Institute of Technology at the University of Washington Tacoma - UWT is expanding its international cooperation by hosting Brazilian undergraduate and graduate students in the Computer Engineering and Systems program. In the first research project originated from this cooperation we propose a generic and scalable system, based on Wireless Sensor Networks (WSN). Using the data acquired from the sensor nodes this system will be able to take simple decisions, such as turn on/off heater and lights and help in other more complex decisions, such as rearranging rooms based on the occupancy. These actions can save resources and make buildings more comfortable and efficient. In this paper we describe how this research project is being structured and conducted in order to maximize the cooperation between Brazilian and UWT researchers. Also, we show which strategies are being adopted to make the project scalable and generic. This will allow us to aggregate multi-disciplinary people and make the knowledge and technology produced be reusable by future project members.

Session S3F: Assessment II
Chair: James Rowland (University of Kansas)
1:00 - 2:30 pm
Room: 19

USING COMPUTERIZED LEXICAL ANALYSIS OF STUDENT WRITING TO SUPPORT JUST-IN-TIME TEACHING IN LARGE ENROLLMENT STEM COURSES

Mark Urban-Lurain (Michigan State University, USA)
Luanna B Prevost (University of South Florida, USA)
Kevin Haudek (Michigan State University, USA)
Emily Norton Henry (Michigan State University, USA)
Matthew Berry (Michigan State University, USA)
John Merrill (Michigan State University, USA)

We have been exploring a variety of computerized techniques for analyzing student writing in introductory biology. We achieve computer-to-expert inter-rater reliability (IRR) on par with expert-to-expert IRR (> .8). In Fall, 2012, we piloted the use of automated text analysis to facilitate the use of written formative assessment for Just-in-Time Teaching (JiTT) in a large-enrollment introductory biology course at a large public Midwestern university. A total of 12,677 student responses to 15 online homework questions were collected in three 300+ student course sections with four instructors. We used automated analysis to create feedback for instructors before the next class period (less than one working day), so that instructors could use this feedback to inform their instruction. Instructors used many of the questions pre- and post-instruction and the reports we provided to them allowed them to see how their students’ answers changed as a result of their instruction. Focus groups with the instructors revealed that they already knew some of the topics that challenged students, as revealed in previous semesters with multiple-choice examinations. However, the instructors pointed out that the written assessments were particularly important for gaining insight as to why students have struggled continuously with these ideas.

A COMPREHENSIVE ABET-FOCUSED ASSESSMENT PLAN DESIGNED TO INVOLVE ALL PROGRAM FACULTY

Olga Pierrakos (James Madison University, USA)
Heather Watson (James Madison University, USA)

In this paper, we present a comprehensive and innovative assessment plan and continuous improvement process used by one of the newest engineering programs in the United States. The program was developed from the ground up to have a strong culture of assessment in preparation for ABET. In developing the assessment plan and continuous improvement process, one design requirement was that the assessment plan involve all faculty in the program in order to establish a strong assessment culture. The assessment plan includes both direct and indirect assessment measures, as well as quantitative and qualitative evaluations of student outcome attainments. The assessment plan targets not only program-
level continuous improvement, but also course-level continuous improvement. Course-level continuous improvement involves Course Evaluations and Course Assessment and Continuous Improvement (CACI) Reports, which are prepared by the faculty and serve to document direct assessments of course outcomes and student outcomes. Program-level continuous improvement involves evaluation of the collection of CACI Reports that feed into the Student Outcome Summary Reports (SOSR), which are annually prepared by the Assessment Committee members. Methods developed as part of our assessment plan are generalizable and included in the paper.

**PEER ASSESSMENT IN EXPERIENTIAL LEARNING: ASSESSING TACIT AND EXPLICIT SKILLS IN AGILE SOFTWARE ENGINEERING CAPSTONE PROJECTS**

Fabian Fagerholm (University of Helsinki, Finland)  
Arto Vihavainen (University of Helsinki, Finland)

To prepare students for real-life software engineering projects, many higher-education institutions offer courses that simulate working life to varying degrees. As software engineering requires not only technical, but also inter- and intrapersonal skills, these skills should also be assessed. Assessing soft skills is challenging, especially when project-based and experiential learning are the primary pedagogical approaches. Previous work suggests that including students in the assessment process can yield a more complete picture of student performance. This paper presents experiences with developing and using a peer assessment framework that provides a 360-degree view on students' project performance. Our framework has been explicitly constructed to accommodate and evaluate tacit skills that are relevant in agile software development. The framework has been evaluated with 18 bachelors- and 11 masters-level capstone projects, totaling 176 students working in self-organized teams. We found that the framework eases teacher workload and allows a more thorough assessment of students' skills. We suggest including self- and peer assessment into software capstone projects alongside other, more traditional schemes like productivity metrics, and discuss challenges and opportunities in defining learning goals for tacit and social skills.

**ASSESSMENT OF ENGINEERING FACULTY PERFORMANCE IN THE DEVELOPING ACADEMICALLY AUTONOMOUS ENVIRONMENT - VIT, PUNE, INDIA - A CASE STUDY**

Ashutosh Marathe (University of Pune & Vishwakarma Institute of Technology, India)

The necessity of Documenting and quantifying the accountability of faculty in Higher Education Institutes (HEI) is gathering momentum in countries all around the globe. In India, where Academic Autonomy is slowing spreading its wings outside the Indian Institute of Technologies, National Institute of Technologies and Government Engineering colleges, into the group of Private unaided Engineering Institutions, the need is felt to develop a rubric for assessing faculty performance in a Quantitative manner. Addressing to that need, various attributes are identified which are essential for assimilating a 'complete faculty performance'. This paper details out these efforts and its outcomes in one of the leading Private Engineering Autonomous Institute in the academically progressive western part of the country. The teaching performance of the faculty along with academic, co-curricular, extension and research activities is quantified into a credit based assessment system (CBAS). This system is run under Quality Management Systems adopted at the Institute. This faculty performance assessment is observed to have helped in identifying better performing as well as poor performing faculty. Also the targets for the subsequent Academic year can be set up with clarity and transparency

**RISK MANAGEMENT IN SCIENTIFIC RESEARCH: A PROPOSAL GUIDED IN PROJECT MANAGEMENT BOOK OF KNOWLEDGE AND FAILURE MODE AND EFFECTS ANALYSIS**

Pollyana Mustaro (Mackenzie Presbyterian University, Brazil)  
Rogério Rossi (Mackenzie Presbyterian University, Brazil)

The achievement of different university degrees (from graduate to the specialization, master's and doctoral) usually is related to the development and presentation of research results conducted by an Academic Advisor. However, their finalization or the results may be adversely affected by the lack of identification of risk that may present themselves during the process of construction and development of the research. To minimize these impacts, the present study was based on the alignment and adjustment of processes present in the Project Management Body of Knowledge (PMBoK), a specific guide that consolidates the best practices of project management from the Project Management Institute (PMI), and the use of Failure Mode and Effects Analysis (FMEA). From such elements and the identification of factors relevant to the educational institution involved and the processes related to the advisory and development of scientific research, it was sought to build a proposed risk analysis in the academic, named Academic Project Risk Management Plan (APRMP). This aims to contribute to the discussion and gathering information that can support the Advisor and the
student at all stages of the research (planning, development and conclusion) that downside risks are avoided or minimized and that opportunities become clear and effective possibilities.

