FIRST-YEAR
FYEE
ENGINEERING EXPERIENCE

10th Annual Conference

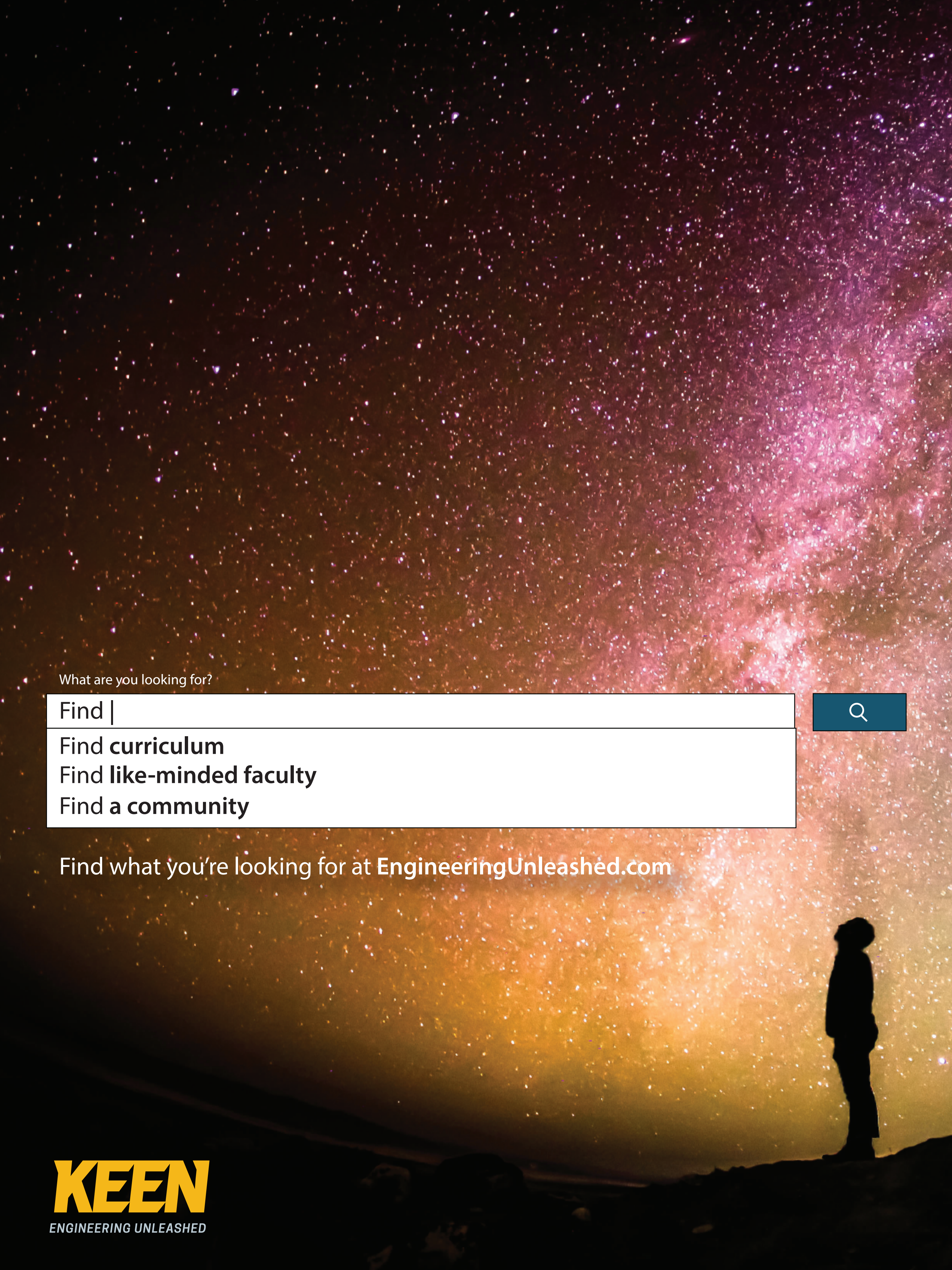
Enhancing the First Year of Engineering Education

Hosted by:

Rowan University
DEPARTMENT OF EXPERIENTIAL ENGINEERING EDUCATION

FIRST-YEAR PROGRAMS DIVISION

July 24-26, 2018
Glassboro, NJ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Welcome

We are thrilled to welcome you to the 10th Annual First-Year Engineering Experience Conference held at Rowan University! The conference seeks to continue the dialogue that began at the University of Notre Dame in 2005 and was recreated in 2012 at the University of Pittsburgh. The experience of first-year engineering students is something that is dear to us at Rowan University, where, in 1994, the Engineering Clinics program was started to give students hands-on and project-based learning experiences throughout their undergraduate career. The program committee hopes that you will enjoy an opportunity to discuss the myriad issues pertaining to the first-year experience while enjoying the local area.

