ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

2017 Zone II Conference

March 2 – 5, 2017

Caribe Hilton,
San Juan, Puerto Rico

Engineering
Everywhere
for Everyone

Conference Welcome

Gary Steffen, ASEE Zone II Council of Sections, Chair

Welcome to the 2017 ASEE Zone II Spring Conference, “Engineering Everywhere for Everyone.” As our conference title suggests, engineering happens everywhere, including here in this tropical jewel that is San Juan, Puerto Rico. It has been quite some time since the three great ASEE Sections that comprise Zone II have convened. Zone II is made up of the Illinois-Indiana Section, North Central Section, and Southeastern section which include 15 states and the Commonwealth of Puerto Rico.

While we take in the beauty surrounding our conference site and enjoy the gracious hospitality shown by our hosts, I hope you also discover the depth of topics that can be found at the National Conference and rekindle personal connections of your local Section Conference.

I anticipate an amazing conference for everyone, and again, welcome to Puerto Rico, on behalf of Zone II.

Gary Steffen
ASEE Zone II Council of Sections, Chair
Associate Professor and Department Chair
Indiana University - Purdue University Fort Wayne

Dan Budny, ASEE Zone II Program Chair & North Central Section Chair

In the spirit of engineering collaboration and innovation, ASEE's Zone II will be held at the Caribe Hilton in San Juan, Puerto Rico on March 2-5, 2017. The Zone II 2017 Conference is the joint conference for the three ASEE Zone II sections: North Central, Southeastern and Illinois/Indiana. ASEE members from the other zones and interested engineers are welcome to participate in this spring conference. The three sections usually have annual spring conferences. During this spring 2017, the Zone II conference will serve as the sections' annual conference.

Welcome to San Juan, Puerto Rico. Please find time to enjoy the broad range of experiences that have been planned. This multi-sectional collaboration will allow you to select from multiple sessions and workshops. The conference will incorporate optional excursions to Castillo San Felipe del Morro (below, left) and the Arecibo Radio Telescope (below, right). The El Morro fortress is located in Old San Juan which is about 15 minutes from the conference venue. This excursion is planned for Sunday, March 5 after noon. The Arecibo telescope is the largest dish antenna in the world. The dish, built into a bowl in the landscape, focusses radio waves from the sky on the feed antenna suspended above it on cables. This half-day trip will be offered on Saturday, March 4 after noon. There are opportunities for faculty, graduate students, and undergraduates to present their work at the conference. Abstracts for papers and posters may be submitted on this web site by Friday, September 9, 2016. The Zone II Conference is a unique opportunity that allows attendees and presenters to discuss ideas, reflect on the topics and issues from the sessions, and chart new directions and collaborations. Invited facilitators from around the country will hold short workshops and discussion groups on important topics. Conference attendees are encouraged to share best practices through technical sessions.

The Zone II conference begins on Thursday morning with several invited workshops continues with afternoon's individual section's executive board meetings and concludes with the welcome reception at the Las Olas Terrace. Friday morning begins with a breakfast buffet for all the ASEE engineering divisions meetings. All

attendees are invited to come to breakfast sitting with your fellow engineering discipline. This breakfast serves as a unique opportunity to get involve with ASEE. We will have a keynote presentation followed by four concurrent lively paper presentation sessions and networking. Friday concludes with a dinner evening reception and awards banquet. Saturday morning will have concurrent paper presentation sessions and a recruitment fair in the afternoon. Sunday morning has the last concurrent paper presentation sessions with the concluding lunch with an invited guest presentation.

Thomas Trusty, ASEE IL-IN Section Chair

Welcome to our combined 2017 ASEE Zone II and IL-IN Section Annual Conference in beautiful San Juan, Puerto Rico. I am always excited to arrive at our conference each year, and with a location like this, this year is great one! The overall experience of the event, learning from those who are sharing their education research, meeting new friends, catching up with those who I may only see here once each year is excellent. This always allows me to return refreshed and renewed, ready to finish the semester with ideas for the future. Thank you to all of the authors who have come to share their research. Learning from your efforts and your presentations are the heart of why we come together each year and your support this year is much appreciated. The combined conference this year will allow opportunities to participate in an even more diverse group of paper, posters, and presentations than our typical annual conference, and I know this will greatly enhance our combined experience.

Be sure to say hello and thank our General Conference Chair, Barbara Bernal, for heading up this special event for Zone II when you see her. It has been her vision for some time to bring together the sections and open up the opportunity in San Juan for this event, and this year that vision has been realized. I believe that without her efforts, vision, and intimate knowledge of this beautiful local area, this conference would not have been possible and I am thankful for her leadership.

I do look forward to our next annual conference back in our section and am excited to be currently working out the details with Purdue University in West Lafayette in preparation for them to be our host site in 2018. The date will be March 24th, 2018 and the theme is, "Reflecting on the Path of Engineering Education: Transforming the Field". It will be great to see the growth and advancement that has taken place at the Purdue campus since our last conference visit.

Enjoy your time learning, laughing, and exploring the local area. I look forward to discussions with you all as we take in the event together.

Thank you for coming!

Best Regards,

Thomas Trusty

John Brocato, ASEE SE Section President

Welcome to the 2017 ASEE Zone II Conference! We in the Southeastern Section are tremendously excited to have worked with the North-Central and Illinois-Indiana sections in putting together the first Zone II conference in many years. I always look forward to our own section conference for the same reasons I've looked forward to this conference: an opportunity to catch up with old acquaintances and make new friends, all of whose professional endeavors share the goal of this conference's theme, ***Engineering Everywhere for Everyone***.

I must begin by thanking each of the conference authors for helping make this conference possible. Whether presenting a poster for the first time or faithfully sharing a presentation year after year, your work helps motivate and enrich us, your peers. Please continue supporting our section and zone conferences in the future by continuing to share your work.

I must next thank Southeastern Section stalwart Barbara Bernal for her vision and boundless enthusiasm in making a Zone II conference in Puerto Rico a reality. Next I must recognize Zone II Chair Gary Steffen along with the conference's technical program chairs: Dan Budny (North-Central Section), Thomas Trusty (Illinois-Indiana Section), and Sally Pardue (Southeastern Section). These folks have truly performed the lion's share of the work necessary to hold this year's conference. Lastly, no conference could take place without the hard work of all the other section, unit, and division officers who play vital roles and make Zone II the best in the ASEE. Thank you all!

What makes our section and zone strong, of course, is our volunteer workforce. We encourage everyone attending the conference to become further involved with your ASEE section by considering officer positions. If you have never been an officer before, you can start by volunteering as the secretary for one of the divisions. If you have worked your way through a division chair and are interested in the Programs, Awards and Recognition, or Publications and Promotions Units, then seek out one of the current Unit officers and let them know you are interested. The division and unit officers will be selected during the conference's business meetings.

For 2018, the Southeastern Section returns to its traditional conference event, this time hosted by Embry-Riddle Aeronautical University in beautiful Daytona Beach, FL. As always, we look forward to connecting with colleagues and sharing our ideas on providing first-class engineering education for all of our students.
We hope you'll join us!

Thanks for coming, and *¡a centro, adentro*!

John Brocato
President, ASEE-SE

A Special Thank You…

Welcome to the Island of Puerto Rico. We hope you enjoy your time at the conference and find the program sessions, workshops, and tours fun and rewarding. This is the perfect time of year to sit back and evaluate your courses for this past semester and attend the conference to get ideas on how to improve your courses. The planning and execution of any conference such as this involved the dedication and hard work of many people. I want to express my sincere thanks to the following:

- The 200 plus registered conference attendees representing over 80 different institutions.
- The 207 students that make up the 61 student teams in the poster competition
- The 369 authors that make up the 154 presenters in the 28 technical sessions
- The 10 exciting workshops
- The staff at the Caribe Hilton, especially Gerardo Bonilla and Diana Vela
- The Arecibo Observatory staff and experience at the facility
- The local universities especially the Polytechnic University of Puerto Rico, University of Puerto Rico at Mayaguez, and the Universidad del Turabo

Enjoy your time learning, laughing, and exploring the local area. I look forward to discussions with you all as we take in the event together.

Thank you for coming!

Barbara V. Bernal, 2017 Zone II Conference General Chair

GENERAL INFORMATION

Dates:
Thursday, March 2 – Sunday, March 5, 2017

Meeting Site:
Caribe Hilton
1 San Geronimo Street
San Juan, PR 00901
P: 787-721-0303

F: 787-725-8849

Registration/Check-in:
Please register/check-in at the Hilton Conference Registration Desk to receive your name badge and conference materials. Below are the registration hours:

Thursday, March 2, 8am-6pm in the Caribe Hilton Second Floor Conference Area - Las Olas Marble Desk
Friday, March 3, 8:30am – 5pm in the Caribe Hilton First Floor San Cristobal Foyer
Saturday, March 4, 8:30am – 10am in the Caribe Hilton First Floor San Cristobal Foyer
Sunday, April 12, 8:00am-10:30am in the Caribe Hilton First Floor San Cristobal Foyer

Transportation and Parking:
From Luis Munoz Marin International Airport (SJU):

From Luis Munoz International Airport take the first exit to the right: Baldorioty Expressway #26 west. Drive straight for approximately 7 miles. The Expressway ends and you continue on Munoz Rivera #25. Over the Dos Hermanos Bridge go through one set of traffic lights, follow the road round the corner and the Caribe Hilton hotel is on the right-hand side.

Student Poster Session:
Student Poster Set Up: Friday, March 3 from 9:30am-9:45am
Student Poster Session: : Friday, March 3 from 11:15am-12:30pm

Poster set-up and tear down:
Posters need to be hung on your assigned poster board prior to the poster judging starting on Friday, March 3 at 9:30am. Please refer to the Poster Session Listing on page 36-66 to find your poster number. Poster boards will be numbered and push pins will be provided to hang up each poster. Please remove your poster by the end of the day on Friday, March 3.

Zone II At a Glance

Thursday, March 2, 2017

<table>
<tr><td>Time</td><td colspan="4">Location: Caribe Hilton</td></tr>
<tr><td>Thursday

8:00 am - 6:00 pm</td><td colspan="4">Registration in the Caribe Hilton Second Floor Conference Area

Las Olas Marble Desk</td></tr>
<tr><td>Time</td><td>Caribe Hilton

2nd Floor

Salon Del Mar</td><td>Caribe Hilton

2nd Floor

Conference 10</td><td>Caribe Hilton

2nd Floor

Tropical</td><td>Caribe Hilton

2nd Floor

Conference 8 + 9</td></tr>
<tr><td>Thursday

8:00 am - 10:00 am</td><td rowspan="2">Invited Workshop 2 - Synthesizing Engineering Ethics and Communication Via Active Learning Exercises</td><td rowspan="2">Invited Workshop 3 - The Freshman Experience: A modular Approach to Experiential Learning</td><td rowspan="2">Invited Workshop 12 - Got an Education Project? How to Write Your Proposal for NSF and Where to Submit It</td><td>Invited Workshop 4 - TED-Ed Ideas Worth Sharing in Your Classroom</td></tr>
<tr><td>Thursday

10:15 am - 12:15 pm</td><td>Invited Workshop 6 - A holistic workshop on flipped classes</td></tr>
<tr><td>12:15 am - 12:45 pm</td><td colspan="4">Lunch Break on your own</td></tr>
<tr><td>Thursday

12:45 pm - 2:45 pm</td><td>Invited Workshop 1 - (New*) Developing ABET Confidence</td><td rowspan="2">Invited Workshop 8 - Leveraging civic engagement opportunities to increase URM engineering students' science identity, belonging, and persistence: a workshop for faculty and advisors</td><td rowspan="2">Invited Workshop 9 - How to improve engineering recruitment and retention</td><td>Invited Workshop 10 - Active Learning for Busy Skeptics</td></tr>
<tr><td>Thursday

3:00 pm - 5:00 pm</td><td>2:45 pm - 5:00 pm Southeastern Executive Board of Director Meeting</td><td>Invited Workshop 5 - Innovative Tools for Assessing Student Sustainability Knowledge</td></tr>
<tr><td>Thursday

6:00 - 8:30 pm</td><td colspan="4">Reception for all full Registrants

Location: Caribe Hilton - 2nd floor Las Olas Room and Las Olas Terrace. Join us for light finger food and refreshments while you meet and greet your fellow conference attendees. Please wear your badge. Student registrants need to purchase a ticket for this event.
There will be a cash Bar available. The goal of the reception is for for everyone to meet every conference attendee. Any registrant can bring a guest to the reception by registering for an extra Thursday reception ticket ($75) - see the Registration Table.</td></tr>
</table>

Friday, March 3, 2017				
Viernes (Friday)	Room: 1 - Auditorium	Room: 2 -San Cristobal B	Room: 3 - San Cristobal C	Room: 4 - San Cristobal D
7:00 am - 8:00 am	Good Morning: Light Breakfast for all Registrants, please wear your badge Location: Caribe Hilton First Floor San Cristobal AEFG			
8:30am 5:00pm	ASEE Zone II Conference Registration Location: Caribe Hilton First Floor San Cristobal Foyer			
Viernes (Friday) 8:00 am - 9:30 am	**V1A** Topics related to K-12 Session 1	**V1B** Engineering Research Topics 1	**V1C** Topics on Improving Instruction 1	**V1D** Education Topics in Civil Engineering 1
9:30 am - 9:45 am	Time to locate a new session Student begin setting up their posters in San Cristobal Foyer			
Viernes (Friday) 9:45 am - 11:15 am	**V2A** Topics in Engineering Technology 1	**V2B** Professional Practice 1	**V2C** Transition to College and First Year Topics 1	**V2D** Education Topics in Mechanical Engineering 1
Viernes (Friday) 11:15am - 12:30 pm	Student Poster Session Come Meet the Students in the San Cristobal Foyer. Poster presentations by both local and state side undergraduate students Talk to the local Puerto Rican students about graduate school at your university			
Viernes (Friday) 12:30 pm - 2:00 pm	Welcome and Keynote Lunch - San Cristobal AEFG The lunch will include a welcome presentation, and the Keynote speaker, the Evans Award recipient. This lunch provides a networking opportunity between attendees and students. Use this time to meet the students and discuss graduate school at your university			
Viernes (Friday) 2:00pm - 3:00pm	Special session: "Engineering Everywhere for Everyone" Invited Speakers: Dr. Bevlee Watford, ASEE President Elect Dr. Louis Martin-Vega, ASEE President Dr. Joseph Rencis, ASEE Immediate Past President Dr. J P Mohsen, ASEE Past President Dr. Claudio da Rocha Brito, IEEE Computer Society President A thoughtful conversation about the science & engineering decisions taking place around us.			
3:00 pm - 3:15 pm	Time to locate a new session			
3:15 pm - 5:00 pm	**V3A** Education Topics in Industrial Engineering 1	**V3B** Administrative Topics 1	**V3C** Education Topics in Electrical Engineering	**V3D** Education Topics in Civil Engineering 2
5:00 pm - 6:00 pm	A break before the Awards Dinner			
6:00pm - 9:00pm	Zone 2 (North Central, Southeastern and Illinois-Indiana Section) Awards Dinner. The three sections will present their annual awards. Location: Caribe Hilton San Cristobal AEFG			

Saturday, March 4, 2017

Room	Room: 1 - San Cristobal E	Room: 2 - San Cristobal B	Room: 3 - San Cristobal C	Room: 4- San Cristobal D
8:30 am - 10:00 am	ASEE Zone II Conference Registration Location: Caribe Hilton First Floor San Cristobal Foyer			
7:00 am - 7:45 am	Good Morning: Light Breakfast for all Registrants, please wear your badge Location: Caribe Hilton First Floor San Cristobal A			
7:30 am - 8:15 am	Breakfast Section Business Meetings ASEE Zone II sections: North Central in San Cristobal F, Southeastern in San Cristobal A and Illinois/Indiana in San Cristobal G			
Sabado (Saturday) 8:15 am - 10:00 am	**S1A** Topics related to K-12 Session 2	**S1B** Education Topics in Computer Engineering 1	**S1C** Professional Practice 2	**S1D** Education Topics in Civil Engineering 3
10:00 am - 10:15 am	Time to locate a new session			
Sabado (Saturday) 10:15 am - 12:00 pm	**S2A** Topics in Bio and Chemical Engineering	**S2B** Engineering Research Topics 2	**S2C** Transition to College and First Year Topics 2	**S2D** Education Topics in Mechanical Engineering 2
Sabado (Saturday) 12:00 pm - 9:00 pm	Time to Explore Puerto Rico There are a number of professional and social activities that you can join, or just go on your own and explore the Enchanted Island. **Special Guided Tour of the Arecibo Observatory 12noon - 6pm**			

Sunday, March 5, 2017

Room	Room: 1 - San Cristobal F&G	Room: 2 - San Cristobal B	Room: 3 - San Cristobal C	Room: 4 - San Cristobal D
Domingo (Sunday) 7:00 am - 8:00 am	Good Morning: Light Breakfast - Please wear your badge Location: San Cristobal A			
8:00 am - 10:30 am	ASEE Zone II Conference Registration Location: San Cristobal Foyer			
Domingo (Sunday) 8:00 am - 9:45 am	**D1A** Topics in Engineering Technology 2	**D1B** Topics on Improving Instruction 2	**D1C** Administrative Topics 2	**D1D** Education Topics in Mechanical Engineering 3
9:45 am - 10:00 am	Time to locate a new session			
10:00 am - 11:30 am	**D2A** Transition to College and First Year Topics 3	**D2B** Engineering Research Topics 3	**D2C** Education Topics in Computer Engineering 2	**D2D** Education Topics in Civil Engineering 4

Thursday, 2 March Program

Thursday 8:00am - 12:15pm

Invited Workshop 12 - Got an Education Project? How to Write Your Proposal for NSF and Where to Submit It (Room: Caribe Hilton 2nd Floor Tropical)

Session Chair: Elliot P. Douglas, National Science Foundation

Got an Education Project? How to Write Your Proposal for NSF and Where to Submit It

Elliot P. Douglas, National Science Foundation

Many faculty have ideas for new education projects but may not be sure of how to turn that idea into a fundable proposal. This interactive workshop will help engineering faculty understand the elements of a competitive proposal and get them started on preparing a proposal for submission. It will cover key elements of proposals, helpful hints and fatal flaws, and how the submission and review process works. This workshop will also describe current opportunities for funding of engineering education projects available through the National Science Foundation. NSF education programs span the range from foundational to scale-up research, and include opportunities for investigators new to educational research. There are also programs intended to support institutional change efforts.

Invited Workshop 2 - Synthesizing Engineering Ethics and Communication Via Active Learning Exercises (Room: Caribe Hilton 2nd Floor Salon Del Mar)

Session Chair: John Brocato, Mississippi State University

Synthesizing Engineering Ethics and Communication Via Active Learning Exercises

John Brocato, Mississippi State University

Enriching engineering courses and curricula with ethics- and communication-related content can be a challenge for even the most accomplished educators. While some institutions devote standalone courses to one or both of these subjects, others choose to infuse these subjects into existing technical courses, meaning the vehicles for such infusion must be portable and relatively simple. This workshop will discuss several best practices for engaging students in rich discussions of professional ethics and communication and will lead workshop participants through three brief, low-stakes, active-learning exercises: “The Propeller Car Letter: Writing to a Misguided Reader,” “The Pendergrass Email: Choose Your Own Adventure!,” and “Space Shuttle Challenger Document Analysis and Discussion.” Although the workshop facilitator has devised and uses these exercises in a technical-communication course housed within a college of engineering, the exercises’ portability and simplicity mean they can be easily imported into technical courses. Workshop participants will receive copies of all workshop materials, including the active-learning exercises, along with guidance on how to incorporate the materials into their own courses and curricula.

Invited Workshop 3 - The Freshman Experience: A modular Approach to Experiential Learning (Room: Caribe Hilton 2nd Floor Conference 10)

Session Chair: Afroditi Filippas, Virginia Commonwealth University

The Freshman Experience: A modular Approach to Experiential Learning

Afroditi Filippas, Virginia Commonwealth University
Umar Hasni, Virginia Commonwealth University
Alen Docef, Virginia Commonwealth University
Georgios Bakirtzis, Virginia Commonwealth University
Angelica Sunga, Virginia Commonwealth University
Hiba Nabi, Virginia Commonwealth University
Arthur French, Virginia Commonwealth University

We will train interested faculty in using our modular approach to the Introduction to Engineering course and demonstrate how it provides rigor and specific learning outcomes, while being appropriate not only for engineering freshmen but also for students from other disciplines who are interested in engineering or considering a change of major. The course provides rigorous and in-depth learning of important engineering fundamentals while clearly demonstrating the areas of interaction between all the engineering disciplines as well as the sciences and math. This is achieved through the implementation of simple but fun lab projects where students design and build working prototypes of simple machines. Participants will be introduced to the challenges and benefits of putting engineering courses online (rampages.us/vcuengineering) and how MATLAB™, LON_CAPA (a learning on-line network – loncapa.org) and an open-source electronics platform (Arduino) are used to supplement students' learning and mastery of fundamental concepts and engineering tools. Examples and training in the use of LON-CAPA to generate dynamic problem sets will be provided. One or two specific lab exercises with associated homework, lab work and innovative reporting modalities will be presented in detail. Participants will be able to experience the modal nature of these exercises, and see how they can use the specific resource or expand it by creating their own learning modules. We will also go through "Two weeks in the life of a 101 student", to present how the students are trained to stay in constant contact with the course through judiciously spaced homework and reporting exercises. The purpose is to create a network of first-year instructors who prepare and share their learning modules, thus strengthening the first year experience for all as well as improving the pipeline into STEM through outreach to community colleges and high schools.

Thursday 8:00am - 10:00am

Invited Workshop 4 - TED-Ed Ideas Worth Sharing in Your Classroom (Room: Caribe Hilton 2nd Floor Conference 8+9)

Session Chair: Alicia Lane, District of Columbia Public Schools

TED-Ed Ideas Worth Sharing in Your Classroom

Alicia Lane, District of Columbia Public Schools

In this workshop, Alicia Lane, TED-Ed Innovative Educator and Project Lead the Way State Leader for D.C., will expose participants to the vast and incredibly engaging TED-Ed community. This award-winning education platform serves millions of teachers and students around the world every week. Participants will learn how to curate, create and share TED-Ed's growing library of free original animated videos and interactive lessons. Alicia will also share how she has used TED

videos and the TED-Ed platform to enhance her high school engineering lessons and camps. Participants are encouraged to bring laptops or tablets. A more detailed proposal can be viewed here: goo.gl/MrzEI1

Thursday 10:15am - 12:15pm

Invited Workshop 6 - A holistic workshop on flipped classes (Room: Caribe Hilton 2nd Floor Conference 8+9)

Session Chair: Autar Kaw, University of South Florida

A holistic workshop on flipped classes

Autar Kaw, University of South Florida

When you complete this workshop, you will: 1) be prepared to teach an engineering course in flipped manner using evidence-based best practices 2) know simple but effective technological tools to flip the classroom 3) be aware of the lessons learned by others in teaching a flipped classroom. With computers being affordable, smart phones becoming ubiquitous, and internet available at low cost, flipped classrooms are becoming more popular as a pedagogy in STEM classes. Flipped classrooms take the transmission of content from the classroom to home, and the assimilation of the content at home to the classroom. In this interactive workshop, we will discuss the differences between traditional, blended and flipped classrooms, the tools and techniques used to teach a flipped classroom, the challenges and opportunities of teaching a flipped classroom, and the evidence or lack thereof of the effectiveness of flipped classrooms in higher education. The presenter has extensively taught blended, partially- and fully-flipped classes, and will also present the personal lessons learned in the process. Throughout the workshop, the audience will be engaged in developing an outline of how they would flip a classroom including student activities.

Thursday 12:45pm - 5:00pm

Invited Workshop 8 - Leveraging civic engagement opportunities to increase URM engineering students' science identity, belonging, and persistence: a workshop for faculty and advisors (Room: Caribe Hilton 2nd Floor Conference 10)

Session Chair: Pamela Leggett-Robinson, Georgia State University - Georgia Perimeter

Leveraging civic engagement opportunities to increase URM engineering students' science identity, belonging, and persistence: a workshop for faculty and advisors

Pamela Leggett-Robinson, Georgia State University - Georgia Perimeter

Brandi Villa, Belay Consulting LLC

Naranja Davis, Georgia State University - Georgia Perimeter

In this workshop, we propose to address the benefits and mechanisms of incorporating civic engagement opportunities into student support programs. We will present a literature-based overview and justification for inclusion of service opportunities in engineering programs. In particular, we will examine the effects of participating in volunteer opportunities that encourage students to draw upon their math and science expertise in ways that allow students to contribute to their communities. Furthermore, workshop participants will be exposed to the evidence for improved engagement and engineering identity as a result of these opportunities. Additionally, we will use case studies of student support programs that have integrated civic engagement to demonstrate the benefits to students and discuss challenges and successes of incorporating both compulsory and non-compulsory volunteer hours. Through active, facilitated discussion, we will explore the actual and potential civic engagement opportunities available to students of programs

represented by workshop participants. Finally, as small groups, we will use the design thinking process to address the problem of incorporating and increasing service learning in these programs; faculty and advisors will exchange ideas about their programs and provide feedback to each other in this facilitated activity. Participants will leave the workshop with a valuable list of resources, an enhanced network, and a basic plan for integrating or improving civic engagement opportunities as part of the student experience at their institutions.

Invited Workshop 9 - How to improve engineering recruitment and retention (Room: Caribe Hilton 2nd Floor Tropical)

Session Chair: Paul Lin, Cleveland State University

How to improve engineering recruitment and retention

Paul Lin, Cleveland State University

The United States accounts for less than 8% of new engineers globally each year. As of 2000, approximately 9% of high school students considering engineering as their future major in college. More specifically, only 4.5% of college students major in engineering, as compared to 12% in Europe and 40% in Asia. Furthermore, 50% of current engineers in US will retire by 2017. Clearly, shortage of engineers in US has become an emergent issue, which leads to a challenge in how to effectively recruit and retain engineering students. Recruitment and retention should not be treated as two separate issues. Without a sound strategy for improving retention rate, the effort of recruitment may be in vain. In comparison, improving retention is, indeed a more complex task, which has to do with student advising, student success, tutoring and first-year engineering programs.

The author ‘s job responsibility is academic affairs at undergraduate and graduate levels, and would like to share some success in undergraduate recruitment, student advising and retention. Nevertheless, there are still challenges in many aspects of engineering recruitment and retention. This proposed workshop intends to discuss the following issues:

1. how to engage regional high school students earlier to let them know what engineering is all about; in other words, how to make engineering a more viable option as a field of study and career opportunity 2. how to effectively recruit regional high school students to engineering 3. how to effectively retain engineering students 4. how to effectively use scholarships as a means to attract better students from high schools 5. how much co-op and internship programs help recruit and retain students 6. how to effectively recruit domestic and international graduate students

Thursday 12:45pm - 2:45pm

Invited Workshop 1 - Developing ABET Confidence Workshop (Room: Caribe Hilton 2nd Floor Salon Del Mar)

Session Chair: James Warnock, ABET

Developing ABET Confidence - James Warnock, ABET

Dianna Vass, ABET

Nike tells you to “Just Do It”, BMW drivers have “The Ultimate Driving Machine” and ABET accredited programs can “Be Confident”. For prospective students and their parents, they can be confident that an ABET accredited program has sufficient faculty, and the necessary facilities and resources to provide a quality educational experience. For employers of graduates from ABET accredited programs, they are confident that their new hires will have the knowledge, skills and behaviors they desire for entry level employees. For ABET accredited program faculty, staff and

administrators, they are confident that an efficient and effective process is in place to assess student education and continuously improve the program. This workshop is specifically designed to provide a brief outline for those new to program assessment of how to be confident that their processes and procedures are efficient and effective. Participants will learn how to define their student outcomes so they can clearly articulate the skills and knowledge they expect students to attain as part of the program. Participants will also learn how and when to strategically collect data to optimize the assessment process. Finally, participants will learn different ways to "close the loop".

Invited Workshop 10 - Active Learning for Busy Skeptics (Room: Caribe Hilton 2nd Floor Conference 8+9)

Session Chair: Michael Prince, Bucknell University

Active Learning for Busy Skeptics

Michael Prince, Bucknell University

Active learning has consistently been shown to be more effective than traditional instruction for promoting learning, motivation and student retention in STEM programs. Despite this overwhelming research support, instructors have a number of significant concerns about adopting active learning techniques in their own classes. Common concerns include worries about preparation time, content coverage and student resistance to new teaching methods. This hands-on session is designed to introduce quick and simple active learning techniques that are effective, require little preparation or class time, and which generate little or no student resistance.

The workshop is relevant for all instructors, but especially those concerned with engaging and retaining students in STEM programs. The teaching practices discussed in the workshop have extensive research support and this research will be shared with participants as appropriate. But the focus of the workshop will be to provide several practical examples for how to translate the research on active learning to the engineering classroom. Instructors at all levels will be given time and coaching to develop active learning techniques that they can use in their own courses.

This workshop is part of ASEE's National Effective Teaching Institute, which has been offered to engineering audiences for over 20 years, with consistently positive reviews.

Thursday 3:00pm - 5:00pm

Invited Workshop 5 - Innovative Tools for Assessing Student Sustainability Knowledge (Room: Caribe Hilton 2nd Floor Conference 8+9)

Session Chair: Mary Katherine Watson, The Citadel

Innovative Tools for Assessing Student Sustainability Knowledge

Mary Katherine Watson, The Citadel

Elise Barrella, James Madison University

A workshop will be conducted to introduce tools for assessing students' conceptual and applied sustainability knowledge. First, concept maps will be presented as direct measures of students' conceptual understanding of sustainability. Participants will construct their own sustainability concept maps, as well as practice applying scoring methods. Given that scoring is the major barrier to application of concept maps, an automated scoring program will be provided to participants. Finally, methods for assessing students' abilities to engage in sustainable design will be presented. Focus will be on a newly-revised, cross-disciplinary sustainable design rubric. Participants will have an opportunity to provide feedback on the validity of the rubric, and they will be provided with

documentation on how to apply the rubric in their own classes. Overall, participants will be provided with a framework for classifying different types of sustainability assessments and practical methods for assessing students' conceptual and applied understanding of sustainability in engineering contexts.

Southeastern Executive Board of Director Meeting (Room: Caribe Hilton 2nd Floor Salon Del Mar)

Session Chair: John Brocato, Mississippi State University

Thursday 6:00pm - 8:30pm

Reception (Room: 2nd floor Las Olas Room and Las Olas Terrace)

Session Chair: Barbara Bernal, Kennesaw State University - Marietta Campus

Friday 7:00am - 8:00am

Good Morning: Light Breakfast (Room: San Cristobal A)

Session Chair: Barbara Bernal, Kennesaw State University - Marietta Campus

Friday 8:00am - 9:30am

V1A Topics related to K-12 Session 1 (Room: Auditorium)

Session Chair: Joni Lakin, Auburn University

Paper V1A1 - Thiel College Electronic Invention Camp: An Outreach Initiative for Pre-College Inventors

Ronald Anderson, Thiel College
Eugene Torigoe, Thiel College
Dylan Squires, Thiel College

Recent developments in microcontroller hardware and programming tools have empowered hobbyists of all ages in realizing innovative projects. The relative low cost and user-friendly aspects of the Arduino microcontroller make it an ideal choice for introducing K-12 students to the often-challenging concepts of programming and electronics. This paper presents the inaugural Electronics Invention Camp at Thiel College as an outreach program and recruitment tool. The camp took place for five days during summer 2016, with students meeting two hours each day for sessions covering a wide range of topics common to microcontroller projects. The syllabus included many important hardware and software topics, such as breadboarding; 8X8 displays; sensors; variables, conditional branching, and loops. The camp sought to foster attendee interest in both the art and engineering of electronics projects.

Paper V1A2 - Developing Engineering and Computer Science Skills for Middle School Minority Male Student

Otsebele Nare, Hampton University
Chutima Boonthum-Denecke, Hampton University
Jean Muhammad, Hampton University
Marci Turner, Hampton University
Elaine Dietz, Hampton University
Arthur Affleck, Hampton University.

A year round program to help cultivate engineering and computer science skills in middle school minority males' was initiated to address some of the disparities observed among African American and Latinos. Electrical Engineering, Computer Science, and Architecture faculty instructed the

students along with the support of undergraduate students in respective fields. This report discusses the approach used in the initial summer program launch, which focused on 6 local schools from 2 districts resulting in 49 student participants. Preliminary results indicate that 51% of the student participants have increased interest in STEM subjects and 45% have increased STEM proficiency based on a pre- and post-survey and assessment outcome. In addition, 41% of the participants increased their programming and coding skills whilst 36% increased their knowledge of digital manufacturing and 3D printing after a 2-week summer program. The program is continuing through the academic year.

Paper V1A3 - Increasing College Opportunity in STEM Education through High School Visitation Day at the Two- Year College

Pamela Leggett-Robinson, Georgia State University - Perimeter College
Cynthia Lester, Georgia State University - Perimeter College
Brandi Villa, Belay Consutling, LLC
Naranja Davis, Georgia State University - Perimeter College

The benefits of a post-secondary STEM education are well documented in the literature. However, for many underrepresented students and especially those who are low-income and first generation, the culture of obtaining a STEM degree presents barriers. These students often lack guidance, encouragement, and support to attend college. They are less likely to attend schools with a strong "college-going" culture or engage in exposure experiences. Georgia State University, Perimeter College attempts to address these barriers through a program aimed at increasing exposure to STEM for K-12 students. Funded in part by the National Science Foundation, the goals of High School Visitation Day (HSVD) are to provide an exposure experience that introduces a collegiate setting, encourages a college-going mindset and equips students with information on STEM majors and the college application process. In this paper, we discuss the importance and impact of increasing college opportunity and STEM education awareness through HSVD.

Paper V1A4 - Introducing Sustainability to Secondary Level Students Using Automated Tracking Solar Arrays

Kenly Ayres, University of Tennessee at Chattanooga
Trevor Elliott, University of Tennessee at Chattanooga
Chuck Margraves, University of Tennessee at Chattanooga

With the national push to develop STEM education programs and increase interest and performance levels of students, the need for alternative educational programs is growing. The goal of this work was to design and construct a small-scale solar array that could be used by high school students to both manually and automatically track the sun. Based on the results of both of these systems students would be introduced to the idea of creating an algorithm that could be used to optimize a system with regards to solar energy collection and thus understand the importance of STEM education. It should be noted that this experiment will be used in conjunction with a number of other small-scale projects that highlight several aspects of the zero plus energy building (more energy is converted to electric power than used) developed by the University of Tennessee at Chattanooga. For ease of demonstration, separate manual and automatic trackers were designed for the experiment. Using a standard camera tripod, the solar panels were attached to fabricated mounts to allow for omnidirectional movement. For the automated, or active tracker, an Ardunio Uno microcontroller was used in conjunction with two 180˚servos to position the active tracker into

the optimum orientation for energy collection.

Paper V1A5 - WIP: K-12 Aerospace Academy Program at ECSU: Implementation and Evaluation

Kuldeep Rawat, Elizabeth City State University

In this Work-in-Progress (WIP) paper, an aerospace-themed STEM outreach program for all levels of education in rural North Carolina is discussed. This comprehensive outreach project is a partnership between NASA, Elizabeth City State University, school districts, state agencies, private foundation, and other STEM enrichment programs. The goal of this K-12 outreach project is to improve STEM literacy by engaging students, family members and teachers. The K- 12 outreach program adopted NASA STEM curriculum at its core and integrated 3D printing technology, robotics programming, and Unmanned Aerial Vehicle (UAV) design to enhance authentic and experiential learning experiences. In its first year of implementation, a total of 646 students received 36-40hours of hands-on STEM experience. Other activities included teacher professional development and STEM engagement/skills for family members of the participants.