**ASSESSING CONCEPTUAL UNDERSTANDING IN MATHEMATICS**
Audrey DeZeeuw (University of Texas at Austin, USA)
Tara Craig (University of Texas at Austin, USA)
Hye Sun You (University of Texas at Austin, USA)

Modern mathematics careers are now requiring conceptual skills such as, critical thinking, modeling, and application of the content. This change in skillset needed for careers has strongly impacted mathematics curriculum and assessment. Meaningful assessment involves examining students' ability to inquire, to reason on targeted questions or tasks, and to promote conceptual understanding, not just focusing on discreet facts and principles. Mathematics assessment tools still focus solely on this procedural side of understanding mathematics instead of the equally important conceptual aspect of learning mathematics. Given that math is an active process that encourages higher-order thinking and problem solving, an assessment focusing on the growth of conceptual understanding is required. The proposed research focuses on the development of a tool that will be used to assess current U.S. calculus students' ability to apply their conceptual understanding of a mathematic concept to scientific phenomena through modeling. The assessment using Netlogo would be very useful for math educators to have good tools to assess students’ conceptual understanding, as well as to develop instructional strategies used.

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**SESSION S3G: Energy Engineering Education II**
Chair: Je-Hyeong Bahk (Purdue University)
1:00 - 2:30 pm
Room: 20

**SUSTAINABLE ENERGY ENGINEERING INTERNSHIPS FOR COMMUNITY COLLEGE AND HIGH SCHOOL STUDENTS**
Tiffany Wise-West (University of California Santa Cruz, USA)
Michael Isaacson (University of California Santa Cruz, USA)
Melissa Hornstein (Hartnell College, USA)
Zachary Graham (University of California Santa Cruz, USA)

As a result of a partnership between the University of California Santa Cruz (UCSC) and a Hispanic-serving Institution, Hartnell College, a micro-grid and test bed facility are being constructed at Hartnell's Alisal campus. The facility will provide a real-world student training center on renewable energy technologies where students can participate in research to develop new, experimental renewable energy generation systems. Over the next several years, Hartnell's Sustainable Engineering laboratory courses will be transitioned to focus on the microgrid and test-bed. Related courses and lab modules developed at UCSC will also be integrated into the program. An early outcome of this collaborative partnership was the internship support of teams of high school and community college students working with UCSC graduate students on several different sustainable energy projects over the summer of 2012. Program mentors and interns all reported a high degree of satisfaction with their internship experience.

**SYSTEM NORMALIZATION AND IRON SATURATION BASED ON GENERALIZED COUPLED CIRCUITS ANALYSIS AS FUNDAMENTALS FOR ELECTRIC MACHINES MODELING COURSE**
René Wamkeue (Université du Québec en Abitibi-Témiscamingue – UQAT, Canada)
Léandre Nneme Nneme (Ecole Normale Supérieure de l'Enseignement Technique – ENSET, Cameroon)
Fouad Slaoui-Hasnaoui (Université du Québec en Abitibi-Témiscamingue – UQAT, Canada)

This paper describes the use of a suitable approach to teaching generalized magnetically coupled electric circuits as an introduction chapter to the electric machines modeling and simulation course for power engineering students. The teaching methodology focuses on some common concepts and fundamentals of electrical machine theory such as machine inductances (self, leakage and mutual), equivalent circuits, magnetic circuits, iron saturation, reciprocal per unit system, state modeling and simulation, so that the modeling approach of each type of classical machine can easily be deduced from the general theory established by the chapter on magnetically coupled electric circuits.
REAL WORLD PHOTOVOLTAIC ENERGY ENGINEERING
Enrique Ballester Sarrias (Universitat Politècnica de València, Spain)
Juan Angel Saiz Jiménez (Universitat Politècnica de València, Spain)
Luis M. Sanchez Ruiz (Universitat Politècnica de València, Spain)

Photovoltaic solar energy has recently enjoyed a technical and economic progression achieving a high level of reliability. With the aim of obtaining a better knowledge of this type of energy by part of the students from the Electrical, Electronic and Mechanical Engineering Degrees of the School of Design Engineering ETSID in Valencia, Spain, they are offered an elective subject in which they are asked to conduct a “field practice” in which they design an isolated installation that will fully supply the house in which they live including. In addition they perform a photovoltaic installation connected to the electrical network. In both cases students must obtain market prices and find out the supply equipment commonly used. With this data they should develop a proposal similar to the one supplied to a customer requesting an installation of this kind. Hence this is a field project where factual data is required and enables students to talk to companies supplying the electrical and photovoltaic materials. These assignments include the final assessment of the cost of the power generated, so that students can identify if the final price in photovoltaic is higher or lower than the cost of electricity supplied by the electricity distribution companies.

AN ONLINE SIMULATOR FOR THERMOELECTRIC COOLING AND POWER GENERATION
Je-Hyeong Bahk (Purdue University, USA)
Megan Youngs (Purdue University, USA)
Kazuaki Yazawa (Purdue University, USA)
Ali Shakouri (Purdue University, USA)
Oxana S Pantchenko (University of California at Santa Cruz, USA)

We present an online simulator that can be used to teach the principles of thermoelectric energy conversion, and analyze the detailed performance of Peltier coolers or thermoelectric power generators with simple user interfaces. The simulation tool is implemented on nanoHUB.org, so it can be run on any web interface without the need to install commercial software. The simulation tool solves the heat balance equations at the top and bottom sides of the thermoelectric device using 1D thermal network model and the electric circuit model to analyze the steady-state temperatures of the device and the thermoelectric energy conversion efficiency. Both cooling and power generation modes can be solved upon user's input. Using this simulator, users are able to optimize the performance of a thermoelectric device with a variety of different design parameters such as the device dimensions and material properties. In particular, this simulator can be very useful to teach the importance of the thermoelectric figure of merit, ZT, of the material used on the performance of the device. This simulation is also instructive to show that as material properties improve Carnot limit can be achieved at negligible output power, while efficiency at maximum output power converges to Curzon-Ahlborn limit.

Session S3H: pK-12 STEM V
Chair: Julie Rursch (Iowa State University)
1:00 - 2:30 pm
Room: 2

REMOTE EXPERIMENTS IN SECONDARY SCHOOL EDUCATION
Olga Dziabenko (DuestoTech - University of Deusto, Spain)
Javier Garcia-Zubia (DuestoTech - University of Deusto, Spain)
Pablo Orduña (DuestoTech - University of Deusto, Spain)

This paper describes current influence of remote laboratory on practical learning aspects of secondary sector. The key challenges faced by teaching of science include insufficient hands-on laboratory usage in classrooms. The main objective of the paper is presenting adaptation and usage of WebLab-Deusto remote experiments in secondary school. The activity was organized in collaboration with teachers of P. Andrés Urdaneta School. The teaching of Ohm’s Law in Physics curriculum of secondary school was one of the topics executed during this research. The remote laboratory assignment for students was developed on VISIR. The existing remote laboratories are more or less copies of hands-on ones. VISIR is a remote laboratory created by BTH for designing, wiring and measurement of electric circuits. This main feature of VISIR allows one building a scenario of performing basic DC and low frequency AC circuits experiments related to Ohm's and Kirchhoff's laws. Moreover, the students will become familiar with instruments, components, manuals, data sheets, circuit wiring, and other laboratory work. In the paper the main principle of VISIR will be presented.
the remote experiments executed by students will be shown. Finally, the result of integrating of remote experiments for study in Urdaneta School will be discussed.