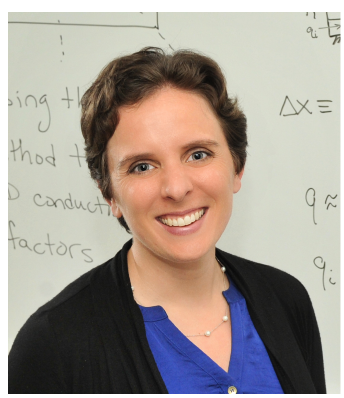
FYEE represents a unique opportunity to better understand the complexities associated with educating first-year engineering students. Through combinations of keynote addresses, workshops, and technical sessions, conference attendees are encouraged to share best practices and innovative ideas for improving first-year engineering education.

The FYEE conference will take place in the Enyon Ballroom of the Chamberlain Student Center and in Engineering Hall, both on Rowan University's 200-acre campus, starting on Tuesday evening with a social reception. Wednesday will feature two keynote addresses and, along with Thursday, will be filled with workshops and technical sessions.

With the continued focus on the connection between academic advising, K-12 preparation, and first-year engineering experiences, we hope to see many old friends as well as lots of new faces at FYEE 2018.

We look forward to seeing you all!

Stephanie Farrell, PhD
Professor and Chair
Experiential Engineering Education Department
Rowan University



Kaitlin Mallouk, PhD
Assistant Professor
Experiential Engineering Education Department
Rowan University

FYEE 2018 General Chairs

Rowan University

July 19, 2017

Dear Colleagues:

I am delighted to welcome you to Rowan University. The Henry M. Rowan College of Engineering is proud to be the host of the 10th Annual First-Year Engineering Experience Conference. We hope you will enjoy this time on our campus and that you will have some to explore everything that this area has to offer.

Rowan University has evolved from its humble beginning in 1923 as a normal school with just 236 students and a mission to train teachers for South Jersey classrooms to a comprehensive public research university with a strong regional reputation and over 18,000 students.

In 1992, after several decades of growth that transformed the Glassboro Normal School to Glassboro State College, a multipurpose institution, industrialist Henry M. Rowan and his wife Betty donated $100 million to the school. That gift was, at the time, the largest ever to a public college or university. Later that year, the school changed its name to Rowan College of New Jersey to recognize its benefactors' generosity. The Rowans' only request was that a College of Engineering be created with a curriculum that would address the shortcomings of engineering education. The college achieved University status in 1997 and changed its name to Rowan University. The College of Engineering quickly earned national accolades for its successful new curriculum and hands-on, minds-on approach to engineering education.

The Experiential Engineering Education Department (ExEEd) was launched as a new Department in 2016 to reinforce the translation of educational innovations into the classroom, foster a collaborative environment for engineering education research, and to lead the College's undergraduate engineering educational mission in the freshman and sophomore years. We are very excited to host FYEE 2018 and to have this opportunity to share ideas and promising practices for first-year engineering education.

We are delighted to have the honor to host two exceptional keynote speakers this year. Jennifer Turns, Professor of Human Centered Design & Engineering in the College of Engineering at the University of Washington will deliver the opening keynote on Reflection and the First-Year Experience. Her talk will be at 9:00 AM on Wednesday in the Enyon Ballroom in the Chamberlain Student Center (CSC). On Wednesday evening, we welcome Maria-Isabel Carnasciali as our dinner keynote speaker. Maria-Isabel is the Chair of the Department of Engineering & Applied Sciences Education at the Tagliatela College of Engineering, University of New Haven, CT. Her talk, Is the first-year in Engineering the right time for Entrepreneurial Thinking?, is at 6:00 PM, also in the Enyon Ballroom in the Chamberlain Student Center (CSC).

I wish you a productive and successful conference!