V1B Engineering Research Topics 1 (Room: San Cristobal B)

Session Chair: Pilar Pazos, Old Dominion University

Paper V1B1 - Work in Progress: The Effects of Computer Simulation and Animation on Student Metacognition During Engineering Dynamics Learning

Ning Fang, Utah State University
Collen Kretzer, Utah State University
Ashton Jessup, Utah State University
Moe Tajvidi, Utah State University

Research on metacognition (i.e., the awareness and management of one's own thought) has long been conducted in the conventional learning environment, such as "chalk and talk" classroom lectures. This work- in-progress study investigates how computer simulation and animation (CSA) affects student metacognition during the process of learning engineering dynamics, a foundational course that students in many engineering programs are required to take. The results show that when learning with CSA, student metacognition primarily focuses on four activities: clarifying understanding by interfering or questioning; paraphrasing, scanning, skimming the problem; demonstrating confidence, and deciding to focus on the mathematical representation.

Paper V1B2 - Updated AADMLSS: Design and Evaluation of a Culturally Relevant Algebra Application

Naja A. Mack, University of Florida
Tiffanie R. Smith, University of Florida
Jessica N. Jones, University of Florida
Juan E. Gilbert, University of Florida

Algebra I students often feel learning and practicing algebraic concepts is an extremely boring task. Current online software exists to help make learning more engaging, however students have reported dislike of several of its available features. Difficult explanations, negative reinforcement, as a result of utilizing hints, and lack of customization and interactivity are factors that contribute to their disdain. Researchers at the University of Florida created a culturally relevant web-based application to assist in the engaging of minority Algebra I students. Their alternate approach to resolving students' issues include providing: a three-part system that infuses the students culture

into their lesson, an interactive way to practice learned information and informative and action-specific help and feedback. This application takes a culturally relevant approach and uses hip-hop music, cartoon or comic-like imagery, and a game-like environment to teach algebra. Results from the study indicate, although the system did not improve performance on administered pre and post quizzes, students preferred the new system to current software.

Paper V1B3 - Self Determination Theory to Develop Strategies for the Retention of Women in Engineering and Engineering Technology Programs

Elizabeth Dell, Rochester Institute of Technology
Yen Verhoeven, University of Rochester

Women are drastically underrepresented in engineering fields. Although efforts have been successful at recruiting women into engineering and engineering technology (ET) programs, retention remains an issue due to several factors such as stereotype threat and a lack of established women role models. This paper reports on a five year National Science Foundation Scholarships in Science, Technology, Engineering, and Math (S- STEM) funded project: Critical Mass of Engineering Technology Scholars (COMETS), and how the utilization of self-determination theory (SDT) fostered a supportive professional community to retain women undergraduates in ET programs at the Rochester Institute of Technology (RIT). SDT posits that learning, motivation, and persistence are facilitated when the psychological needs of autonomy, relatedness, and competence are met. Interview and focus group findings show that although students continued to face amotivating factors from within their programs, they received, through their personal and professional communities, support for their psychological needs. This paper provides suggestions and evidence on how an SDT framework may guide programs and improve departmental cultures to support the retention of women in engineering.

Paper V1B4 - Developing Critical Consciousness to Promote Engineering for Social Justice: A Pilot Program to Enhance STEM Outreach and Engineering Education through Service-Learning

Valeri Werpetinski, University of Illinois at Urbana-Champaign
Sahid Rosado Lausell, University of Illinois at Urbana – Champaign

There is a growing literature on the intersections between Engineering and social justice.1-4 This paper describes the context and rationale for developing an Engineering for Social Justice Scholars Program in an effort to create new opportunities to enhance engineering education and support a growing K-12 engineering outreach program serving underrepresented minorities in the STEM fields. The pilot program features a two- semester service-learning course sequence. The first course, Social Justice and STEM Education, engages undergraduate students as mentors in a STEM education outreach program for middle school youth in Chicago Public Schools. In the second course, Leadership in Engineering for Social Justice, students apply their knowledge to manage local STEM education outreach programs and also work in teams to develop and implement projects that support engineering for social justice. Through complementary readings, activities, and reflection related to the experiential learning, the program is designed to help students develop a critical consciousness about gender and racial/ethnic disparities in STEM education and the integral role of social justice in engineering education and practice.

Paper V1B5 - Faculty Development as Process: Perils in Evaluation

Lori Bland, George Mason University

Interactive teaching strategies have become increasingly important within undergraduate STEM education. Even when faculty have the will to change, barriers can impede the adoption process. Examining how faculty change is important. This paper examined implementation of a faculty development project. The project hypotheses were that faculty who participate in a supportive teaching network will make initial small changes in their teaching. Small changes will lead to increasingly larger changes over time. The purpose for this paper was to discuss the results of a formative evaluation and challenges associated with a process-focused grant. Results indicated that aligning the evaluation methods to the grant intention is important.

V1C Topics on Improving Instruction 1 (Room: San Cristobal C)

Session Chair: Monika Bubacz, The Citadel

Paper V1C1 - Observations on Using the Flipped Classroom Model in an Introduction to Environmental Engineering Course

Richard Mines, Mercer University

This paper reports on student perceptions of using the Flipped classroom in an undergraduate course on environmental engineering. The responsibility of taking ownership of learning was placed on students by asking them to view recorded lectures, read the text, and complete 6, on-line assignments prior to coming to class. During class time, students worked in teams of 2 or 3 to complete problem-solving activities with assistance from the instructor. A pre- and post- survey were conducted to ascertain student perceptions about using the Flipped classroom approach. Results from the survey indicated that students prefer a combination of a Partially Flipped and Partially Traditional Lecture-based course over the Traditional Lecture-Based course or the Flipped Classroom. These results are most likely attributed to the maturity of the students and their ability to assume the responsibility for life-long learning.

Paper V1C2 - Importance and Sequence of Laboratory Course in Environmental Engineering: A Case Study

M. A. Karim, Kennesaw State University

A university study in science/engineering, devoid of a practical component such as laboratory work, is virtually unthinkable and is not be acceptable to ABET accreditation process. One could even go so far as saying that it is extremely rare for anyone to question the necessity of laboratory work in university science/engineering curricula. Laboratory work is an essential part of the science/engineering game that needs hands-on experience and learning process. This article is primarily directed at a clarification of sequence of environmental engineering laboratory offerings as well as group learning experience in a lab course at a University setting based on the students' perception and attitude. Based on the responses of 102 students out of 133 students in the class, it appears that students' perception and attitude towards offerings the environmental engineering lab and the lecture in the same semester appeared to be favorable. But no inference could be drawn for the experience they gained from group work in the lab class, although overall group learning experience seems to be favorable with a scale of 3.76 on a 5.0 scale based on summer 2016 and fall 2016 data.

Paper V1C3 - A Comparison of Teaching Modalities for Student Success

Chadia Affane Aji, Tuskegee University
M.Javed Khan, Tuskegee University

This paper provides a case study comparing the effectiveness of traditional face-to-face, flipped classroom, hybrid and asynchronous fully online teaching and learning environments. An analysis of the collected data is discussed for student success rates in three lower level courses in mathematics including College Algebra, Pre-Calculus, and Calculus and an introductory aerospace engineering course that were taught with these different teaching delivery modes. The gender base difference in performance is analyzed for the math courses. The students enrolled in these courses were from under-represented groups at a historically black university. In addition, this paper identifies the strengths and weaknesses of each pedagogical approach.

Paper V1C4 - Developing Knowledge of Infrastructure Sustainability Using the ENVISION Rating System

Ashraf Ghaly, Union College

Envision is the sustainability rating system that the American Society of Civil Engineers (ASCE) has developed to rate infrastructure facilities. The rating speaks to the triple bottom line of social, economic, and environmental goals. Existing rating systems such as LEED and Greenroads are sector-specific. A general system that covers all aspects of infrastructure does not exist, and Envision was designed to fill this gap. In rating America's infrastructure, ASCE evaluates capacity, condition, future need, operation and maintenance, public safety, resilience, and innovation. In the latest report card issued by ASCE in 2013, America's infrastructure collectively received a (D+) grade. Many of the facilities rated in this report card received poor grades and the highest grade achieved by any type of facility was (C+). This led to the realization of the need to identify areas of weaknesses and the attempt to improve the design process. ASCE identified the need to promote sustainability and resilience as an important starting point to enhance infrastructure performance. This approach resulted in the development of a rating system that helps designers score high marks in the design of infrastructure facilities by implementing features that increase resilience and sustainability. A course entitled sustainable infrastructure was developed and taught to highlight the advantages of sustainable design. The ENVISION rating system was introduced and explained in detail to heighten awareness of the need to implement in the design of a facility as many as possible of the features that contribute to a higher score on the sustainability scale. Students were excited to learn that many easy-to- implement features could be adopted in facility design and that would significantly enhance its rating and performance. This method of teaching showed the students the practical side of design and opened their eyes to the need to take a fresh look at innovative design possibilities.

Paper V1C5 - Expert Evaluation of a Sustainable Design Rubric

Elise Barrella, James Madison University
Mary Katherine Watson, The Citadel
Charles Cowan, James Madison University

Sustainable development poses a challenge for all engineers, regardless of discipline, to improve the design of infrastructure, products, and processes by balancing technical, environmental, social, and economic objectives. Prior work developed and applied a sustainable design rubric based on the Nine Principles of Sustainable Engineering to civil engineering student design projects.

Subsequently, the rubric was updated based on insights from the pilot application phase and a subsequent systematic literature review. This paper presents preliminary expert evaluations of the cross-disciplinary sustainable design rubric. Paper and web- based forms were used to gather perspectives from engineering education professionals from the United States and abroad. Participants, with different disciplinary perspectives, ranked the importance of 34 criteria related to sustainable design. Quantitative and qualitative analysis of feedback will be used to validate and update the sustainable design rubric for use across various engineering disciplines.

V1D Education Topics in Civil Engineering 1 (Room: San Cristobal D)

Session Chair: Harry Powell, University of Virginia

Paper V1D1 - Enriching the Experiential Learning Experience through Inverted Classrooms

Peter Rogers, Georgia Southern University Clint Martin, Georgia Southern University

Concern that larger class sizes are reducing student-instructor interaction and impacting student learning has motivated educators to look for innovative teaching and classroom management techniques. One approach involves combining the features of an “inverted classroom” with an experiential learning environment. With the inverted (flipped) classroom model providing students with lesson material outside the classroom through an online environment, class time is devoted for experiential learning activities that complement the online lessons while also stimulating critical thinking and reflection. This paper discusses how the inverted classroom was used in collaboration with experiential learning activities in two required courses from two separate programs. In doing so, it also reveals several interesting findings regarding student engagement, the role of a collaborative classroom environment in creating a learning community, and the impact of experiential learning activities in developing problem solving skills.

Paper V1D2 - A case for the inclusion of structural dynamics in undergraduate structural engineering programs

Niranjan Desai, Purdue University Northwest

Undergraduate structural engineering programs at their core are generally limited to studying the linear elastic behavior of structural systems under static loads. This knowledge is essential, giving students a fundamental understanding of the field of structural engineering. However, to obtain a holistic and complete picture of the field, it is necessary that students are exposed to the inelastic behavior of structural systems under dynamic loads. This is even more relevant in small, rural, teaching-focused satellite campuses of major schools that have a significant population of lower income, first-generation students who do not intend to pursue graduate degrees, possibly due to financial reasons or due to a lack of exposure to the possibility of doing so. In this light, this paper presents a case for the inclusion of two basic structural dynamics courses as electives in an undergraduate structural engineering program. They have been recently included as novel and unique additions to the undergraduate program at Purdue University Northwest. The paper also describes the theoretical content of these courses, along with a description of a creative “project” component that requires students to apply their theoretical principles to a problem in the area of earthquake resistant design, using a state-of-the-art software. The course offers students an excellent opportunity to go beyond the minimum amount needed at the undergraduate level, thereby giving them an edge in a competitive employment market. It provides students with a passion for structural engineering an opportunity to advance their knowledge in this area, without having to incur the financial and time related costs of a master’s degree. It also helps teaching-

focused schools offer a unique program that differentiates itself from standard programs, helping them to stay competitive in a market with abundant educational choice. Finally, teaching more advanced material helps to motivate and challenge faculty in teaching-focused schools.

Paper V1D3 - Can the Use of Guided Notes Lead to more Efficient Instruction?

Bryan Boulanger, Ohio Northern University
David Johnstone, Ohio Northern University

Guided notes are instructor designed note packs that aim to engage student learning. Previous research has demonstrated that the use of guided notes improves student performance in non-engineering classrooms. However, the use of guided notes within engineering education is under-reported. The purpose of this research was to study the incorporation of guided notes into a senior level engineering course. The study results indicate that the implementation of guided notes led to a 28.9% time savings in covering course material. The study data also indicates that mean student performance on graded assessments did not change when the method of notes delivery was changed from a traditional style of writing all note materials on the board to guided notes (all p-values were greater than 0.05 for a two-tailed t-test assuming equal variance at a 95% confidence interval). In addition to these findings, students from both junior and senior level classes were polled as to their desire to use or recommend guided notes in future classes. Using a Likert scale from one (strongly disagree) to five (strongly agree), the junior level class (n = 12) which used traditional notes had an average response of 2.75 ± 1.29. However, after participating in a class which used guided notes, the senior level class (n = 24) had an average response of 4.46 ± 0.98. Although this study polled two different sets of students, preliminary findings suggest that switching from traditional style notes to guided notes resulted in time savings that could be used to elaborate on or cover additional material while maintaining the integrity of the learning environment and contentment of the students.

Paper V1D4 - Relevance of Sustainable Design Projects in Environmental Engineering Education

Veera Gnaneswar Gude, Mississippi State University

The need for preparing engineering students through hands-on experiences and real-world projects can never be overstressed. Environmental engineering students require more emphasis on sustainable design to solve the complex environmental issues though real-world projects. This approach was applied in our environmental engineering elective and graduate civil engineering courses in which undergraduate and graduate students worked together to provide sustainable design and solutions for water desalination, wastewater treatment and biofuel production. Four projects received support from the US Environmental Protection Agency over the past three years which focused on 1) sustainable design tools for small communities; 2) low-cost water desalination; 3) anammox microbial desalination cells for enhanced energy and water recovery; and 4) innovative in-situ extractive-transesterification of algal lipids. This article discusses the relevance of the sustainable design projects undertaken by the undergraduate and graduate civil engineering students for engineering education in deepening their course content and environmental engineering principles.

Paper V1D5 - Fluid Mechanics Laboratory Experiment: Calibration of a Semi Circular Weir

William Janna, University of Memphis
Paul Palazolo, University of Memphis
Jeffrey Marchetta, University of Memphis

Experiments in open channel flow are important especially to Civil Engineering students. Flow rate is commonly measured in an open channel by using a weir. Weirs that are used in our fluid mechanics lab include a V-notch weir, a suppressed edge weir, and a contracted edge weir. Each of these weirs has been studied extensively, and calibration methods/results have been published in many undergraduate fluid mechanics texts. These weirs are modeled mathematically using an equation relating flow rate to liquid depth over the lowest point of the weir. In an effort to find an additional weir for study, the semi circular weir was proposed. Relating flow rate to liquid depth for this weir involves an infinite series. To make the semi circular weir useful in the lab would require the derivation of a single term, power law equation to relate flow rate to depth. The objective of this study is to derive such an equation, and to present data obtained for purposes of verification. Finding such an equation and avoiding an infinite series permits the use of the semi circular weir, as an additional weir experiment, in the fluid mechanics lab. The results indicate that the semi circular weir is a worthwhile addition to the study of weirs.

Friday 9:45am - 11:15am

V2A Topics in Engineering Technology 1 (Room: Auditorium)

Session Chair: Maria M Garcia-Sandoval, Polytechnic University of Puerto Rico

Paper V2A1 - Joining Aluminum to Aluminum and Dissimilar Materials – a New Course Development for Designers and Technicians

Azadeh Sheidaei, Kettering University
Yaomin Dong, Kettering University
Javad Baqersad, Kettering University
Craig Hoff, Kettering University

Aluminum is replacing steel for its strength to weight ratio, equal or better stiffness and toughness properties, durability and manufacturability considerations. It has other major benefits such as corrosion resistance, fuel economy in vehicles, sustainability, enhanced image and maintenance advantage. Aluminum components can be joined among themselves and with other materials using numerous methods. The selection of an adequate joining technique depends on the material combination to be joined, the required joint characteristics, and the boundary conditions given by design and engineering as well as production engineering and, last but not least, economic considerations. The course learning outcomes (CLOs) of programs at research universities and community colleges are very different. This paper presents a new course, “Joining Aluminum to Aluminum and Dissimilar Materials” that focuses on student learning outcomes for community college students, future designers, and technicians. The course was developed for the Center for Advanced Automotive Technology (CAAT), which is funded by the National Science Foundation. One of its missions is to create a curriculum that meets the needs of educating people in new technology developments in the automotive industry. The material developed in this course contains the course syllabus, course learning objectives, course materials, homework assignments, term projects and tests.

Paper V2A2 - A Simple Experiment to Enhance Student Learning in the Area of Fins

Robert Edwards, Penn State Erie, The Behrend College
Liyong Sun, Penn State Erie, The Behrend College

At Penn State Erie - The Behrend College a project is underway to create a series of laboratory exercises to use in the Heat Transfer lab and the Fluid Power lab for Mechanical Engineering Technology (MET) curriculum. The intent of the exercises is to have simple to understand equipment so that the students can concentrate on the concepts rather than get distracted by the operation of the equipment. These exercises focus on key topics within the course. The exercise described in this paper relates to fin calculations, and the basic concepts affecting the results. This exercise is new, and has only been used one time to date. This exercise does not simply employ a "cookbook" approach. A pre-exercise worksheet is used to have the students predict results based on an understanding of the theory. After the worksheets are complete the exercise is run and data is collected. A post-exercise worksheet is used by the students to help guide them in the analysis of the data, and to make comparisons with the applicable theory. This paper describes the worksheets, outlines the equipment and exercise and presents an evaluation of the student work for the first in class trial of the exercise. Suggestions for improvements are also discussed.

Paper V2A3 - Florida Pathways to Engineering Technology Careers

Marilyn Barger, Florida Advanced Technological Education Center, FLATE
Richard Gilbert, University of South Florida

This work in progress addresses how the National Science Foundation Advanced Technological Education Center of Excellence for manufacturing in Florida (FLATE) addresses Florida's manufacturing sector re- shore, resurgent, and emergent technology requirements for preparing engineering technology professionals to support this vital economic sector. FLATE's target objectives address the widening skills gap manufacturers face with respect to engineering technology related jobs. This paper outlines the strategies FLATE is using to integrate Florida's education structure, to provide multiple pathways to various career levels within Engineering Technology. The paper outlines how high school, two year technical degree, and ABET accredited B.S Engineering Technology degree participate in an articulated pathway, The Florida Plan, to interesting and lucrative careers in manufacturing.

Paper V2A4 - Crashworthiness of a Jet Dragster

Paige Sanchez, Florida Institute of Technology
David Fleming, Florida Institute of Technology
Matthew Jensen, Florida Institute of Technology

An analysis on a Larsen Motorsports (LMS) Generation-6 jet dragster chassis has been conducted to determine the crashworthiness of the frame and to identify problematic areas which need to be addressed in order to project the driver from injury in the event of a crash. This analysis was conducted in conjunction with specialized graduate coursework in Automotive Engineering, particularly Crashworthiness, at the Florida Institute of Technology. The foundation of key concepts, such as crash mechanics, trauma biomechanics, and computer simulation of high-speed impacts in LS-DYNA, were introduced in the course and complemented the jet dragster research that built upon these concepts. Static and dynamic crash analysis has been conducted using ANSYS and LS-DYNA, simulating a variety of crash scenarios – frontal and angled impacts at varying speeds. Static structural simulations conducted in ANSYS are used as a baseline to

compare the results of the dynamic simulations conducted in LSDYNA. Reduced complexity of the model affected realistic behavior of the dragster in the dynamic simulations. Additionally, because the Gen-6 car is brand new and does not have any performance or crash data, additional sources of crash data for similar high- performance vehicles will need to be researched in order to validate the simulation results. Recommendations for energy-absorbing foam locations in the car will then be made and implemented to improve driver safety.

Paper V2A5 - AUTOMATED HYBRID WIND-SOLAR SYSTEM USED FOR OUTDOOR LIGHTING (INDUSTRIAL USE)

Yazid Amrani, West Virginia University Institute of Technology
Gaetan Tchewa, West Virginia University Institute of Technology
Farshid Zabihian, West Virginia University Institute of Technology

This project addresses one of the major issues in the power engineering industry where power generation and distribution companies are often faced with situations where the consumer power demand is very high, thus resulting in temporary blackouts or the re-scheduling of a unit's maintenance which increases the risk of the unit's sudden failure. Several transitions have been made in the power industry to try matching today's growing power grid demand. Recently several municipalities converted their street lights from HPS lights to LED as a result of the heavy consumption. The proposed capstone project, if fully integrated in several cities, will remove a large load from the power grid mainly through the use of wind and solar energy. The prototype will optimize power output by utilizing a Vertical Axis Wind Turbine (VAWT) and a photovoltaic polycrystalline solar panel that will provide necessary energy for a LED light bulb. The choice of exploiting wind energy and solar energy is counteractive since wind energy is available at days where solar energy is missing. An IES type III Lighting distribution will be used to meet the minimum illuminance and luminosity that is set by the National Department of Transportation. The team will attempt to include an Arduino programmed dual-axis solar tracker that is expected to increase the solar panel's electricity output by more than 25%. The team will try to overcome the complexities posed by the integration of this automated system, however a study has been done on optimizing power output by accurately calculating and positioning the solar panel in a way that it meets the exact altitude angle (α) and azimuthal angle (β) that are desired for a maximum energy output by the panel. Undergoing research will determine the specific type of polycrystalline panel, battery, controller, pole material, stepper or servo motors, and VAWT that will be featured in the system. Due to the mobility of the prototype, this lighting system could potentially be the ultimate solution to reach certain remote areas in third world countries that do not have electricity or lighting in the areas concerned because power companies and governments do not want to spend a large sum of money to set up transmission lines.

V2B Professional Practice 1 (Room: San Cristobal B)

Session Chair: Autar Kaw, University of South Florida

Paper V2B1 - Work in Progress: Am I an engineer yet? Perceptions of identity among first year students

Joni Lakin, Auburn University
Ashley Hill, Auburn University

This project is a Work in Progress. The development of a professional identity is believed to be a critical pathway to persistence in an engineering major. Engineering programs increasingly realize

that this identity development begins in the first year of college (or even before). Students who perceive themselves to be engineers and to use engineering ways of thinking are believed to be more likely to persist and to engage in important professional development experiences like co-op, internship, research experiences, and discipline- related extracurricular clubs. This paper reports preliminary findings on common concepts and themes that appeared when first-year pre-engineering majors were asked to describe the nature of engineering and their own development as engineers. We used qualitative text analysis approaches to understand the breadth of responses that these students had to open-ended prompts.

Paper V2B2 - Autoethnographical reflections of an immersive development engineering program

Aaron Gordon, Clemson University
Jeffery Plumblee, Clemson University
Claire Dancz, Clemson University

Clemson Engineers for Developing Countries (CEDC) is a student-driven service-oriented program whose mission is to provide sustainable, engineered solutions to communities in the developing world. One of the most successful features of CEDC, from both undergraduate education and community development perspectives, is the structured and innovative internship experience. In addition to student participation in design, planning, and project implementation, a few students are selected annually for an internship in the host community where they also have the opportunity to enhance their technical and professional skills while engaging with a different culture. In CEDC's current internship program, Clemson engineering students live in rural Haiti for 6-12 months while designing and implementing infrastructure projects in the surrounding communities. The paper includes lessons learned and suggestions for program replication to establish similar experiences at other academic institutions, including partnering with NGOs in developing countries and establishing a study abroad framework for students.

Paper V2B3 - Student Perception of Teamwork Skills and Experiences Across Prerequisite Courses in Transportation Engineering at The Citadel

William Davis, The Citadel
Dimitra Michalaka, The Citadel
Kweku Brown, The Citadel

Teamwork is an important professional skill for engineering students to obtain knowledge, develop proficiency, and attain constructive experience during their undergraduate education program of study. This paper describes student team formation, assigned teamwork activities, and student perception of teamwork activities for a series of connected transportation engineering prerequisite courses extending across all four years of the undergraduate curriculum. Teamwork assignments within the transportation engineering course prerequisite thread include: laboratory teams, problems solving sessions, homework assignments, class presentations, proposal preparation, design projects, and design project presentations. Student perceptions of team formation, collaboration, learning, leadership and effectiveness were obtained though a survey questionnaire instrument. Survey results will be presented with the intention of providing further insight on how the curriculum is preforming on this crucially important professional skills outcome.

Paper V2B4 - Improving Household Environmental Practices in Central Georgia: Low-Cost Renewable Energy Systems

Michael MacCarthy, Mercer University
Gabriel Ramirez, Mercer University
Kyla Semmendinger, Mercer University
Andrew Kelley, Mercer University

An ongoing project of the Engineering for Development program at Mercer University focuses on applied research and education that aims to improve environmental practices at the household level in Macon, Georgia (including water and energy efficiency; re-use and recycling; and use of renewable energy technologies). It is intended to improve the local environment while saving households money over the medium- and long-term, with key aspects incorporated into Mercer University's environmental engineering curriculum. This paper focuses on sustainable design and implementation of low-cost renewable energy technologies (specifically low-cost solar photovoltaic and geothermal heat pump systems), and use of these technologies in academic teaching. Social Marketing ('marketing behavior change') is central to the design and implementation of the project. A low-cost 'Solar Self-Supply' starter solar photovoltaic kit was designed, constructed, and tested as part of a senior capstone engineering class. This affordable, expandable system encourages local households to take advantage of recent drops in prices in photovoltaic panels, as well as partial federal subsidies for the entire cost of solar household systems. System design, construction, and testing results are discussed, as are project implementation strategies. Also, initial plans to design low-cost household heating and cooling systems using a geothermal heat pump and manually drilled well(s) are discussed.

Paper V2B5 - Curricula and Program Innovations to Enhance the Professional Readiness of Mechanical Engineering Graduates

Oscar Barton, Jr, George Mason University
Robert Gallo, George Mason University
Cindy Dupree, The Mitre Corporation

George Mason's mechanical engineering program is the newest to be established in the Volgenau's School of Engineering. Added in the fall of 2014, themes for the curriculum and program focus on strategies to increase student access through multiple pathways and to enrich their learning experiences once they become part of the department. Using assessment collected in the ASME's vision 2030 report and engagement with its advisory board on curriculum design, improvements in the curriculum are presented. Specifically, continuous improvement to produce a more curriculum flexibility, to expose students to a faculty with a more diverse professional background, and to address the need to expose students to additional professional core skills rather than enhance their abilities in engineering science and design, are presented. Content of the modified senior seminar course, now titled "Developing the Society EngineerTM", has been created to address some gaps in professional skills absent in well-established engineering programs for instance. End-of-semester feedback from students and faculty will be used to evaluate how these changes affect the attainment of student outcomes.

V2C Transition to College and First Year Topics 1 (Room: San Cristobal C)

Session Chair: Beth Newborg, University of Pittsburgh

Paper V2C1 - Thinking Foundation for Product-Process-People Model

Jan Tyler, Purdue University
James Maley, Purdue University

What happens when a professional engineer and a higher education professional become faculty colleagues at a statewide location of Purdue University's Polytechnic Institute? An interdisciplinary approach to course transformation! Over the last year, we have developed and refined a model to facilitate our students' understanding of the relationships between products, processes, and people. Across the majority of engineering disciplines, focus is directed upon the product (e.g., design, composition, structure, sustainability, life cycle; discovery, theory, application). Our areas of industrial engineering and leadership focus more on development and improvement of processes and people. In transforming the teaching and learning in first- year courses, we ground the content in foundational theories and concepts and address the need for polytechnic thinking, including systems, process, relational, reflective, and metacognitive thinking. Through our work, we seek to teach students to be flexible and innovative thinkers who see process- and people- oriented solutions and implications from multiple perspectives.

Paper V2C2 - Developing Team-work Skills in a First-Year Seminar

Karinna Vernaza, Gannon University

The First-year Seminar in Engineering at Gannon University is a two-credit course with nine course outcomes: five common to all seminars and four specific to engineering. ABET student learning outcome "d", an ability to function on multidisciplinary teams, is one of the seven ABET student learning outcomes mapped to this course. A semester long, community based, design project serves as a framework for team activities; therefore, it serves as the platform for outcome "d". This paper presents a brief overview of the seminar and the structure of the community-based engineering design project. The tools and strategies employed to foster team- work are discussed. Students use the zero-sum game tool to evaluate teamwork. The results of the team evaluation and the technical deliverables are discussed and correlated. Lessons learned on the effectiveness of the activities to develop team-work skills are presented.

Paper V2C3 - Betting your Grade: Using Introductory Statistics to Teach Data-Driven Decision Making

Mark Archibald, Grove City College

This paper describes a technique for enhancing student motivation and providing meaningful context for introductory statistics. Additionally, students learn how to make – and the importance of – data-based decisions. Sophomore students in Grove City College's experimental methods lab course were unable to perform or understand basic statistical data analyses such as confidence intervals, regression and tests of hypotheses. Basic instruction using Matlab's statistical toolbox allowed some students to perform the analyses by rote, but the understanding was poor, and many students continued to struggle. In 2014, the structure of the course was changed, reducing the number of experiments and increasing the time devoted to data analysis by spending two weeks on each lab. During the first week, students conduct the experiment and record data, followed by an introduction to the statistics principles required to answer the lab questions. The following week, after a more detailed explanation, students are required to demonstrate an understanding of the

statistical method by making predictions based on their own measured data. For example, in an experiment involving linear regression, students use their data from the previous week and a regression model to predict the outcome of three new trials for which the instructor provided values of the independent variable. The students then experimentally measure the outcomes. Their grade for the demonstration depend on the width of their prediction intervals and the fraction of trials within their predicted intervals. This provides very high motivation for learning the statistical method, and also set an example for how engineers make decisions based on data. Application of statistics to their end-of-semester student-design lab assignment show that students better understand statistical methods and their applications. Other metrics, such as quiz scores and course evaluations, did not show clear improvement, possibly due to increased rigor on the quizzes.

Paper V2C4 - Teaming and Designing for Art for All - Work in Progress

Cecelia Wigal, University of Tennessee at Chattanooga
Louie Elliott, University of Tennessee at Chattanooga
Christina Vogel, University of Tennessee at Chattanooga

The Art for All (AfA) endeavor brings together teams of freshman engineering students and sophomore art students to address the physical barriers many with disabilities encounter when using art tools and resources of the able artist community. Freshman engineering students in an introduction to engineering design course team with art students in a sophomore figure drawing course to understand the users' boundaries with art creation and to brainstorm and select the best solution. The engineering students design, build, and test the solution, including the client and art students as needed. Upon completion, the finished device is delivered to the user or the customer's facility. This paper reports on the experience of the collaboration of the art and engineering students and its effect on the brainstorming component of the design process.

Paper V2C5 - Comparison of Student and Faculty Perceptions of Intent and Effectiveness of Course Evaluations in an Engineering Curriculum

Thomas James, Rose Hulman Institute of Technology
John Michael Van Treeck, Rose Hulman Institute of Technology

This paper provides a comparison between a student's apparent belief system and faculty perceptions of the intent and effectiveness of course evaluations. Data collection was through a survey instrument and in-person interviews. The focus of information gathering was directed toward how student course evaluations may have impacted faculty teaching methodologies, choice of course materials, and content of curriculum from both a scale and timing viewpoint. The results from this research are useful for those interested in examining gaps that may exist between student and faculty perceptions related to the usefulness of course evaluations. In particular, the conclusions drawn from the data are applicable to educators of newly matriculated students when introducing and setting expectations for their institute's course evaluation system, for example during a first semester College and Life Skills course.

V2D Education Topics in Mechanical Engineering 1 (Room: San Cristobal D)

Session Chair: Nancy Moore, North Carolina State University

Paper V2D1 - Methods to Improve Students Learning in Dynamic Systems and Control Course

Arjumand Ali, Grand Valley State University

Study of Dynamic Systems involve modeling and analysis of system response to different inputs. Mathematical models of electrical and mechanical systems consist of first order and second order differential equations. To find the response of such systems, students need to solve the resulting modeling equations. Conventional methods using trial solution approach may sometimes be frustrating for the students if the model is complex. Laplace transform method do help by converting the differential equations into algebraic equations but that method is also not very helpful when it comes to solving multi degree of freedom systems. Using MATLAB simulations to solve these modeling equations make life easier for students and is a subject of this paper. While MATLAB do not replace the need for theoretical teaching, it offers a quick solution to increase students' engagement and comprehension. This method of teaching is adapted for the first time this semester and needs further investigation of its popularity and its impact on students' result but midterm evaluation feedback from students suggest that these simulations are providing an effective and enjoyable source of learning.

Paper V2D2 - Creation and Integration of a New Manufacturing Lab into the Mechanical Engineering Curriculum

Robert Michael, Gannon University Mahesh Aggarwal, Gannon University

Industrial employers seek mechanical engineering graduates with integrated knowledge and practical hands- on skills related to manufacturing. This paper focuses on the creation of a new manufacturing lab designed to strengthen the manufacturing preparation of engineering students to meet the needs of industry. The new lab addressed the need for improvement identified by the ME Industrial Advisory Board. The Board is strongly influenced by small- and medium-sized manufacturers in northwest Pennsylvania. The board identified a need for improvement in the following areas: basic manufacturing/machining, drawing interpretation, metrology/measurements, statistical process control, process capability (based on six sigma concepts), and a basic understanding of manufacturing tolerances and CNC/automation. An emphasis was placed on teaching knowledge of the aforementioned items and not skills. The continuous improvement initiative was also in response to students. The major complaint students had over the last several years was lack of experience in machining and basic manufacturing which prevented them from completing senior design projects and hindered industry collaboration. Their complaint directly related to ABET Student Outcomes (c) and (k). The creation of the new lab and associated new equipment addresses a critical need identified by the Advisory Board and students for continuous improvement of the ME program.

Paper V2D3 - Are Steam Tables Running Out Of Steam?

Smitesh Bakrania, Rowan University

Considering air and water are common power cycle working fluids, engineering thermodynamics courses begin with an introduction to the ideal gas law and the steam tables. The ideal gas law is a relatively straightforward concept. On the other hand, students often struggle with the steam tables. Instead, many students prefer to use computerized resources to determine steam properties. This paper highlights the deficiencies of both steam tables and popular computerized resources in their

ability to reinforce the thermodynamics concepts. Thermodynamic properties are inter-related and therefore supplying state property values without emphasizing their relationships holds limited value from a student learning perspective. This paper recommends the use of property diagrams instead. Thermodynamic property diagrams are relatively simple to use, and more importantly, enable students to visualize the property relationships.

Paper V2D4 - Energetic vs. Exergetic Efficiency of Food Drying Via Forced Convection with and without Electrohydrodynamic Enhancement

Madeline Mitchell, Grove City College
Erik Bardy, Grove City College

This study investigated differences in efficiency quantified using an exergetic vs energetic model approach for food drying via forced convection with and without ElectroHydroDynamic (EHD) enhancement. An energetic efficiency could vary depending on the process used to condition the primary airflow. In an exergetic model, this is simplified by looking at the state difference between the primary airflow and ambient conditions. This study is a preliminary look into the variability of energetic efficiency values compared to an exergetic model. Two primary airflow conditioning processes were chosen to build an energetic efficiency model - dehumidification by saturated cooling, and by desiccant material. Energetic efficiency values were computed by recasting data from a previous study used to compute exergetic efficiency. Results showed that energetic efficiency values varied greatly for method 1 compared to method 2. It was therefore concluded that an exergy model can normalize efficiency among different air treatment processes.