**INFUSING SYSTEM DESIGN AND SENSORS IN EDUCATION**
Nathan H Bean (Kansas State University, USA)
Mitchell L Neilsen (Kansas State University, USA)
Gurdip Singh (Kansas State University, USA)
Jacqueline Spears (Kansas State University, USA)
Naiqian Zhang (Kansas State University, USA)

INSIGHT, an innovate graduate STEM Fellowship Program integrates sensor technology and computer science within in a K-12 standards-based science, technology, and engineering curricula. Graduate STEM Fellows are teamed with science, technology, and physical education teachers for two years to carry out hands-on classroom activities utilizing technology and engineering practice with a focus on the use of sensors, computing, and information technology aligned with K-12 state curriculum standards. One of the project's main goals is the establishment of sensor, computing, and information technology as a foundational high school skill by accelerating the integration of sensor technology content into K-12 classrooms. This project encourages participation in engineering and technology from a wider, more diverse group of students from rural Kansas. This paper shares detailed examples of summer institute and academic-year K-12 activities that have been successful. It also provides a preliminary assessment of the project.

**INTEGRATION OF SENSORS AND ELECTRICAL ENGINEERING INTO SECONDARY GEOMETRY CURRICULUM**
Mounir Ben Ghalia (University of Texas-Pan American, USA)

Several studies have reported on the potential benefits of integrating engineering education in K-12 curricula. Such benefits include: (i) an improved student learning and achievements in mathematics and science, (ii) an increased awareness of engineering and what engineers do, and (iii) an interest in pursuing engineering as a career. To help realize these benefits, the goals of the University of Texas-Pan American Research Experiences for Teachers in Emerging and Novel Engineering Technologies (RET-ENET) program are to: (i) engage math and science teachers in engineering research during the summer for the period of six weeks, and (ii) support the recruited teachers to translate their engineering research experiences into hands-on engineering-inspired curricula that they implement in their classrooms during the academic year. Using specific examples from the 2012 RET-ENET program, this paper discusses the activities conducted by a team of teachers who worked on a radar imaging research project and the process that led to the development of hands-on geometry lessons inspired by the research experience. The observation of the implementation of the lessons in the teachers' classrooms and the results of student assessments showed that the engineering-inspired hands-on lessons engaged students and increased their interest in learning the geometry concepts.

**THIS IS CHILD'S PLAY CREATING A "PLAYGROUND" (COMPUTER NETWORK TESTBED) FOR HIGH SCHOOL STUDENTS TO LEARN, PRACTICE, AND COMPETE IN CYBER DEFENSE COMPETITIONS**
Julie Rursch (Iowa State University, USA)
Doug Jacobson (Iowa State University, USA)

The IT-Adventures program is designed to increase high school students' interest in information technology (IT) as a career. It allows them to learn about IT in non-threatening, extracurricular IT-Club activities using inquiry-based learning. The IT-Clubs have four tracks from which students can select to study: cyber defense, game design programming, robotics, and multimedia. This paper focuses on the cyber defense venue and the need for students to have equal access to computing equipment on which to learn about computer operating systems, networking, and information security prior to competing in a cyber defense competition (CDC) at the end of the academic year. The creation of a remotely located and managed "playground" provides uniform access to equipment across schools. This paper shares our knowledge and experience in creating the "playground".
A CURRICULAR FRAMEWORK FOR CRITICAL INFRASTRUCTURE PROTECTION EDUCATION FOR ENGINEERING, TECHNOLOGY AND COMPUTING MAJORS
Sumita Mishra (Rochester Institute of Technology, USA)
Carol Romanowski (Rochester Institute of Technology, USA)
Rajendra Raj (Rochester Institute of Technology, USA)
Trudy Howles (Rochester Institute of Technology, USA)
Jennifer Schneider (Rochester Institute of Technology, USA)

The 16 critical infrastructure sectors identified by the US Department of Homeland Security employ many engineering, technology and computing graduates who increasingly face critical infrastructure protection (CIP) issues. However, most undergraduate curricula in these disciplines do not incorporate CIP in any meaningful way. This paper proposes a flexible curricular framework for integrating CIP into undergraduate education via self-contained inter-disciplinary CIP course modules; a course module is a distinct curricular unit such as a lab or teaching component for use by an instructor in existing courses without requiring any course or program modifications. The proposed course modules cover physical, human, and cyber aspects of CIP. The framework is designed for use in multiple disciplines, and the modules are designed for presentation at different levels of the undergraduate experience, with subsequent modules building on those presented earlier. This approach is intended to prepare students for careers solving problems in design, implementation, and maintenance of robust, sustainable infrastructure assets.

SIMULATING INDUSTRY: AN INNOVATIVE SOFTWARE ENGINEERING CAPSTONE DESIGN COURSE
Lynette Johns Boast (The Australian National University, Australia)
Shayne Flint (The Australian National University, Australia)

Universities are required to produce graduates with good technical knowledge and 'employability skills' such as communication, team work, problem-solving, initiative and enterprise, planning, organizing and self-management. The capstone software development course described in this paper addresses this need. The course design contains three significant innovations: running the course for two cohorts of students in combination; requiring students to be team members in 3rd year and team leaders in their 4th (final) year; and providing assessment and incentives for individuals to pursue quality work in a group-work environment. The course design enables the creation of a simulated industrial context, the benefits of which go well beyond the usual, well-documented benefits of group project work. In order to deliver a successful outcome, students must combine academic theory and practical knowledge whilst overcoming the day-to-day challenges that face project teams. Course design enables the blending of university-based project work and work-integrated learning in an innovative context to better prepare students for participating in, and leading, multi-disciplinary teams on graduation. Outcomes have been compellingly positive for all stakeholders - students, faculty and industry partners.

USING A THREADED FRAMEWORK TO ENABLE PRACTICAL ACTIVITIES IN OPERATING SYSTEMS COURSES
Aleardo Manacero (São Paulo State University - UNESP, Brazil)
Renata Spolon Lobato (São Paulo State University - UNESP, Brazil)

Teaching Operating Systems (OS) is a rather hard task, since being an OS designer is not a desired goal for most students and the subject demands a large amount of knowledge over system's details. To reduce the difficulty many courses are planned with laboratory practices, differing in how the practices are designed. Some try to implement next-to-real kernels, others use simulators, and even others use synthetic kernels. In this paper an approach based on synthetic kernels is described. It uses thread programming in order to establish control over the operating system components. This approach allows the kernel to grow following the materials presented in the course. It has been successfully applied in two different courses at our University, the first one being a basic OS course and the second one an upper level course. Results from these applications are presented.
**BUG OF THE DAY: REINFORCING THE IMPORTANCE OF TESTING**
Daniel Krutz (Rochester Institute Of Technology, USA)
Michael Lutz (Rochester Institute of Technology, USA)

Software engineering students typically dislike testing. In part this is due to the simplicity of the programming and design exercises in introductory computing courses - the payoff for thorough testing is not apparent. In addition, testing can be seen as tangential to what really matters: developing and documenting a design addressing the requirements, and constructing a system in conforming to the design. Such dismissive attitudes do not accord well with the realities of commercial software development. The cost of fixing, repairing and redistributing a flawed product can dwarf that of development. The Software Engineering Department at the Rochester Institute of Technology (RIT) teaches (and requires) basic testing as part of its foundation courses in the first two years. In addition, it offers an upper division course on testing, giving an in-depth treatment of best-practice tools, techniques and processes. Recently we've incorporated a "Bug of the Day," which serves to broaden student awareness of the cost of software flaws. Class discussions focus on the cost of the bug, its root causes, and how it might have been discovered and repaired prior to product release.