Sincerely,

Anthony M. Lowman, PhD
Dean, Henry M. Rowan College of Engineering

Office of the Dean

Henry M. Rowan College of Engineering
Rowan Hall
201 Mullica Hill Road
Glassboro, NJ 08028

856-256-5300
856-256-5350 fax

Conference at a Glance

Tuesday, July 24, 2018	
4:00 p.m. – 7:00 p.m.	**Registration**, in the Chamberlain Student Center (CSC)
5:00 p.m. – 7:00 p.m.	**Welcome Reception with dinner buffet**, Room: Owl's Nest of the Chamberlain Student Center (CSC)
Wednesday, July 25, 2018	
7:00 a.m. – 5:00 p.m.	**Registration**, in the Chamberlain Student Center (CSC)
7:30 a.m. – 8:30 a.m.	**Good Morning Breakfast Buffet** Room: Enyon Ballroom in the Chamberlain Student Center (CSC)
8:30 a.m. – 8:45 a.m.	**Conference Welcome/Announcements** Room: Enyon Ballroom in the Chamberlain Student Center (CSC)
8:45 a.m. – 10:00 a.m.	**Keynote Presentation** by Jennifer Turns Keynote Topic: Reflection and the First Year Experience Room: Enyon Ballroom in the Chamberlain Student Center (CSC)
10:00 a.m. – 10:30 a.m.	**Break**
10:30 a.m. – 11:45 a.m.	**Technical Sessions & Works-in-Progress** Room: 127, 129, 144, 221 in the Chamberlain Student Center (CSC)
11:45 a.m. – 12:45 p.m.	**Lunch** Enyon Ballroom in the Chamberlain Student Center (CSC)
12:45 p.m. – 2:00 p.m.	**Sponsored Workshops** Room: 224, 227 Robinson Hall
2:00 p.m. – 2:15 p.m.	**Break**
2:15 p.m. – 3:30 p.m.	**Technical Sessions & Works-in-Progress** Room: 127, 129, 144, 221 in the Chamberlain Student Center (CSC)
3:30 p.m. – 4:00 p.m.	**Break with food**
4:00 p.m. – 5:15 p.m.	**Technical Sessions & Works-in-Progress** Room: 127, 129, 144, 221 in the Chamberlain Student Center (CSC)
5:15 p.m. – 6:15 p.m.	**Break**
6:15 p.m. – 8:15 p.m.	**Dinner Reception and Keynote by Maria-Isabel Carnasciali** Presentation by KEEN Keynote Topic: Is the first-year in Engineering the right time for Entrepreneurial Thinking? Room: Enyon Ballroom in the Chamberlain Student Center (CSC)

Thursday, July 26, 2018	
7:00 a.m. – 10:00 a.m.	**Registration**, in Atrium Engineering Hall/Rowan Hall
7:30 a.m. – 8:30 a.m.	**Good Morning Breakfast Buffet and Tours (8:00 a.m.)** Room: Atrium Engineering Hall/Rowan Hall
8:30 a.m. – 9:45 a.m.	**Technical Sessions & Works-in-Progress** Room: 319, 320, 321 Engineering Hall/Rowan Hall
9:45 a.m. – 10:00 a.m.	**Break**
10:00 a.m. – 11:15 a.m.	**Technical Sessions & Works-in-Progress** Room: 319, 320, 321 Engineering Hall/Rowan Hall
11:30 a.m. – 12:30 p.m.	**Lunch and Tours (12:00 p.m.)** Atrium Engineering Hall/Rowan Hall
12:30 p.m. – 1:45 p.m.	**Technical Sessions & Works-in-Progress** Room: 319, 320, 321 Engineering Hall/Rowan Hall
1:45 p.m. – 2:30 p.m.	**Wrap-up & Send-Off Session** Auditorium (117) Engineering Hall/Rowan Hall

Campus Logistics

Campus Guides and Navigation

We plan to have a student in the Courtyard Marriott Parking Circle on Wednesday and Thursday mornings to help you get your bearings. There will also be signs with the FYEE logo along the walking route from the Parking Circle to the conference events.

WiFi

Complimentary visitor WiFi is available by selecting Rowan_Visitor_Wireless from the available networks, opening a browser window and following the instructions to log in.

Parking – Tuesday through Thursday

Parking is available in lots D and D-1 and in the Townhouse Garage. No special action is required—simply find an open spot in one of those locations and park.