Paper V2D5 - Multi-Disciplinary Approach to an Undergraduate Engineering Analysis Course

Alta Knizley, Mississippi State University
Rogelio Luck, Mississippi State University
Aaron Smith, Mississippi State University

Courses in the Mechanical Engineering curriculum should support practical applications, address various subject areas, and relate to other coursework. However, students often find it difficult to completely grasp the connections between courses. At Mississippi State University, the junior- level Engineering Analysis course links mathematical approaches across most mechanical engineering subject areas. Therefore, this course has been selected to introduce a multi- disciplinary instructional component that maps concepts from various courses through a common mathematical framework, while tying practical applications to the course material. The instructional techniques employed include homework and projects designed to illustrate practical examples of engineering solutions, verification statements, and in-class examples explicitly illustrating conceptual material from other courses and practical applications of numerical techniques. Additionally, ample opportunity for open discussion of material application to the overarching curriculum is provided. The primary objective is to help students' view their collective education as connected pieces of a whole process.

Friday 11:15am - 12:30pm

Student Poster Session (Room: San Cristobal Foyer)

Session Chair: Richard Stansbury, Embry-Riddle Aeronautical University

Poster 30 - Antibacterial Effects of Silver and Copper Nanoparticles Deposited by High Vacuum Magnetron Sputtering on Water Filtering Materials

Dorina Mihut, Mercer University - Laura Lackey, Mercer University - Stephen Hill, Mercer Univesity - Khang Le, Mercer University - Ronaldo Trento, Mercer University- Elizabeth Oliver, Mercer University- Paul Harpe, Mercer University

Water purification is an important problem confronting our generation at a global level and justifying the effort to develop appropriate filtration technologies. A team of students: one student from Brazil Scientific Mobility Program (BSMP) and three other students from Mercer University (working under “Research that Reaches Out” program) investigated the antibacterial effects of different metallic nanoparticles deposited on microsize pores filtration materials. Students analyzed the technical variables associated with the problem: deposition techniques, filtering materials, flow rates, testing procedures and antibacterial properties of nanoparticles. Different types of filtering materials were selected and deposited with metallic nanoparticles using the DC High Vacuum Magnetron Sputtering System. The testing media containing the bacterial samples was the water collected from different local water resources (e.g. lakes and rivers). The structures consisting of filtering material deposited with nanometallic particles were tested for their antibacterial effect. The deactivation rates for fecal coliform and Escherichia coli were measured with varying metallic compositions and thicknesses using standardized techniques. The research helped students understanding the associated environmental problems, becoming familiarized with international standard methods for the examination of water and wastewater and offered exposure and “hands on” activity working with different equipment, e.g.: DC Magnetron Sputtering for nanoparticle deposition, surface profilometry for coating thickness evaluation, and optical microscopy for surface morphology evaluations.

Poster 91 - Design and Implementation of Tremolo Effect Circuit

Matthew Kauffman, Grove City College Timothy Mohr, Grove City College

One of the most enjoyable things for any engineer is to work in an area that relates to their other interests. Over the past year, I used my knowledge of electrical engineering and my love for electric guitar to design and build my own tremolo effects pedal. The tremolo effect is one which varies the amplitude of the guitar’s signal according to an input waveform. My goal was to create this effect using only analog techniques and also add a new element to the effect that I hadn’t seen in other effects units. I achieved this by using two oscillators and using one to control the frequency of the other. Another part of this project was to integrate the circuit onto a printed circuit board (PCB) so as to fit it in a standard pedal enclosure. After an initial circuit was designed, it went through 5 different iterations before I reached the final design. I had to solve many issues such as oscillator noise bleeding into the audio signal and achieving the proper power supply to different areas of the circuit. Overall, it was an extremely productive learning experience with a final product which I currently use on a regular basis.

Poster 125 - Promoting Critical Thinking Skills in Non-Calculus Ready First Year Engineering Students

Anika Coolbaugh, West Virginia University- Sai Sadhika Veeramachaneni, West Virginia University - Lizzie Santiago, West Virginia University

Attrition tends to be high among first year engineering students that are not calculus ready. These students tend to migrate out of engineering at a higher rate in comparison with calculus ready students or leave college without finishing a degree. Most institutional efforts and resources are allocated to engineering students that are calculus ready. In order to fill this gap, it has become necessary to develop a course that serves multiple purposes. First, it must introduce the students to engineering, the engineering design process, and critical thinking skills. Second, the course must be able to combine engineering and critical thinking skills with mathematics in order to prepare the students for higher level courses.

A course of this nature has been implemented for the at West Virginia University as of Fall 2015. Thus far, 17 students have participated in the class, with approximately 65 students enrolled in the Fall 2016 semester. Engineering projects, assessments, lectures, and in class activities have all been designed in order to promote critical thinking and in order to teach the Conceive, Design, Implement, and Operate (CDIO) Educational Framework. In addition, a laboratory portion has been added to the class in order to further develop math skills as they relate to engineering. Preliminary math and CAT critical thinking tests are administered in order to collect baseline data. At the completion of the course, the work done by the students is analyzed and a second math and CAT critical thinking test is administered in order to determine the success of the course in improving students' critical thinking skills. This paper summarizes the implementation of the course and presents the course material developed to promote critical thinking skills in participants in the study.

Poster 157 - Curriculum Evaluation of the Transportation Engineering Courses Using the Outcome-Base- Education Framework

Heriberto Pujols, University of Puerto Rico at Mayaguez - Aidsa Santiago, University of Puerto Rico at Mayaguez -

Enrique Gonzalez, University of Puerto Rico at Mayaguez

Each nation's economic and social development depends on a good transportation system. To offer a continuous expansion to cover all social and economic needs its necessary to possess an accessible, efficient, cost effective and reliable transportation system. While simultaneously incorporate modern technological advances needed to make the system safer and more efficient. Furthermore, transportation is vital to the development and performance of the country's mobility needs. As we get better, transportation systems will be more efficient in terms of energy consumption, pollution and commute time.

It is essential to meet all academic requirements faced by engineering students who enroll in transportation courses, so they can complete their studies while gaining the necessary knowledge for their professional development. Previous research done at the university established the technical requirements for a transportation engineer. Our university system is facing the need to prepare students and at the same time provide the right tools and knowledge for them to face current and future challenges in the transportation area. As well as search for the different cognitive strategies to enhance their education. Therefore, as part of these efforts and to meet all professional needs, this research study plans to develop a curricular sequence that allows students to obtain certification in transport.

As a result, we will revise and redesign the transportation curriculum, resulting in the creation of a

certification in the area of transportation for undergraduate students. This will be achieved through the implementation of the Outcome-Based Education framework as proposed by Streveler et.al.; in which the course content, assessment and pedagogical techniques will be perfectly aligned. To be successful in this project, we will reference material available from publications and also from ITE official documentation (including from TRB Standing Committee on Education and Training). Thus, it is expected to improve students' academic experiences.

Poster 195 - Developing a new, online, modular Introduction to Engineering class – A student's perspective

Umar Hasni, Virginia Commonwealth University - Angelica Sunga, Virginia Commonwealth University - Hiba Nabi, Virginia Commonwealth University - Afroditi Filippas, Virginia Commonwealth University - Georgios Bakirtzis, Virginia Commonwealth University

Introduction to Engineering sets the foundation of student success. We present a student's eye-view of a modular Introduction to Engineering course designed to provide meticulous conceptual learning of fundamental engineering principles in a broad scope that demonstrates the overlap between various engineering disciplines. The modularity comes from the implementation of engaging lab projects where students design and build simple conceptual machines around which the course content is structured. The modules are self-contained and provide smooth transition from one module to any other. The lab exercises are augmented by course notes which cover a wide variety of topics specific to the exercises. The use of LON-CAPA allows instructors to code dynamic problem sets and the judicious use of fundamental MATLAB™ exercises emphasize algorithmic problem solving techniques. The use of the Arduino for some lab exercises provided further mastery of engineering tools. Examples of these modules and student work can be found online at rampages.us/vcuengineering. The use of undergraduate engineering students in the design and implementation process of this course gives insight to what is perceived engaging and academically enriching under the supervision of the principal instructor. By directly engaging rising sophomores in the education of their peers, these students engage more fully and independently in their own education while providing important mentorship to first time freshmen. This engagement has a salutary effect on both sets of students, thus increasing student satisfaction and retention. This poster will present the impact of the modular nature of the course on the students who took the course as well as helped redesign it. We will discuss the engagement factor of the course and how it relates to retention of students from the students' perspective. Student motivation and dedication in post-requisite classes will also be discussed.

Poster 219 - Renewable Energy Harvested Through Kinetic Flywheels and DC Motors and its Impact on Engineering Education

Tia Belvin, University of Florida - Jonathan Farji, University of Florida - Jonathan Robuck, University of Florida - Cody Wilde, University of Florida - Maxwell Sibner, University of Florida - Fazil Najafi, University of Florida

With the end of the age of fossil fuels in sight, businesses, universities, and private homes are implementing renewable energy technologies to generate power. In an attempt to transition into this new era and recognize the growing concern for environmental cleanliness, the University of Florida has made a commitment to creating a carbon-neutral campus by the year 2025. Considering this commitment, the research team has taken a new clean-energy technology and made it more cost-efficient. The device, a kinetic pressure plate, includes an integrated flywheel, as well as a DC motor. Compared to the industry standard in kinetic plate technology, using piezo electric crystals to generate electricity, the suggested technology is far more cost efficient and

accessible. When pressure is applied to the plate, the DC motor generates an electrical current, which can be stored in a battery, used immediately, or sent back to the grid. The kinetic plates can be installed at high-traffic areas on campus, embedded in the pavement. They will then generate electricity when stepped on (plates will be able to withstand the maximum force of a human footstep without breaking.) There are several options, considering what to do with the electricity generated: The electricity produced can be used to power street lights or stored in underground batteries on campus. The electricity can also be sold back to the grid, which can lead to further savings on energy, for UF. The introduction of the suggested technology to the University of Florida, as well as other institutions, will act as a key step in the pursuit of carbon-neutral campuses and a cleaner, healthier Earth. In addition, installing our kinetic plates in the public will bring awareness to such renewable technologies, as they will be seen by students every day. With each kinetic plate installed, an educational sign or plaque will accompany the plate, describing the plates' significance and how they work. This will bring the idea of renewable energy into citizens' everyday lives. As students interact with this hands-on renewable technology, they will realize that even they can make a difference, prompting them to pursue further education in this field. With growth in the renewable sector, engineering instructors may increase research opportunities for students, in this field.

Poster 221 - Comparative Analysis of Success Factors for Waste Anaerobic Digestion Globally and Their Educational Potential for Engineering Institutions through the Integration of Interdisciplinary Approaches

Nicholas Thomas, University of Florida - Mayuko Mizutani, University of Florida - Christina Finizio, University of Florida - Christopher Cuevas, University of Florida - Fazil Najafi, University of Florida

Many of the major strides made towards sustainable development over the past 15 years have had the goal of achieving a circular economy. Effective collection, storage, and recycling of various wastes is vital to achieving this goal and continues to be a critical issue in modern society. A variety of factors including the political environment, waste flow composition, and other geopolitics play major roles in determining how waste is to be addressed. Decisions have to be made at every level of government and industry on not only how to manage these wastes, but also how to divert waste from storage sites to be recycled or converted to energy: combining technical (i.e. engineering) and other intersectional areas of study (i.e. sustainability, political science, and economics). Anaerobic digestion is just one of these processes that has great potential to divert and reuse waste through the breakdown of biodegradable materials into bio-energy and other byproducts in anoxic conditions. The intent of this study is to examine where efforts are being made globally in implementing anaerobic digestion processes, as well as how and why they have succeeded using relevant literature. This is followed by an examination of how that knowledge can be used to change public policy and increase utilization of anaerobic digestion processes in the United States. Attention will be paid to the technical feasibility, the economics, and the environmental impacts, specific to its current successes. This approach illustrates the connectivity and necessity of an interdisciplinary approach to achieve a sustainable future which needs to be integrated into educational institutions for complex issues.

224 - A case study of photovoltaic cost effectiveness in Gainesville, Florida and its educational value

Meg Simms, University of Florida - Fazil Najafi, University of Florida

This research evaluates the cost and benefit of using photovoltaic (PV) panels in residential and commercial buildings in Gainesville, Florida. Furthermore, the objective was also to reduce the

greenhouse effect of carbon dioxide. The method of this research included researching online databases to identify the benefits and costs to quantify them. Data was collected from the local utility system, Gainesville Regional Utilities. From the data analysis, utilizing Excel, the results showed several findings including the near future monetary benefits of using PV panels on residential and commercial buildings. The implementation of PV panels contributed to reduction of certain pollution in Gainesville. In conclusion, PV panels are great investments which not only saves the individuals' and businesses' electric bills, but also saves the environment from the greenhouse effect. The case study in this research has a potential educational value for researchers and students within the engineering discipline. Innovation in clean technology resulted from coordinated and diverse policy effort, which includes tax credits, loans, pollution regulations and increase in efficiency.

Technological advancement resulted in PV cost reduction which then resulted in the growth of PV industry. Thus, this research will provide an opportunity for the researchers and engineering students to learn more about PV panels and potentially help the cost reduction and greater efficiency of PV panels in the future. Furthermore, the concern for global warming is a wake-up call for mankind and it should motivate researchers and engineering students to focus on this issue for the future generations.

Poster 225 - Development of A Nearest-Neighbor Method (NNM) Method for Annual Streamflow Prediction

Nian Zhang, University of the District of Columbia - Tilaye Alemayehu, University of the District of Columbia - Sasan Haghani, University of the District of Columbia

Traditional k-nearest neighbor methods couldn't be able to correctly classify objects when their k nearest neighbors are dominated by other classes. This paper formulates a two-class classification problem, and applies a modified k-nearest neighbors (KNN) classifier algorithm based on maximal coherence, validity ratings, and k-fold cross validation to classify the test samples. We build a validity score for the pairs of sample and their surroundings according to their labels. The k nearest neighbors (including the unknown test object) of each sample in the training set as well as the unknown test object itself will be determined. The unknown test object will be tentatively assigned to a class membership. Then we use the validity scores to quantify the degree to which a pre-determined group of samples resemble their k nearest neighbors. A classifier is designed which take into account the coherence and validity ratings. A numerical example demonstrates the effectiveness of the algorithm in detail. The enhanced KNN method is compared with the conventional KNN and the modified KNN method on both real world wine data and photo-thermal infrared imaging spectroscopy (PT-IRIS) data for up to 20 different k values. Classification accuracy of KNN method and our method in terms of various combinations of k-value and k-fold cross validation are compared. The experimental results show that the proposed enhanced KNN method outperforms the conventional KNN and the modified KNN method on real world wine data, PT-IRIS data, and annual streamflow data. In addition, the classification accuracy of both the conventional KNN and our method increase drastically when k = 5. The average classification accuracy of our method on the PT-IRIS data featuring small sample size and high overlap is 97.87%.

Poster 238 - Curriculum Evaluation of the Transportation Engineering Courses Using the Outcome-Base- Education Framework

Heriberto Pujols, University of Puerto Rico ar Mayaguez - Aidsa Santiago, University of Puerto Rico at Mayaguez- Enrique Gonzalez, University of Puerto Rico at Mayaguez

Each nation's economic and social development depends on a good transportation system. To offer a continuous expansion to cover all social and economic needs its necessary to possess an accessible, efficient, cost effective and reliable transportation system. While simultaneously incorporate modern technological advances needed to make the system safer and more efficient. Furthermore, transportation is vital to the development and performance of the country's mobility needs. As we get better, transportation systems will be more efficient in terms of energy consumption, pollution and commute time. It is essential to meet all academic requirements faced by engineering students who enroll in transportation courses, so they can complete their studies while gaining the necessary knowledge for their professional development. Previous research done at the university established the technical requirements for a transportation engineer. Our university system is facing the need to prepare students and at the same time provide the right tools and knowledge for them to face current and future challenges in the transportation area. As well as search for the different cognitive strategies to enhance their education. Therefore, as part of these efforts and to meet all professional needs, this research study plans to develop a curricular sequence that allows students to obtain certification in transport. As a result, we will revise and redesign the transportation curriculum, resulting in the creation of a certification in the area of transportation for undergraduate students. This will be achieved through the implementation of the Outcome-Based Education framework as proposed by Streveler et.al.; in which the course content, assessment and pedagogical techniques will be perfectly aligned. To be successful in this project, we will reference material available from publications and also from ITE official documentation (including from TRB Standing Committee on Education and Training). Thus, it is expected to improve students' academic experiences.

Poster 240 - Applications and Challenges of RFID in Hospitals

Teresa Paczuska, Wentworth Institute of Technology - Shankar Krishnan, Wentworth Institute of Technology

Hospitals are experiencing increases in the numbers of patients admitted, which necessitates corresponding increases in associated medical devices for efficient services. The overwhelming demand on healthcare services has created significant amounts of effort for locating proper resources, impacting professional healthcare delivery, often in times of emergencies. This essential requirement of locating accurately and utilizing medical devices and caregivers can be effectively managed by applying radio frequency identification (RFID) technologies. The objectives of the present project are to review the applications of RFID systems in hospitals to locate patients, staff, and equipment and identify the associated operational challenges.

As timely and efficient medical services are vital for proper patient care, local as well as international hospitals struggle to keep up with the demands and to manage the proper equipment and staff needed to provide exceptional patient care. The case studies included in the project demonstrate that RFID systems used for various applications at hospitals resolve problems related to expected on-time and appropriate patient care. While the cost of initial implementation of RFID-integrated systems in hospitals can be substantial, it has been shown that long term cost savings and return on investment can be achieved by diligent design and management.

In conclusion, it is evident that hospitals can increase productivity by having knowledge of available

medical devices, rooms and staff while maintaining high levels of services available to patients. The use of RFID can be instrumental in addressing the challenges and providing real time information on medical device tracking and staff to achieve superior patient care at reasonable costs.

Poster 241 - A Hydroelectric Phone Charger

Dillon Sluss, University of Tennessee at Chattanooga - Charles Margraves, University of Tennessee at Chattanooga

A capstone design project at the University of Tennessee at Chattanooga (UTC) was tasked with developing a mobile hydroelectric turbine to charge a cell phone or other small electronic devices by converting the kinetic energy of water into electrical energy. The team was also given the responsibility of developing a test apparatus that could be used to determine the effectiveness of the turbine. Due to the lack of high-pressure head in the small creeks and rivers surrounding the Chattanooga area, a water wheel was selected as the best and simplest option for this project. The waterwheel is connected through a set of gears to a DC motor that converts the kinetic energy to electrical energy. The test apparatus created utilizes a pump capable of delivering water at a flow rate of eighty gallons per minute at 5ft of head and can be set up in three separate modes common to working water wheels. These modes include overshot, where the water engages the blades of the wheel from the top, breastshot where first contact is at the midpoint of the water wheel, and undershot where the water runs below the wheel and only contacts the bottom most blades. Three tests were run for each type of flow and the power output was recorded. As expected the maximum amount of power was measured in the overshot position and a minimum in the undershot. Further improvements will be added to this device, including a more accurate flow measurement gage, and then used in the fluid mechanics lab at UTC to demonstrate the production of hydroelectric power.

Poster 242 - Gannon University- Globally Utilized Tabletop Sterilizer

Anna Barr, Gannon University SEECS - Jason Bensur, Gannon University SEECS - Sabrina Rider, Gannon University- SEECS -Alexis Stahl, Gannon University- SEECS - Leilani King, Gannon University SEECS- Nicholas Williams, Gannon University SEECS
Kaitlyn Babiarz, Gannon University SEECS -Blake Dantio, Gannon University SEECS

At Gannon University, eight engineering students embarked on a student-led, service learning, engineering design project funded by the National Science Foundation's S-STEM Grant. These students are part of the Scholars of Excellence in Engineering and Computer Science (SEECS) program at Gannon, with backgrounds in mechanical, environmental, electrical, and biomedical engineering. Beginning in fall of 2014, the group partnered with Christian Hospitals Overseas Secure Equipment Needs (CHOSEN), a non-profit organization that provides medical equipment to mission hospitals. The goal of the project was to retroactively engineer a table-top medical sterilizer to be compatible with unreliable power. This design project will have a global effect by giving people safe medical equipment to use in places where sanitation is not necessarily a given. Doing a student-led design project in college is beneficial to students as well because it helped us gain hands-on experience and learn how to collaborate as a team.

Poster 243 - Second Language Acquisition in a Blended Learning of programming languages (SLA-aBLe): Students respond to new materials

Paula Sanjuan Espejo, Embry-Riddle Aeronautical University

SLA-aBLe, Second Language Acquisition applied to a Blended Learning of programming

languages, is an on-going project the team started on 2014. The objective is to improve student's learning experience of a programming language class by applying second language acquisition techniques to make the process more comprehensive and interactive for students. This is a fluid project in which new changes and improvements based on students' feedback are implemented after each term. The materials created include: new slides and videos for online learning purposes, new labs and activities, active programming quizzes and discussion boards online. In previous terms, the students have responded positively to the new materials and suggested further ways to improve them. The team has made changes based on the student's response to these new materials, which is worth analyzing in this poster. The grades of students in the sections will be compared.

Most importantly, their responses to the surveys and one-on-one interviews carried out regarding the students' feedback on the project will be discussed. It is also important to analyze and present the demographics of the students who have taken this course and how and if that has affected their SLA-aBLe experience. As a student who has taken this course without the SLA-aBLe experience but a second language speaker, the author can compare and contrast the advantages and disadvantages SLA-aBLe supposes for students taking the programming language course. Future work and outreach of this project will also be analyzed in this poster.

Poster 244 - Sustainable Stationary Bicycle

Ben Zook, Eastern Mennonite University - Dylan Grove, Eastern Mennonite University - James Paetkau, Eastern Mennonite University -Collin Longenecker, Eastern Mennonite University - Austin Engle, Eastern Mennonite University- Ben Stutzman, Eastern Mennonite University - Esther Tian, Eastern Mennonite University

Background: In our current society it has become clear that alternate forms of energy are a necessity. Eastern Mennonite University has recognized this issue and has several sustainable initiatives throughout the campus. In congruence with these goals, the Engineers for a Sustainable World club recognized the waste of mechanical energy generated by exercise machines. To reduce the unnecessary waste, the club saw the opportunity to add an alternative form of energy created by gym goers on campus.

Specified Goal: Our aim was to create a stationary bicycle that could harness the mechanical energy created by a rider and recycle it into EMU's grid. The stationary bicycle would serve as a way to promote sustainability and give an opportunity for individuals to generate clean energy while exercising.

Implementation Process: To begin the project, EMU ESW club collaborated with EMU's Cycling Club to obtain a functional bicycle. Once a bike was chosen, the back wheel was removed and a steel stand was designed to provide stability. A 350 Watt Gear Reduction Electric Motor was fastened to the stand. A bike chain was attached to the chain ring of the bike and connected to the crankshaft of the motor. The motor's electrical leads were then attached to a Grid Tie Inverter which converts direct current to alternating current compatible with EMU's grid.

Results: The construction of the stationary bike is nearly completed. Some revisions to our current design are still required for an improved user experience and maximize efficiency. These changes will be completed by the first week of February in order to allow time for proper analysis.

Conclusion: Creating this sustainable stationary bike allowed the students in the ESW club an opportunity to practice basic design implementation. The premise of our project also advocates for healthy habits, sustainability, and ingenuity, something that Eastern Mennonite University is looking to emphasis in the culture of its student body.

Poster 245 - Academic Network Operations Center (ANOC) Project

Taylor Broach, East Carolina University - John Pickard, East Carolina University - Phil Lunsford, East Carolina University

This poster presentation will present the experiences and skills I gained as part of an ongoing undergraduate student lab-worker project that involves designing, building, troubleshooting, and maintaining the Academic Network Operations Center (ANOC). The ANOC provides 24/7 remote-lab access to more than 500 students in 20 graduate and undergraduate courses annually. Phase 1 of this project began in the summer term of 2016 with an outdated lab, repurposed with the addition of over 100 new devices. These additions called for the complete relocation and redesign of the lab infrastructure.

Details are provided on the methodologies and best practices I used to relocate, design, build, and bring the ANOC up to an operational state. Precise troubleshooting and preventative maintenance quickly proved invaluable throughout the project. In addition, I will share from the perspective of an undergraduate student, how the project reinforced classroom theory, with in-depth and hands on experience, which came from working in a live operational environment. The project learning experience went beyond just building critical technical knowledge and skills, it also required the application of strong team work ethics, communication and project management skills as well. Collaboration and coordination with the various support teams, University offices, faculty, and product vendors were critical to meeting project deadlines.

We are now in phase 2 of the project and have incorporated varying departmental proof of concept and IPv6 research projects into our system. We are currently working on proof of concept for virtualizing industrial automation lab equipment to provide remote access to labs for industrial engineering classes. To conclude the poster presentation, I will outline some of our best and most common practices so that similar projects can be replicated at other schools and adapted to other student projects.

Poster 246 - Art Stamper

Michael LePage, University of Tennessee at Chattanooga - Jonathan Burkeen, University of Tennessee at Chattanooga - Brandon Roberts, University of Tennessee at Chattanooga

The purpose of the Art Stamper is to allow students requiring a wheelchair for mobility at Spring Creek Elementary School to create art on the ground from their wheelchair or other mobile assistive device. To develop the Art Stamper a team of three students in the freshman level Introduction to Engineering Design course at the University of Tennessee at Chattanooga set a goal to design a product that is inexpensive and easy to operate as well as entertaining and educational for the students. The team used several brainstorming techniques during the original solution generation, including rich pictures, morphological charts, and pairwise comparison. The exercise of using these techniques allowed the team to choose a solution that best fits the customer's needs. The resulting Art Stamper consists of four main parts – handle, sensory feedback encasement, stamper head, and chalk holder. The handle is an adjustable painted metal broom handle with generic threads that fit most broom attachments as well as most paint roller attachments. The feedback encasement is a spring encasement screwed into the broom handle which provides tension and sensory feedback, The stamper head attaches to the feedback encasement and accommodates both ink and paint stamps. There are 23 ink stamps, consisting of an assortment of zoo and water animals, and 14 paint stamps of assorted basic shapes. The chalk holder also attaches to the feedback encasement. The Art Stamper cost approximately and all

parts can be purchased from a chain hardware store. This allows the customer to easily replace parts or replicate the design. The collection of paint and ink stamps cost less than . The team delivered three Art Stampers to Spring Creek Elementary School.

Poster 247 - Splatapult

Jacob McDaniel, The University of Tennessee at Chattanooga - Zachary Jones, The University of Tennessee at Chattanooga
Brandon Lewis, University of Tennessee at Chattanooga - Greg Hamoui, University of Tennessee at Chattanooga

Art is a means to express oneself as a human being. There is no limit on how art can be created, but some circumstances are present that limit artists' ability to create. Open Arms Care (OAC) Corporation of Chattanooga, TN requested that students from the freshman Introduction to Engineering Design course at the University of Tennessee at Chattanooga design and produce a device that assists their clients in the painting activity widely known as "splat art". Many of the OAC clients are diagnosed with Cerebral Palsy which limits body movement and control and thus their ability to create art. The device the team of four students developed is based on the basic catapult and is affectionally called "Splatapult". This design allows artists with various limitations in movement to create art, with or without assistance.

Before choosing a final design, the team defined the following objectives for the device to reflect: be mountable, easy to adjust, easy to clean, easy to trigger and portable. The Splatapult's primary function is to splat paint, but it also holds paint, delivers paint, positions direction, adjusts height, releases paint, and interchanges parts. The constraints given by the customer focused on ensuring user safety during use.

The Splatapult uses a three-spring system that creates enough force to launch paint from a desired distance of 6-10 feet. The throw arm is held in the launch position by a smooth pin release. The Splatapult sits on top of a mobile support platform comprised of a wheeled laptop table. The mobile support platform gives the Splatapult the ability to rotate, tilt, and adjust height for aiming purposes. The Splatapult requires assistance from Open Arms Care art department personnel to set position and load paint.

Poster 249 - Design of Portable Filtration Device for Arsenic Removal for use in Developing Countries

Anna Barr, Gannon University- Sidney Smith, Gannon University

The goal of this project is to design a low-tech portable filter to reduce the arsenic concentration in portable water. Arsenic is a naturally occurring heavy metal known to cause adverse health effects with prolonged exposure. In some areas of the world, surface water is unsafe to drink due to biological contaminants, and so the population must use groundwater as their primary source of water for drinking, cooking, and bathing.

There are areas around the world, especially in southern Asia, such as Bangladesh and eastern India. In these areas, the concentration of arsenic in groundwater exceeds 0.2 mg/L, which is well above the US EPA's maximum contaminant level (MCL) of 0.010 mg/L and their own national standards of 0.050 mg/L. The MCL represents a safe concentration of a specific chemical for chronic exposure over an average lifetime.

The performance goal of the filter would be to lower the concentration of arsenic below national standards. Our design requirements recognize that a treatment device must be inexpensive, not require the use of electricity, be effective over an acceptable period of time, and not require high technology support or parts, while reducing the arsenic concentration in the water to an acceptable

level. The device will use ferric oxyhydroxide, a known sorbent for arsenic, which comes from the rust of steel. The media will be tested in our own prototype to ensure effectiveness. The poster will discuss the alternatives, design requirements, the design process and data regarding the effectiveness of the prototype.

Poster 250 - Cold-rolling of Novel Mg Alloys

Carlos Soto, Western Michigan University - Pnina Ari-Gur, Western Michigan University - Andrew Kline, Western Michigan University

In any industry, the reduction of costs is the driving force for innovation. One method of reducing costs is to research new materials and determine if the new material is a better alternative to previous ones involved in the manufacturing of products. The very low density of Mg alloys may make them an attractive substitution to heavier alloys, but the poor ductility of Mg has prevented their wide-spread application as cold-formed components. Plastic deformation in Mg alloys is strongly affected by the initial texture, and by process conditions, since the operation of non-basal slip systems requires thermal activation. The insufficient number of slip and twinning systems results in the magnesium alloy demonstrating poor formability at room temperature. The small addition of Sn (tin) and Pb (lead) as alloying elements improves the ductility of magnesium alloys. Three alloys, AZ-31 and two modified alloys (“Sn” and “Pb”), were tested using the Advanced Photon source and the results are analyzed. This research supports further investigation on a large scale of Mg alloys being a feasible replacement in cold-formed components.

Poster 251 - Study of the Heat Treatment and Surface Coatings Influence on the Erosion Behavior of Aluminum and Steel Alloy

Stephen Hill, Mercer University - Dorina Mihut, Mercer University - Vinicius Alves, Mercer University- Joao Borba, Mercer University - Pedro Maleson, Mercer University- Paul Harpe, Mercer University -Rodrigo Couto, Mercer University -Ryan Patterson, Mercer University

The current study is observing the erosion behavior as a surface process that depends on the type and size of eroding particles mixed with water, their pressure intensity, angle of impact, and the surface properties of the eroded material. Aluminum and steel alloys are classic materials used extensively in industry that are suffering erosion as they are parts of equipment working in harsh environmental conditions. The present research involves performing erosion testing on 6061 Aluminum, 4140 Steel, and other metals in their original state, after the corresponding heat treatment and after coating their surface with titanium nitride. The substrates are coated with micron size thickness titanium nitride using the DC high vacuum magnetron sputtering deposition system. The coatings’ thickness is in-situ monitored using a quartz crystal microbalance and ex-situ evaluated using a profilometer. The chemical composition of the structures is characterized using the X-Ray diffraction analysis. All samples are evaluated by a custom designed erosion apparatus using different impingement intensities of eroding particles and angles of impact.

Poster 252 - Starting a New Technology Business in the Drone Marketspace

Shubhankar Gandhi, Rose-Hulman Institute of Technology - John Micheal Van Treek, Rose-Hulman Institute of Technology

Thomas James, Rose-Hulman Institute of Technology

A team from Rose-Hulman Institute of Technology launched a drone gaming and accessory company at the Startup Weekend competition in Twin Cities, Minnesota in January 2017. The problem identified was that after mastering the art of flying, most drone owners do not have much

opportunity to challenge their abilities and hence put their expensive drones away. Drone owners, drone kiosk managers and parents of children who own drones, validated the problem through a series of customer interviews held at the Mall of America in Minneapolis. The solution created was to supplement the burgeoning market of drones with a product line of games for drones. The first product in development is a DIY drone obstacle kit to be set up in the backyard.
Further development plans include a course timing launch pad and a smartphone application to create an online community of digital drone flyers. The poster aims at presenting the future development plan, the business canvas model of our enterprise and the preliminary financial data.

Poster 253 - Design of an ergonomic coffee basket to increase worker productivity and comfort

Iraida Martínez, University of Puerto Rico, Mayagüez Campus - Amanda Dee Moreno-Hernández, University of Puerto Rico, Mayagüez Campus - Cristina Pomales-García, University of Puerto Rico, Mayagüez Campus

In 2013, the Bureau of Labor Statistics reported a total number of recordable cases of nonfatal occupational injuries and illnesses of 5.5 out of 100 workers in Crop Production. Still, many factors may undermine the injuries and Musculoskeletal Disorders (MSD's) suffered by farmers, as national statistics show that only 4 to 10% of farms are subject to the OSHA reporting requirements because they employ less than 11 workers.
Previous attempts to design a coffee harvesting basket showed no effects on productivity, a small reduction on worker-reported pain, increased strain on upper back and shoulders, and increased muscle activity. Our work aims to design a coffee harvesting basket with supporting mechanisms to increase productivity and comfort, focusing on the needs of puerto rican workers. Impacts in worker strain and comfort will be assessed using mixed methods approach (i.e. pressure sensors, biomechanical analysis and questionnaires). With the proposed basket design and harvesting methods improvement, we expect an increase in productivity, comfort and reduction in worker strain. Basket design ideas will assess the form, fit, weight, support and related work methods to empty the basket. A preliminary study showed evidence of stress on the worker's shoulders and backs due to carrying a 30 pound bucket and 90 pound bag, excessive over the shoulder movements during harvesting due to the coffee bush height, and coffee beans lost due to unreachable branches, reducing worker productivity. Evidence of upper body postural evaluation suggested further investigation and changes are required to reduce worker risks, and the development of MSD's. This work in process will document the design methodology to create a coffee harvesting basket, along with the methodology to evaluate its impact. We would like to acknowledge the support of workers in Hacienda Candelaria in Yauco who participated in the preliminary study.

Poster 254 - Impact of Materials Science and Engineering Clubs on students expectations and perceived challenges toward pursuing higher education degrees

Johana Mercado-Colón, University of Puerto Rico, Mayagüez Campus - Zairelys Reyes-Rivera, University of Puerto Rico, Mayagüez Campus - Cristina Pomales-García, University of Puerto Rico, Mayagüez Campus

In partnership with Puerto Rico Public Middle Schools and High Schools, the Nanotechnology Center at the University of Puerto Rico, Mayaguez Campus sponsored 20 Materials Science and Engineering Clubs (MSE), impacting over 500 low income students through outreach activities. Annually, MSE Club members participate in 6 guided hands-on demonstrations, experiments and interactive STEM related activities. A research study to monitor the short and long term effectiveness of the outreach activities in MSE Clubs was conducted using a pre-post test questionnaire. We hypothesise that MSE Club outreach activities impact directly and positively: (1)

students' expectations in pursuing higher education degrees in STEM related fields; (2) increased frequency in conversations with parents about: (a) advanced STEM courses in high school, (b) preparation for the College Board, (c) future professional career and (d) financial aid; (3) interest for pursuing STEM degrees in college; and (4) reduction in perceived challenges to start college in the future. MSE Club members completed the questionnaire at the beginning and end of the academic year. In 2015, 109 (18%; 64% females, 34% males) members from 47% of the 17 active MSE Clubs, submitted answers to both questionnaires. To test our hypotheses, responses were coded, and data was analyzed using descriptive statistics. Results show that 21% of students increased their expectations with regards to advanced degrees, while 90% expected to pursue either bachelors, masters or doctoral degrees in the future. Over 65% maintained or increased the frequency of conversation with parents about advanced STEM courses at high school, the college board, professional degrees or financial aids. On average, 23% increased their interest in pursuing STEM degrees in college and 21% changed their perception about financial aid as a challenge to start college in the future. Overall, research results evidenced the effectiveness of the Center's outreach activities in MSE Clubs.