**DIDACTIC AND INTERDISCIPLINARY EXPERIENCES IN A SOFTWARE ENGINEERING COURSE**
Juan Carlos Martinez Arias (Pontificia Universidad Javeriana - Cali, Colombia)
Gerardo Sarria (Pontificia Universidad Javeriana - Cali, Colombia)

Didactic experiences are very important in a Software Engineering course. We think they help to achieve at least six objectives of the course: to identify fundamental concepts of software engineering, to recognize software life cycles, models and methodologies of software development, to perform analysis of software products requirements, to design and develop a software product, to use the methodical processes of a real-world project, and to implement solutions following specific methodologies. In this paper we will show our didactic experiences in the Software Engineering Processes course. We developed a sequence of learning activities and their application (extracted from real requirements of clients and users) in different contexts such as environmental, medical and social, which results in higher levels of learning, interdisciplinary exercises and practices close to what students will face in their professional lives.

**SELF-AFFIRMATION AND SUCCESS IN UNDERGRADUATE COMPUTER SCIENCE**
Meriel Huggard (Trinity College Dublin, Ireland)
Ciaran McGoldrick (Trinity College Dublin, Ireland)

This paper reports on the category of "self-affirmation", one of the key abstracted categories identified in a qualitative study that sought to examine the factors that influence student perception of success in undergraduate Computer Science. Self-affirmation is the process whereby an individual focuses on important and positive aspects of their life with the aim of affirming their sense of self-worth and value. This positive self-regard makes individuals more accepting of negative feedback. The grounded theory approach employed in this substantive study provides a unique insight into the students' perspective of the key factors that influences their perceived success. Self-affirmation processes emerged as a key element of this theory and merit inclusion in future efforts to support and scaffold freshman learning in computer science.

**DECIDING TO STAY: THE INTERSECTION OF SEX AND RACE/ETHNICITY**
Elizabeth Litzler (University of Washington, USA)
Catherine Samuelson (University of Washington, USA)

While much of prior research has focused on understanding the reasons students leave engineering, and therefore talk to those students who switched out of an engineering major, this study contributes the new perspective of students who seriously considered leaving but ultimately decided to stay in their engineering major. The qualitative analysis suggests that about one-third of students seriously considered leaving engineering but ultimately decided to stay. The reasons students decided to stay in engineering fell into eight main categories, with the most common reasons being the rewards that will come with an engineering degree; enjoyment of engineering; or an aversion to quitting or desire to prove that
you can do it. Differences in rationales were discovered between males and females, between different race/ethnicity groups and at the intersection of sex and race/ethnicity.

**EXAMINING THE CORRELATION BETWEEN RELIGION AND SOCIAL RESPONSIBILITY IN ENGINEERING**
Nathan Canney (University of Colorado Boulder & Seatte University, USA)
Angela Bielefeldt (University of Colorado Boulder, USA)

The development of social responsibility, both personally and professionally, is critical in the movement toward developing more holistic engineers, as called for by many professional engineering societies to address the complex problems that face our society. This paper presents correlations between engineering students' religious beliefs and their views of personal and professional social responsibility. Data were gathered from 895 engineering respondents to the Engineering Professional Responsibility Assessment tool and from 25 semi-structure interviews with engineering students. It was found that students who considered themselves ‘very active’ in their religious preference had stronger beliefs of their ability and personal obligation to help others, and in a professional sense of obligation to help others as engineers.

**AN EXAMINATION OF STUDENTS' MOTIVATION IN ENGINEERING SERVICE COURSES**
Natasha Mamaril (University of Kentucky, USA)
David Ross Economy (Clemson University, USA)
Ellen Usher (University of Kentucky, USA)
Marian Kennedy (Clemson University, USA)

To increase the number of science, technology, engineering, and mathematics (STEM) graduates, educators need to identify ways to increase student persistence from entry until graduation. The objectives of this study are to determine (1) if motivation affects learning outcomes in engineering service courses and (2) whether students' level of motivation tracks with specific engineering disciplines. Students enrolled in a sophomore level engineering service course were surveyed to examine their motivation in engineering service courses and to assess the relationship between their motivation and their achievement and desire to persist in the engineering discipline. The survey measures for self-efficacy, task value, and achievement goals in engineering were created and evaluated during an initial pilot study. Initial results showed internal consistency among the items in each measure.

**MEASURING STUDENT ENGAGEMENT IN THERMODYNAMICS COURSES**
Patrick Tebbe (Minnesota State University, Mankato, USA)
Stewart L. Ross (Minnesota State University, Mankato, USA)
Jeffrey Pribyl (Minnesota State University, Mankato, USA)

This paper will discuss an on-going NSF-CCLI grant that addresses improvements in student pedagogy and educational materials for the engineering thermodynamics curriculum by completing development of an online material titled "Engaged in Thermodynamics". The Engaged material is a textbook supplement based on actual engineering facilities and equipment. During Fall 2012 an engagement Opinionnaire was administered in two separate, and distinct, thermodynamics courses. Results indicate a student perception that preparing better for a course leads to improved performance in the course. However, there was no correlation between students' desire to learn and the amount of questions they ask in class. Regarding student interest, the results indicated it was higher for the course that used the Engaged material. Additional data collection and student focus groups will be ongoing.
THE EFFECTS OF EXTRA CREDIT OPPORTUNITIES ON STUDENT PROCRASTINATION
Stephen Edwards (Virginia Tech, USA)
Anthony Allevato (Virginia Tech, USA)

Many techniques have been attempted to encourage students to exercise better time management on class projects, such as staging an assignment into multiple deliverables, requiring students to keep records of the time they spend, and offering extra credit for early completion. This paper reports on a study of the effects of offering extra credit for early completion. Students in an introductory course completed four programming assignments throughout the term. For two assignments, no extra credit was offered. For the other two, students were offered a 10% bonus if they finished at least three days before the deadline. While one might expect this incentive to encourage students to shift their work habits, we found that there was no positive change in their time management. In fact, students started on the assignments where extra credit was offered later than on those where it was not offered. This leads us to believe that there were other pressures or concerns that outweigh the possibility of earning a bonus on an assignment, so that this kind of incentive only helps students who already manage their time well.