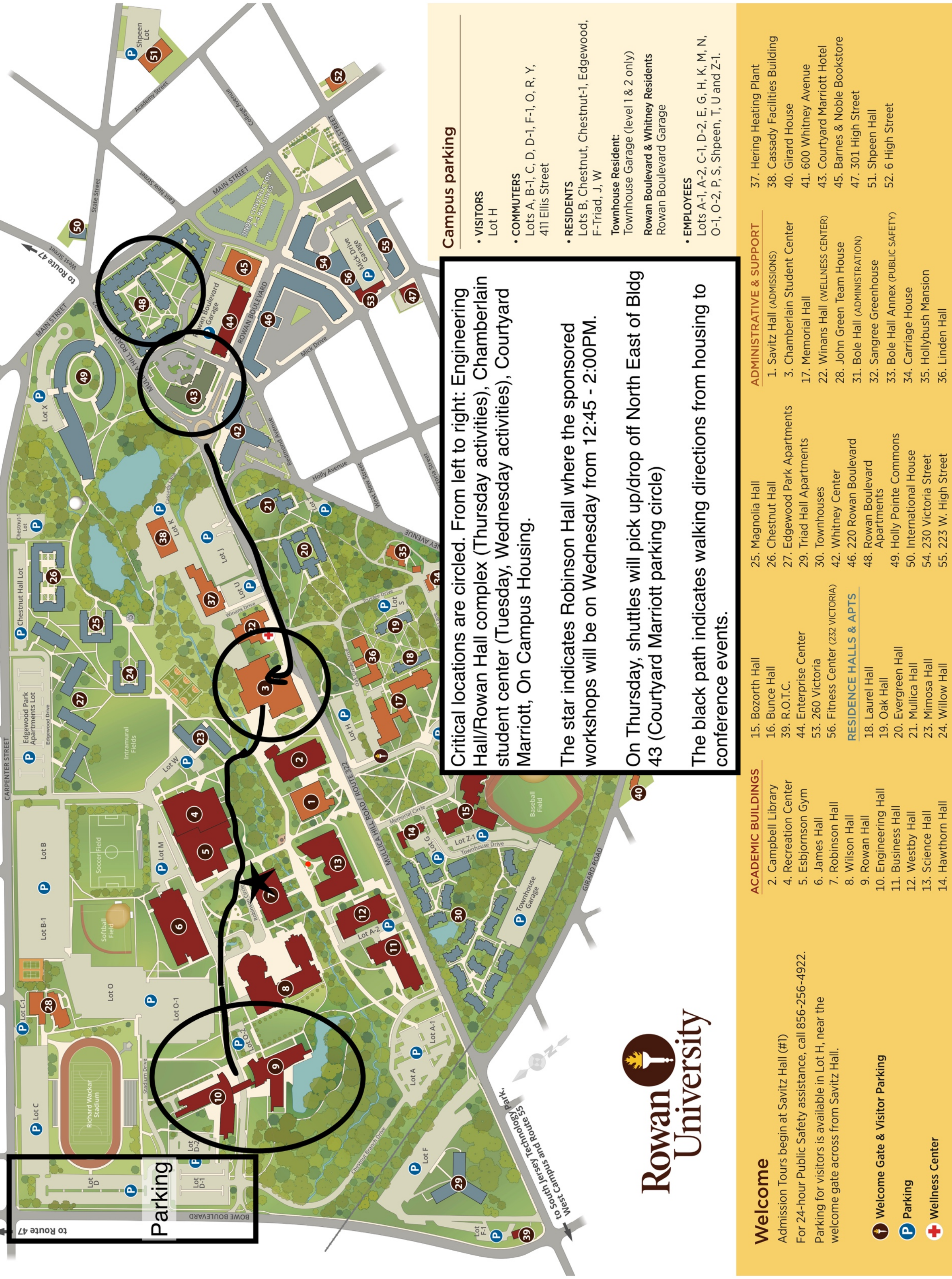
Shuttle - Thursday

A complimentary shuttle will be provided on Thursday from the Courtyard Marriot parking circle to Engineering/Rowan Halls starting at 7:15AM with the last pickup at 8:15AM. At the conclusion of the conference, a shuttle will run from Engineering/Rowan Halls to the Courtyard Marriot parking circle starting at 2:00PM and concluding at 3:00PM.