Poster 255 - The Portevin-Le Chatelier Phenomenon in Al-Mg Alloys Containing Nanoparticles

Michelle Marrero-Garcia, University of Puerto Rico - Mayaguez - Angelisse Ramos-Morales, University of Puerto Rico - Mayaguez - David Florian-Algarin, University of Puerto Rico - Mayaguez - Oscar Marcelo Suarez, University of Puerto Rico – Mayaguez

The Portevin-Le Chatelier (PLC) phenomenon or dynamic strain ageing results from the interaction between dislocations and solute atoms supersaturating a solid solution and presents itself as serrations in the stress- strain curves upon plastic tensile deformation of Al-Mg alloys. This research focuses on the study of the phenomenon when NbB2 nanoparticles are present in a magnesium-supersatured Al matrix, with different levels of Mg. The nanoparticles were obtained by fragmentation in a high energy ball mill, and were then mixed with aluminum powder to obtain Al–NbB2 nanocomposite pellets that were later added to an Al-Mg melt. This was cast into rods that were cold-rolled into 1mm diameter wires. The wires were solution treated and water-quenched. The tensile tests were conducted with rates of 0.125, 0.250 and 0.500 mm/min. As expected, the phenomenon was observable as the material entered the plastic region of the stress-strain curves. The NbB2 nanoparticles affected the phenomenon, causing a reduction of the serrated signal amplitude. Also, it was found that a reduction in the Mg content caused a decrease in the serrated signal amplitude.

Poster 256 - SERVISER: A Car Maintenance and Repair Tracking Program

Fabian Velez-Vicente, Universidad del Turabo - Eduardo Hidalgo-Rijo, Universidad del Turabo - Jaimar Cruz-Cabrera, Universidad del Turabo - Wilma Pabon-Ramirez, Universidad del Turabo

Currently, there are approximately 1.2 billion cars being used all around the world. Surprisingly, Puerto Rico is one of the countries with the biggest number of cars per a thousand inhabitants. There are 635 vehicles per 1000 inhabitants in Puerto Rico. In other words, for each person living in Puerto Rico, there are 0.66 vehicles. Maintaining these vehicles in good working conditions represents a significant expense for most people. It has been estimated that, on average, American citizens spend 1.5 percent of their annual salary on repairs, maintenance, and modifications of their vehicles. Without a detail tracking of these expenses, it is not possible to keep good accounting in regards to how much it costs to keep the vehicle in good working conditions. Hence, there is a need for a platform to help people keep a record of the cost, quantity, date and how often all these

maintenances, repairs, and modifications occurred or should occur. A program named Serviser was developed to help users keep track of all the maintenances, modifications and repairs made to their cars. Serviser includes essential details for the vehicle's maintenances, repairs, and modifications activities such as costs, dates, automotive shop where work was performed, and a reminder for the next maintenance to the vehicle. The Serviser program was developed using C++ as part of the final project of the intermediate programming course. The program was tested with control data, and it was executed with no errors generating the expected results. Future work will include the development of a mobile application.

Poster 257 - NovaCode: A Smart Money Manager Application

Jorge Cruz-Agosto, Universidad del Turabo - Javier Sanchez-Navarro, Universidad del Turabo -Luis Rivera-Gotay, Universidad del Turabo - Wilma Pabon-Ramirez, Universidad del Turabo

Financial management is an issue poorly understood amongst people of all ages. People spend their salary without doing any regards to the accounting of their finances, which may lead to people getting into in high debt situations, particularly unsecured debt (credit cards) and high interest rate loans. The purpose of this project is to design and develop an accounting tool to help people manage their finances. This easy-to-use tool will allow users to track their income and expenses; therefore, they will have more and updated information to make their personal financial decisions, and allow them to maintain a positive balance. The program will be able to store the user's salary and debts, and it will give the user the exact amount of money available to spend, the amount they should put in a savings account. In addition, it is going to pinpoint your location, so it can help the user locate and recommend nearby restaurants, gas stations, etc. based on disposable money. In this way, users of the application will get the most out of their money without compromising their savings and equity. We have developed this personal money assistant using C++ as part of the final project of the intermediate programming course. The program was tested with control data, and it was executed with no errors generating the expected results. Future work will include the development of a mobile application.

Poster 258 - Project Lapsus

Manuel-Jose Perez-Vargas, University of Puerto Rico - Mayaguez - Grexarie Torres-Caraballo, University of Puerto Rico - Mayaguez - Nicole Mendez-Santos, University of Puerto Rico - Mayaguez - Joan Garcia-Torres, University of Puerto Rico – Mayaguez

This is a design project of senior industrial engineering students sponsored by the General & Age Related Disabilities Engineering (GARDE) Program of the National Science Foundation (NSF) focusing on adults with disabilities. In today's market, systems designed for helping caretakers in the process of seating or helping clients to standing positions are not designed for portability or comfort. Current systems are bulky, need an electrical input for them to work, are expensive, and are not designed for portability. Need for affordable and portable systems that meet the purposes already described are on the rise, given that as caretakers take on more strenuous tasks they are more prone to spinal injuries related to the incorrect movements and/or use of excessive force when taking care of clients with mobility problems. The main objective of this project is the creation of a system capable of lessening the amount of stress a caretaker takes into his or her body at the moment of helping a patient to a seating or standing position. The second objective is to lessen the impact stress that the patient's body receives when seating, given that most patients throw themselves into the seat or the caretaker is unable to support their weight when lowering them. The project's success will be defined on being capable of designing a portable, economic, and fully

mechanical system to help in this task taking into consideration ergonomics, cost, portability, and other parameters. The system usefulness will be measured by a series of interviews to patients with mobility problems, caretakers and experts in the area of mobility, including doctors and physical therapists. Analysis will also be validated with real time tests on functional prototypes of the system. The expected delivery of the device is by the end of the Spring 2017 semester.

Poster 259 - Car Maintenance and Services: An Appointment Scheduling Program

Alberto Cruz-Rosario, Universidad del Turabo - Carlos Birriel-Martinez, Universidad del Turabo - Wilma Pabon-Ramirez, Universidad del Turabo

A common problem among automobile owners is to secure a timely appointment at an automotive shop for preventive or reactive maintenance. The former is required by car manufacturer to keep the warranty valid, whereas the latter has to be done when the car breaks down. Even when customers are able to secure a time appointment, they may not get the service right away because of the lack of parts. As result, customer lose time and may be without transportation during the time their automobile is at the shop. The purpose of this project is to create a simple way for clients to schedule a convenient appointment time slot, to verify if the parts needed for the work to be done are available, and to obtain an estimate of the time needed to perform the repair or maintenance service. We have prototyped an application program that provides clients with the ability to see the specific time at which their cars will be taken in for service, the time required for the maintenance or repair service, and the total cost of labor and parts. Clients will have access to a database containing their cars maintenance and service history. The prototype has been developed using C++ programming language, and it part of the final project in the intermediate programming course. The program was tested with control data, and it was executed with no errors generating the expected results for the preventive or reactive car maintenance appointment scheduling. Future work includes the development of a mobile application of this program.

Poster 260 - Automated Rain Shield for a Mechanical Wheelchair

Christopher Pagan-Rodriguez, UPRM - Oscar Salgado-García, UPRM

The automation of processes has always been an extraordinary tool in most cases. Whenever a process or activity needs an improvement because of poor human skill or simply because is not possible to a common person to perform, the developing of an automated tool or process, in most cases, is the answer. As Industrial Engineers we many times face these types of challenges, which to overcome is to bring the best results. That is the case for this project. The objective is to improve the life of an undergraduate computer engineering student in our campus. We face the challenge to empower him to do activities that right now are limited to him. This student normally feels preoccupation because it takes too much time and effort to accomplish certain activities. This serves as a great opportunity, not just as professionals, but also as human beings to improve the quality of living of this person by applying engineering knowledge. In the process of knowing all the everyday major life activities that the student has to perform, we determined that we are going to design, develop and construct an automated rain shield for the mechanical wheelchair of the student. By doing this we expect to empower the student to move across the university campus, getting outside of his house and other places without having fear of getting wet because of rain or damaging his wheelchair. Working in this project means that we will have the opportunity to feel the change in the student way of life, and hopefully bring us the satisfaction of solving a problem using an engineering approach.

Poster 261 - Immersive virtual reality approach for fluid dynamics applications

Daniel Rodriguez, University of Puerto Rico Mayaguez Campus - Gabriel Torres, University of Puerto Rico Mayaguez Campus -Carlos Caro, University of Puerto Rico Mayaguez Campus - Jose Lugo, University of Puerto Rico Mayaguez Campus

Guillermo Araya, University of Puerto Rico Mayaguez Campus

Virtual reality is an emerging technology able to immerse a person within a simulation. This cutting-edge technology can be applied to many fields within science and engineering to provide a unique perspective of the data gathered. As high performance computing and visualization approaches are rapidly gaining ground in research, tools are needed to take advantage of the resulting data. A computational driven discipline such as Fluid Dynamics can be benefitted by the use of virtual reality to visualize the results from a computational simulation. To achieve this extent, the results of a Direct Numerical Simulation are extracted to be viewed in a virtual reality headset.

Direct Numerical Simulation with high spatial/temporal resolution of a spatially-developing turbulent boundary layer is performed. The initial turbulent flow in a zero pressure gradient boundary layer is subjected to a very strong favorable pressure gradient. The sudden acceleration imposed to the turbulent flow induces a concept known as quasi-laminarization. This phenomenon can be visualized by means of the use of an iso- surface algorithm.

An iso-surface algorithm creates a surface from the coordinates of a simulation that contain the same value. Distinct iso-surfaces vary depending on the data set that is used, such as velocity, pressure or temperature, and a chosen iso value. Once the iso-surfaces are calculated, it is then exported into a game engine with virtual reality capabilities. The game engine projects the iso-surface within a virtual reality headset to be viewed in 3D. With the results of a simulation in a headset, a completely immersive experience can be achieved.

Poster 262 - The design and construction of a removable respirator and oxygen tank adapter for a scooter wheelchair

Francisco Alejandro Granado Santos, Universidad de Puerto Rico, Mayaguez - Monica Jorge, Universidad de Puerto Rico, Mayaguez- Mayra Mendez Pinero, Universidad de Puerto Rico, Mayaguez

This is a design project of senior industrial engineering students sponsored by the General & Age Related Disabilities Engineering (GARDE) Program of the National Science Foundation (NSF) focusing on adults with disabilities. The design and construction of a removable respirator and oxygen tank adapter for a scooter wheelchair is going to help a young adult woman that suffers from bilateral hip dysplasia and obliterating bronchiolitis. These are degenerative conditions that are not commonly found together. Hip dysplasia forces the subject to require a scooter wheelchair for daily transport and obliterating bronchiolitis requires the subject to use a Continuous positive airway pressure (CPAP) respirator and oxygen tank all the time. This project has the purpose to help the subject to achieve independence from her care takers by being able to move without the help of others or with minimum help. Achieving independence from an assistant and improving the overall life quality of the user, will be obtained by developing the right cost-effective design for an automated wheelchair adapter to hold an oxygen tank and its corresponding respirator. The use of the adapter for the CPAP respirator will enable the subject to move to further places without assistance, thus increasing her independence from other subjects and engaging on a more active lifestyle. The created device would be evaluated by the identified user and by health professionals prepared to work with people with the above-mentioned conditions. It is the intention of the students design team to deliver the developed device by the end of the Spring semester after being

evaluated and tested as needed.

Poster 263 - Fabrication of Novel Aluminum Welding Fillers Reinforced with NbB2 Nanoparticles

Jorge D. De Jesus SIlva, Universidad Puerto Rico Mayaguez - Andres F. Calle, Universidad Puerto RIco Mayaguez - Oscar M. Suarez, Universidad Puerto RIco Mayaguez

Aluminum welds satisfy requirements of strong joints of parts adding minimal weight, as demanded in many structures. However, the performance of these welds at high temperatures is unsatisfactory showing crack sensitivity. Aluminum fillers containing niobium diboride (NbB2) nanoparticles for TIG welding can improve the weld quality and increase its high-temperature service capacity. Our ongoing research centers on the study of the thermal expansion coefficient of the reinforced filler along with an analysis of the melting behavior upon welding on a commonly-used base material. The thermal expansion coefficient of the filler containing nanoparticles was compared to a commercial 5356 filler through a full factorial design experiment. The hardness and porosity of these materials were also compared through analysis of variance.

Poster 264 - Design and Construction of an Airplane Seat Adaptable Device for a Person with Cerebral Palsy

Michelle Gonzalez Arias Gonzalez-Arias, UPRM - Nicole Castiel, UPRM

This is a design project of senior industrial engineering students sponsored by the General & Age Related Disabilities Engineering (GARDE) Program of the National Science Foundation (NSF) focusing on adults with disabilities. Most people that travel on airplanes have similar concerns: will I get to the airport on time? is my luggage overweight? did I get the window seat? For people with disabilities, traveling on airplanes comes with a few extra worries. In this case, we will be working with a subject that has Cerebral Palsy, a condition that causes his body to have involuntary movements. Currently, his caretakers must seat on both sides and constrain his entire body, specially his legs, to impede his movements from hurting him, or the people around him. The purpose of this project is to design, develop, and manufacture a device that can adapt to airplane seats to provide the necessary support, and constraint, needed for a cerebral palsy patient to avoid spasticity movements. This will also take care of the stress and the danger of construing his movements away from his caretakers. Using a design thinking method and morphological chart exercise, base on the literature revision that we did during the last semester, we created a preliminary design that we will be constructing and testing during this semester. The system usefulness will be evaluated by the identified user, his caretakers and health professionals knowledgeable in the condition of the user. The expected delivery of the device is by the end of the Spring semester 2017.

Poster 265 - Brassier Retrofitting

Gerardo Rodríguez, University of Puerto Rico at Mayaguez - Estela Ortiz, University of Puerto Rico at Mayaguez

This is a design project of senior industrial engineering students sponsored by the General & Age Related Disabilities Engineering (GARDE) Program of the National Science Foundation (NSF) focusing on adults with disabilities. In our current society, each day that passes away we are engaging an independence system, with technologies of infinite capabilities. Moreover, not every person is suited to embrace these changes quickly enough. Consequently, a personal intimate task as simple as getting a brassier put on, is observed to have its difficulties for some users. In particular, an identified user with Encephalopathy and suffering from oral motor problems, she can't

communicate with words, she also has problems with balance, and lack of fine motor skills, this last conditions is the one that is used to develop a specific design. The main objective of this project is to design and develop a brassier retrofitting for users with limited range of motion and motor skills. The identified user requires the intervention of a second person to put on a brassier, specifically in the closure. The intended device must provide the user with privacy on this daily task, as well as independence while increasing her auto sufficiency in repetitive tasks. Through morphological analysis and research, a preliminary additive model that will be 3D printed has being created. The purpose is to start with the 3D printed device, then make a functional prototype, and finally a ready to use and deliverable unibody product for the user. The focus is on front closing brassieres and the expected delivery of this invention is by the end of the Spring 2017 semester. Before delivering the device, it will be evaluated by the user and by appropriate health professionals to ensure it is functioning properly.

Poster 267 - RealTimePC: An Outreach Initiative to Transform Industrial Engineering

Lourdes Medina, University of Puerto Rico, Mayaguez Campus - Maria Hernandez, University of Puerto Rico, Mayaguez Campus - Sabrina Sierra, University of Puerto Rico, Mayaguez Campus - Julienne Deynes, University of Puerto Rico, Mayaguez Campus

IƆDEAS (Improving Design Decisions in Engineering and Applied Systems) Research Group is dedicated to innovate in the areas of automation as well as product development and process improvement. The group is affiliated to the Industrial Engineering Department and has accepted the challenge of doing outreach activities to inspire the next generation of engineers. IƆDEAS pioneered towards providing a meaningful learning experience to high school students of all parts of Puerto Rico by creating the first Industrial Engineering summer camp: Real Time Process Control. Although the summer camp focuses in the field of Industrial Engineering, it is also a space to promote receiving an education from the UPR system, pursuing a college career in general, and also provide enough information and hands-on experiences to consider Industrial Engineering as a career. IƆDEAS acknowledges Puerto Rico and the world is facing serious challenges that this and future generations face the responsibility of overcoming by making important decisions, and represent positive changes towards the well being of humanity. The message IƆDEAS seeks to deliver and portray is that many of these challenges can reach and actually are in the scope of Science, Technology, Engineering and Math (STEM). It is through this realization that RealTimePC seeks to promote that Industrial Engineering is an exciting option to become the problem solvers of the future. During campus open houses and laboratory demonstrations, automation has been one of the main attractive to young Medina et al. students. For this reason it is one of the core elements of Real Time Process Control summer camp: educating through automation, building a small-scale model and watching it work at the end of the program.

Poster 268 - The Science Behind the Creation of a Design Challenge for Research

Julienne Deynes, University of Puerto Rico, Mayaguez Campus - Sabrina Sierra, University of Puerto Rico, Mayaguez Campus

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In the past years design challenges have become very popular amongst universities and education environments in general. Different intentions motivate the creation of such events. For some, a design challenge sets the environment for research while others use it to motivate entrepreneurship and innovation. Some may argue about the effectiveness of these events to

trigger the creation of start-ups or realistic businesses. Considering that design challenges are not necessarily planned with much science taken into account and with these motivations, this work provides a scientific perspective for the effective planning of a design challenge. Starting with the identification of needs, the most important phase of the design process, researchers should carefully consider the information to be provided to design teams. Considering it can affect the outcome of possible solutions, since the design process needs to be open for creative ideation. Depending on the aim of the event a needs assessment should be conducted to openly approach the objective. Recruitment is not trivial. Therefore, to attract highly performing participants a literature review of the characteristics good designers should have is provided along with the instruments developed for this purpose. In addition, team characteristics are reviewed to obtain a selective group that can offer the appropriate structure to enhance each team's performance. The schedule preparation is addressed by comparing similar events to approach the design challenge in the most effective way possible. The result of this study is intended to guide in a successful planning of a design challenge with the use of scientific resources as a means to promote design challenges for research purposes.

Poster 269 - Characterizing Teamwork in Google Docs as a Web-based Collaborative Environment

Jessica Gonzalez, UPRM - Elizabeth Ayala, UPRM - Joshua Bonilla, UPRM - Lourdes Medina, UPRM

Effective collaboration and communication when working in teams are amongst the 21st century skills required to develop competent students that are able to address complex challenges. However, for most students, teamwork is a challenge by itself. Differences in availability, workload assignments, and sense of responsibility represent a challenge that increase with the group size. Effective engagement of diverse resources enriches any project outcome as a result of different backgrounds, experiences and expertise.

Nowadays, technology imposes new requirements were faster communication tools represent expectations for faster outcomes. With these motivations, the objective of this research is to examine how technology enables this process in relation to team collaboration and communication. In particular, a methodology is developed to characterize teamwork in the context of web-based collaborative environments such as Google docs. The impact of this research is beyond traditional educational settings since web-based collaborative environments can be used as mechanisms to facilitate distance education while implementing project-based learning.

Inspired by the game Guitar Hero, team iterations are analyzed. Using Google docs history option, a timeline is created of every edit in the order that they were performed and with details of the team member involved. Two case studies are performed to study how teams complete tasks during the Fuzzy-Front End's ideation process with different techniques: radial thinking, analogies, inversion and morphological chart. Results have shown that students tend to divide the work with limited edits to the work of their peers. While students knew that the professor had access to the document, they still completed most of the work near the deadline.

Additional results include detailed analysis of iterations per task completed.

Poster 270 - Why food comes cold to the customer's table?. Statistical Analysis of the process of delivering food in a restaurant

Grabiel Melo-Figueroa, Polytechnic University of Puerto Rico - Juan M Fernandez, Polytechnic University of Puerto Rico

Ricardo Davila, Polytechnic University of Puerto Rico- Maria M Garcia-Sandoval, Polytechnic University of Puerto Rico

Using the DMAIC methodology and quality tools a Latin Restaurant were assessed to improve customer service. In the analysis of VOC it was determined that the number one complaint was delivering customer cold meals. According to literature review an important factor of quality service in a restaurant is delivering meals to a proper temperature. The average waiting to deliver meals order to a customer was 49.07 minutes with a standard deviation of 21.37. The average time to complete a meal in one order was 18.71 minutes. On average the first meal of an order waited 5 minutes. The process flow for delivery the food orders was analyzed. Furthermore, the problem was analyzed using a cause and effect and 5S tool. Multiple factors that delay the delivery of the meals were identified. Among them, the space in the kitchen, the availability of tools and to prepare the meals, distribution of tasks between the cooks, the temperature of the place where dishes are placed ready to deliver among others. To reduce customer complaints some improvement were suggests.

Poster 271 - Recycling onto functional domestic artifacts: an educational and technical endeavor

Stephanie Villanueva, The Applied Optimization Group at UPRM

About 80% of the plastic water containers in the US end up in the trash. These take tens to hundreds of years to degrade. Recycling has been recognized as a desirable activity that, nonetheless, is still far from being widespread. Our group has proposed that, in order to make recycling more attractive, it is necessary for it to result in goods that are truly useful and immediately available for use. In previous works, the prototyping of a planar self-assembly was carried out by our group resulting in small modules that could withstand up to 150 lbs in flexural tests. These 3D printed modules could then be further assembled to create larger planar objects. This work extends these design and testing efforts to produce stepping-stones for home gardens. An assessment on the viability of the final product will be presented. Eventually, these modules currently 3D printed using PLA, could be produced with recycled PET from bottles. The intention is, then, to tie recycling with convenient usefulness to drive design and the development of a simple personal recycling system.

Poster 272 - Fuzzy Logic Controller Realization Using Microcontrollers

Luis Santiago, University of Puerto Rico - Jonathan Fortis, University of Puerto Rico

Introduction Fuzzy logic is the codification of common sense, it can model nonlinear functions of arbitrary complexity and is tolerant to imprecise data. Fuzzy logic (FL) controlling systems are based on a set of rules established by an expert. These rules are translated into mathematical steps which allow the realization of a physical controller.

Problem & Hipotesis Instead of using traditional control systems and Boolean logic, we can use fuzzy logic as a control system to analyze inputs from quadcopter orientation and outcast outputs to the four motors in terms that humans can understand, which can makes it easier to automate tasks that are already performed by humans. Our Flight Stabilization Controller will apply Fuzzy Logic on MSP-430 and KL25Z microcontrollers from Texas Instruments and NXP respectively. The system will be done using two realizations: a) Lookup table which contains pre- processed actions to

compensate position changes given by sensor inputs. b) Program the Fuzzy Logic Control System within the microcontrollers.

Objectives Fuzzy Logic Controller will be used to make a Flight Controller which stabilizes a quadcopter at its current position, holding orientation and altitude against position changes. Analyze and examine inputs from a 10 DoF Inertial Measuring Unit (IMU) which consists of accelerometer, gyroscope, compass and barometer. Interpret collected data and process it using FL controllers and PID controllers to provide a reliable quadcopter stabilization.

Result Quadcopter orientation and motor power simulations were made in MATLAB Fuzzy Logic Toolbox. The FL functions applied to orientation and motor power used three linguistic variables: low, medium, high for each axis. A preliminary Reference Lookup Table was stored from MATLAB Fuzzy Logic Toolbox into MCU ROM. Motor Control Interface with microcontroller has been designed using MSP-430 using Pulse Width Modulation (PWM) at an operation frequency of 500Hz. IMU chip interface has been done with the use of I2C Serial communication which we obtain yaw, roll pitch and height values with temperature compensation.

Future Work Improve IMU orientation data with the use of Filters and error compensation. Continue FL programming design for the target MCUs. Design a testing area which restraints the quadcopter within an area for testing purposes.

Poster 273 - VESO-Drone: A Novel Drone-Carried Service System for Emergency Response Applications

Fernando Ortiz, UPRM - Kenneth Padro, UPRM - Nicole Lopez, UPRM

The Versatile Service Oriented Wireless Mesh Network (VESO Mesh) is a useful platform developed on a previous project for IAP. It is a mobile ad-hoc network with data storage, processing and distribution capabilities inside the mesh network. The main components are small, single board computer that compose the nodes of the wireless mesh, running the Debian based Voyage Linux as server and Optimized Link State (OLSR) as a routing protocol.

On a previous IAP submission, the current version of VESO Mesh was used as a platform in hardware and software for M2M applications. The result was an Interface Control Document (ICD) that describes the configuration of the system for such purposes. The main goal of this project is to use the ICD to develop and evaluate a VESO-Drone system for data dissemination in emergency response via a web and/or mobile application.

Poster 274 - The Tech. Carnival: A STEM Outreach Program for HS Students

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Karina Martinez, University of Puerto Rico at Mayaguez - Pedro Rivera, University of Puerto Rico at Mayaguez
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Maria Jimenez, University of Puerto Rico at Mayaguez

With the advancements in technology, it has become apparent that the demand for professionals in the areas of science, technology, engineering, and mathematics (STEM) is drastically increasing with the years.

Students from high schools in Puerto Rico's public education system receive little exposure to these areas, especially electrical and computer engineering (ECE). The proposed outreach program, "The Tech.

Carnival", is based on interactive games that students can recreate and aims to increase interest and exposure about the previously mentioned areas. It aims to achieve this goal by focusing the outreach program on high school students from public schools in Puerto Rico considering their level of competence and knowledge.

The idea is to provide the students with a kit that includes the materials needed to recreate the game and a step-by-step manual corresponding to the game module. They will have limited time to complete the game while working in teams. In case any questions arise, the teacher in charge at the moment will have a teacher's guide with general information about the game modules and a troubleshooting section. In general, this program implements a series of interactive games that will vastly improve the students' knowledge on certain topics such as electrical and computer engineering, hardware, software, teamwork, basic concepts of engineering, etc. The students will be given an assessment or survey to the students before and after the activity to measure the effectiveness of the outreach program and receive feedback from students so that we can adapt the required modifications to the program.

Poster 275 - Water Disinfection Alternatives

Jomary Torres, Polytechnic University of Puerto Rico - Alexamar Rosario, Polytechnic University of Puerto Rico - Perla Lopez, Polytechnic University of Puerto Rico

The most used method for the disinfection of water is chlorine gas. This is the most common method used in potable water and sewerage filtration plants in Puerto Rico. It is known that chlorine gas represents a high risk for the health and safety of employees and surrounding communities. This compound also represents risks to the environment and fauna. Due to this, the investigation of different disinfection alternatives was produced to replace the chlorine gas system in the Filtros de Canóvanas plant. The main goal is to find a viable alternative that is cost-effective and economically competitive, easy to handle and that significantly minimizes the risk of health and the environment. To develop this research, we begin with a literature review of the different methods that exist of disinfecting drinking water. After this analysis, two possible alternatives were selected. These were; sodium hypochlorite, better known as liquid chlorine and calcium hypochlorite, which is in solid form. Following an evaluation of the possible limitations and benefits of each option, taking into account the objectives of the research, it was determined that the best option was to replace the chlorine gas with a liquid chlorine application system. Liquid chlorine (sodium hypochlorite) is commercially available in different concentrations ranging from 12% to 20% by volume of chlorine in solution. By a jar tests, it was determined that the use of a more concentrated solution is more effective. Representing the best economic alternative and allowing a greater amount of storage while maintaining the same application conditions as the different concentrations. In short, the option more costs beneficial and more effective for the filtration plant. The design does not require major considerations for the handling of the product. Two 1,000 gallon tanks with a pumping application.

Poster 276 - Hardware in the Loop Simulation of a Photovoltaic Generator using a Texas Instrument Platform

Luis Torres Soto, University of Puerto Rico at Mayaguez - Natalie Rivera Torres, University of Puerto Rico at Mayaguez

Edna Rivera Sepulveda, University of Puerto Rico at Mayaguez - Sergio Alzate Drada, University of Puerto Rico at Mayaguez

Having in mind that Puerto Rico has a large annual solar energy and that the dependency on fossil fuels needs to be eliminated, this project proposes to develop a Hardware in the Loop (HIL) simulation of a photovoltaic (PV) generator using a Texas Instruments (TI) platform as a possible solution for energy sources. The main objective of our project is to encourage the use of renewable energy in Puerto Rico for the establishment of a paradigm shift of the energy sector. This will be

based on distributed generation and Smart Grids. Using the concept of Hardware-in-the-Loop (HIL) we will model a photovoltaic inverter to characterize the generation capacities that Puerto Rico has. Hardware in the Loop consists of a type of real time simulation to test controller strategies where the controller responds, in real time, to realistic virtual changes of process variables, such as Solar Irradiance and Temperature. To achieve this, two different control strategies will be developed to analyze the behavior of the PV generator when small and large disturbances appear, such as a cloudy day. The entire system will be simulated with the use of low cost Printed Circuit Boards (PCB) in order to make the program algorithm efficient in terms of time to carry out instructions and avoid to spend money on hardware that may not fit the ideal scenario. This project expects to open door for further research on renewable energy resources and to be able to construct a working prototype that fits Puerto Rico's system.

Poster 277 - Multi-sensor Buoys for Underwater Data Collection

Luis Millán, University of Puerto Rico at Mayaguez - Luis Padró, University of Puerto Rico at Mayaguez - Leslie Soto, University of Puerto Rico at Mayaguez - Rolando Ortiz, University of Puerto Rico at Mayaguez

Unprovoked shark attacks are a cause of concern among surfers, divers, and swimmers in general. Data collected by the International Shark Attack File (ISAF) since 1958 shows that over 2500 shark attacks had occurred around the world in the last 50 years. These attacks are not usually mortal but can cause severe health and financial problems to the victims. Having concern for water safety, the first phase for the shark detection system's design, a solar powered multi-sensor buoy. The first phase of the implementation of this system consists of a multi-sensor buoy equipped with sonar technology and a visible camera in order to collect underwater data. The lack of studies in underwater data to distinguish between marine species is a problem within the scientific community. The principal reason for the absence of advanced technology to explore harsh environments is because of its high cost. As a result, the first phase of the system will provide a solution to this problem by making available a system capable of recording marine data with the advantage that this design can be implemented as an array of buoys capable of covering more area with the capabilities of communicating with other buoys. The product can be acquired by university departments, research centers or general investigators interested in studying the marine life. Finally, it will provide the necessary information for the development of the second phase of the project, which include the design of a classifier to detect sharks and alert nearby swimmers of a shark's presence.

Poster 278 - Piezoelectric Template

Carlos Feliciano Morales, Ingenieria

According to the law of conservation of energy this can't be created or destroyed, only transformed. As a result, the total amount of energy never changes. Kinetic energy is associated with bodies in motion and depends on mass and velocity. The discovery of the direct piezoelectric effect was in 1880 by the Curie brothers, they proved to be able to capture energy present in movements and more when pressure is applied on a polarized glass, and that the deformation causes an electric current. Based on these data the following problem was developed: Will the piezoelectric be able to transform kinetic energy caused by pressure when making movements into electric energy to recharge a portable battery of 2000mA? After evaluating the information on the topic, the following hypothesis was proposed: If the piezoelectric method is used, we will be able to transform kinetic energy present in electric energy, then it can be stored in a battery of 2000mA to be used for

recharge mobile devices. The materials used are: piece of PVC, pair of sneakers, 14 piezoelectric cells, conductive cables, industrial glue, small welder, tin, diode bridge, voltmeter, battery, USB cable and connectors. The procedure begins by drawing a template on the PVC and cutting it, then tracing the 14 piezocells on the PVC and removing this area. Then make 6 horizontal lines and cut through each line, glue the piezocells in each place and weld them in parallel. Place a bridge of diodes and solder the cells to the AC entrance and the battery to the DC departures of the bridge with two connectors. In conclusion, piezoelectric insoles are not only an innovative method for energy transformation, it also helps to lower obesity and increase physical activity in people with a cost-effective and completely natural way.

Poster 279 - 3D Point Cloud Exploitation for Line of Sight Analysis

Edwin Rivera, University of Puerto Rico - Mayagüez - Yomar Ruiz, University of Puerto Rico – Mayagüez - José Natal, University of Puerto Rico - Mayagüez - Ivan Caballero, University of Puerto Rico – Mayagüez - Stephanie García, University of Puerto Rico - Mayagüez

A Point Cloud is a data structure that represents a collection of n-dimensional points (usually in 3-D). Points are used to represent objects virtually for applications that require models for simulations, animations, and entertainment. These point clouds can also be a terrain representation of a location in which a Line of Sight (LOS) algorithm can be implemented to identify the visibility from a point to an object. Some possible uses for LOS are: building design, surveillance cameras, video games, telecommunications, and real estate. Due to the ever growing precision of sensors to extract the morphological information from real objects, point clouds have become denser. As a consequence, the time complexity of the algorithms that process that information has become a point of interest in many applications. Also, common algorithms utilized for image processing cannot be implemented to execute a line of sight analysis in a point cloud due to its data lacking a reference to adjacent points in the Euclidean space. For this reason, an original design was created for the LOS algorithm with the knowledge of its functionality and other point cloud algorithms such as K-nearest neighbor and Edge Detection. The algorithm is being implemented in C++ and after finalizing the sequential version we will develop a parallelized version with Compute Unified Device Architecture (CUDA) to optimize the solution. This is considerable because of the massively parallel properties that the current sequential LOS algorithm has due to having various simple and independent instructions for each of the points in the collection.

Poster 280 - DESIGN AND CHARACTERIZATION OF CONCRETE MASONRY CONTAINING PLASTIC AGGREGATE.

Jossmarlyn Montanez Rivera, CREST - Hildelix Soto Toro, CREST - Oscar Marcelo Suárez, CREST

Plastics are materials with multiple desirable properties including low density, durability, low fabrication cost, and ability to be molded in different forms, which favor their application in the automotive, aeronautical, food, and pharmaceutical industries. Further, plastics are categorized as recyclable, reusable, and disposable. As a consequence, the broad demand of plastic products have caused a dramatic accumulation of this material waste. In effect, in Puerto Rico not all plastics are recycled and most end in the landfills and the ocean. To counter this environmental problem, different concrete bricks was designed with replacement of aggregates with plastic chips. This research particularly focused on the ones with the denominations of PET carbon, parts of plastic pallets, and unsorted plastic mixtures. The concrete mix designs for the brick are composed of Portland cement, sand, plastic, and water. Mechanical characterization is performed via

compressive tests according to the ASTM C55 14a standard. As expected, the use of plastic in large quantities reduces the compressive strength of the bricks. Nevertheless, depending of the plastic type used the minimum strength, as established in the standard, could be achieved. The maximum plastic percentage should not be higher than 30% by brick volume to obtain a manageable and strong brick. The compressive test results exceeds 2,000 psi, minimum value for the concrete solid bricks. In conclusion, the results of this research justify the use of plastic in concrete masonry bricks. As future work, mixes for structural concrete with the incorporation of fly ash and plastic will be studied. This studies contemplate the used of silica nanoparticles to improve concrete performance. This work was made possible with the generous support of Reciclaje del Norte Ltd. and the National Science Foundation under grant number HRD 1345156 (CREST program).