USING OPEN SOURCE PROJECTS IN SOFTWARE ENGINEERING EDUCATION: A SYSTEMATIC MAPPING STUDY
Debora Maria Coelho Nascimento (Federal University of Sergipe, Brazil)
Christina Chavez (Federal University of Bahia, Brazil)
Roberto A Bittencourt (State University of Feira de Santana, Brazil)
Kenia Cox (Federal University of Sergipe, Brazil)
Thiago Almeida (Federal University of Sergipe, Brazil)
Wendell Sampaio (Federal University of Sergipe, Brazil)
Rodrigo Souza (Federal University of Bahia, Brazil)

Context: It is common practice in academia to have students work with "toy" projects in software engineering courses. One way to make such courses more realistic and reduce the gap between academic courses and industry needs is getting students involved in Open Source Projects with faculty supervision. Objective: This study aims to summarize existing information on how open source projects have been used to facilitate students' learning of software engineering. Method: A systematic mapping study was undertaken by identifying, filtering and classifying primary studies using a predefined strategy. Results: 53 papers were selected and classified. The main results were: a) most studies focus on comprehensive software engineering courses, although some papers deal with specific areas; b) the most prevalent approach was the traditional project method; c) surveys are the main learning assessment instrument, especially for student self-assessment; d) conferences are the typical publication venue; and e) more than half of the studies were published in the last five years. Conclusions: The resulting map gives an overview of the existing initiatives in this context and shows gaps where further research can be pursued.

A TALE OF TWO PROJECTS: A PATTERN BASED COMPARISON OF COMMUNICATION STRATEGIES IN STUDENT SOFTWARE DEVELOPMENT
Shreya Kumar (Michigan Technological University, USA)
Charles Wallace (Michigan Technological University, USA)

Preparing students for the communication realities of software development is as difficult as it is important. Training in specific genres of oral and written communication is vital, but successful software developers must also design their communication, choosing appropriate genres and styles to fit the audience and context. We introduce a pattern language for classifying and describing communication strategies. Communication Patterns serve both as an approach for rigorous qualitative analysis and as a library of established practices that students can draw from. The approach has clear links to software design patterns and highlights the fact that communication, like software, is a designed artifact. We focus on two software projects from our case study repository, using Communication Patterns. The two case studies have a great deal of overlap in objectives, stakeholders, responsibilities and timescales, but the outcomes are drastically different. Through patterns, we assess communication at strategic and tactical levels, and we find major differences in
communication choices. We also discuss our attempts to expose students to Communication Patterns in the classroom. We conclude with a look at future efforts to deepen our pattern library and diversify our approaches to building and using them.

CAN NATURAL LANGUAGE BE UTILIZED IN THE LEARNING OF PROGRAMMING FUNDAMENTALS?
Osvaldo L. Oliveira (Faculty of Campo Limpo Paulista, Brazil)
Ana M. Monteiro (Faculty of Campo Limpo Paulista, Brazil)
Norton Trevisan Roman (University of São Paulo, Brazil)

The complexity and importance of learning programming fundamentals (i.e., sequences of sentences that express actions, conditions, and repetitions in computing) for undergraduate students has motivated the development of an intense educational research area. One frequently studied problem is the difficulty in the learning of traditional context-free grammars which are present, for example, in programming languages such as Pascal and C. This study experimentally investigates the use of natural language in the learning of programming fundamentals by two groups of undergraduate students without prior knowledge of programming and compares its use with that of a traditional grammar language. Results suggest that the use of natural language is a good alternative, despite the small differences, to the use of traditional programming languages defined by context-free grammars. This alternative is attractive and promising because the student does not need to learn a formal grammar to learn the fundamentals of programming.

DYNAMIC PROGRAMMING - STRUCTURE, DIFFICULTIES AND TEACHING
Emma Enström (Royal Institute of Technology, Sweden)

In this paper we describe action research on our third year Algorithms, Data structures and Complexity course, in which students have considered dynamic programming hard in comparison to the other topics. Attempting to amend this, we wanted to know which difficulties the students encountered, where they gained their knowledge, and which tasks they were most certain that they could perform after the course. We identified subtasks that could be taught separately, and adapted the lectures to Pattern Oriented Instruction in order to help students cope with the cognitive complexity of solving problems using dynamic programming. For this, we prepared new clicker questions, visualisations and a lab assignment. We also constructed self-efficacy items on the course goals for dynamic programming, and administered them before and after the teaching and learning activities. Among the self-efficacy items, determining the evaluation order and solving a problem with dynamic programming with no hints had the lowest score after the course. As for the activities, arguing correctness of a solution was something many students claimed that they did not learn anywhere. Students considered the lab exercise most useful, but they also learned a lot from the other activities.

Session S4E: Engineering in International Contexts II
Chair: Luis Amaral (University of Minho)
3:00 - 4:30 pm
Room: 18

OUTCOME BASED ENGINEERING DIPLOMA CURRICULUM - 2012 GUJARAT EXPERIMENT
Vijay Agrawal (National Institute of Technical Teachers Training and Research, India)
Joshua Earnest (National Institute of Technical Teachers Training and Research, India)
Shashi Gupta (National Institute of Technical Teachers Training and Research, India)
Jaganath Tegar (National Institute of Technical Teachers Training and Research, India)
Susan Sunny Mathew (National Institute of Technical Teachers Training and Research, India)

In India the universities have numerous engineering institutes affiliated to them that are geographically spread across large provinces. Gujarat Technological University (GTU) is one such example. Since examination and certification is the main responsibility of the University, it becomes necessary to conduct centrally administered end-of-the-term examinations every semester. This necessitates the curriculum for each program to be same in all the institutes affiliated to the University. In 2012 NITTTR Bhopal, one of the four premium institutes established by the Government of India for quality improvement of the technical education systems, was assigned the task to completely re-design the curricula of twenty five engineering diploma programs to produce ‘work ready’ personnel by GTU. The authors who were core members of the team undertook this task of evolving this innovative outcome-based curriculum model to address the challenges and opportunities faced by the engineering education system due to fast changes taking place in society, industry and education. This paper discusses the various facets of the philosophy, approach and structure of this model. It
also briefly describes the planning, designing, implementation and evaluation of the curriculum development process, and the strategies adapted to render it outcome-based to satisfy all the stakeholders.

**WOMEN IN COMPUTING: A CASE STUDY ABOUT KUWAIT**

Rehab El-Bahey (American University of Kuwait, Kuwait)
Amir Zeid (American University of Kuwait, Kuwait)

Female under-representation in the field of computing has been a global concern. According to recent research studies in the US, females are less likely than males to consider a career or a degree in computer-related fields. Opposite trends have been appearing in other parts of the world showing a high female turnout in computer studies. One of those countries is Kuwait, a small country situated in the Persian Gulf. According the UNESCO Institute for Statistics, the percentage of female graduates in tertiary education in Kuwait has reached 69% in 2009 (80% in science related disciplines). Female undergraduate enrollment in computing studies in Kuwait is in the range of 40 to 50 percent, which is considerably high compared to other parts of the world. In this paper, we present a case study about women in computing in Kuwait, through which we highlight their motivations for studying computer science and information systems. A survey was conducted among male and female university students in Kuwait about attitudes and perceptions on females in computing and reasons for joining computer studies. The results were analyzed and compared to similar studies in the US.