Poster 281 - ANALYISIS OF MECHANICAL PROPERTIES OF CONCRETE CONTAINING FLY ASH AND NANOSILICA

Silvia T. Esteves, University of Puerto Rico Mayagüez -Hildélix Soto, University of Puerto Rico Mayagüez - O. Marcelo Suárez, University of Puerto Rico Mayagüez

Environmental protection is a major concern in the construction industry nowadays. For instance, in concrete manufacturing fly ash is a repurposed industrial waste. Unfortunately, fly ash decreases the rate of strengthening in concrete at early age due to a resulting slower reaction. Hence, the main focus of this research has been to design a high strength concrete using fly ash and nanostructured silica (nS). Nanosilica is used to counter balance the strength loss due to the addition of fly ash, used as partial replacement of cement. The use of nS in the construction industry is not yet common, causing that the mechanical properties of concrete with these partial replacements are not fully understood. Compressive strength, tensile strength, flexural, absorption, and permeability tests were performed at an age of 7, 28, and 90 days of curing of concrete containing fly ash and nS. In the present research, concrete microstructure and overall strength was found to be improved by adding nS. Future work will focus on further understanding other mechanical properties such as hardness, creep deformation, fatigue, and durability. This work was made possible with the support of the National Science Foundation under grant number HRD 1345156 (CREST program).

Poster 282 - 3D Rum

Raisamarie Robles Colon, University of Puerto Rico Mayaguez Campus - Richard Rosario Santiago, University of Puerto Rico Mayaguez campus

A 3D printer is a machine design to create any object, within the printer's parameters and capabilities, that the designer desires for many applications. The printer uses thermal plastic filament's that are heated to a certain temperature (depending on what type of material is used) and then cooled to room temperature. This is how each layer is created and by staking each layer on top of the other one the part or object comes to life. There are many type of filament like PLA, ABS and many more. The 3D printer is a very useful device that can create many things like a simple geometric shape up to a scale model airplane. Many people use 3D printers to create toys for children, home improvement parts and more, the limitation are endless. Although the 3D printing seems very new, it can be dated back to the 1980's when some industries used it to create a fast and cost effective prototype for product development. But now because of new technologies and a more cost- effective manufacturing process 3D printing has occupied the lives of many inventors,

fanatics, consumers and is used for education. This is because of the resourcefulness of the printer. 3D-RUM is a special group project that dedicated to investigate which are the full capacities and application of 3D-printing. The team has recently started to create a homemade 3D printer in which could have different uses. One of the team goal is to create a 3D printer that can be somewhat self-efficient by having parts that are created by its own. If done like this the printer life span would only depend on its mechanical and electronical part. 3D-RUM long term goal is the possible creation of printers that have the capability of printing a faster and more cost-effective prosthesis.

Poster 283 - Photovoltaic Testing: Low-Cost Smart Solar Simulator

Francisco Matos, University of Puerto Rico Mayaguez Campus - Alejandro Aponte, University of Puerto Rico Mayaguez

The project was started based on the need, of various groups in the university, for a tool to perform indoor tests to photovoltaic systems, because of this the team decided to design and construct a solar simulator. A Solar simulator is an instrument used to imitate the spectrum and irradiation of the sunlight; usually used to test photovoltaic panels in a controlled environment. The goal of this research is to create a LED solar simulator. However, to exceed LED solar simulators already in the market, the device the team is aiming for will be cost-effective, transportable and accessible to educational entities with a limited budget for instrumentation or research. The research is interdisciplinary, combining students from mechanical, electrical and industrial engineering majors.

Poster 284 - Bluetad Mobile Application

Jonathan Montañez, Universidad del Turabo - José Almodóvar-Faría, Universidad del Turabo

Everyday college professors deal with many tasks. Some of these tasks are directly related to education, others are not. For instance, professors must keep record of student attendance which is very often done by passing around a sign-in sheet and then manually entering data into a computer in order to generate and send attendance reports. Automating non-educational tasks allows instructors to focus on improving their teaching. Furthermore, using technology for educational tasks improves the classroom learning experience. For example, in some active learning techniques, instructors may survey the classroom to get feedback on student knowledge and clarify misconceptions. However, this practice is only effective if students participate. Often students restrain from answering in class mainly due to the fear of being wrong. Having a method such as an electronic polling using mobile devices to quickly and anonymously get students to speak their mind may increase student participation.

Developing a comprehensive mobile application to facilitate faculty tasks will ultimately result in a superior classroom experience. This is the focus of the Bluetad mobile application project. During its starting phase, Bluetad features will include automated attendance keeping and in-class electronic polling. To achieve this, the Bluetad mobile application will carry out a node discovery technique employing Bluetooth LE (BLE) technology to create intermittent local networks. These networks will address the built-in transmission range limitation of BLE (30 meters) by having nodes discover other neighboring nodes and populate them in a data table. This data will then be routed to the sink node which will hold the data for all nodes within a determined area. Bluetad's long term goal is to keep adding functionalities that will address classroom limitations and challenges in order to improve the learning experience and progress education.

Poster 285 - Improving the Efficiency of a Savonius Wind Turbine Learning Module Experiment for Distance Learning Courses

Lamar Bostick, Clemson University - Chris Knippenberg, Clemson University - Hayden Wilson, Clemson University - Jennifer Asselin, Clemson University - John Wagner, Clemson University -Todd Schweisinger, Clemson University

To improve student outcomes in a wind energy course, a mobile wind energy experiment and learning module for distance learning was prototyped. A Savonius wind turbine design was chosen due its relatively simple construction and quality start up characteristics. Traditional Savonius wind turbines consist of two semicircle cups placed around a shaft to create an s-shaped rotor attached to a geared generator. The prototype gear box was removed from the turbine for intimal assessment because the rotor was unable to overcome the torque requirement at the wind speeds tested. The electrical power generation of this prototype wind turbine was evaluated using a blower at three different wind velocities; 16.9m/sec, 19.8m/sec, and 21.9m/sec. The peak electrical power output at the maximum wind speed tested was 2.7 Watts, which was 40% less than the theoretically predicted output. A research team of undergraduate students, funded by the Clemson University Creative Inquiry Program, is tasked with designing a new rotor that would yield a greater electrical power output. The team consists of students in their freshman to senior years, pursuing majors in mechanical or electrical engineering at Clemson, and enrolled in one credit hour of research. The team focused on changing the rotor geometry. The redesigned turbine consists of two modified Savonius rotors that are stacked atop of each other, and offset from one another. The rotor blade geometry is changed to be more elliptical in shape and offset from the shaft of the wind turbine to increase rotor speed. The new system will be evaluated for the same testing conditions to determine how much improvement the changes in rotor geometry improve electrical power output. The new design is currently being manufactured by the campus machine shop.

Poster 286 - The RUM3D Project

Faviola Villariny, University of Puerto Rico - Mayagüez - Félix Martínez, University of Puerto Rico – Mayagüez

For the past few years, technology has taken great steps on turning creative thoughts into reality. First, 3D printers came out, which let you design anything you want from your computer and print it in 3D. From this, people have been creating all kinds of 3D printing, including organs with Bio 3D printing. But a new way of turning dreams into reality has been developed: 3D pens. 3D pens let you draw anything you want on air.

Many models have come out with unique and innovative 3D pens, including bio pens to assist physicians during surgeries. The goal is to create a model that's affordable, easy to use and that can improve learning experiences, along with showing a new side of the world of engineering.

Poster 287 - Avara Manufacturing Industry Utility Steam Improvemets

Roxanna Vazquez, Polytechnic University of Puerto Rico - Heidy Sierra, Polytechnic University of Puerto Rico - Jenmarie Acevedo, Polytechnic University of Puerto Rico

At Avara Pharmaceutical Services, located in Arecibo, Puerto Rico, the manufacturing facility is comprised of a heating system from which a vital utility for the process is obtained, referring to vapor. The mainstay technology used to generate the high-pressure, high-temperature utility steam is a diesel oil fire tube boiler, whose efficiency is currently compromised by several factors, some of which are thermal losses experienced by the system and parameters controlled by the equipment that precedes do not benefit the process. Thermal losses in the form of radiation and convection, as well as the effectiveness of the heat exchanger is accounted for in the determination of the boiler

overall efficiency, also denominated fuel-to-steam efficiency. For this heating system design, the primary concern is the operating cost of the plant; which is mostly dependent on the energy source of the boiler, referring to the diesel oil. The overall boiler efficiency represents the difference between the energy input and energy output of the system. A fire tube boiler that has been operating over a period of twenty years may have a maximum efficiency of 85%; however, typical efficiency values range between 65% to 75%; through calculation the efficiency of the fire tube boiler was found to be 71%. For this case, 29% of the energy input exits through the equipment's chimney with no appreciable benefit. Several energy saving considerations where proposed to the client, where the heat recovery from the flue gas through the implementation of a four-coil rectangular economizer would make the process feasible. Implementing the economizer would increase the efficiency of the equipment to 76%, lower the diesel consumption to 364,000 gal/ year, which reflects an annual saving of ,000 from which Avara Pharmaceutical Services would benefit.

Poster 288 - Synthesis, Characterization and Swelling Ratios of pH-Sensing Solid-State Magnetic Resonance Imaging Contrast Agents

Michael Concepción Santana, Polythecnic University, San Juan, Puerto Rico - Gregory J. Ekchian, Massachusetts Institute of Technology - Michael J. Cima, Massachusetts Institute of Technology

Magnetic Resonance Imaging (MRI) is a noninvasive method that uses magnetic fields to produce internal images of the body with good contrast between soft tissues. MRI scans of the body can be augmented with the addition of liquid contrast agents. These agents are frequently gadolinium based and aid in the characterization of tissue damage and tumors. The objective of this project is to synthesize a pH-sensing MRI contrast agent that is sensitive in the neutral pH range (6.5 to 7.4). MRI depends on the excitation and relaxation of protons. The difference in the rate at which the protons relax can provide contrast in images between different types of tissue and foreign materials and tissue. Bound protons on hydrogels tend to have shorter relaxation times compared to protons on free water molecules. The project includes the synthesis of copolymer hydrogel-based contrast agents. These materials were characterized using Time Domain Nuclear Magnetic Resonance (NMR) (Bruker Minispec, 0.47T) and swelling ratios calculations. MRI depends on the excitation and relaxation of protons.

Poster 289 - Analysis of Spatial-Spectral Relationships in Real Hyperspectral Imaging to use for Hyperspectral Unmixing.

Miguel A. Goenaga-Jimenez, Universidad del Turabo - Eduardo Castillo-Charris, Universidad del Turabo

The basic statement on the linear unmixing model apply to hyperspectral images, is that the pixels are in the convex hull of the cone with the endmembers at its vertices. Real hyperspectral data, in general, does not follow this structure. Here we use data exploration to analyze how spatial information can be used to extract uniform regions in the image. Several spectral unmixing algorithms look for a single convex region to depict a hyperspectral scene for a particular set of endmembers. A convex region can be defined in Euclidian space as if for every pair of points within the data cloud, every point on the straight line segment that joins the pair of points is also within the data cloud. For instance a solid cube is convex data cloud. This research proposes a methodology to perform unsupervised unmixing establishing how the spatial information help to capture the relationship between the grade of uniformity of the clusters, and the convex regions in the image data set. The effect of splitting the image helps us to obtain homogeneous regions. To achieve the localization of the endmember, principal component analysis is used, and the first three of them containing about 96% of the total information of hyperspectral image and then they are plotted for

visualization their behavior. This analysis help us to understand the relation between the spatial domain information and data cloud structure.

We saw experimentally that by partitioning the image in homogeneous regions we can decompose the data cloud in piece wise convex regions. We can then apply linear unmixing to these regions and easily extract endmembers for different homogeneous tiles in the image and shows how to perform hyperspectral unmixing using local information and merge them at a global level to develop an accurate description of the scene under study.

Poster 290 - Image Processing Based Bio-Sensing System for Cancer Cells Detection

Jenipher D. González Aponte, Universidad del Turabo - Miguel A. Goenaga-Jimenez, Universidad del Turabo - Lisandro F. Cunci-Perez, Universidad del Turabo

Would it be beneficial to have a system that provides preliminary results of whether a patient has cancer? While several techniques were developed for the detection of cancer, pathological analysis has been the gold standard. However, it may take a significant amount of time to provide definite results, which sometimes can be subjective to the Pathologist that did the analysis. In some cases, the results come back negative using an enormous amount of resources for the test. In other cases, the result may be positive after waiting for many weeks without the patient having started the treatment, this leaves the patient with a worse prognosis than if the treatment was started earlier. For this reason, accurate and fast diagnostic tools are required to be developed.

Biosensors are devices that recognize a biological component and transduces their detection into readable outputs for electronic systems to understand and process. However, Bio sensing Systems are expensive and require experts to operate, which are not available in many parts of the world. The main purpose of this research is design and develop an electric embedded system that will identify cancer cells from an image and quantifying the amount of the pixels in the RGB spectrum around the cells, using algorithms from image processing for detection, together with fluorescence probes, can provide the diagnosis to the physician in just a few hours or less, which can be used to start an early treatment to improve the prognosis

Poster 291 - Autonomous Hybrid Power Generation System for Low-Power Applications as Public Lighting and Homemade Hydroponic Systems in Puerto Rico.

Hector L. Carrasco Rodriguez, Universidad del Turabo - Miguel A. Goenaga-Jimenez, Universidad del Turabo

In recent years there has been an increasing use of NFT hydroponic systems, to supply a variety of freshly vegetables in homes (to help the local food safety), increasing accordingly electric power consumption in these homes. Similarly, the constant use of public lighting accounts for about 1.5% of the total energy generated by the AEE. Therefore, with the current economic crisis facing the country, it is imperative to explore alternative sources of energy such as wind, solar and geothermal; natural resources available of our tropical environment, that will help to mitigate a possible increase in the cost of energy while providing clean energy and reducing our greenhouse gases emissions. The most affected by a possible increase in the energy cost would be the agro-industry. Also, an increment on cost of energy consumed by public lighting will be most likely passed to the customers of the AEE. How could we help for these agro-industry not be affected by the increasing cost of energy, and the AEE to be more efficient with lighting public service? It is proposed to create an autonomous hybrid power generation system for low-power applications as public lighting and homemade hydroponic systems. The proposed system is a combination of wind and solar energy transformation to electric energy for power generation. The wind energy is

transformed using a wind turbine with a low speed electric generator (3-5 m/s) and will be rectified and stored in a battery bank. On the other hand, the solar energy is converted to electrical energy through solar cells that will be stored directly on the batteries bank with a capacity of up to 300W per 24h. The system is programmed to work automatically isolated from the network. A sensor monitors two types of energy and simultaneously charge batteries and supply power to the load. It also, has the ability to supply power of the batteries if have not enough wind speed have and is night.

Poster 292 - Experimentation and Analysis of the PGA900 to Find New Fields of Application

Carlos Rivera, UPRM Rodnie Hernandez, UPRM

The PGA900 (Programmable Gain Amplifier) is currently used in applications that involve pressure and temperature monitor. Further applications are being searched in fluid field. Our objective is to design a dynamic incline sensor using the PGA900 as a new instrumentation field of application. These sensors are becoming popular in video games, aerial drones and entertainment as technology keeps advancing. Using the high resolution and processing power offered by the chip, it should result in higher precision for a better experience and performance of electronic devices.

Friday 12:30pm - 2:00pm

Welcome and Keynote Lunch (Room: San Cristobal A)

Session Chair: Gary Steffen, Indiana University–Purdue University Fort Wayne

Friday 2:00pm - 3:00pm

Special session: "Engineering Everywhere for Everyone" (Room: San Cristobal A)

Session Chair: Barbara Bernal, Kennesaw State University - Marietta Campus

Invited Speakers: Dr. Bevlee Watford, ASEE President Elect

Dr. Louis Martin-Vega, ASEE President

Dr. Joseph Rencis, ASEE Immediate Past President

Dr. J P Mohsen, ASEE Past President

Dr. Claudio da Rocha Brito, IEEE Education Society President

A thoughtful conversation about the science & engineering decisions taking place around us.

Friday 3:15pm - 5:00pm

V3A Education Topics in Industrial Engineering 1 (Room: Auditorium)

Session Chair: Lori Bland, George Mason University

Paper V3A1 - Developing an Integrated Mathematics and Human Factors Engineering Curriculum for Middle School Students

Joi-Lynn Mondisa, University of Michigan Kenneth Chelst, Wayne State University

In this work-in-progress study, we an integrated mathematics and human factors engineering curriculum for middle school students. The curriculum will integrate mathematics and human factors engineering topics to specifically increase young students' awareness of math in engineering applications as well as career opportunities. The curriculum will be grounded in evidence-based teaching methods and pedagogy. It will first be developed and created in a teachers' workshop and then piloted in an informal environment, a weeklong summer camp for middle school students. Then it will be offered as an ongoing after school activity. Finally, it will be transitioned into a 4-week core module that is team taught by middle school math teachers. This research will provide: (1) critical insights about the learning outcomes of middle school students

who are exposed to an engineering curriculum in an informal environment and (2) an evaluated example of an engineering curriculum for middle school students.

Paper V3A2 - Teaching Industry Relevant and Application Oriented Skills in Automation and Control by Developing State-of-the-Art Integrated Robotic Workcell

Aleksandr Sergeyev, Michigan Tech
Siddharth Parmar, Michigan Tech
Nasser Alaraje, Michigan Tech

There is an increasing demand for automation in the industry due to expensive manual labor and faster manufacturing processes. Therefore, there is a need to educate future engineers in relevant to current industry needs automated systems which generally consist of Programmable Logic Controllers (PLCs), industrial robots, conveyors, pneumatic, various sensors and vision systems. Objective of this project is to develop an integrated work cell using 6-axis FANUC robots, PLCs, Conveyor, Sensors, pneumatics and vision systems for academic curriculum bridging the gap between industry and educational institution by teaching rapidly emerging technologies. The developed system provide the students with an opportunity to develop real time scenarios in material handling applications similar pick and place parts moving on a conveyor using sensors and vision systems, end-effector tools, hand shaking of two 6-axis robots and controlled by PLC. Training engineering professionals and testing them on different applications using a single work cell will help them to develop a holistic approach towards solving real time solutions in the automation industry. Presented in this paper work provides a detailed, state-of-the-art laboratory setup that can be replicated by the other educational institutions demanding to expand in the field of industrial automation and controls.

Paper V3A3 - Industrial Engineering Students Making a Difference - Capstone Design Projects Impacting Adults with Disabilities

Mayra I. Méndez-Piñero, University of Puerto Rico
Cristina Pomales-García, University of Puerto Rico
María Irizarry, University of Puerto Rico

This work in progress describes the results, direct impact, and experiences of senior Industrial Engineering (IE) students who ventured in an IE Capstone Design Experience, funded by NSF, to "Make a Difference to Benefit Adults with Disabilities". This particular experience required pairs of senior students to interact with a multidisciplinary team to develop, build, and implement prototypes to foster independence and self-care, improve the safety and quality of life of individuals with disabilities, and augment their functional capabilities. The results of five capstone projects and the student learning outcomes are described from a program assessment perspective, along with evidence of how these experiences create awareness, sensibility, and knowledge on the needs of adults with disabilities while broadening students' appreciation of the impact IEs can have in society and wellbeing of others. The impact of developed prototypes on the users is shared as part of documenting the success of the implementation.

Paper V3A4 - Introducing an Industrial Robotics Course to Manufacturing Engineering Program at GSU

Guanghsu Chang, Georgia Southern University

Manufacturing in North America is experiencing a significant jump in "Bring manufacturing jobs

back to the United States." Many products such as electronics components, mechanical parts are being manufactured in the U.S. again.1,3 Today, industrial robots are widely used in many manufacturing factories. They can help manufacturers become more competitive and efficient. The most obvious impact of industrial robots is that they eliminate many dirty, repetitive, and dangerous tasks with hazardous materials and in challenging environments. The Manufacturing Engineering Department at Georgia Southern University (GSU) has been involved in a continuous effort to introduce new industrial robotics and vision system courses in manufacturing engineering laboratory and curriculum. The purpose of Industrial Robotics course is to respond to the demand for Georgia regional industries and meet 21st Century Workforce needs. This course includes several new lab activities and projects to provide students hands-on experience. The selected industrial robotics topics are (1) pick-and-place, (2) stacking and sorting, (3) robotic palletizing, and (4) robotic machine tending. The manufacturing engineering curriculum developing also involves the integration of previous laboratory activities with new projects on existing and new equipment.

Paper V3A5 - Evaluating the Effect of "Flipping the Classroom" in a Probability and Statistics Course: A Plan for Formal Assessment

Laura Moody, Mercer University

In this paper, the author will detail a plan for assessing the effectiveness of a flipped probability and statistics course. The author has taught the course for more than 20 years and first taught it as a flipped class in the fall of 2012. As a result of this experience, the author has data going back several years with which to compare student performance under the same instructor for each paradigm (traditional and flipped). In addition, while the author teaches in an institution that is moderately small and both section size and number of sections in a given term are limited, colleagues within the department have agreed to participate in a direct comparison of student attitudes and performance. The author will draw on both of these resources to develop a comprehensive assessment of flipped classrooms that will be implemented during the 2017-2018 school year.

Paper V3A6 - The Case for Lean Six Sigma Certifications for Engineering Faculty

Melinda Hollingshed, Mercer University
Joan Burtner, Mercer University

Given the rising expectations for engineering graduates to have Lean Six Sigma knowledge upon entering corporate America, a need has developed for engineering schools to offer LSS courses and certifications at the undergraduate level. In order to address this need, the faculty members who teach this methodology should hold LSS certifications at least at a Black Belt level themselves to ensure they understand the methodology as a whole and to be viewed upon as credible teachers, trainers, and project coaches. Currently, all credible Black Belt and Master Black Belt certification programs require that applicants conduct a real world project within a manufacturing environment or some other type of service environment such as healthcare, finance, or government. This project requirement may pose a significant obstacle for career educators. These circumstances provide the justification for the creation of a specialized Lean Six Sigma certification for post-secondary engineering educators. This post-secondary educator specialty certification would include an experiential component that involves using the Lean Six Sigma methodology to improve the engineering education process for students, as well as a knowledge assessment component that involves passing a certification exam similar to industry- standard Lean Six Sigma

exams.

V3B Administrative Topics 1 (Room: San Cristobal B)

Session Chair: Charles Margraves, University of Tennessee at Chattanooga

Paper V3B1 - Leading Diverse Engineering Organizations

Scott Goldman, Indiana University Purdue University Indianapolis (IUPUI)
Patricia Fox, Indiana University Purdue University Indianapolis (IUPUI)
Charles McIntyre, Indiana University Purdue University Indianapolis (IUPUI)

Many positions within the engineering field continue to call for leadership skills as academic institutions still struggle to find ways for engineering and engineering technology students to develop these types of skills. In addition, today's engineering organizations are becoming more culturally and organizationally diverse; and therefore, all employees are expected to be competent in their discipline and function within a diverse multidisciplinary team environment. While some older leadership styles such as trait based leadership and contingency theory are still reliable, the evolution of some engineering work environments demand a different approach to leadership. Organizations today need a flexible, a more egalitarian structure that allows employees to learn their role as a process, emphasizing communication with leadership. Situational leadership can provide these parameters, allowing for extensive personnel growth within an organization. This pilot study examines how the lack of leadership development in both engineering and engineering technology university curriculums as well as organizations can effect both leaders and followers growth within organizations.

Paper V3B2 - Subtle and Not-So-Subtle Messages of Non-Inclusion

Claire McCullough, University of Tennessee at Chattanooga
Sviatlana Chesser, University of Tennessee at Chattanooga
Bart Weathington, University of Tennessee at Chattanooga

Numbers involved in the gender gap in computer science are substantial and growing. The gender gap has been slowly decreasing in most STEM fields, with several showing significant gains, leading some to believe that time will solve the problem. However, the percentage of degrees awarded to women in computer science peaked in 1986, and has been significantly decreasing ever since.1 Many studies have been performed, and many hypotheses formed to try to explain why this is so. One hypothesized reason is that subtle, and not-so- subtle, messages convey to women in computer professions that these are "men's fields;" another, that cyberbullying affects women disproportionately. Both may cause women to leave computer professions. This paper gives examples of messages of non-inclusion, discusses preliminary results of an on-going study on cyberbullying, and invites discussion of what those both in, and outside, the computer professions can do to address the climate for women.

Paper V3B3 - ABET Program Assessment (A.P.A) for a New Engineering Program

Monika Bubacz, The Citadel
Robert Rabb, The Citadel
Jason Howison, The Citadel
Kevin Skenes, The Citadel
Patrick Bass, The Citadel
Jason Geathers, The Citadel
Emily Book, The Citadel

This is a continuation of a series of papers written to document the tools and methods developed to ultimately assist in continuous improvement of a new engineering program. The Citadel School of Engineering initiated a Bachelor's of Science in Mechanical Engineering program in the fall 2014. The School of Engineering has two ABET accredited programs (Civil and Electrical) and applied for accreditation of the new Mechanical program when the first students graduated in 2016. The initial ABET visit was scheduled for the fall 2016.

The new program courses have been prepared using the ABET engineering accreditation criteria, and the new team of mechanical engineering faculty has worked on collection, assessment and evaluation of the program in order to provide a quality educational experience for students. This paper will describe the tools, techniques, and best practices developed during this process. It will show the connection between the course assessments and how they provided input into the program assessment. Additionally, other direct and indirect measures will be illustrated to show how they provide a more thorough assessment of student outcomes and the overall ABET program assessment. The tools and procedures will allow the ME faculty to assess, analyze and suggest improvements that can be implemented in the future offerings. These tools are currently being used by the ME faculty to identify areas in need of improvement in all ME courses. The authors hope that this assessment process will provide a better, unified, consistent, efficient and transparent evaluation and reporting across all courses in the new program.

Paper V3B4 - Lessons Learned During the ABET Readiness Review Process by the Engineering Faculty at Universidad De San Buenaventura in Cali-Colombia

Ivan Cabezas, Universidad de san Buenaventura - Cali
Walter Magaña, Universidad de san Buenaventura - Cali
Rocio Segovia, Universidad de san Buenaventura - Cali
Beatriz Grass, Universidad de san Buenaventura - Cali

Engineering programs seeking an initial accreditation in an institution with no currently ABET accredited programs must undergo a readiness review process. A key distinctive factor of the ABET accreditation approach is its focus on what is learned rather than what is taught. It is fundamental for achieving a continuous program improvement, but it also may turn an accreditation project into a cumbersome effort for programs with a small number of faculty members. Moreover, although the ABET accreditation process follows the same criteria and procedures regardless of the location of the program, it imposes some additional challenges when is conducted outside of the United States, due mainly to cultural and language barriers. This paper presents and discusses the learned lessons during the initial phase of the ABET accreditation project conducted by the five programs of the Engineering Faculty at the Universidad de San Buenaventura – Cali, in Colombia.

Paper V3B5 - Investigation of Myths and Realities of Studying Abroad

James Warnock, Mississippi State University
Galyna Melnychuk, Mississippi State University

Students often cite a number of perceived barriers preventing them from studying abroad. These barriers are diverse and include: cost associated with study abroad, lack of knowledge of a foreign language, limited availability of courses causing a delay in graduation, difficulties transferring courses from a foreign institution, and negative impact on their GPA due to taking courses at a non-US university. In this study, these anticipated barriers were investigated to determine if they were myths for engineering students or if they represent real difficulties. Data were collected for students that participated in semester-long programs between 2010 and 2015. We examined cumulative GPA before and after their study abroad, the number of semesters it took for the students to graduate and compared to students that had not done a study abroad, and the pass rate for courses taken at a foreign institution. Furthermore, we subdivided students by the geographical location of their study abroad experience to determine if this had an impact, and by countries that were native and non-native English speakers.

Paper V3B6 - The Benefits and Costs of Shortening Time to Graduation

Karen De Urquidi, East Carolina University
Matthew Ohland, Purdue University
Allison Godwin, Purdue University

Time to graduation for students varies significantly by the type of degree being pursued, the pre-college preparation of the student, the level of support provided by a student's family, and other factors. The intended completion time for a bachelor's degree is four years; however, there is sufficient variation in completion time that both the United States Department of Education and the National Collegiate Athletic Association use a six-year completion rate as the measure of success. The effect of pre-college preparation involves both circumstance and choice. Some students matriculate with Advanced Placement credit, others choose not to enroll in AP courses, and still others never had the opportunity to enroll in them. Others must take remedial courses before they are able to enroll in the published curriculum. To investigate how time to graduation may vary, our research question is, 'All pre-college factors being equal, what are the consequences of longer or shorter times to graduation?' This paper will examine the various consequences of a longer or shorter time to graduation.

V3C Education Topics in Electrical Engineering (Room: San Cristobal C)

Session Chair: Otsebele Nare, Hampton University

Paper V3C1 - Development of Concept-Linking Inventories for a Breadth-First Approach in Electrical Engineering Fundamentals Pedagogy

Harry Powell, University of Virginia
Todd Delong, University of Virginia
Ronald Williams, University of Virginia

Our Electrical and Computer Engineering (ECE) Department started an effort three years ago to revise core courses in electrical circuits, electronics, and signals & systems. The revision effort sought to combine the three subjects into a tightly integrated three-course sequence. An objective was to include aspects of all three subjects in all three courses so that students would develop an understanding of relationships across the subjects. This revised approach introduced challenges to

the assessment of learning outcomes. Traditional concept inventories are well established for individual topics such as electronics and signals and systems, but these single-subject inventories are not intended to assess relationships spanning multiple subjects. We endeavor in this paper to present our view of the interrelation among these core subjects and the resulting additions to concept inventories needed to assess understanding developed to bridge the topics.

Paper V3C2 - Enhancing Student Engagement in an Electrical Engineering Course for Non-majors Using Project- Based Homework

Timothy Mohr, Grove City College

This paper describes major revisions made to an Electrical Engineering course for non-majors with the express purpose of increasing student engagement by replacing a significant portion of the traditional homework with hands-on projects to reinforce concepts. Projects included a small magnetic levitation system, audio filtering and amplifier circuits, a light meter, and a final project requiring control of DC and stepper motors to create a machine to lift and accurately deposit small objects. Strategies for efficient grading of projects are also discussed. Evidence of increased student engagement in the form of numeric and written course evaluation results are presented, as well as lessons learned from the implementation of these projects over a two-year period.

Paper V3C3 - Sensors and Actuators Designed and Fabricated in a Micro-Electro-Mechanical-Systems (MEMS) Course Using Standard MEMS Processes

Mustafa Guvench, University of Southern Maine

Use of “MUMPs” (Multi-User-MEMS-Processes) is being described as a platform to teach Silicon based MEMS technologies and to implement design projects in a new, interdisciplinary senior level undergraduate engineering course offered at the University of Southern Maine. In addition to the standard lectures/reading/homeworks/tests routine of a typical coursework students in this class are assigned to design, as term projects, various MEMS sensors and actuators using integrated circuit layout design tools and standard Silicon MEMS technologies available and known as “MUMPs”. Initially “SOI-MUMPs” was chosen for the final class projects to design crash sensors and capacitive acceleration sensors. In the latest offering of the course a newer technology, “Piezo-MUMPs” was adopted for its additional piezo-electric film which facilitated MEMS designs to incorporate acoustic and vibration sensors, vibrational energy harvesting devices, piezoelectric drives, micro-resonators as well as higher temperature micro-heaters, thermal actuators and thermocouples. Successfully completed student designs were combined to form a multi-project MEMS chip and fabricated thanks to funding received from NASA/MSGC and USM. The paper presents examples of such designs including simulation and test results and test set ups/equipment.

Paper V3C4 - Structural Engineering Education by Incorporating Visual Understanding and Interactive Learning

Pyoyoon Hong, University of Guam

More than 90% of the Millennial students agreed to the questions, “I am a visual learner.” and “I like education with entertainments.”[1] Hence, it is desirable to use visual effects in presentations incorporated with interactive classroom activities. Adequately designed visual worksheets for structural concepts may reduce the possible mismatches between the teaching and learning styles by utilizing the synergetic relationship between visual and mathematic understanding for both

sensing and intuitive learners. The goal of this paper is to identify the modifications needed to improve structures education to prepare engineering students for the complex real-world problems that the engineering workforce of the future will be facing. In an attempt to address this problem correctly, three visual engineering workbooks have been introduced and integrated with class group work in three structures courses. This paper presents a first-hand experience with the preparation, use, and assessment of the visual workbook projects.

Paper V3C5 - Assessment of the electrical and computer engineering senior design projects at Old Dominion University

Hani Elsayed-Ali, Old Dominion University
Shao - Hui Natalie Chuang, Old Dominion University

The senior capstone design experience for computer engineering and electrical engineering majors at Old Dominion University (ODU) is a two-semester course. The projects are multidisciplinary, with some projects involving collaboration with industry and federal labs. In the first semester, the students mainly focus on proposal development, acquiring components needed, and conducting preliminary designs. In the second semester, the students implement the design proposal developed in the first semester, write their final report, and present their results in oral and poster formats. The Electrical and Computer Engineering Department at ODU uses a set of rubrics to evaluate the outcome of the senior design projects. A committee of three faculty plus the faculty project adviser complete the assessment rubric and the results are summarized and used to assure that the design projects fulfill the Accreditation Board for Engineering and Technology (ABET) outcomes and to continue to improve the students' learning. In, this paper, we discuss the course structure, requirements, and the grading rubrics.

V3D Education Topics in Civil Engineering 2 (Room: San Cristobal D)

Session Chair: M. A. Karim, Kennesaw State University

Paper V3D1 - Writing as an essential tool to teach environmental engineering design concepts

Veera Gnaneswar Gude, Mississippi State University

Writing in engineering courses provides a mechanism for processing scientific information related to an engineering issue and synthesize sound solutions through a descriptive narrative often including sound engineering judgement or justifications, outstanding contributions and key conclusions. Some critical findings and contributions may not be recognized unless they are presented through a formal writing narrative. The Accreditation Board for Engineering and Technology (ABET) criterion 3 has stipulated the engineering
education outcomes (f) through (j) which are intangible. These intangible ABET outcomes can be better accomplished by providing writing assignments to engineering students. In our civil engineering senior design elective course, CE4883-6883:Engineered Environmental Systems, various types of writing exercises such as informal writing, free writing, exploratory writing, formal writing, project report, and reflective writing were provided to enhance students' knowledge of the subject matter. Student learning experiences and the effectiveness of writing exercises to meet ABET outcomes were discussed in this paper.

Paper V3D2 - Faculty and Student Perceptions of Plickers

Timothy Wood, The Citadel
J. Michael Grayson, The Citadel
Kweku Brown, The Citadel

Plickers is a novel, robust, low-cost, audience response system. The Plickers system requires access to the Plickers website, an instructor smart phone with camera and Plickers app, and a Plicker card per student. Each Plicker card has a unique, simplified QR-style design labeled A, B, C, and D on each side. During class, the instructor uses his or her phone to present a multiple choice or true-false question to the class through the Plickers website. The students then hold up their Plicker cards with their indicated answer at the top of the card. The instructor uses his or her phone camera to scan the room, recording an answer for each student. The Plicker technology has facilitated an enjoyable interaction between professors and students in statics, dynamics, and surveying lectures. This paper describes the Plicker technology, the experiences of assistant professors implementing the technology, and student-perceptions of the Plickers learning experience.

Paper V3D3 - Use of Active versus Passive Learning Pedagogies in a Statics course to Address Variations in Student Performance between Course Sections

J. Michael Grayson Grayson, The Citadel - The Military College of South Carolina
Simon Ghanat, The Citadel - The Military College of South Carolina
Timothy A. Wood, The Citadel - The Military College of South Carolina

Three sections of an undergraduate Statics class were taught using traditional passive classroom pedagogy where students received a standard lecture presenting the material theory followed by a short example that implemented this theory. However, up through the midterm examination, the afternoon section of the course (i.e., section 3) performed consistently lower than either of the other two sections on student assessments (e.g., homework, quizzes, the first examination, etc.). Therefore, the instructor implemented an active learning strategy after the midterm exam that consisted of the instructor presenting an example relative to the lesson topic with relevant theory introduced as necessary so that students, sometimes working as individuals, other times in groups, could complete the presented scenario and/or examples. A qualitative comparison of student perceptions before and after the midterm examination illustrate that there was an influence on student performance when comparing the implemented active versus passive learning pedagogies.