**PRELIMINARY ANALYSIS OF AN APPEALING PROGRAM FOR OUTSTANDING STUDENTS AT THE SCHOOL OF DESIGN ENGINEERING (ETSID) OF VALENCIA**

Enrique Ballester Sarrias (Universitat Politècnica de València, Spain)
Laura Contat Rodrigo (Universitat Politècnica de València, Spain)
Luis M. Sanchez Ruiz (Universitat Politècnica de València, Spain)

During the 2010/2011 academic year, the Universities of the Valencia region (Spain) started up a pioneer experience in Spanish Higher Education: the High Academic Performance Groups (in Spanish, the so-called ARA groups "Grupos de Alto Rendimiento Académico") aiming to support and attract the brightest students with the best skills, so that they can achieve a high academic performance. The Universitat Politècnica de València (UPV), as a result of its commitment to promote its quality and internationalization, has taken part in this project from the dawn of its implementation. Since then, ARA groups have been set up in five of the UPV Bachelor Degrees, two of them being offered at the School of Design Engineering (ETSID). In this work, we analyse the implementation process of the ARA groups at ETSID since 2010/2011, outlining some of the future strategies that should be taken into account for their consolidation.

**INTRODUCTION OF ENTREPRENEURSHIP AND INNOVATION SUBJECTS IN A COMPUTER SCIENCE COURSE IN BRAZIL**

Eduardo Cruz (Universidade Federal de São Carlos - UFSCar, Brazil)
Alexandre Alvaro (Universidade Federal de São Carlos - UFSCar, Brazil)

The recent changes in the world and in technology present both challenges and opportunities to the computer education, which must be adapted / change to meet these challenges. More and more computer courses strive to include entrepreneurship and innovation in the curriculum. However, integrating entrepreneurship and innovation education in computing curriculum could have a significant effect on the creativity, innovativeness, leadership and entrepreneurial intentions of computing undergraduates. In this way, this paper present a view on teaching entrepreneurship to computer science students and describe an experience in introducing entrepreneurship and innovation in computing curriculum in a computer science course at Brazil.

**ESTABLISHING A GLOBAL SOFTWARE DEVELOPMENT COURSE: A CULTURAL PERSPECTIVE**

Amir Zeid (American University of Kuwait, Kuwait)
Rehab El-Bahey (American University of Kuwait, Kuwait)

Global software development (GSD) is one of the main practices in software industry. The ability to outsource and manage software development at remote sites allows organizations to benefit from GSD since they get access to a wider and more economically feasible pool of developers. Recently, global software engineering courses are being introduced at academic institutes as part of computer science and software engineering degree requirements. There are many challenges associated with managing and executing globally distributed software projects in academic settings. In this paper, we will attempt to analyze the framework and components of a collaborative global software engineering course.
from a cultural perspective. We examine the different challenges related to team-setting, grading, communication tools, gender issues and associated risks. A discussion of how cultural differences may affect setting up the course is included. The uniqueness of the proposed research lies in two main areas: it examines collaboration between Kuwait, USA and Poland; and it investigates the proposed topics from a cultural perspective.

Session S4F: Assessment III  
Chair: Asako Ohno (Osaka Sangyo University)  
3:00 - 4:30 pm  
Room: 19

CRITICAL SUPPORT FOR UPPER DIVISION TRANSFER STUDENTS IN ENGINEERING AND COMPUTER SCIENCE  
Mary Anderson-Rowland (Arizona State University, USA)

A Motivated Engineering Transfer Students (METS) Program at Arizona State University (ASU) was established to aid the transition, retention, and graduation of engineering and computer science community college transfer students. The METS Program provides critical support in the form of an Academic Success and Professional Development (ASAP) Class and a METS Center to help provide academic and social support, as well as scholarships. In this paper, we look specifically at the impact of the METS Center for transfer students and the impact on transfer students of the $4K per year scholarship funded by NSF grants. The ASAP Class transfer students were surveyed to evaluate the Center and scholarships. The transfer students were asked: “How does the METS Center help you?” and “How did the METS scholarship help you?” The top three identified benefits of the METS Center were: a place to meet/connect with other transfer students, the use of computers and free printing, and the ability to get information about internships. The top student benefits of the METS scholarship are not having to work as much, not having to take out a loan and, for some students, not having to work. The scholarship benefits did not differ by gender.

IMPROVING STUDENT RESULTS IN A STATICS COURSE USING A COMPUTER-BASED TRAINING AND ASSESSMENT SYSTEM  
Luis Felipe Zapata Rivera (EAFIT University, Colombia)  
Jorge L. Restrepo (EAFIT University, Colombia)  
Jaime Barbosa (EAFIT University, Colombia)

One of the main causes of university desertion in engineering programs at EAFIT University (Medellin, Colombia), is the poor student academic performance in basic courses. One of these courses is Statics for mechanical, civil and production engineering, which is taught at the undergraduate level. Between the years 2009 and 2011 about 51% of students did not get a satisfactory score to pass the course and a high percentage of these students deserted from their engineering program. This paper describes the results of using a computer system to support training and assessment processes to convey concepts as related to a Statics course uses an existing open source tool and implements a dynamic assessment generation scheme (generation of multiple versions of the same problem using algorithms with variables). This system has been used in the Statics courses during two academic periods in the year 2012 involving the participation of 250 students from 7 different groups. The results of this experiment are compared with performance results from other groups of students from previous years who used traditional practice and assessment methods. Results have had a positive impact in student retention.

SEARCH ENGINE FOR ENGINEERING EDUCATION ASSESSMENT INSTRUMENTS  
Denny Davis (Washington State University, USA)  
Sarah J Brooks (Washington State University, USA)  
Shane Brown (Washington State University, USA)  
Howard Davis (Washington State University, USA)  
Jennifer LeBeau (Washington State University, USA)  
Brian French (Washington State University, USA)  
Michael Trevisan (Washington State University, USA)

Adoption research has guided the development of a classification and rating system for assessment instruments valuable to the engineering education community. The ASSESS website enables users to search for instruments that measure outcomes of interest and that possess desired characteristics. The website classifies instruments by outcomes assessed,
technical features, instrument format, and administration parameters. Instrument descriptions and ratings are displayed in forms useful to both experienced and inexperienced users seeking instruments for specific needs. The user community contributes to ASSESS by rating instruments and suggesting others for development or inclusion. ASSESS developers invite user input to make ASSESS highly valuable to the engineering education community.

A METHODOLOGY TO TEACH EXEMPLARY CODING STYLE CONSIDERING STUDENTS' CODING STYLE FEATURE CONTAINS FLUCTUATIONS
Asako Ohno (Osaka Sangyo University, Japan)

Readable source code should contain a relatively small amount of latent bugs and should be easy to maintain. However, it is difficult for a teacher to teach all students to write code in accordance with a certain coding style because each of them naturally has his/her own different coding styles, and the teacher needs to advise them considering their original coding styles. To deal with this issue, the CM algorithm is introduced, which was originally developed to detect source code plagiarism in Java programming classes. It quantifies a student's coding style feature by using a set of hidden Markov models called coding models. Coding models quantify a person's code writing style as that person's coding style feature. In this paper, an attempt to apply the CM algorithm for facilitating coding style instruction is reported. Experimental results showed that the coding models provided information that was useful for teaching coding styles.