Paper V3D4 - Study of Pre- and Post-Test Surveys in an Engineering Economy Course

Simon Ghanat, The Citadel
Dimitra Michalaka, The Citadel
James Grayson, The Citadel

This study examines the pre- and post-test data from two class sections of Engineering Economy taught in a 2016 compressed summer term at The Citadel. A background knowledge probe (pre-test) and course knowledge survey (post-test) were developed based on key concepts in engineering economics to assess the knowledge gained over the course of the summer term. The pre-test was administered to measure student's prior engineering economy knowledge and to identify student misconceptions at the beginning of the term. The same short-answer test (post-test) was administered on the last day of semester to assess knowledge gained as a result of the course experience. Statistical analyses were performed using the collected data. The results show

that the students gained significant understanding on the various concepts in engineering economy over the course of the summer term. Additionally, the pedagogical approaches used in the classes and how they were applied in the classroom are discussed.

Paper V3D5 - Low-Cost Groundwater Development: Manual Drilling in Academic Research and Training

Monica Resto, Mercer University
Michael MacCarthy, Mercer University
Kenneth Trout, University of South Florida

Manual drilling techniques can be of value in academic research and training environments, and are increasingly being promoted as a cost-effective way of providing water for drinking and irrigation purposes in developing communities throughout the world. The relatively low cost of manually drilled wells, compared to machine-drilled or hand-dug wells, as well as the relative portability of their equipment, make them an attractive water supply option when hydrogeological conditions are favorable. Those same qualities also make manually drilled wells useful in many academic research and training situations. The research consists of an assessment of percussion-jetting-rotation manual drilling, a low-cost hybrid method developed in Bolivia. The equipment set-up is assessed for relevance in academic field research, where collection of hydrogeological data is often limited by the expense of conventional machine drilling. The study also considers how manual drilling can be used to teach essential aspects of drilling concepts and groundwater science from a field perspective. Nine monitoring wells were installed at the University of South Florida Geological Park (USF GeoPark) using the manual percussion-jetting-rotation drilling method, up to a maximum depth of nine meters, through sands, clays, and thin layers of limestone. Drilling, well installation, and well development experiences were recorded. Geology was observed and logged during drilling. For training purposes, groundwater flow was determined between three wells. Hydraulic head was measured in each well, and hydraulic conductivity was measured in one well.

Paper V3D6 - Pedagogical Techniques Employed in an Engineering Drawing Course

Simon Ghanat, The Citadel Kweku Brown, The Citadel

A variety of teaching and learning tools were employed to introduce the first year Civil Engineering majors at The Citadel to engineering drawing. These techniques engaged and motivated students to learn the fundamentals of engineering drawing. The effectiveness of various teaching and learning tools was assessed directly by measuring student learning through questions on the final exam and indirectly by examining student responses on a self-perception survey at the end of the course. More than 75% of students rated team project, class-wide tutoring, hands-on activities on Auto-CAD, employing models, and summarizing and correcting misconceptions very highly. The direct assessment of the learning objectives also showed statistically significant gains in learning engineering drawing concepts. The paper will discuss the teaching and learning tools employed, as well as the direct and indirect assessment of course learning objectives.

Friday 6:00pm - 9:00pm

Zone 2 (North Central, Southeastern and Illinois-Indiana Section) Awards Dinner. (Room: 2nd floor Las Olas Room and Las Olas Terrace)

Session Chair: Dan Budny, University of PittsburghSaturday 7:00am - 8:00am

Good Morning: Light Breakfast (Room: San Cristobal A)

Session Chair: Barbara Bernal, Kennesaw State University - Marietta Campus

Saturday 7:30am - 8:15am

Section Annual Meeting Illinois/Indiana Section (Room: San Cristobal G)

Session Chair: Thomas Trusty, Trine University

Section Annual Meeting North Central Section (Room: San Cristobal F)

Session Chair: Dan Budny, University of Pittsburgh

Section Annual Meeting Southeastern Section (Room: San Cristobal A)

Session Chair: John Brocato, Mississippi State University

Saturday 8:15am - 10:00am

S1A Topics related to K-12 Session 2 (Room: San Cristobal E)

Session Chair: Sindia Rivera-Jimenez, University of Florida

Paper S1A1-Teamwork Using an Authentic Product Development Environment

M. Javed Khan, Tuskegee University
Marcia Rossi, Alabama State University
Fan Wu, Tuskegee Universiity
Christine Schnittka, Auburn University

The effectiveness of an authentic product development environment to enhance teamwork skills of rising 9th
-12th grade students was studied as part of a 3-week summer program. Teams of students were provided scenarios of 'customer' requirements. The teams translated customer requirements into technical requirements, researched content and developed websites. Usability studies were conducted including heat maps of the websites using eyetracking equipment to provide feedback for closing the loop in the product development cycle. Student reactions to teamwork were documented using survey instruments and interviews. Results indicate participants recognized teamwork as an important element of real world work. The product development environment simulated an authentic real world scenario and played a positive role in emphasizing the need for teamwork.

Paper S1A2-Design of a Virtual Escape Room for K-12 Supplemental Coursework and Problem Solving Skill Development

Kimberlyn Gray, West Virginia University Institute of Technology
Stephany Coffman-Wolph, West Virginia University Institute of Technology
Marcia Pool, University of Illinois at Urbana Champaign

This paper describes the process of creating an educational and entertaining game for K-12 students based on the "escape room" concept. Escape room games require players to find objects and use them in specific locations; the challenge is to vary the virtual problem solving system to allow the game to be replayed and new material to be incorporated into the game. This instructional escape room will require students to use skills and concepts learned from their coursework to solve

puzzles to advance within the game and provide a supplemental method for reviewing material as well as improve their problem solving and logic skills. The authors are working with senior computer science majors to design a modular and flexible game play system and a separate development interface that allows teachers to add content specific to their class

Paper S1A3-Introduce a Girl To Engineering Day: Assessment and Future Directions

Mary Katherine Watson, The Citadel
Laura Russo, The Citadel
Dimitra Michalaka, The Citadel

Each year, the Citadel student chapter of the Society of Women Engineers (SWE), the Lowcountry Branch of SWE, and the Girl Scouts of Eastern South Carolina coordinate to plan and facilitate "Introduce a Girl to Engineering Day," a three-hour outreach event designed to excite middle-school-aged females about engineering. A survey, adapted from the Middle and High School STEM-Student Survey developed by the Friday Institute for Educational Innovation, was administered before and after the Spring 2016 outreach event. Participants were asked to indicate their level of agreement with nine statements related to their interest in and motivation to pursue an engineering degree. Statistical analyses indicated that engagement in the event led to positive changes in participants' engineering attitudes, perhaps most notably their belief that they could "be successful in a career in engineering."

Paper S1A4-EMPOWERING MIDDLE STUDENTS TO BE TECHNICAL DESIGNERS THROUGH AN INTERGENERATIONAL PARTNERSHIP

Sanethia Thomas, University of Florida
Jessica Jones, University of Florida
Christina Gardner-McCune, University of Florida
Juan Gilbert, University of Florida

This research presents strategy for broadening participation in computer science by empowering middle school students to be technical designers through an afterschool outreach program. An intergenerational partnership was formed between 12 graduate students and 12 middle school students who worked together to improve the design of 6 educational technology prototypes developed by graduate students during their Educational Technologies course. The researchers conducted training sessions on basic user interface design principles and leveraged several best practices within participatory design methods. Middle school students learned about user interface design, participated in design activities, and generated ideas to improve the design interfaces of the existing projects. Findings show that middle school students believe that designing usable interfaces is a good technical skill to have. Additionally, the graduate students favored the design recommendations given by the middle school students and viewed the middle school students as effective collaborators. This research concluded that participatory design methods offer a strategy to expose students to STEM and involve graduate students in mentoring middle school students to design effective and engaging educational technologies. This paper will give an overview of design training and activities the middle school students received. A description of the projects and participatory design techniques will be included. A discussion of the challenges and lessons learned will be presented and conclude with results and overall perceptions of technology design methods.

Paper S1A5-Dean's Early Research Initiative (DERI) – Pathways to STEM

Afroditi Filippas, Virginia Commonwealth University Lorraine Parker, Virginia Commonwealth University

Two years ago, we initiated a collaborative program called "Dean's Early Research Initiative" (DERI) with area high schools that introduced students to the exciting world of research and development. These students were placed with engineering research teams within four engineering and one computer science discipline.

The program has tripled the number of applicants and doubled in size within the span of three years. The students participating are culturally diverse and include a high percentage of female students. In this paper, we present the challenges and the benefits inherent in running a program like this as well as quantitative and qualitative results on the fellow and mentor experience. This will be done in the form of survey results, tracking of retention and perseverance in the program and goals for the future.

Paper S1A6-WIP: Mobile STEM Learning Lab Initiative to Expand Engineering Education to Rural Counties

Kuldeep Rawat, Elizabeth City State University

The Work-in-Progress (WIP) paper discusses an engineering-focused Mobile STEM Learning Lab initiative to expand STEM literacy to rural and underserved counties in northeastern North Carolina. This initiative is important in developing the STEM educational foundation of and for students from Northeastern North Carolina, the most economically distressed region in the State. The project extends laboratory resources and learning activities to the school districts and rural communities using Roadshow-in-a-Box model. This highly interactive format provides students with hands-on inquiry-based activities and rich digital media content to develop awareness and increase interest of STEM related subjects, especially engineering. The initiative, supported through both federal and private partnerships, is expected to serve over 200 schools during the course of three years. The project has potential to improve student exposure and interest in STEM and create a pipeline of college-ready students from underrepresented and disadvantaged backgrounds.

S1B Education Topics in Computer Engineering 1 (Room: San Cristobal B)

Session Chair: Claire McCullough, University of Tennessee at Chattanooga

Paper S1B1 - Overview of ABET Accredited Online Engineering/Engineering Technology Programs in the US

CHAO LI, FAMU

Antonio Soares, FAMU

The dramatic development of Information Technology (IT) has changed the world and our lives in many ways since the 1990's. One of the important aspects changed as a result of IT technology is how education is conducted. Since the 1990's, the education community has found ways to incorporate IT as a tool to provide online degree programs. But online programs in engineering and engineering technology fields are still few and far between in the US. The authors review the current status of online degree programs in engineering and engineering technology fields in the nation. As an accrediting agency for engineering and engineering technology programs, ABET plays a vital role in maintaining the standards of the accredited programs and making sure that they are continually improving themselves. The authors bring ABET into this topic of online engineering and engineering technology programs by taking a thorough review of the ABET accredited online engineering/engineering technology programs. In this process, the authors explore the challenges

faced by online programs in engineering and engineering technology. Using the authors' institution as an example, the difficulties, including administrative and technical ones are explained.

Paper S1B2 - Making Online Industrial Engineering Technology Education a Reality: An Assessment of the Tools and Technologies that Facilitate Remote Lab Instruction

John Pickard, East Carolina University
Ranjeet Agarwla, East Carolina University
Jimmy Linn, East Carolina University
Wendell Collie, East Carolina University

Making an industrial engineering technology (IET) degree program available to everyone, everywhere is only achievable through a distance education model of online instruction and labs. Traditional on-campus IET programs are limited to those students who are able to physically get to campus during the times when courses and labs are scheduled. With demand for highly trained industrial engineers growing, IET degree programs must expand their reach to everyone, including those who are unable to attend on-campus courses due to physical distance, disability, or professional reasons. We present a comprehensive assessment of a wide scope of simulation tools and remote access technologies and evaluate their ability to meet all lab objectives in a 4-year ATMAE accredited undergraduate Industrial Engineering Technology (IET) degree program. Each tool and technology is individually appraised on its ability to provide the distance education IET student with a hands-on lab experience comparable to that of the face-to-face student.

Paper S1B3 - Integrating Modular Strategies into an Embedded System Design Laboratory: An Outcome-Based Educational Approach

Danilo Rojas Mendez, University of Puerto Rico at Mayaguez
Manuel Jimenez Cedeño, University of Puerto Rico at Mayaguez
Aidsa Santiago Roman, University of Puerto Rico at Mayaguez

Teaching embedded systems design and enhancing student skills in this area is an important task in computer engineering programs to provide an up to date education. This work focuses on the development of a teaching methodology based on a modular design, aided by an Outcome-Based educational framework. To achieve this objective, the content, pedagogical, and assessments activities for an embedded system design laboratory were aligned to ensure proper student learning. The pedagogical methods were designed based on modular strategies through progressive lab experiences. The proposed methodology is currently in the process of validation through a performance comparison between students who took the course in previous semesters (control) and those currently taking it (experimental). At the moment, the data for the control group have been collected and analyzed while the data for the experimental group is being collected.

Paper S1B4 - Identifying Changes in Teacher Practice: The Addition of an Online Journal in a Mixed Methods Study

Alison Polasik, The Ohio State University
Teresa Shiverdecker, The Ohio State University

Since 2012, a professional development program has operated in central Ohio in conjunction with these camps to provide 120 hours of contact time to high school science teachers. As a result, there is a wealth of anecdotal and qualitative evidence demonstrating that this program has resulted in changes in teacher practice. Teachers who have participated in the program for multiple

years in particular have shown a marked increase in their use of exploratory classroom activities in lieu of demos and are more likely to employ guided inquiry pedagogy. In addition, a journaling activity has been developed to analyze the progression and type of changes in teacher practice across the academic year. These journaling activities are filled out roughly once per week and ask whether specific activities occurred during a specific lesson. By tracking this information longitudinally and comparing the results between the treatment and comparison groups of high school teachers, it is hoped that the study can better identify how and when changes in teacher practice are occurring. This activity will also be correlated with the Survey of Enacted Curriculum (SEC), Reformed Teacher Observation Protocol (RTOP), and focus groups among participating teachers. This analysis is currently in process during the 16- 17 academic year. As part of the presentation, the author will outline the methodology and instruments being used and seek comments, questions, and suggestions from fellow researchers.

Paper S1B5 - Writing Mini Protocol Stacks as an aid to teaching networking protocols

Anand Richard, Saint Joseph's College

Current research literature abounds with many innovations in approaches to teaching networking. Simulators like NS2 (Network Simulator version 2) and NS3 are widely used in academia to teach network protocols.

Zenghin and Saroughian present an OSPF (Open Shortest Path First) simulator called the DEVS-Suite (Discrete Event Discrete Time Simulator) that helps students study and understand the OSPF protocol (Zengin & Sarjoughian, 2010). Yang, Yang, Gao, Shen, Zhu and Tan contend “Network protocols are mass, stuffy, abstract and difficult to understand for students to learn” and suggest a layered task based method based on the layered TCP/IP protocol itself as a solution to teach networking (Yang et al., 2010). Feitelson looks at the pros and cons of using two different textbooks by different authors that can be used to teach networking courses (Feitelson, 2007). These text books emphasize building small networks that students can use as labs to gain a better understanding. Feitelson concludes that while these approaches equip the students to become better network administrators they do not do much to make them network researchers. One is inclined to agree with Feitelson because knowing how to use a protocol is only a first step to understanding it. The ‘learn by implementation’ paradigm is also recommended by Uldag and McBride in implementing Bluetooth stacks as a method to teach networking (Uludag & McBride, 2010).

S1C Professional Practice 2 (Room: San Cristobal C)

Session Chair: Karinna Vernaza, Gannon University

Paper S1C1 - Engineering Internships – Individual and Program Assessment

Coleman Floyd, The Citadel
Kyle Johnson, The Citadel
Robert Rabb, The Citadel

One of the highlights of engineering education is the opportunity to participate in an internship. Although not a graduation requirement in most curricula, the internship provides experience and opportunities to engage a professional organization to supplement the academic experience. The Citadel recently developed a mechanical engineering program and sought opportunities to promote academic activities beyond the basic engineering requirements. Internships allow students to enhance their learning and problem solving experience in a real world environment and perhaps

give them a start on their senior design project. The summer internship program allows them to conduct research and solve engineering problems with scientists and engineers in some of the nation's finest facilities. Internships are purely voluntary, but nearly half of the mechanical engineering majors forfeit some of their free time at least one summer to participate in these programs. These internships are usually all summer (12 weeks) but some are shorter in duration due to other institutional requirements that can only be accomplished during the summer. This, however, is sufficient time to allow the students to be exposed to, work on, and sometimes solve an engineering problem. The John Hopkins Applied Physics Lab (APL) and Army Research Laboratory (ARL) along with a host of local and regional organizations sponsor most of the internships. This paper describes the internship program and discusses how it attracts engineering majors and assists in job placement. Additionally, feedback from the project sponsors can be used to measure student progress and assess the curriculum.

Paper S1C2 - Development and Design of a Medical Sterilizer for Mission Hospitals

Anna Barr, Gannon University- SEECS
Jason Bensur, Gannon University- SEECS
Sabrina Rider, Gannon University- SEECS
Alexis Stahl, Gannon University- SEECS
Leilani King, Gannon University- SEECS
Nicholas Williams, Gannon University- SEECS
Kaitlyn Babiarz, Gannon University- SEECS
Blake Dantio, Gannon University- SEECS

At Gannon University, eight engineering students embarked on a student-led, service learning, engineering design project funded by the National Science Foundation's S-STEM Grant. These students are part of the Scholars of Excellence in Engineering and Computer Science (SEECS) program at Gannon, with backgrounds in mechanical, environmental, electrical, and biomedical engineering1. Beginning in fall of 2014, the group partnered with Christian Hospitals Overseas Secure Equipment Needs (CHOSEN), a non- profit organization that provides medical equipment to mission hospitals2. The goal of the project was to retroactively engineer a table-top medical sterilizer to be compatible with unreliable power. This design project will have a global effect by giving people safe medical equipment to use in places where sanitation is not necessarily a given. Doing a student-led design project in college is beneficial to students as well because it helped us gain hands-on experience and learn how to collaborate as a team.

Paper S1C3 - Engaging Engineering Students with Non-Engineering Majors in Interdisciplinary Service-Learning Projects: A Model for Engineering Everywhere for Everyone

Valeri Werpetinski, University of Illinois at Urbana-Champaign

The ability to function in multidisciplinary teams and understand the impact of engineering solutions in a global, economic, environmental, and societal context are important learning outcomes to prepare engineers for a global workforce.1 And, there are increasing calls to enhance undergraduate engineering education with opportunities to engage in real world experiences.2-3 This paper describes the rationale and design of a two- tiered service-learning course model, which provided a new organizational structure to promote interdisciplinary engineering and a socio-technical approach to community problem-solving. Using inquiry- guided learning to scope and implement community projects coupled with the assets of student leaders in the role of project

managers, disciplinary silos and resource constraints were overcome to establish a model that was both accessible to students of all levels and majors and adaptable to meet the complex and varying needs of local and international partners. Re-centering the needs, interests, and constraints of community partners created opportunities for interdisciplinary work, as students needed to identify, mobilize, and integrate knowledge and resources from multiple fields to develop and implement effective projects. However, this approach also presented instructional challenges due to multiple degrees of complexity involved in the course design, diversity of student majors and experience levels, the broad range of community partners, and the nature and scope of projects. Implications of teaching in this community-engaged context will be discussed.

Paper S1C4 - Developing critical collaboration skills in project based courses

Pilar Pazos, Old Dominion University
Zikai Zhou, Old Dominion University
Nina Magpili, Old Dominion University

In highly technical organizations, work is becoming increasingly distributed; requiring practicing engineers to master virtual collaboration skills while acquiring expertise in a range of collaboration technologies.

Although there has been great emphasis on developing collaboration competencies in the engineering curriculum, empirical evidence of successful strategies for distributed team settings is scarce. As an attempt to fill this gap this study investigates the impact of a scalable intervention in developing virtual collaboration skills. The intervention, based on instructional scaffolds embedded with collaboration technologies, is aimed at supporting specific processes including planning, goal setting, clarifying goals and expectations, communication, coordination and progress monitoring. A quasi-experimental design was used to evaluate the impact of the intervention on student teamwork skills. Data from 278 graduate and undergraduate engineering students participating in virtual team projects was used in the analysis. Results from the analysis are presented suggesting a statistically significant impact of the intervention on self-management skills when comparing randomly assigned teams with and without the intervention. The intervention is designed to be scalable so that it can be embedded into existing project-based courses. Our findings have important implications for the development of teamwork skills in engineering courses and provide evidence of a successful strategy that can be integrated into the existing engineering curriculum.

Paper S1C5 - Professional Practice: Teaching the Value of Licensure

Shane Palmquist, Western Kentucky University

ABET accredited engineering programs require a substantial amount of math, science, engineering science, and engineering course and lab rigor. Come senior year, students are focused on finishing their course work, writing their resume, networking for job opportunities, and/or applying to graduate schools. Often, taking the fundamentals of engineering (FE) exam or studying for the exam does not get the needed time and attention it deserves. Teaching the value of licensure to engineering students is important, and to do so impacts the civil engineering curriculum. Faculty have a significant role and responsibility to teach this to their students. This paper examines parts of the curriculum that focus on licensure and the impact on students. While successes have occurred, there are still many challenges including FE and PE awareness and passing rates.

Paper S1C6 - An Empirical Study of Teaching Methodologies and Learning Outcomes for Online and in-class Networking Course Sections

Pouyan Ahmadi, George Mason University
Khondkar Islam, George Mason University
Salman Yousaf, George Mason University

To enhance student learning, we demonstrate an experimental study to analyze student learning outcomes in online and in-class sections of a core data communications course of the Undergraduate IT program in the Information Sciences and Technology (IST) Department at George Mason University (GMU). In this study, student performance is evaluated based on course assessments. This includes home and lab assignments, skill-based assessment, and traditional midterm exam across all 4 sections of the course. All sections have analogous content, assessment plan and teaching methodologies. Student demographics such as exam type and location preferences that may play an important role in their learning process are considered in our study.

We had to collect vast amount of data from the learning management system (LMS), Blackboard (BB) Learn, in order to compare and study the results of several assessment outcomes for all students within their respective section and amongst students of other sections. We then tried to understand whether demographics have any influence on student performance by correlating individual student's survey response to his/her performance in the class. The numerical results up to mid-semester reveal remarkable insights on student success in the online and face-to-face (F2F) sections.

S1D Education Topics in Civil Engineering 3 (Room: San Cristobal D)

Session Chair: Anna Howard, North Carolina State University

Paper S1D1 - New Video Tool for Demonstrations in Distance Education Statics

Anna Howard, North Carolina State University

Basic demonstrations can help students connect the concepts from class with their own understanding of how the world works. Previous research has focused on inexpensive demonstrations for Statics which have been well received by the students.1 But such demonstrations best serve the students in the first couple rows of an in-person delivery of Statics. Conventional video can show a demonstration but does not easily serve for teaching modeling the system.2 Lightboard technology which has been used at several universities for teaching physics and engineering is adapted here to show a Statics demonstration and teach the accompanying free-body diagram (FBD) and equilibrium modeling in the same short video.3,4 One demonstration from Statics was filmed including the lightboard to assess student learning and get feedback from the students. Student experience is being tracked for several groups of students: those who saw the demonstration in person, those who saw a synchronous video of the classroom through distance education using a polycom link, and those who saw an asynchronous video through distance education.

Paper S1D2 - Introduction of a "project" component into the sophomore-level "Statics: Basic Mechanics" course

Niranjan Desai, Purdue University Northwest
Nuri Zeytinoglu, Purdue University Northwest

Engineering programs in the United States are faced with the challenging problem of decreased

retention rates at the undergraduate level. The focus on theory is one, among several factors that has been identified as a possible reason for students losing interest in completing their chosen engineering degree. The capstone course attempts to create a balance between theory and practice, and exposes students to the practical side of engineering. However, it is offered during the final year of the undergraduate program and does not influence retention rates in the earlier stages of the program. In this light, this paper describes a novel "project" component that has been incorporated into a sophomore year "Statics: Basic Mechanics" course, which is a core requirement across all disciplines. The goal of this paper is to describe the structure and scope of the project, so that it can be replicated and incorporated into a variety of different freshman and sophomore level engineering courses.

Paper S1D3 - From Analyzing Geotechnical Failures to Generating and Solving Crossword Puzzles: Adding Variety to a Geotechnical Engineering Course

Simon Ghanat, The Citadel
Michael Woo, The Citadel
Monika Bubacz, The Citadel
James Grayson, The Citadel

The civil engineering majors at our institution take the first geotechnical engineering course in their senior year. At that time, they have already been introduced to all sub-disciplines of civil engineering, except geotechnical engineering. As an instructor, it then becomes a challenge to introduce students to an unfamiliar sub-discipline, since by all likelihood; they have already decided on the field they will pursue in employment or graduate study. An effective strategy for addressing this issue is to design the course to provide various active teaching and learning strategies that engage students and focus on their different learning styles. This paper discusses how various active teaching and learning techniques focused on different learning styles were employed in a geotechnical engineering course. The paper also reports effectiveness of these techniques on student learning gains and students' self-perception of the active learning tools.

Paper S1D4 - NEW DESIGN MODEL FOR CAPSTONE DESIGN PROJECT AT CHRISTIAN BROTHERS UNIVERSITY

L. Yu Lin, Christian Brothers University
Robert H. Hunt, Christian Brothers University

Capstone design project in the Department of Civil and Environmental Engineering (CEE) at Christian Brothers University is implemented through two semester courses (CE 431 and CE 432). All students are required to take these courses in their senior year to fulfill graduation requirements. Because students had a difficult time finding the topic of their projects and completing their projects in time, the CEE Department teamed up with governmental and private practitioners to develop a series of strategies and to extend senior project from two semesters to three semesters. As a result, students will have more time and better management skills to organize their projects, find topics, layout design components, and work with practitioners. Since this change started in 2014, the graduation rate has improved from 65% to 96%. This paper will present this new design model of the capstone project including, planning stage, project development, project implementation, and final assessment.

Paper S1D5 - Understanding student personality trends for curriculum development

Veera Gnaneswar Gude, Mississippi State University
Seamus Freyne, Mississippi State University
Dennis Truax, Mississippi State University

Keirsey's personality test was administered to our students in introductory civil engineering course to help students realize their personalities over the past six years. A similar evaluation was performed for those approaching graduation. In addition, data collected from our senior civil and environmental engineering students was evaluated to understand the trends of different personalities in our student population and the student evolvement through our civil engineering curricula. We examine the impact of student personality on overall activities and effectiveness of the program and student performance and development through their graduation. Further, the authors examine if changes in program structure will impact the diversity of students, as defined by their temperament, who graduate from that program. This article presents the outcomes/observations and learning lessons from data evaluation and correlates with potential modifications to the overall curriculum to enhance student learning experiences and career development and preparedness to the professional careers.

Paper S1D6 - A Multisensory Approach to Improving Student Efficacy in an Introductory Steel Design Course

Keith Landry, Georgia Southern University

Research on multisensory approaches to teaching demonstrate such methods have proven useful with students who lack well-developed visualization skills.1, 2, 3 To improve the ability of students to visualize important lesson concepts in a 1st year steel design course, the author augmented the concept mapping structure used in the daily lesson plans to present material visually and aurally in the classroom with full- scale, 3D steel models of figures from the course textbook. Integration of these models into the lesson structure are shown to have had a positive impact on students' ability to visualize loads, load paths and failure limit states and thus conduct effective analysis and design. Class averages on graded problems involving lesson concepts related to the full-scale steel models are compared to averages from prior semesters to assess impact on student ability. Responses from course surveys are used to compare subjective parameters related to both ability and motivation.

Saturday 10:15am - 12:00pm

S2A Topics in Bio and Chemical Engineering (Room: San Cristobal E)

Session Chair: Cristina Pomales-Garcia, University of Puerto Rico

Paper S2A1 - Entrepreneurial Training for REU Students

Susan Burkett, The University of Alabama
Eric Giannini, The University of Alabama
Rachel Frazier, The University of Alabama
Debra McCallum, The University of Alabama
Stephanie Wood, The University of Alabama
Garrett Quenneville, The University of Alabama

An innovative Research Experience for Undergraduates (REU) program gave engineering undergraduates an opportunity to improve their technical and professional skills while experiencing

entrepreneurship firsthand. The unique learning experience embedded a six-week entrepreneurship training into the 10-week REU program to broaden learning outcomes. On questionnaires administered before and after the program, students rated their knowledge about (1) developing a business model and (2) turning a research or technology idea into something marketable higher on the post-test than on the pre-test. In spite of this increase in knowledge, students expressed some level of dissatisfaction. In response to open-ended questions and in a focus group discussion, students offered suggestions for increasing satisfaction with the contribution of the entrepreneurial program, Crimson Startup, to the research experience. We plan to improve the training and tailor it specifically to enhance the experience for REU students.

Paper S2A2 - Engineering Knowledge Capture and Enhancing Academic Institutional Memory to Support Cyclical Industrial Sectors

Rocky Taylor, Memorial University of Newfoundland

Economic activity in different industrial sectors is cyclical. For sectors with long cycle times, downturns in economic activity can result in significant losses of local, national and international engineering capacity as individuals retrain and migrate into other sectors. For engineering sectors faced with demographic challenges, where many world-leading experts are near or past retirement age, this problem can be particularly acute since down cycles eliminate opportunities for mentorship and knowledge transfer between seasoned experts and younger generations of engineers. Such engagement opportunities are particularly crucial in the transfer of tacit knowledge. Traditional approaches for capturing and codifying methods and best practices, such as the development of standards, publishing books and peer-reviewed articles are typically able to capture only certain aspects of the knowledge of a segment of the population of practicing engineers. In the context of economic cycles, academic institutions serve a special function in society as, amongst other things, they help capture and disseminate knowledge and develop skills needed to train future generations of experts and they serve to maintain continuity of a core knowledge base, even during economic down cycles. In doing so, they help accelerate economic recovery in a given sector by ensuring knowledge captured in the “institutional memory” during past periods of high activity are transferred to new, highly qualified personnel during future upturns. This paper discusses ongoing work at Memorial to identify mechanisms for increasing engagement with industry practitioners to better understand what knowledge and skills are crucial to a given sector, and assessing approaches and technologies that can be used to enhance and accelerate knowledge capture from industry practitioners and transfer this to teaching and learning environments in academic institutions which train next generation experts. The highly specialized engineering field of Ice Engineering is explored as an example.

Paper S2A3 - Work in Progress: Increasing Student Knowledge Acquisition and Transfer Through the Use of Heuristics in a Team/Lab-Based Protein Engineering Course

Morgan L. Bocci, Tennessee Technological University
J. Robby Sanders, Tennessee Technological University
Pedro E. Arce, Tennessee Technological University

The Renaissance Foundry pedagogical platform pioneered at the Tennessee Technological University (TTU) Chemical Engineering Department and now integrated in the new engineering model for the College of Engineering at TTU is a rapidly evolving pedagogical platform for improved student learning. The Foundry model incorporates both knowledge acquisition and knowledge

transfer paradigms that are integrated through utilization of “resources” towards the development of prototype solutions to problems often required to be identified by student teams1. In the protein engineering course reported on herein which has been offered at both the undergraduate and graduate levels, numerous strategies are pursued for increasing both acquisition and transfer outcomes in the students. Teamwork is a critical aspect of the activities in the course in which student teams of chemical engineering students are guided through the process to produce a modified version of a fluorescent protein. Especially in the constraints of a summer semester, the pace of the course is accelerated necessitating the use of focused, hands-on team-based activities, analogies, and other heuristics (i.e. electrophoresis heuristic) to maximize learning in this fast-paced environment. This effort is greatly enhanced through the expert guidance of TA's who have taken the course prior. To facilitate knowledge acquisition of the principles of the polymerase chain reaction (PCR) that is used to modify a DNA base sequence and increase the amount of the target sequence, teams participate in an activity guided by a visual approach of “binding” primers to template DNA and carrying out the steps in each cycle of PCR as described by Chambers et al.3 This approach allows students the ability to see and understand what is happening in their reaction mixtures of clear fluid. Analogies are used to familiarize students with aspects of molecular biology in which cells are considered to be tiny factories that perform a process to produce a product (the protein). Outcomes associated with the use of these tools will be reported on as will reflections on future directions.

Paper S2A4 - Understanding lived experiences of students in a blended-learning neuroscience MOOC

Casey Lynn Haney, Purdue University Jawaria Qureshey, Purdue University
S. Zahra Atiq, Purdue University Jennifer DeBoer, Purdue University David Cox, Harvard University

This study is part of a larger research project that aims to understand the lived experiences of students enrolled in a Massive Open Online Course (MOOC) on neuroscience, offered by Harvard University in the Fall of 2013. The course provided 185 students with physical lab kits to conduct electrical engineering experiments. Our previous descriptive analyses of the online survey, clickstream, and grade data show that students' engagement with certain activities affected their overall grades1. However, these findings do not fully reflect students' lived experiences or their unobserved behaviors. This paper will discuss students' perceptions of using the online and offline components of the course through thematic analysis performed on the interviews of students who received lab kits. Understanding students' lived experiences may allow STEM MOOC educators to design online and offline activities and materials that reflect the interactive nature of STEM topics.

Paper S2A5 - Identifying Potential Causes of Attrition in the Biomedical Engineering Specialization at Mercer University

Joanna Thomas, Mercer University

Biomedical and bioengineering programs have grown in recent years due to an increased demand for new and improved medical devices and disease therapies. Enrollment in the Biomedical Engineering (BME) specialization at Mercer University has followed this trend. However, while often initially garnering the majority of incoming engineering freshman, BME at Mercer sees a decrease in its freshman cohort of more than 60% by graduation. This is unlike traditional engineering tracks at Mercer and other universities that typically see a 40-50% decrease in class size over four years. Through a review of student enrollment data collected by Mercer University's Admissions Office,

the Office of Institutional Effectiveness and Academic & Advising Services, we determined BME attrition rate, at what point in the curriculum BME is losing students and how those students' academic careers progress.

Paper S2A6 - A Student-Taught Course bringing Research to the Introductory Biomedical Curriculum

Daniel Tavakol, University of Virginia
Cara Broshkevitch, University of Virginia
William Guilford, University of Virginia
Shayn Peirce-Cottler, University of Virginia

In the first year of study for the Undergraduate School of Engineering and Applied Sciences at the University of Virginia (UVa), there are few opportunities for students to explore the field of the biomedical sciences and build research skills. In order to set a precedent for undergraduate teaching and address this shortcoming of the undergraduate BME curriculum, a 1000-level, 1-credit, pass-fail course was designed entitled "Introduction to Regenerative Medicine." Led by a two-student team with one faculty advisor, the focus of the course is to synthesize and contextualize peer-reviewed scientific literature, covering both basic science and clinical applications. Leadership by undergraduate instructors provides a unique perspective on the needs of peers and allows instructors to hone their own research skills. The critical impact of this course is an early introduction to BME and research, and encouragement for younger students to appreciate the value of interdisciplinary interactions.

S2B Engineering Research Topics 2 (Room: San Cristobal B)

Session Chair: Aidsa Santiago Roman, University of Puerto Rico at Mayaguez

Paper S2B1 - Early Undergraduate Research Experience using Affinity Research Groups for Hispanic Engineering Students

Angel Gonzalez-Lizardo, Polytechnic University of Puerto Rico
Ernesto Ulloa-Davila, Polytechnic University of Puerto Rico
Omayra Rivera-Castro, Polytechnic University of Puerto Rico
Joanne Brenes, Polytechnic University of Puerto Rico
Angie Escalante-Santana, Polytechnic University of Puerto Rico

Affinity Research Groups (ARG) is a cooperative learning approach to provide students with structured tasks and activities to strengthen their skills, promoting the success of team members. ARG was used by a group of Hispanic undergraduate engineering students at the Polytechnic University of Puerto Rico's Plasma Engineering Laboratory. The students were provided with training in research, plasma physics, and programming to work in research projects assigned by the fac- ulty members to subgroups of students. The students were required to develop experimental or simulation work as required by the projects, and to present their results in undergraduate research fori. The objective of the project was to study the effect of applying the ARG methodology to students in an early stage of their academic career in terms of engagement, interest, self-reliance, self-belonging, and cognitive factors. Results show a positive change in some of the measured variables and negative change in others.

Paper S2B2 - A literature review of the different approaches that have been implemented to increase retention in engineering programs across the United States

Niranjan Desai, Purdue University Northwest
George Stefanek, Purdue University Northwest

Engineering programs in the United States are faced with the challenging problem of decreased retention rates at the undergraduate level. This paper presents an exhaustive literature review that summarizes the attempts made by several different universities across the United States to increase retention in engineering programs. A common theme between different approaches is developed and presented in a clear and concise manner. The main purpose of this paper is to provide engineering faculty members and administrators that are attempting to increase retention in their programs with a resource that will provide them with a general background idea of the strategies that have already been attempted, enabling them to make informed decisions while attempting to increase retention in their programs.

Paper S2B3 - Understanding the reasons behind the decreasing enrollment numbers in engineering programs in the United States

Niranjan Desai, Purdue University Northwest
Lucas Neuhold, Purdue University Northwest

Engineering programs in the United States are faced with the challenging problem of decreased enrollment levels at the undergraduate level. This paper explores possible reasons behind this by obtaining feedback from high school students in order to understand their perspective. Junior and senior year high school students are surveyed on what career path they can see themselves pursuing and why, their impression of the nature of work performed by an engineer, their exposure to basic mathematics and physics that will prepare them for engineering, their interest in studying these subjects, their level of motivation to put in the hard work needed to master abstract concepts while studying these subjects, their awareness of the different opportunities for financial aid to support their college studies that they have access to, the requirements that they need to fulfill in order to satisfy admission criteria for undergraduate engineering programs, and the direction and support that they receive from the administration and faculty in their local high school while considering what they might want to study in college. The survey feedback is analyzed, based upon which recommendations are made that attempt to increase enrollment in undergraduate engineering programs.

Paper S2B4 - Students' Perception of Flipped Classroom Design in Engineering Courses

Lulu Sun, Embry-Riddle Aeronautical University
Hongyun Chen, Embry-Riddle Aeronautical University
Shuo Pang, Embry-Riddle Aeronautical University

Today many engineering instructors are struggling to include more course contents and exercises within the limited class time. To address student-centered learning, and enhance student learning and conceptual understanding, three engineering faculty flipped their classes so that students can study concepts online at their own pace and more active learning can be implemented in the class time. The online content module consists of audio/video lectures, lecture slides, and online quizzes. Students may begin module study as soon as the content is available. Online quizzes are used to check understanding of key study points in the lecture slides after their self-study within allocated time. Instructors will assist in student's exercises or assignment problems in class time and clear

their questions they have in their online self-study. It is believed that self- study will encourage more questions and this increased communication between students and instructors will promote student's understanding and class involvement.

Paper S2B5 - Enhancing student success by providing video recordings of traditional lectures

Johannes van Oostrom, University of Florida

In this study, we explored if there was a difference in the success of students who attended lecture and/or watched videos of the same lecture. Study habits of 27 students were analyzed and their performance on 7 quizzes was recorded. Students who attended all lectures but watched no videos scored and average of 8.73
+/- 1.16 (n=67) on the quizzes, while students who attended no lectures but watched all videos scored 9.20
+/- 1.24 (n=20).

Paper S2B6 - Applying Psychometric Theory to the Examination of Learning within Informal Engineering Learning Environments

Lori Bland, George Mason University

Learning occurs in formal and informal environments across the lifespan. Informal learning has becoming increasingly present within engineering students' experiences as co-curricular opportunities. Multiple positive outcomes have been reported by students related to technical and professional skills, beliefs, attitudes, and executive control functions. Identifying methods to assess these outcomes has been difficult. The variety across informal learning environments related to the voluntary nature and structure leads to complexity in assessing outcomes. Determining the nature or extent of student learning in informal engineering environments has largely relied on self-report. It is important to examine assessment of outcomes from a psychometric perspective to ensure that decisions based on the data from the measures are valid and reliable. The purposes for this work-in-progress paper are to: (a) describe the process to develop a measure of student outcomes from informal learning environments in engineering, such as engineering competitions; and (b) if available, report the results of a pilot study.

S2C Transition to College and First Year Topics 2 (Room: San Cristobal C)

Session Chair: Keith Landry, Georgia Southern University

Paper S2C1 - It Won't Sell Itself: Promoting K-12 Teacher and School Buy-In for University-Led Programs

Joni Lakin, Auburn University Rashida Askia, Auburn University

As evaluators of STEM interventions, we are in the front row observing what works and does not work in K- 12 STEM interventions. We are also often aware of a problematic disconnect between program theory and modern educational theory that can reduce the impact that grant-funded interventions have on K-12 educational outcomes. A critical concern for K-12 interventions, particularly when they are led by university- based leaders in partnership with K-12 schools, is maintaining buy-in for the program for teachers and school administrators. Even when funding for the school intervention is available and plentiful, encouraging teachers to adopt and implement program interventions with fidelity is a substantial challenge. This paper presents some lessons we have learned from working with university faculty as they develop and implement interventions with K-12 teachers.

Paper S2C2 - The Effectiveness of Single-Gender Engineering Enrichment Programs: A Follow-up Study

Linda S. Hirsch, New Jersey Institute of Technology
Suzanne Berliner-Heyman, New Jersey Institute of Technology
Rosa Cano, New Jersey Institute of Technology
Jacqueline Cusack, New Jersey Institute of Technology

Research comparing aspects of single-gender (female-only & male-only) summer enrichment programs to equivalent mixed-gender programs found female-only programs to be effective in educating young girls about engineering, positively influencing their perceptions of engineers and attitudes toward engineering as a career, with mixed results. A recent examination of gains in content knowledge, self-efficacy, beliefs about gender equity and qualitative perceptions of engineers using the Middle School Attitudes toward Engineering, Knowledge of Engineering Careers Survey and the Draw an Engineer Test in equivalent post- 4th grade, 2015 summer programs found significantly positive results; females in the single-gender program showed greater improvement in engineering content knowledge than females in a mixed-gender program, as well as significant increases in self-efficacy and perceptions that women can be engineers. A follow-up study was conducted to determine if changes in girls' attitudes towards engineering, perceptions of engineers and gains in content knowledge were sustained. A majority of the students who participated during 2015 returned for the post-5th grade program in 2016 with 50% more new students. Comparisons amongst the 2016 mixed- and single-gender programs and between the 2015 and 2016 programs showed sustained effects for returning students, especially girls, and a greater 2016 impact for girls who participated in the 2015 single-gender program.

Paper S2C3 -Exploring Pathways to Developing Self-Efficacy in New Computer Science Teachers

Jessica Ivy, Mississippi State University Shelly Hollis, Mississippi State University
Dana Franz, Mississippi State University
Sarah Lee, Mississippi State University
Donna Reese, Mississippi State University

Multiple efforts at Mississippi State University (MSU) are working to support the Mississippi Department of Education (MDE) and White House initiatives of providing access to computer science learning for all K12 students. In the summer of 2016, MDE, in partnership with the Research and Curriculum Unit at MSU, conducted professional development workshops in preparation for the rollout of computer science courses in 68 self-selected public schools. In addition, MSU piloted a teacher institute with a goal of enabling teachers from a variety of disciplines to integrate computing and cybersecurity concepts into the classroom. Although both of these professional development programs offered support for the goal of providing computer science learning to all K12 students, the approaches were distinctly different. A summary of both experiences and related observations will be shared, with recommendations for best practices in bringing computer science to K12 classrooms in the state of Mississippi.

Paper S2C4 - Building Communities through the Creation of Dialogues

Jeremy Waisome, University of Florida Juan Gilbert, University of Florida Stephen Roberts, University of Florida Darryl McCune, University of Florida Curtis Taylor, University of Florida

At the Office of Student Transition and Retention (STAR), engineering graduate students with an

affinity for student affairs and program development are supported and fostered to be key stakeholders. Through conversations with college administration and staff, programs have been developed and implemented by graduate students throughout the years to meet student needs. With growing student populations in engineering, engaging student leaders in addressing existing gaps in programming is paramount to student success. The Women in Engineering Luncheon and the Engineering Undergraduate Research Panel were specifically designed by graduate students to support underrepresented populations. These programs represent how student affairs can nurture engineering graduate students' inherent problem solving skills to support building community, one of the Herbert Wertheim College of Engineering's strategic goals. This paper focuses on leveraging graduate student perspectives to enhance efforts towards inclusion and broadening participation in engineering.

Paper S2C5 - Using interconnected CMM laboratory Modules for Geometric Dimension and Tolerancing, Metrology and Manufacturing processes area courses: Lessons Learned

Guanghsu Chang, Georgia Southern University

Making good products requires collective knowledge of materials, metrology, and manufacturing processes. Metrology is the scientific study of measurement and contains all theoretical and practical aspects of measurement. A Coordinate Measuring Machine (CMM) is an excellent tool used for measuring the physical geometrical characteristics of a product. Preparing manufacturing engineering students with the metrology skills and knowledge required to be successful engineers in the 21st century is one of the primary objectives of undergraduate educators. From the results of CMM reports, manufacturing engineering students can detect and predict deteriorating cutting conditions through the continuous improvement of using a CMM. This paper introduces a new approach to developing CMM laboratory modules, teaching materials, hands-on lab activities, and projects developed as an integrated educational environment similar to ones implemented in today's industry. CMM laboratory modules are used as a post process confirmation of the machined test components and other discrete parts machined in drilling and milling machines. The purpose of CMM lab modules is to illustrate the interconnected laboratory modules of Geometric Dimensioning and Tolerancing (GD&T), Metrology and manufacturing processes area courses. To be productive, CMM measurement information must generate appropriate knowledge that is used as continuous improvement feedback for better product and process design use. The Manufacturing Engineering Department at Georgia Southern University (GSU) has been involved in a continuous effort to introduce new metrology related learning activities in Manufacturing Engineering laboratory and curriculum. The goal of CMM lab modules is to respond to the demand for Georgia regional industries and meet the 21st Century Workforce needs. The new CMM laboratory activities and projects include the following topics: (1) CMM part coordinate system, (2) CMM probe calibration, and (3) Gage Repeatability & Reproducibility (GR&R). This paper presents a method to improve the CMM learning modules and offer students the opportunity to enhance their hands-on activities.

Paper S2C6 - WIP: Introducing engineering principles into PreK-6 through a service learning partnership

Stacie Ringleb, Old Dominion University
Jennifer Kidd, Old Dominion University
Pilar Pazos, Old Dominion University

We report on an interdisciplinary project in which pre-service teachers and engineering students worked collaboratively to design and deliver engineering lessons for elementary school students. We describe the approach and preliminary results for two participating populations: freshmen engineering students and pre- service teachers. Specifically, we explored the following research questions: 1) Does the development and implementation of engineering lessons for elementary students affect education students' a) knowledge of engineering; b) beliefs about the incorporation of engineering in elementary school instruction; and c) comfort and motivation to teach engineering? 2) What do education and engineering students perceive as the benefits and challenges of collaborating to develop and teach engineering lessons to elementary students, and how do they characterize the impact on the elementary students? We provide preliminary findings and discuss the results.

S2D Education Topics in Mechanical Engineering 2 (Room: San Cristobal D)

Session Chair: Carmen Cioc, The University of Toledo

Paper S2D1 -Design with Composite Materials – a New Course Development for Designers and Technicians

Yaomin Dong, Kettering University
Azadeh Sheidaei, Kettering University
Javad Baqersad, Kettering University
Craig Hoff, Kettering University

Composite materials are widely used due to their advantages in high strength-to-weight ratios, high corrosion resistance, high fatigue life in cyclic loading, and great potential in styling design. The automotive industry is currently challenged with meeting the new government emission and fuel economy standards. One of the ways of achieving this is with weight reduction, resulting in many new materials being used in automotive construction. The course learning outcomes (CLOs) of programs at research universities and community colleges are very different. This paper presents a new composite course that focuses on student learning outcomes for community college students, future designers, and technicians. The course was developed for the Center for Advanced Automotive Technology (CAAT), which is funded by the National Science Foundation. One of its missions is to create a curriculum that meets the needs of educating people in new technology developments in the automotive industry. The material developed in this course contains the course syllabus, course learning objectives, course materials, homework assignments, term projects and tests.

Paper S2D2 - Development of Low Cost Experimental Measurement Solutions for Capstone Design

Valmiki Sooklal, Kennesaw State University
Loraine Lowder, Kennesaw State University
Cody Meeks, Kennesaw State University

One challenge faced by students in realizing their final design goals for a capstone course is the

validation of results obtained from numerical techniques, such as finite element analysis. This is particularly common in institutions where, due to resource constraints, students have limited access to testing equipment and lab facilities. This study describes the setup and implementation of a low cost bank of measurement test stations that can be easily acquired and implemented to assist students in validating numerical results. Test stations were developed to measure temperature, force, strain, or acceleration. The cost to create all four stations was less than 0. The intention of the stations is not to provide access to the most accurate testing capabilities, but rather to instill an understanding of the importance of developing experimental procedures for testing and validating numerical results using a structured approach.

Paper S2D3 - An Experimental Study on the Efficiency of Bicycle Transmissions

Rachel Bolen, Grove City College
Mark Archibald, Grove City College

The objective of this project is to measure the efficiencies of bicycle drive systems. Previous efficiency studies tested several planetary hubs, belt drives and derailleur chain drives. This study will evaluate the efficiency of Pinion® internally geared transmission models P1.12 and P1.18. A new apparatus provides improved accuracy, reduced measurement noise and increased functionality for testing efficiency over a range of speeds and power levels. Each drivetrain gear is tested for five minutes at fourteen different speed and power combinations, spanning a range of output torques. Efficiency is then modelled as an exponential function of output torque and is fitted to the data with a non-linear regression. Results to date indicate the Pinion® P1.12 transmission is comparable to higher quality hub gears, with efficiencies ranging from 90.41% to 98.82%, depending on the gear. The Pinion® P1.18 transmission will be tested after further repeatability studies are performed on the P1.12 model.

Paper S2D4 - Evaluation of immediate feedback tools in an undergraduate statics/solid mechanics course

Kenneth Marek, Mercer University

In an age where students' ability to learn course material is understood to depend on many factors including personal learning styles, family background, and the accumulation of past personal experiences and educational opportunities, the problem of teaching large classes of diverse students and evaluating their performance in an effective, efficient, and equitable manner can seem daunting. In an effort to improve the student learning process, an instructor introduced two significant changes into a statics and solid mechanics course in the spring semester of 2016. Homework was changed from a paper assignment to the textbook publisher's online platform, and frequent in-class quizzes were introduced, in which students graded their own work and were awarded full credit for turning in the quiz, regardless of the assigned grade. These two measures had the mutual benefit of reducing the instructor's grading load, while simultaneously providing students with much more immediate feedback on their learning progress. Additionally, the feedback available to students was also available to the instructor, who could therefore make more immediate lesson changes to accommodate student needs. To collect specific feedback on overall student perception of these changes, an anonymous survey was given at the end of the semester, in which students rated the effectiveness of various tools and techniques employed in the course. Other than the items already described, the survey asked about lectures, the course textbook, publisher-based online resources other than the homework system, and independently obtained

learning resources. These surveys, combined with other available feedback data, are analyzed in a continuing attempt to improve the teaching of this course.

Paper S2D5 - Learning Through Re-Engineering Historic Machinery

Bruce Carroll, University of Florida
John Abbitt, University of Florida
John Schueller, University of Florida

A common complaint of both graduating mechanical engineering students and their employers is that the graduates do not have a good understanding of actual machines and how they work. Another complaint is that, despite laboratories to study such concepts as material properties or fluid flow basics, the students do not have “hands-on” experience with complex integrated machines. A new three-credit elective course allows students to perform a complete machine disassembly and reassembly. The students determined whether the components need to be replaced to best perform their function. During this disassembly and reassembly, faculty judiciously interrupt to ask guiding questions. A once-a-week lecture provided background concepts and prepares the students for the design project part of the course. For example, when first offered in Summer 2016 the machine was a 1950 Ford 8N tractor. Unlike modern tractors, the drive, PTO, and hydraulics are all driven through one clutch. The design project for the students was to design a practical modification to the tractor so that the hydraulics were powered independently of the PTO. Faculty perceptions are that students who took this course increased their appreciation of the many implications of design choices and understanding of how machines work.

Paper S2D6 - Review of Project-Based Learning in a Junior Level Mechanical Engineering Course

Hodge Jenkins, Mercer University

The use of project-based learning in a junior level mechanical engineering course, Machine Design, is reviewed and discussed in this manuscript. The Machine Design course focuses on application of engineering analysis to the design and selection of machine elements. A significant part of the course is an open-ended design experience via project work. The project component was typically a semester long exercise, culminating in a formal written report. Project goals were to provide a realistic mechanical engineering design experience for the students, similar to what a new graduate engineer might do, but to a limited degree. The specific project varied from year to year. In some instances students were allowed to suggest and vote on projects, while in other instances projects were developed without student input. Starting with a machine functional description, operating conditions, and limited specifications/ design requirements, students interpreted the given information in engineering terms of parameters and values, creating detailed engineering specifications. All projects required visualization and modeling. Stress analysis was performed using a combination CAD models and hand calculations. Students were tasked with developing static, dynamic, and cyclic loads. Fatigue life and maximum loadings were to be considered in the stress analyses. Students were limited to designing specific engineering elements to focus their efforts into time-appropriate projects. Design work included making an engineering drawing of the device assembly, determining power requirements, stress analysis of major frame/body in critical locations. Shafts, threaded fasteners, springs, power transmission (belts, chains or gearing), keys, couplings, and bearings were also required design elements, selecting actual commercial components where possible, applying appropriate vendor engineering data in lieu of generic

textbook data. Students were required to critic their final design, suggesting revisions based on their final design results. Variations in the project implementation were reviewed and analyzed over 10 years for success, with varying project content and structure. Course size also varied and had much to do with the project structure. Project implementation was compared to those found in the current literature for project-based learning, focusing on machine design.

Sunday 8:00am - 9:45am

D1A Topics in Engineering Technology 2 (Room: San Cristobal F&G)

Session Chair: Chadia Affane Aji, Tuskegee University

Paper D1A1 - Low Cost Lab Equipment Implementation of a Machinery & Controls Course in Engineering Technology

Gregory Harstine, University of Akron
Andrew Milks, University of Akron
Joshua Boley, University of Akron

Existing lab facilities were inadequate and out of date for teaching a sophomore course on electrical machines and their control. Many of the existing lab experiences were faculty demonstration oriented rather than hands on student labs. The limited number of matching and working pieces of equipment caused difficulty in developing meaningful lab experiences. A further hindrance was the availability and location of available three phase power outlets. The existing situation necessitated a low cost method for delivering laboratory experiences in a required Associate of Applied Science Degree course, titled Machinery & Controls.

Packaged educational machinery systems were investigated but were determined to be cost prohibitive leading to the development of customized lab systems. This paper will walk through the incorporation of three-phase power to the lab and the purchase of up to date equipment found in modern industrial environments. The initial equipment implementation is focused on induction machines with plans to incorporate, synchronous, single phase, brushless DC and stepper motors as funding for additional purchases becomes available. The design process, purchase and installation of laboratory three-phase induction motors, loads and control equipment is discussed. The controls equipment included in the lab facilities is intended to give the student a practical exposure to the actual control items found in industry including variable frequency drives and solid-state soft starters. The lab equipment is designed to be supplied by a 208Y/120, 3 phase source and as such up to date electrical safety considerations according the NFPA 70E are emphasized in the course. Student feedback on the learning experiences during the first course offering with the new equipment will be included.

Paper D1A2 - Geometric Redundancy in CAD Instructions

Zhongming (Wilson) Liang, Indiana University Purdue University Fort Wayne

Commonly methods of mechanical assembling involve geometric redundancy. It can be confusing to students especially those in mechanical engineering technology. Methods to avoid redundancy is proposed.

Paper D1A3 - Update on Managing Engineering and Engineering Technology Summer Internships for Academic Credit

Fredrick Nitterright, Penn State Erie, The Behrend College

Baccalaureate engineering and engineering technology programs typically require senior design

projects which greatly aid in fulfilling ABET outcomes. An issue with some engineering and engineering technology programs is that they have too few faculty and an abundance of students working on senior design projects. This causes a large demand on the faculty to advise senior design project students throughout the academic year. To alleviate these demands on the faculty, summer internships can be offered for credit allowing the student to substitute their internship in the place of the senior design project. This would reduce the demands on faculty to advise senior design projects. In addition to alleviating the demands on the faculty, industrial work experience is very valuable and provides both the sponsoring company and the senior many benefits. Summer internships need to be managed properly to ensure consistency between the internship and the senior design. This paper will discuss how to manage the summer internships. The summer internship course should be open to students who have completed required core courses within the major and who are between their junior and senior year of their baccalaureate engineering or engineering technology program.

Paper D1A4 - Radio Frequency Power Meter Design Project

Timothy Holt, University of Akron
Andrew Milks, University of Akron

This student paper discusses a radio frequency power meter developed and prototyped as part of a senior project capstone course in electronic engineering technology. Radio Frequency Power Meters find wide application as primary commissioning and maintenance tools within various industries, from communications systems of all types, to industrial systems incorporating radio frequency energy. Their primary purpose is to first of all, provide an indication of the radio energy delivered to the antenna system or other load from the transmitter for the purpose of carrying intelligence, or enabling industrial processes. Secondly, this instrument will provide an indication of the transmission line match characteristics that exist between the transmitter and transmission system, and the antenna or other load. In this student project, a directional radio frequency power meter is developed for the purpose of measuring low frequency radio energy. Power measurement instruments of this type, operating at frequencies up to 50 MHz, are used primarily for the measurement of plasma excitation energy in the semiconductor process industry. In addition, these instruments also find wide application in the maintenance of high frequency (2-30 MHz) tactical military communications networks.

Paper D1A5 - Teaching Systems Engineering During the First Semester

Massood Towhidnejad, Embry-Riddle Aeronautic University

The complexity of the systems being build are ever increasing, and the traditional engineering curriculum is having a hard time to keep up with preparing their graduates to work on such a complex systems. In recent years, most engineering and computing degrees are integrating capstone design project as part of their senior curriculum. Only part of these projects require students to work on a complex multidisciplinary projects, and some do not even require teamwork. Requiring students to work on a multidisciplinary project is a step in the right direction for preparing the graduates to enter the workforce. However, waiting until the last year to expose the students to such projects are just too late. This paper describes a multi-disciplinary introduction to engineering course that is offered during the first semester freshman year.

Paper D1A6 - Mental Rotation Skills and Academic Success A Case Study at an HBCU

M.Javed Khan, Tuskegee University
Chadia Affane Aji, Tuskegee University

This paper reports findings on how performance on a mental rotation test is related to academic performance, specifically to performance on mathematics. Limited empirical studies are available for students from underrepresented groups. The participant population of this study is traditionally underrepresented in Science, Technology, Engineering and Mathematics (STEM) disciplines. The comparison between male and female participants and the impact of an engineering graphics course on performance on the mental rotation test is also discussed.

D1B Topics on Improving Instruction 2 (Room: San Cristobal B)

Session Chair: Beth Todd, University of Alabama

Paper D1B1 - Math Success for STEM Majors: Active Learning Strategies and Engineering Contexts

Holly Anthony, Tennessee Tech University
Stephen Robinson, Tennessee Tech University
Wilson Christopher, Tennessee Tech University

The Math Success for STEM Majors (2010–16) project (NSF STEP) was designed to increase the number of STEM graduates at Tennessee Technological University by pursuing six main strategies based in education research.1 The two strategies relevant for this paper were: (1) incorporating active learning in the redesign of precalculus courses2,3 and (2) integrating the STEM disciplines through context-driven mathematics applications within an “introduction to university life” course for entering STEM freshmen.4 This paper describes the active learning strategies/modules that were designed and implemented by interdisciplinary teams of engineers, educators, mathematicians, and physics researchers in these redesign efforts. The strategies/modules have proven effective at motivating and retaining STEM majors at TTU and are transferable to other courses/institutions. Engineering educators can adapt/modify these for use in their respective contexts/settings.

Paper D1B2 - A Comparison of Civil Engineering Education at the University of Hail, Saudi Arabia and the University of Florida

Abdulmajjid Alrashidy, University of Florida
Fazil Najafi, University of Florida

Civil engineering is one of the most important disciplines, which contribute to a sustainable planning, design, operation, and maintenance of world’s infrastructure. Recently, civil engineering education has improved significantly to keep up with the-state-of-art due to rapid technological advancement and market demand. The curriculum of civil engineering education is different from university to university depending on countries’ needs and market demand. The primary objective of this paper is to compare civil engineering curriculum at the University of Florida and the University of Hail, Saudi Arabia. The curriculum includes a type of courses, credit hours, grading systems and graduation requirements. The purpose of the comparison is to learn from each other’s curriculum and perhaps modify their curriculum for future improvements, which is significant to the field. At both institutions, student’s admission to the university depends on a student’s specific test scores. Selection process is different at both institutions. Although there are some differences in Civil Engineering education, there are some similarities as well. Both institutions strive to enhance civil engineering education and to cultivate the knowledge and the skills required for their

graduating students.

Paper D1B3 - More than Recruitment and Outreach: Diversity and Inclusion in Engineering Education Curricula and Classrooms

Deborah Kuzawa, The Ohio State University

In engineering education, diversity and inclusion may be buzzwords, but the overall focus tends to be diversity and integration, placing the burden of change and knowledge-building on underrepresented individuals and groups. The result is the “leaky pipeline,” where an increase in majors from underrepresented groups does not cause an increase in engineering workplace diversity or impact engineering workplace culture. If engineering education makes diversity and inclusion an explicit pillar in our curricula and classrooms, there is the potential to patch the leaky pipeline by improving engineering culture for not just underrepresented groups but everyone and increase the overall diversity and strength of engineering disciplines. In particular this work-in-progress explores how an engineering education course, Engineering Technical Communications, addresses and teaches issues of diversity and inclusion and provides an exploration of how D/I can be central to engineering education curricula.

Paper D1B4 - Randomized Factorial Experimental Design (RFD) Concept in Student Learning Effectiveness Assessment in Engineering Curricula

Jaewan Yoon, Old Dominion University

Characteristic of classroom instruction in Engineering curricula is highly uni-directional and passive, and subsequent assessment of student learning effectiveness depends on specific instruction delivery mechanism and /or level of learning readiness by the recipient, students. Also, conventional assessment methodology is largely based on discretized quantification via test and assignment scores, which the very assessment efforts become reduced to mere proportional comparisons of posterity of events at a sample level that do not guarantee much needed reproducibility of desired effects or improvements under similar or the same measure implemented to the course in interest. The motivation of this research is to introduce a new pedagogical assessment framework based on statistical Randomized Factorial Design (RFD) Assessment Framework concept to capture true student feedbacks at system-level so that assessment findings can be correctly used to reproduce gains in student learning effectiveness in the future. Thus this new pedagogical assessment framework is based on an approach of logical deduction with clarity, compared to conventional assessment framework of an additive and qualitative reasoning approach, to identify what works and what does not.

Paper D1B5 - Meeting new institutional goals by renovating a 20-year-old industry- sponsored capstone design course

Sindia Rivera-Jiménez, University of Florida
Keith Stanfill, P.E., University of Florida

The following work in progress summarizes the efforts of the Integrated Product and Process Design (IPPD) Program in the Herbert Wertheim College of Engineering at the University of Florida (UF). Since 1995, IPPD provides an outstanding opportunity for engineering students to work in multidisciplinary teams to solve real- world challenges of interest to sponsor companies with the guidance of a faculty member and staff. UF expects IPPD to increase 30% in the number of students and projects for the upcoming year. Growing IPPD’s enrollment will bring many challenges

for capstone design instruction, development of assessment tools, faculty performance evaluations, and multidisciplinary team management. The current work will share the findings of 9 years of collected data and examples of instructional design strategies such as lesson plans, online environment, active learning, and assessment tools. Finally, this will lead to a discussion about the new strategies and efforts needed to improve course delivery, management, and assessment.

Paper D1B6 - An Initial Exploration: Perspectives from Graduate Teaching Assistants

Rachel Kajfez, The Ohio State University
Courtney Smith-Orr, University of North Carolina at Charlotte Rachel McCord, University of Tennessee, Knoxville

Graduate Teaching Assistants (GTAs) play a critical role in many undergraduate STEM courses. They serve in supporting capacities, but they are also often used as instructors of record. It is essential that GTAs are trained on the technical content needed for these positions; however, it is also crucial that they are well versed in pedagogy so that they can effectively teach their students the technical content. Through this Work in Progress paper, we will briefly describe a course that serves as the inspiration of this work and provide initial results from a survey designed to measure GTAs' self-regulation, self-efficacy, and cultural sensitivity. The information we have collected will allow us to improve opportunities for GTA development.

Through this Work in Progress paper we will describe a course that is required of our GTAs that was designed based on general GTA and teacher preparation literature. Now that the course has been successfully piloted for GTAs teachings in different first-year engineering courses, we are interested in expanding the objectives and impact of this course to other settings. Specifically, our research question is: How do GTAs develop their pedagogical epistemologies? To begin to answer our research question, we have collected pilot data from a survey which will also be presented in this paper. The survey aims to capture GTAs' self- regulation, self-efficacy, and cultural sensitivity. The information we have collected will allow us to improve opportunities for GTA development. As this work progresses, we plan to develop resources that can be used by a variety of institutions to better support GTAs in their pedagogical development. While the implementation of this training will cater to STEM fields specifically, we believe that the results will encourage its integration into existing resources to complement the range of resources currently provided by teaching and learning centers and departments.

D1C Administrative Topics 2 (Room: San Cristobal C)

Session Chair: Donna Reese, Mississippi State University

Paper D1C1 - Opportunistic Engineering – A Student Project That Keeps on Giving

Scott Schultz, Mercer University
Pablo Biswas, Mercer University

Last year we authored a paper describing a unique opportunity to develop a summer internship program at Mercer University. This successful program teamed small groups of students with faculty to address either a research topic or engineering project. The name of this internship program is the "Mercer Summer Engineering Experience, or MeSEE. In this paper we describe the MeSEE project we directed with four summer intern students. The problem we were addressing was improving the registration process for our freshmen engineering students. Specifically, we were trying to address the challenge of creating viable Fall schedules for our Freshmen from the thousands of possible schedules. In addition, we were also attempting to obtain the best schedules

for our students while competing against other schools to fill common classes. This paper describes forming the team of students, the solution approach, and the final engineered product. What took two and half days of frustrating work for two schedulers for the Fall 2014 freshman class, took approximately three hours for four schedulers when registering the Fall 2015 class. The Fall 2016 registration process repeated the performance of 2015.

Paper D1C2 - Chemical Engineering Technology Program Conversion to an Online Certificate

Chester Little, Austin Peay State University

The Chemical Engineering Technology (ChET) program at Austin Peay State University (APSU) has been suspended after an extensive 3-year effort to convert the program to online delivery. One of the possible opportunities to recover this work involves the compression of the captured ChET body of knowledge into a 1-year, 30 credit hour certificate program. Three fit- for-purpose preparation courses (Math, Chemistry and Physics) will be developed using the analogous courses in the current ChET curriculum. It is expected that students will be allowed to “test-out” of the preparation courses. Then the existing eight ChET courses will be combined and compressed into 6 more-focused courses. The target audience for a certificate program includes experienced individuals currently working in the Chemical Process Industries (CPI) and the companies of the CPI that do not have a close relationship with a ChET education program.

Paper D1C3 - Engaging the Engineering Community

Allan Gonyo, Old Dominion University

The Civil and Environmental Engineering Visiting Council (CEEVC) is a volunteer advisory body to the Civil and Environmental Engineering (CEE) Department at Old Dominion University, Norfolk Virginia. It was established in 1987 to meet the need for collaboration between the University and the local engineering community. The council is presently comprised of 25 senior professional engineers from a cross-section of local industry, government, business, and academia. Many are ODU Civil and Environmental Engineering alumni, and all are local engineering leaders - valued ‘friends of the university’. This presentation documents how CEEVC brings ODU and the engineering community together, and provides guidelines, procedures, and documents for engineering departments to establish similar organizations to engage the engineering community in higher education.

Paper D1C4 - Helping Engineering Students Decide on the Advantages of Obtaining Lean or Six Sigma Certification

Joan Burtner, Mercer University Melinda Hollingshed, Mercer University
Shelia Barnett, Warner Robins Air Force Base

The benefits of applying Lean and/or Six Sigma principles in manufacturing and service industries are well- documented. Organizations spend considerable amounts of money delivering on-the-job training in Lean and/or Six Sigma tools and techniques. Increasingly, employers list Lean or Six Sigma certification as a desirable attribute for engineering or management positions. At one time, there were a limited number of organizations or institutions that offered quality- related certifications. However, current Google searches indicate the number of organizations is growing exponentially. This is mainly due to the increasing awareness of the value of Lean Six Sigma as a process improvement methodology. At our institution, upper-class engineering students who are actively involved in job searches are questioning the value of obtaining Lean or Six Sigma

certifications during, or soon after, graduation. In this paper we discuss the development of a mini-curriculum in which we present advice we have given our students with respect to the relative value of existing certification opportunities. We discuss the variety of certification opportunities available, including the experience requirements, the time commitment, and the cost. The curriculum also includes data from our alumni and employer surveys. In addition, we emphasize the need for career planning and instruct students on the value of choosing internships and senior design projects that offer exposure to Six Sigma and Lean methodologies.

Paper D1C5 - A Discussion of the Barriers Present to Female Engineering Students

Danielle Grimes, Mississippi State University
Dr. Jean Mohammadi-Aragh, Mississippi State University

Diversity in engineering has been a focus in research for decades. Recruitment efforts for women in engineering have had limited success in recent years, and studies have shown that the percentage of women enrolling in engineering fields began to decline in the early 2000s. In this study, we investigated the stories of nine different female engineering students on their experiences in engineering. Using semi-structured interviews, we gathered information on what factors impacted these students' decisions to major in engineering. Our research question in this paper is What external factors do female engineering students cite as barriers to female entry into the field? We found in our investigation that stereotype threat embodied within peer expectations and societal pressures form a barrier for women in engineering. The women in our study cited specific instances in their own lives that emulate the need for better recruitment practices as well as diversity education.

Paper D1C6 - Continuous Improvement for a Unique Modeling and Simulation Engineering Program

Frederic McKenzie, Old Dominion University

The modeling and simulation (M&S) engineering (M&SE) program at Old Dominion University satisfies the program criteria for general engineering in the ABET Engineering Accreditation Commission (EAC) and also declares discipline-specific student outcomes that can be utilized as a template for future up-and-coming M&SE and similar computational science and engineering programs. M&S is a discipline focused on advancing and using the theories and practices of selecting appropriate modeling techniques, creating associated models, executing models dynamically over time, utilizing visualizations for verification and validation (V&V), and evaluating a range of possible solutions through analytical techniques. We have an educational curriculum that provides students with a well-rounded foundation that can be used either to advance M&S theories or apply such methodologies to virtually any domain. This paper describes our efforts to evaluate our program in attaining these goals through the process of continuous improvement of general engineering and discipline-specific outcomes.