Session S4G: Distance Education II
Chair: Mats Daniels (Uppsala University)
3:00 - 4:30 pm
Room: 20

TEACHING AN INTRODUCTORY PROGRAMMING COURSE USING HYBRID E-LEARNING APPROACH
Asad Azemi (Pennsylvania State University, USA)
Mathew Bodek (Pennsylvania State University, USA)
Gary Chinn (Pennsylvania State University, USA)

The usefulness of hybrid delivery in education has long been realized, and with the advancement of computer and communication technologies and the introduction of Web-based authoring tools, its effectiveness has been further extended. In this regard, it has affected traditional distance learning by transforming the learning experience from a static videotape delivery to a more dynamic format by adding/substituting the web as the delivery media. In this paper, we report our initial results based on offering an introductory computer programming course for engineers using Matlab via hybrid e-learning including virtual face-to-face, for distance course delivery. We present the challenges that teaching a programming course brings about using a hybrid methodology with synchronous online delivery component. Details of this work, including design and delivery issues, student and course assessment, and required technology, as applied to a computer programming course, are included in the paper.

AN ONLINE E-LEARNING AUTHORING TOOL TO CREATE INTERACTIVE MULTI-DEVICE LEARNING OBJECTS USING E-INFRASTRUCTURE RESOURCES
Aldo Gordillo (Universidad Politécnica de Madrid, Spain)
Enrique Barra (Universidad Politécnica de Madrid, Spain)
Daniel Gallego (Universidad Politécnica de Madrid, Spain)
Juan Quemada Vives (Universidad Politécnica de Madrid, Spain)

Education can take advantage of e-Infrastructures to provide teachers with new opportunities to increase students' motivation and engagement while they learn. Nevertheless, teachers need to find, integrate and customize the resources provided by e-Infrastructures in an easy way. This paper presents ViSH Editor, an innovative web-based e-Learning authoring tool that aims to allow teachers to create new learning objects using e-Infrastructure resources. These new learning objects are called Virtual Excursions and are created as reusable, granular and interoperable learning objects. This way they can be reused to build new ones and they can be integrated in websites or Learning Management Systems. Details about the design, development and the tool itself are explained in this paper as well as the concept, structure and metadata of the new learning objects. Lastly, some real examples of how to enrich learning using Virtual Excursions are exposed.
SCAFFOLDING ONLINE LABORATORY EXPERIENCES AS INCLUSIVE AND MOTIVATIONAL TOOLS FOR STUDENTS AND TEACHERS

German Carro Fernandez (Spanish University for Distance Education - UNED, Spain)
Manuel Castro (Spanish University for Distance Education - UNED, Spain)
Elio Sancristobal (Spanish University for Distance Education - UNED, Spain)
Miguel Latorre (Spanish University for Distance Education - UNED, Spain)
Gabriel Diaz (Spanish University for Distance Education - UNED, Spain)
Sergio Martin (Spanish University for Distance Education - UNED, Spain)
Pablo Losada (Spanish University for Distance Education - UNED, Spain)

The ability for accessing learning tools at any time and from anywhere is highly increasing. Technologies such as Internet and mobile devices provide universal integration of teaching and learning. For scientific or engineering subjects, the use of real resources through online laboratories is another step towards bringing the students to the practical laboratory sessions. These platforms show how teacher and student share a common work space in which they work together to solve problems. UNED (Spanish University for Distance Education) is working on the development of techniques that facilitate the building of remote laboratories and their access, both for students and for teachers. Current experience shows that the interaction of the students with these tools makes them more receptive to learning, regardless of their age. It also helps them to understand more easily abstract concepts in engineering and science subjects, associating these abstract concepts with daily life. It is also relevant that students can commit mistakes without any real risk. Moreover as the system will facilitate the building of customized reusable laboratory practices for teachers, these will be motivated to use them in their classrooms whenever possible. Both effects reinforce learning and reaffirm the position of teacher-student couple.

ONLINE ENGINEERING COURSE DESIGN, PART I: TOWARD ASYNCHRONOUS, WEB-BASED DELIVERY OF A FIRST COURSE IN THERMODYNAMICS

Angela Minichiello (Utah State University, USA)
Christine Hailey (Utah State University, USA)
Neal Legler (Utah State University, USA)
V. Dean Adams (Utah State University, USA)

As part one in a series of two, this paper describes the development of a web-based [1] first course in thermodynamics. The course is conceptualized, designed and course materials are introduced to engineering students by a team of practitioner - researchers. The course builds from previous work concerning the development of web-based thermodynamic cycle teaching modules for undergraduate mechanical engineering students [2] and relevant educational literature. The design goals for the online course are that it a) be delivered primarily through asynchronous means and b) fulfill requirements of ABET accredited degree programs in civil, electrical and mechanical engineering as is accomplished by the face-to-face course. The course design team, consisting of engineering faculty, administrators, and instructional design professionals, used a collaborative approach to move the online course through concept, development to initial introduction. As constructed, example segments ("exemplar modules") were introduced within the current face-to-face Thermodynamics I course to witness student reactions and solicit feedback. Once this feedback is filtered back and addressed in the design, the course will be implemented and evaluated in whole within the civil, electrical and mechanical undergraduate engineering programs. The full implementation, evaluation and results will be the focus of a part two paper.

AN AUTONOMOUS ARTICULATING DESKTOP ROBOT FOR PROCTORING REMOTE ONLINE EXAMINATIONS

Warren A Rosen (Drexel University, USA)
Eric Carr (Drexel University, USA)

In this paper we describe a new low-cost, autonomous desktop robot for proctoring examinations in online/distance learning courses. The robot is attached to the student's computer via a USB port and monitors the examination environment using a webcam that articulates in both altitude and azimuth together with an array of acoustic sensors that provides audio directionality. The examination may be monitored in real time by a live proctor via the Internet or the data may be recorded for future review. Authentication of the identity of the test taker is accomplished using the webcam and simple, reliable ear recognition techniques. This eliminates the need for expensive digital fingerprint hardware.
CHANGING PERCEPTIONS: DO ENGINEERING ACTIVITIES MAKE A DIFFERENCE IN K-12 ENVIRONMENTS?
David Reeping (Ohio Northern University, USA)
Kenneth Reid (Ohio Northern University, USA)

K-12 educators often incorporate projects into the science curriculum. Students conduct the activity, fill out answers on a corresponding lab sheet, strive toward results, and then move on to a new topic. With such an abrupt change in pace and lack of assessment, a question emerges: do these activities have a lasting impact on student learning or are these labs extraneous additions to the general curriculum? In an effort to integrate engineering concepts into a middle school environment, sixth graders were tasked with a design lab popularly known as “the marshmallow challenge,” which requires student teams to construct a tower from uncooked spaghetti, tape, and a single marshmallow. Approximately two months after the activity, the students who participated were asked to take a survey with four components: identification, opinion, objective, and open ended. The fifteen question survey was designed to determine if students enjoyed the activity and if students retained information from the short lecture before the activity. The results for the objective portion were averaged between classes and compared; this paper presents an analysis of those scores. Also, commonalities between written student responses are examined and discussed. These results are applicable to schools wishing to evaluate the effectiveness of brief activities similar to “the marshmallow challenge.”