D1D Education Topics in Mechanical Engineering 3 (Room: San Cristobal D)

Session Chair: Veera Gnaneswar Gude, Mississippi State University

Paper D1D1 - Incorporation of Impact Erosion and Corrosion Behavior of Multi-layer Metallic Nitride Structures Deposited on Various Metal Substrates into a Lab-Based Class

Stephen Hill, Mercer University
Dorina Mihut, Mercer University
Paul Harpe, Mercer University
Joao Borba, Mercer University
Pedro Maleson, Mercer University
Vinicius Alves, Mercer University
Rodrigo Couto, Mercer University

Erosion caused by the impingement of solid particles that are carried in a transport fluid on to a metal surface continues to be a common problem. The hardness of the metal, the angle of particle impact, and the intensity of the impact determine the magnitude of the erosional process. A group of international students from the Brazil Scientific Mobility Program (BSMP) were placed on a team that allowed them to investigate impact erosion on various metals using a custom designed erosion apparatus built by students. These metals include various steel and aluminum alloys that have been enhanced through heat treatment and/or multi-layer structures consisting of alternating ceramic (metallic nitride) and metallic coatings deposited on the metal substrates using a DC high vacuum magnetron sputtering deposition machine. This experimental study allowed students to learn about metal enhancement techniques, use current material evaluation equipment, and then compare the changes to the material properties on the surface of the specimen tested with respect to the erosion process. What is presented is a summary of the student's learning experience with respect to the science of plasma deposition, its performance during the erosion process, and how this work can be used in a junior/senior mechanical engineering laboratory class.

Paper D1D2 - Presenting a more efficient approach to teach Materials Science

Monika Bubacz, The Citadel Luiz Dos Reis, The Citadel

Many students struggle with theory because they cannot always associate concepts from the text to the physical world. This is especially applicable in case of materials science that requires a review of many chemistry lessons and discusses phenomena occurring in a micro-scale world. Moreover, materials science laboratories do not always provide enough hands-on experience for students as not every school can afford a few sets of apparatus stations. The equipment is expensive and some processes are time and energy consuming. The materials science instructor at The Citadel took the more challenging approach in order to enhance student learning. The instructor held small weekly laboratory projects starting at the beginning of the semester that involved heat treatment and analysis of different steel microstructures. The previous course offering had only one project scheduled near the end of the semester. The paper will discuss the laboratory projects in detail and will include the assessment from the instructors and students. The course is offered in the fall to day and night students.

Paper D1D3 - Impact of Assigned Seating in a Flipped Course on Student Performance

Nancy Moore, North Carolina State University

For the past three years, the undergraduate Thermodynamics I course at North Carolina State University has been taught in the flipped format. In a flipped course, the concepts delivered in a

traditional lecture are instead provided through online content which allows face-to-face class time to be used on applying the concepts to problem solving. The author has previously used the answers to final exam questions from students during multiple semesters to assess the effectiveness of flipping the course. The current study analyzes the effect of working in teams on individual student success. Students are assigned to a team and to a row of seating in the classroom. Student performance is determined by results of individual tests during the semester. Analysis shows that the students with the highest grades are mostly immune to the effects of assigned teammates but there are mixed results for other students.

Paper D1D4 - Design and Development of a Pediatric Therapeutic Device Using NASA's Systems Engineering Processes

Greg Duke, The University of Alabama in Huntsville

The Rural Infant Stimulation Environment (RISE) School of Huntsville requested a senior-class Capstone Design Team (CDT) from the University of Alabama (UAH) Mechanical and Aerospace Engineering (MAE) Department design and manufacture a device that will assist a RISE student who possesses severe muscular weakness gain more independent mobility. The CDT is utilizing the National Aeronautics and Space Administration (NASA) Systems Engineering (SE) Handbook to ensure a methodical approach to the design and development of a quality product. The NASA SE Handbook will enable the CDT to learn and apply important concepts for product design and development that are practiced in industry. The CDT's design solution, a rechargeable electric mobility platform that will incorporate the RISE student's favored Tumble Form® seat and deploy his existing, rudimentary abilities, is ready for development. This paper will detail the design efforts and assess the educational impact of the NASA SE Handbook upon the CDT.

Paper D1D5 - Using the Capstone Senior Design Project to Retrofit or Design Laboratory Demonstration Units

Carmen Cioc, The University of Toledo
Sorin Cioc, The University of Toledo
Richard Springman, The University of Toledo

As part of the rigorous curriculums for the Mechanical Engineering (MIME) and for the Mechanical Engineering Technology (MET) students, laboratory courses provide a critical component of the engineering education through hands-on observation, measurement, data acquisition, data analysis and interpretation, technical reporting, etc. The laboratory courses rely not just on computer applications and software, but most importantly on current, modern lab equipment. Reduced funding, combined with increased student population in engineering leading to more wear and tear of the existing equipment, can lead to less than optimal experience for the students in the lab. The College of Engineering at The University of Toledo has been continuously working on various means to avoid these pitfalls. This work describes some of the most significant experiences, including potential pitfalls, accumulated by the ET and MIME Departments through using the Capstone Senior Design Project course to retrofit or to design and build new equipment for the labs. A first example was the retrofit of an Armfield FM10 Centrifugal Fan demonstration unit. This project was performed during the spring 2016 semester. The almost 20 year old laboratory equipment had not been operational for the past 10 years mostly due to a faulty membrane and air leakage. A group of four senior MET students took over this project, in which they assessed the equipment, redesigned and updated some of its components, calibrated and tested the equipment

and developed an equipment manual. Currently the equipment is operational and has already been successfully used in the laboratory component of the Applied Fluid Mechanics course in summer semester 2016. In the MIME Department, a more complex project involving the design and building of a new small engine dynamometer was started by the group of four ME seniors and then continued the following term by an MS student. These success stories determined the MET program to update two more Armfield laboratory units: the FM12 Centrifugal Compressor and the FM20 Centrifugal Pump Demonstration Units.

Paper D1D6 - Enhancing Learning using Gas Turbine Engine Simulation and Analysis

Adeel Khalid, Kennesaw State University

In this research, two students that are enrolled in the Aircraft Propulsion class also take part in a research project. The project entails working on gas turbine engine simulator to gather engine performance metrics. The low by-pass ratio engine is designed for light general aviation business or private jet aircraft. Tests are performed at various flight conditions. Input parameters like outside temperature, altitude, velocity etc. are changed one variable at a time. Outputs like thrust, efficiency, fuel consumption etc. are measured for various flight conditions. Temperatures and pressures are also recorded at various stages of the engine. Temperature and pressure are used as inputs for physics based analytical engine cycle analyses. The metrics measured from test bench are then compared with the analytical analyses learned in the class. It was observed that the student showed more interest in the class, spent more time in the lab and overall performed better than their counter parts.

Sunday 10:00am - 11:30am

D2A Transition to College and First Year Topics 3 (Room: San Cristobal F&G)

Session Chair: Carmen Cioc, The University of Toledo

Paper D2A1 - A collaborative design project between introductory engineering and physics classes

Esther Tian, Eastern Mennonite University Daniel King, Eastern Mennonite University

Engineering design is valued across all engineering programs and is typically project-orientated. An important element in engineering design process is the interaction among the client, designer, and user. This past year, one of the design projects our engineering students (as designers) worked on in collaboration with physics students (as clients and users) was to design rolling objects for a physics lab, with a goal of completing a loop-the-loop while satisfying certain constraints on object properties. For the engineering students, the collaboration was a chance to experience the design process. The engineering design teams met with the clients to clarify the project needs and review background physics laws such as energy conservation and rotational dynamics. Following the design process (see Dym and Little 2009 [1]), engineering students developed a problem statement identifying objectives and constraints. After exploring the design space and considering alternative designs, design teams presented a detailed design to their clients and sought feedback. Finalized designs were prepared using a 3D printer, and a technical report and final product were delivered to their clients. For the physics class, the project combined an emphasis on open-ended problem solving toward a specific experimental goal. Unlike many introductory physics labs, which may have more of a “cookbook” nature with students simply following a proscribed method, this lab required students to creatively apply knowledge learned in the classroom. Overall, through the collaboration on this project, engineering students experienced a full engineering design process and physics

students experienced an engineering-type challenge using concepts learned in their own course.

Paper D2A2 - Observations after Taking a Pre-Calculus Course

Christopher D. Wilson, Tennessee Technological University
Troy Brachey, Tennessee Technological University

The first author took Math 1710 Pre-Calculus I during the 2012-13 academic year at Tennessee Technological University. The second author was the instructor of record. This paper describes the first author's experience taking pre-calculus for the first time. The Math 1710 course is similar to a course in college algebra— trigonometry is covered in Math 1720 Pre-Calculus II. In addition to participating in the course for the semester, the first author observed the in-class aspects of the course and talked to students before and after class, playing the role of a nontraditional student. Additionally, the students were not aware that the first author was a fifteen-year veteran faculty member in engineering. In a manner substantially less spectacular than the immersion sports journalism of the late George Plimpton, the first author even managed to make A- marks on some quizzes and tests! Although mostly anecdotal in the nature, the observations of both authors provided some valuable insights into the in-class aspects of the course and the course performance expectations.

Paper D2A3 - Integrating a Career Conference into the First Year Curriculum

Dan Budny, University of Pittsburgh
Beth Newborg, University of Pittsburgh

To help improve students' understanding of the rewards, challenges, and incentives of "being an engineer," and to thereby improve retention in the freshman year, we created a number of engineering-related writing assignments in the University of Pittsburgh's Swanson School of Engineering (SSOE) first year Introduction to Engineering course. These writing assignments require that students research various aspects of engineering education and engineering careers, including research into the particular engineering field the student sees himself or herself being interested in. Despite our efforts, however, many students just did not seem to take the assignments seriously, often seeing this research and writing as not having much to do with "real" engineering (which, in their thinking, involved only STEM-related coursework). As a result, students were not getting the full benefit of the writing assignments. To encourage our students to put more effort into the first year research and writing assignments and to impress on them the value of the "real world" applications of the learning and goals of the assignments, we created the SSOE First Year Career Conference. The conference is a Saturday event, modeled after career conferences at student professional conferences such as SWE, NSBE and SHPE. In the conference we bring in practicing engineers from various companies and organizations; these engineers give talks to the students, emphasizing the importance of thinking carefully and with well-informed awareness, about their career plans. This paper discusses the factors around creating such a conference and the impact it has made.

Paper D2A4 - The Freshman Experience: A Modular Approach to Experiential Learning

Afroditi Filippas, Virginia Commonwealth University
Umar Hasni, Virginia Commonwealth University
Alen Docef, Virginia Commonwealth University
Arthur French, Virginia Commonwealth University
Georgios Bakirtzis, Virginia Commonwealth University
Hiba Nabi, Virginia Commonwealth University
Angelica Sunga, Virginia Commonwealth University

In the summer of 2015, I was asked to teach an Introduction to Engineering course for the Electrical and Computer Engineering department. The course was for the fall, 2015 semester. I had not taught Intro in quite a few years, and its format had changed significantly. With that in mind, I decided to redesign the course to be comprised of lab modules that led instruction rather than the deciding on the instruction and developing labs around that. This course is now in its third semester and it is proving to provide an effective way to teach students fundamental engineering concepts while engaging their attention and stoking their enthusiasm for the engineering profession.

Paper D2A5 - A product dissection project designed for student motivation and retention in an introduction to engineering course

Aaron Smith, Mississippi State University
Alta Knizely, Mississippi State University
Rogelio Luck, Mississippi State University

Many engineering curriculum include introduction courses at the freshman level to motivate and retain students. Providing meaningful introductions to engineering at the freshman level, however, is very challenging because the students lack an engineering background. This paper presents a product dissection based project within an introduction to mechanical engineering course. The project allows students to explore engineering design concepts with little engineering background. In a group project that consisted of 5 total hours of in-class work over the course of several weeks the students studied a purchased product in terms of performance, reliability/safety, manufacturing, and cost. Additionally, students were guided through a study on how the mechanical engineering curriculum would prepare them to create similar design solutions.

Feedback from students was collected and analyzed to determine the qualitative impact on student motivation and understanding of the mechanical engineering curriculum.

D2B Engineering Research Topics 3 (Room: San Cristobal B)

Session Chair: Morgan L. Bocci, Tennessee Technological University

Paper D2B1 - Persistence of African American Females in Engineering: The Identity Factor

Tonya McKoy, Counseling Psychology Department Marie Hammond, Psychology
Catherine Armwood, Department of Civil and Architectural Engineering
Keith Hargrove, Tennessee State University

African American females remain underrepresented in engineering careers, earning only 1% of the bachelor's degrees. While existing research examines African Americans' persistence in engineering careers, limited empirical studies exist on the impact of identity on persistence for this group. This exploratory study examines the effect of social, professional, and ethnic identities to the persistence of African American women in undergraduate engineering programs. Additionally, the study compares African American and other females on ethnic, professional and social identity

variables. Data was collected from a sample of female engineering students at an Historically Black University (HBU). A Multiple regression analyses was conducted to examine the effect of social, ethnic and professional identity on persistence of African American female engineering students. A multivariate analysis of variance (MANOVA) will be completed to examine effects of racial identity on social, group, and professional identity in African American female undergraduate engineering students.

Paper D2B2 - The S-STEM Scholars Program: A Look Back and Lessons Learned

Andrew Kline, Western Michigan University Betsy Aller, Western Michigan University
Ikhlas Abdel-Qader, Western Michigan University Edmund Tsang, Western Michigan University

Financially needy students typically must work to support their academic pursuits, thus reducing the time they have to devote to study or to participate in professional development activities that can contribute to their future success. Begun in 2010 and concluding in 2016, the S-STEM Scholars Program at Western Michigan University (WMU) was funded by a grant from the National Science Foundation with the goal of providing increased opportunities for financially needy but academically talented students in STEM disciplines within the WMU College of Engineering and Applied Sciences. The S-STEM Scholars were tracked throughout their undergraduate degree programs, and data collected to measure student success. Data included retention rate, time to degree, student participation in professional development activities, internship and co-op placements, and rate of success for post-graduation employment or graduate program enrollment.

This paper focuses on outcomes measuring the level of the program's success, as well as lessons learned. The S-STEM Scholar program results should be useful to faculty considering similar engineering education undertakings at their site.

Paper D2B3 - Engaging Students through DICE: Design Thinking, Innovation, Creativity, and Entrepreneurship

Nathalia Peixoto, George Mason University
Padmanabhan Seshaiyer, George Mason University

DICE (Design Thinking, Innovation, Creativity, and Entrepreneurship) was a two-week workshop at POSTECH University, in South Korea. Professors from George Mason University (GMU) engaged a group of undergraduate students from GMU and POSTECH to work on global problem solving using DICE. The focus was on creating scholars with interdisciplinary interest and entrepreneurial streak, empowered to break down disciplinary boundaries for solutions of impact on pressing human needs. Students were teamed up and leveraged user-centered design to innovate in solving real-world challenges. Creativity and engineering concepts included brainstorming techniques, hands-on building and technology enhanced learning modules. For hands-on activities students were asked to present usable and useful projects. We discuss one such case study in this work involving the design of a chair cane. Another example of activity generated solutions to problems identified with glasses. Teams worked on a long-term project to come up with solutions to health issues in their respective countries. Pre and post-tests were applied and creativity level, analytical skills, and design approaches were evaluated.

Paper D2B4 - Overcoming The Challenges of Implementing Offshore Wind Farm Development In The U.S. Through Education and Research

Samuel Babatunde, University of Florida
Fazil Najafi, University of Florida

Higher quality wind resources, less negative impact on aesthetics of the landscape and ease of transportation and installation are some of the advantages of offshore wind farms over wind farm projects on land.

Furthermore, wind turbines are designed to take advantage of the steady wind speed prevalent over the ocean thus enabling higher utilization rate for offshore wind energy generation capacity. More than 66 percent of offshore wind in the United States (U.S.) is in high wind power density. The National Renewable Energy Laboratory (NREL) estimates that the U.S. has 4,200 gigawatts of developable offshore wind potential.

Despite these attributes, there are no offshore wind farms in the U.S. Offshore wind projects have grown steadily in Europe and Asia, with Europe accounting for 90 percent of the roughly 8.8 gigawatts (GW) global offshore wind turbine capacity. The challenges of offshore wind energy projects include, significantly high support structure cost, high Operating and Maintenance (O&M) costs, high electrical infrastructure costs, high turbine costs, stricter environmental standards, and less developed construction techniques. This paper describes the challenges associated with offshore wind energy projects and how to mitigate them. For instance, through technological advances, the high cost of foundation can be reduced. By employing efficient O&M strategy, associated costs can be reduced. By employing these and other methodologies future offshore wind energy projects can be commercially viable. The challenges for conducting research for the implementation of offshore wind farm in the U.S. has educational component. The product of this research work should have educational value for researchers and students of engineering education.

Paper D2B5 - Work in Progress: The "Cilindro Rotador" as a Pedagogical Tool for Complex Engineering Systems

A. Nastasia Allred, Tennessee Technological University
J. Robby Sanders, Tennessee Technological University
Pedro E. Arce, Tennessee Technological University

The engineering description of multiphase systems (such as organs within the human body or packed-bed reactors in the petrochemical industry) represents a challenging pedagogical task for the instructor and a steep learning curve for the students. Both students and instructors face a multitude of domains with different scales and with interconnecting interfaces that need an intimate understanding before physical concepts can be put into mathematical models. Such systems usually involve various transport processes (diffusion, convection and/or migration) with either homogeneous or heterogeneous reactions; they reflect different types of geometries that anchor irregular pore shapes, and they are comprised of different types of materials with various properties (e.g., diffusivity, viscosity, thermal conductivity, etc.). In reaching a successful description, students must bring together "disconnected" concepts from a variety of courses in a coherent manner; they need to assess the assumptions in each phase that match the relevant scale and, therefore, connect them with microscopic or macroscopic models. Their skill set should allow them to identify suitable boundary conditions that capture the interfacial physics. In all, the analysis is a daunting learning task for the students. Within the framework of the Renaissance Foundry Model1, this study

is exploring the use of well- characterized physical or laboratory devices (i.e., a diffusion cell, a simplified reactor, etc.) as pedagogical tools to help the students (and the instructor) acquire the skill set to describe complex systems. In particular, we will present elements and pedagogical functions of the “Cilindro Rotador” to integrate concepts learned in different courses, train the students in the art of simplifying assumptions, identifying suitable scales, and assessing proper conditions for the interfacial boundaries.

D2C Education Topics in Computer Engineering 2 (Room: San Cristobal C)

Session Chair: Liyong Sun, Penn State Erie, The Behrend College

Paper D2C1 - Alternative Energy Pros and Cons and How to Teach

Masoud Fathizadeh, Purdue University Northwest

Wind and solar energies are becoming viable alternatives for electrical energy production. Teaching such new subjects require sound technical and extensive practical background. There are many books and resources available for providing basic principles, formulas and overall understanding of the subject. However, in real world applications, basic understanding and limited technical background would not convince skeptical customers to spend revenue and financially support such activities. The initial cost of solar or wind power systems is high and prohibits an average customer to procure such systems. The impact of the high cost can be substantially reduced if proper incentives and tax breaks are implemented. The electric utilities are required to produce certain amount of their electricity from alternative renewable sources such as wind or solar. Majority of the utilities purchase electric power generated from wind or solar under the title of “Green Energy” to satisfy the quota mandated by the federal government. On the other hand, there are private entities interested in competing with utility companies in purchasing the “Green Energy” and provide fixed contract or competitive pricing per kWh of produced energy to the suppliers. A residence or a business with installed wind or solar system not only can benefit from producing its required energy but also can produce extra power and sell it either to utilities or third parties. A balance between power rating, site selection and incentive calculation must be maintained to provide an optimum design for an alternative energy system. This paper presents step-by-step calculation, code and ethical consideration, cost and incentive analysis to find the optimum design for a site. The students’ participation in the installation and final commissioning of the project will be presented. This type of teaching prepares students for a complete project design, cost analysis, procurement, installation, codes and ethics, and commissioning of a project with a real world experience.

Paper D2C2 - Building a Sustainable ICT Remote Access Lab through Student Lab-Worker Projects

John Pickard, East Carolina University Mark Angolia, ECu
Phil Lunsford, East Carolina University Taylor Broach, ECU

This paper details the experiences of a paid undergraduate student lab-worker project that involved building, troubleshooting, and maintaining a quarter million-dollar network infrastructure used to deliver remotely accessible information and computer technology (ICT) labs. The infrastructure, known as the Academic Network Operations Center (ANOC), provides 24/7 remote-lab access to more than 500 students in 20 graduate and undergraduate courses annually. The assembly and ongoing maintenance of the ANOC by student lab-workers makes the project cost effective and also provides opportunities for the student lab- workers to apply their classroom knowledge and skills to meaningful work experience within the College.

Using a case study approach, this paper provides details on the processes, procedures, and policies implemented at the department and college level to make these types of student managed remote labs a viable alternative for higher education institutions.

Paper D2C3 - Design and Development of A Low-Voltage, Low-Current 3-Phase Power Enabled Lab Bench

Jacob Staniszewski, Michigan Tech
Aleksandr Sergeyev, Michigan Tech

The capstone project course is an intrinsic part of the undergraduate education. The capstone projects are widely regarded as an excellent mechanism for assessing the outcomes of engineering and engineering technology programs and can serve as a direct measure of the quality of graduates. Capstone projects provide an opportunity for students to demonstrate their critical thinking skills, communication skills, as well as time and project management skills. In this article, the design, construction, and results of a low-voltage, low- current 3-phase lab bench as part of a senior design capstone project are discussed. The following article describes the potential for a lab bench that is more user friendly, but still provides the user with practical, real world experience. The current laboratory equipment that is used to teach Electrical Machinery course is outdated and unsafe. The proposed in this article solution provides an increase in the functionality and safety for learning concepts of 3-phase power systems. The construction of the device is documented with high level of details and provides the list of all the necessary components needed to replicate the proposed in this article system. The final design of the system is tested with the newly written labs so that the potential of the unit can be visualized.

Paper D2C4 - Manufacturing Engineering Technology Program Addition of a Sustainability Option

Chester Little, Austin Peay State University
John Blake, Austin Peay State University
William Longhurst, Austin Peay State University

The Chemical Engineering Technology (ChET) program at Austin Peay State University (APSU) has been suspended after an extensive 3-year effort to convert the program to online delivery. Opportunities have been identified to capture the process technology subject matter for deployment in another program that could benefit from the online availability. One of these promising opportunities involves the existing Engineering Technology program at APSU via the addition of a Sustainability option within its Manufacturing Engineering Technology Concentration (B.S. in ENGT). A proposal for a new Sustainability option built upon the captured ChET body of knowledge is currently being prepared. Much of the original ChET subject matter is already commonly included in the ENGT curriculum. The unique material from the ChET program is primarily associated with energy production and consumption, other industrial inputs and the Health, Safety & Environmental concerns in the manufacturing industries. With some additional course work, this unique ChET material will be expanded to meet the requirements of a new Sustainability option. The full paper will provide details for this new Sustainability option inside Manufacturing Engineering Technology.

Paper D2C5 - A Human Factors Perspective on Learning Programming Languages using a Second Language Acquisition Approach

Rebecca Rohmeyer, Embry-Riddle Aeronautical University
Paula Sanjuan Espejo, Embry-Riddle Aeronautical University Lulu Sun, Embry-Riddle Aeronautical University
Christina Frederick, Embry-Riddle Aeronautical University

In this day and age, knowing a programming language is an essential skill to have for those pursuing a career in any of the STEM fields. In most colleges and universities around the world, engineering and computer science students are required to take an introductory course in a programming language. However, many students find these courses intimidating and too challenging. This paper explores a psychological perspective on learning programming languages using Second Language Acquisition (SLA) theories. The paper also describes the basic function of how learning works and how SLA aids in the learning process. This paper also briefly discusses the Second Language Acquisition in a Blended Learning (SLA-aBLe) project, and how the use of SLA techniques facilitated students learning MATLAB. Demographic survey data and overall grade data from spring 2016 show that students in the SLA-aBLe courses received overall higher grades and felt less overwhelmed and intimidated.

D2D Education Topics in Civil Engineering 4 (Room: San Cristobal D)

Session Chair: Valmiki Sooklal, Kennesaw State University

Paper D2D1 - Capstone Design for a Growing Program

Beth Todd, University of Alabama
Nima Mahmoodi, University of Alabama

For a number of years, the Mechanical Engineering program at the University of Alabama completed industry-based Capstone Design projects. A plan was developed to accommodate 72 students per semester which seemed adequate to meet future needs. However in the past ten years, enrollment has quadrupled. The need for adequate resources to advance these students to graduation has led to new ideas for Capstone Design. These include increasing the size of the teams and having multiple teams address the same problem. The previous Capstone Design program will be described from project assignment, design conception, through execution and delivery to the industrial client. Then the current adjustments will be addressed. In the paper, the previous Capstone Design program will be described from project assignment, design conception, through execution and delivery to the industrial client. Then the current adjustments will be addressed.

Paper D2D2 - Creation of On-Campus Living Laboratories for Improved Student Learning

Kyle Kershaw, Rose-Hulman Institute of Technology
Jennifer Mueller-Price, Rose-Hulman Institute of Technology
Matthew Lovell, Rose-Hulman Institute of Technology

Experiential learning has been linked with increased content retention rates among students. Traditionally, many of the experiential learning activities in engineering education have occurred in laboratory settings. However, laboratory activities often lack the complexity of real-world problems that graduate engineers will face. This is particularly true in civil and environmental engineering where large projects and systems must be scaled down and simplified to evaluate in a laboratory setting. To remedy this issue and increase student exposure to complex problems, the Department

of Civil and Environmental Engineering at Rose-Hulman Institute of Technology has begun to develop living laboratories by leveraging existing and planned facilities on campus. This paper will present the rationale behind the design of the living laboratories, descriptions of the projects that have been completed or planned, challenges associated with implementation of labs, and preliminary results of assessment related to the effectiveness of the labs as teaching tools.

Paper D2D3 - Capstone Project: Competition Challenges Students

Shane Palmquist, Western Kentucky University

The capstone design project for engineering students is a culminating experience. At this institution, the senior capstone experience also requires construction of what is designed. This approach forces engineering students to see a project from beginning to end, from concept and design through construction. Like engineering and construction companies that compete for jobs through a competitive bid process, the National Steel Bridge Competition can be used as a capstone experience that challenges civil engineering students by having them compete against engineering students from other schools. This paper examines the successes and significant challenges from the student and faculty perspective of having the National Steel Bridge Competition as a senior design and construction capstone experience.

Paper D2D4 - Teaching Soil Mechanics to the Would-Be Construction Professional

Craig Wise, University of Akron

Conveying the essential fundamentals of soil mechanics in the context of an engineering technology or construction management degree poses some challenges. Soil mechanics curriculum is traditionally much more theoretical than applied. A successful construction engineer or manager needs to develop an understanding of how soils, groundwater and foundations interact, and all of this typically needs to be conveyed in one 15-week course. This leaves precious little space for the development of soil mechanics theory. For the construction career track, a very important aspect of career preparation is to develop a frame of reference to interpret soil-related construction documents such as boring logs, geotechnical reports, and foundation drawings. Relevant courses vary significantly in name within construction degrees, often variations of “Soil Mechanics” and “Foundation Construction Methods”. Dividing such courses into thirds using some included activity modules has been found to be effective in preparing the students for construction careers.

Paper D2D5 - Engineering Curriculum for a Global Village

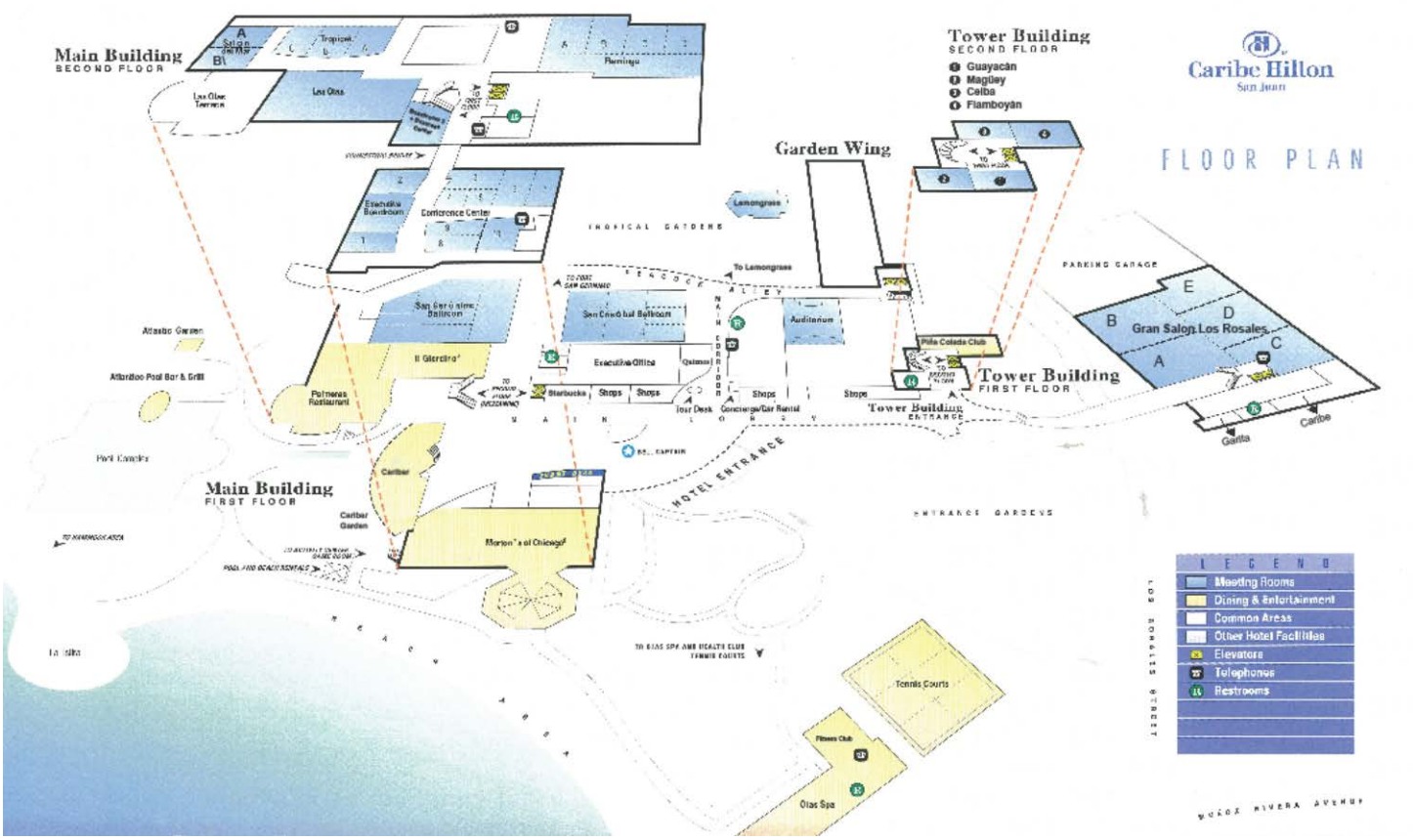
Roop Mahajan, Virginia Tech

At a 2003 Energy & Nanotechnology Conference at Rice University, noted scientist and Nobel Prize winner

R.E. Smalley presented the following list of the top 10 problems of humanity for the next 50 years: 1) Energy, 2) Water, 3) Food, 4) Environment, 5) Poverty, 6) Terrorism and War, 7) Disease, 8) Education, 9) Democracy and 10) Population. These problems have a few characteristics in common. They are challenging and complex, are interconnected, have a high degree of uncertainty, are global in scope, and require multiple perspectives. For engineers who pride themselves as problem solvers, meeting these challenges demands of them decisions that not only require technical expertise but also a keen understanding of broad, socio- humanistic contexts and considerations. We, in academia, must ask the crucial question: Are we preparing our students to

tackle these real-life global challenges? In this paper, I will address this question and propose that the current curriculum in various engineering disciplines move beyond conventional silo-based contents to holistic programs that integrate interdisciplinary inquiry into the core courses and prepare students for global engagement through the use of overseas student exchanges, global academic partnerships, and emerging technologies. As an example, I will present a curriculum for a four-year Mechanical Engineering degree program that blends human and social sciences, applied sciences, communication and leadership with the required math and core mechanical courses. To introduce students to interdisciplinary research and outreach, the curriculum requires them to undertake a multi-year project(s) to reach out to developing communities locally or globally and assist them in self-reliance through sustainable technologies and practices. I believe that by embracing these more encompassing perspectives in learning and discovery, we will prepare our students for careers addressing global problems.

CONFERENCE MAP



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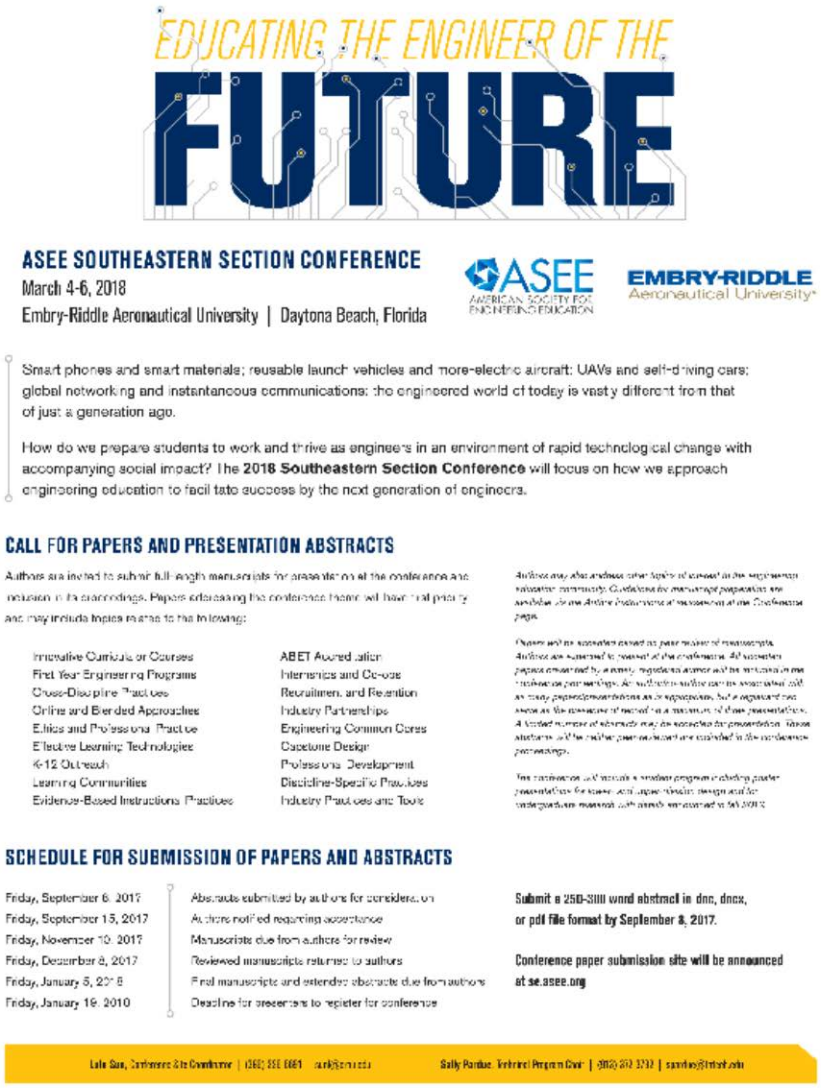
The University of Akron
Akron, Ohio

The 2018 ASEE North Central Section Conference will be held on the campus of The University of Akron and jointly hosted by the College of Engineering and College of Applied Science and Technology. We will share an exchange of Engineering and Engineering Technology education information and networking in the Rubber City.

Watch for details in the fall NCS newsletter.



Paper Author Index (Session, Author, Page)