MIDDLE SCHOOL STUDENTS’ CONCEPTIONS OF ENGINEERING
Michelle Jordan (Arizona State University, USA)
Jan Snyder (Arizona State University, USA)

This study investigated middle school students’ conceptions of engineering. Participants were sixth through eighth grade members of afterschool engineering clubs. Thus, the study contributes to understanding middle school students’ knowledge of engineering, and also to how afterschool activities shape students’ conceptions of engineering. Researchers have increasingly attended to students’ perceptions of themselves as engineers, and their attitudes towards engineering majors and careers. However, little research has investigated middle school students’ conceptions of engineering- what engineering is and what engineers do. The purpose of this study was to understand how middle school students who join afterschool engineering clubs conceptualize engineering and how engineering afterschool club experiences influence students' conceptions of engineering. The results of our study indicate that many participants had limited conceptions of engineering and suggest a need to connect design activities with knowledge of engineering.

LEARNING TO MANAGE UNCERTAINTY IN COLLABORATIVE ENGINEERING DESIGN PROJECTS: LESSONS FROM A FIFTH GRADE CLASS
Michelle Jordan (Arizona State University, USA)
Diane Schallert (University of Texas at Austin, USA)

Collaborative engineering design projects are fraught with subjective uncertainty associated with task issues ranging from understanding math and science concepts, to manipulating technological and digital tools and evaluating design ideas. Also, engineering design projects are contexts in which uncertainty is likely to stem from social issues as students encounter unfamiliar sociocultural practices and as individuals with diverse histories, beliefs, motivations, expectations, and values attempt to share the small space of a classroom. This qualitative discourse analytic study relies on observations and interviews to examine how social and task uncertainty management varied across three groups of students engaged in a collaborative design project. Specifically we asked, (1) how do groups vary in their management of uncertainty during engineering design projects; and (2) how does variation in uncertainty management influence groups' design practices and products? Data were drawn from a larger project that took place over one-school year in an ethnically and academically diverse public fifth grade class in the U.S.
PEDAGOGICAL APPLICATION OF RFID TECHNOLOGY FOR HARD OF HEARING CHILDREN DURING MATHEMATICS AND SCIENCE LEARNING ACTIVITIES
Min-Chi Kao (National Taichung University of Education, Taiwan)

The purposes of this work-in-progress paper are to explore the effect of using RFID technology to assist hard of hearing children learning mathematics and science and the pedagogical implications of using RFID technology to maximize conceptual understanding of mathematics and science for hard of hearing children. Taking into consideration the children's visual learning characteristics, we present a system that uses RFID-tagged lab objects to help young hard of hearing children do operation task during exploration. The preliminary experimental results and the questionnaire results to evaluate the effectiveness of using this system are discussed. Perceived benefits to hard of hearing children up to ten years of age are presented. The use of RFID technology can enhance instructional opportunities for educators in teaching primary STEM and extend learning opportunities for deaf and hard of hearing students.

Session S4I: Interdisciplinary Programs II
Chair: Mahesh Banavar (Arizona State University)
3:00 - 4:30 pm
Room: 4

GENERAL ENGINEERING: AN INNOVATIVE PROGRAM FOR THE REGION
Jean-Claude Thomassian (American University, USA)

This paper describes the efforts of designing an innovative interdisciplinary general engineering program which was recently introduced as part of the newly shaped engineering department at the American University of Iraq in Sulaimani (AUIS). Current progress includes building a state- of-the-art science building that will accommodate the physics and chemistry laboratory, completing the construction of the engineering basement that will accommodate state-of-the-art laboratories to complement engineering fundamentals and capstone courses, and meeting staffing needs. The objective of the program is to create an ABET-accredited program that is unique to the region and serves the development of the region’s economy and people. The paper describes the details of the general engineering program, curriculum development, laboratory facilities, experiences, faculty and staff needs. It also touches upon the theme of global engineer. A concluding section is offered that presents the development and implementation of such a program in a rapidly developing post-conflict society in the Kurdistan region of Iraq.

CELL2ECG: A VIRTUAL LABORATORY TO SIMULATE CARDIAC ELECTROGRAMS
Dietrich Romberg (Anhalt University of Applied Sciences, Germany)
John Dyer (University of Oklahoma & MARIP, LLC, USA)
Edward Berbari (Indiana University Purdue University, USA)

The paper describes a virtual laboratory designed for the study of the generation of the electrocardiogram (ECG) based on cellular electrophysiology. In detail, the virtual lab includes (1) the introduction to biophysical models characterizing the generation and propagation of electrical excitation at the cellular level, (2) the formulation of the mathematical relationship between the biophysical parameters, (3) the determination of resulting extracellular potentials, and (4) the calculation of the ECG by a vectorial summation of extracellular potentials. Since (3) and (4) require specific presumption and knowledge concerning cardiac geometry, a model was constructed using anatomical stylized cross-sectional segments of the left ventricle. In order to verify the model and algorithms simulation results were compared against experimentally obtained action potentials, extracellular potentials and ECGs under various physiological conditions. Although there is considerable scatter in the measurements, the comparison indicates that a definite relationship exists between measured and computed waveforms. Simulations interactively show physiological and pathophysiological changes in ECGs for various user setting of the cell function. In conclusion, the interactive laboratory enables the user to study the relationship between the electric activity of cardiac cells and the resulting extracellular potentials as well as ECGs on the body surface.
INTERACTIVE TOOLS FOR GLOBAL SUSTAINABILITY AND EARTH SYSTEMS: SEA LEVEL CHANGE AND TEMPERATURE
Linda Hinnov (Johns Hopkins University, USA)
Karthikeyan Natesan Ramamurthy (Arizona State University, USA)
Huan Song (Arizona State University, USA)
Mahesh Banavar (Arizona State University, USA)
Louis Spanias (University of California at Berkeley, USA)

Understanding global change is important for creating a sustainable environment, and is a key interest of the Earth systems science community. Here we present an educational tutorial that explores the relationship between sea level and global temperature using modern-day records and time-series analysis and the Java-DSP Earth Systems Edition (J-DSP/ESE) application. The objectives of the tutorial are to apply pre-processing steps based on signal type, perform spectral analysis and identify significant frequencies, perform coherency and cross-phase analysis between two records, and arrive at an informed understanding about the relationship between sea level and global temperature change. Preliminary student assessment indicates that students were comfortable using J-DSP/ESE, and quickly understood the signal processing concepts. The analysis reveals correlation between sea level variations and global temperature at inter-annual timescales related to the El Niño climatological phenomenon. In sum, the tutorial improved students' understanding of basic factors that influence global sustainability and habitability.

A COMPUTER SCIENCE COURSE IN CYBER SECURITY AND FORENSICS FOR A MULTIDISCIPLINARY AUDIENCE
Wendy A LawrenceFowler (The University of Texas-Pan American, USA)

The preparation of a graduate level cyber security and forensics course in a computer science department that addresses theory, policy, and application for an multidisciplinary student audience can be daunting when the majority of students in the class do not have a computer science background. The course takes a holistic approach to broaden knowledge and deepen understanding of the domain of cyber security using cross disciplinary teams to gain understanding and experience taking theory to practice and practice to theory. A framework of understanding is built through the examination of the body of scholarly conceptual and technical works and hands on experience with hardware and software platforms and networks. Computer Science provides the theoretical underpinnings and technical details, methods, and tools to examine security concepts; Forensic Science provides the approach to critical analysis of digital evidence; and Behavioral Analysis provided a way to synthesize knowledge and scientific method to gain some understanding of criminal behavior as well as the breadth and economic impact of cybercrime. This approach resulted in students who gained technical proficiency and perspective and experience working with people with divergent backgrounds, abilities and knowledge sets.
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