Engineering Facilities Tours

On Thursday at 8:00 AM and 12:00 PM College of Engineering students and staff will be running brief tours of the Henry M. Rowan College of Engineering Facilities. Meet in the Rowan Hall Atrium if you are interested.

Conference Location and Map



Conference Committee

The FYEE conference is made possible by the dedication of many volunteers.

The 2018 Planning Committee

Rowan University General Co-Chairs:

Stephanie Farrell & Kaitlin Mallouk

Program Chair:

Tim Hinds, Michigan State University

Publications Chair and Website Management:

Dan Budny, University of Pittsburgh & Jack Bringardner, New York University

Special Thanks to Our Rowan University Student Volunteers:

Annie DiGuglielmo, Coordinator
Jackiey Washington, Caroline Thistle, Jeremy Decker, Kelly Yorke, Alexa Diano, Winnie Cross

The FYEE Conference Steering Committee

Mara Knott, Chair, Virginia Tech

Krista Kecskemety, Ohio State University

Kaitlin Mallouk, Rowan University

P.K. Imbrie, University of Cincinnati

Rich Whalen, Northeastern University

Tim Hinds, Michigan State University

Conference Sponsors

Conference sponsors and affiliates play an important role in supporting the FYEE conference. We are grateful to these organizations whose support of the FYEE 2018 conference enhances the experience for all attendees! Please visit our exhibits area and attend the sponsored workshops to express our appreciation.

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Time	Activity
Tuesday 4:00 PM- 7:00 PM	FYEE Registration Location: Chamberlain Student Center (CSC)
Tuesday 5:00 PM- 7:30 PM	Reception Location: Chamberlain Student Center, Owl's Nest

Tuesday Evening Reception

When: Tuesday July 24 from 5:00 -7:00PM
Where: Owl's Nest in the Chamberlain Student Center

We invite you to join us for food, drinks, and networking at the Tuesday evening reception to be held in the Owl's Nest in the Chamberlain Student Center. Beer and wine will be available along with a hot buffet with Caesar Salad w/ Herbed Croutons, Chicken Francese, Homemade Baked Ziti, Vegetable Rice Pilaf, Sautéed Fresh Vegetables, Freshly Baked Garlic Bread, Individual Italian Pastries and Starbucks Fresh Brewed Regular, Decaf Coffee, and Tazo Tea Service.

This will be a great time to reconnect with old friends and meet newcomers to FYEE before the official start of the conference on Wednesday morning. We look forward to seeing you!

Wednesday Morning Keynote

Dr. Jennifer Turns
Professor of Human Centered Design & Engineering
College of Engineering
University of Washington

Keynote Title: Reflection and the First-Year Experience

Biography:
Jennifer Turns is a professor in Human Centered Design & Engineering in the College of Engineering at the University of Washington (UW) and a faculty affiliate with the UW Center for Engineering Learning and Teaching. Dr. Turns' research focuses on studying and supporting reflection across the engineering education ecosystem. This work has included a focus on engineering students reflecting on educational experience, engineering educators reflecting on their teaching activities, and members of the engineering education research community reflecting on the translation of research findings to practical implications. Dr. Turns has been an associate editor of the Journal of Engineering Education, a member of the governing board for the international Research in Engineering Education Network, and a holder of the J. Ray Bowen Professorship for Innovation in Engineering Education. Dr. Turns holds a Ph.D. in Industrial Engineering from the Georgia Institute of Technology.

Wednesday Evening Keynote

Maria-Isabel Carnasciali
Chair, Department of Engineering & Applied Sciences Education
Associate Professor of Mechanical Engineering
Tagliatela College of Engineering
University of New Haven, CT

Keynote Title: Is the first-year in Engineering the right time for Entrepreneurial Thinking?

Biography:
Maria-Isabel Carnasciali obtained her Ph.D. in Mechanical Engineering from Georgia Tech and her B.S. from MIT. She teaches the Introduction to Engineering course for first year students and serves as the faculty liaison to the Engineering Living Learning Community.

She has been active in faculty development since her time as a postdoc at the Center for Enhancement of Teaching & Learning at Georgia Tech -- where she developed skills and interests in engineering education research and program assessment methods. During the past 5 years, she has been a PI/Co-PI on several grants aimed at embedding entrepreneurial thinking into the engineering curriculum. As part of this effort, she is one of the lead facilitators for the KEEN ICE Workshops – a 4-day workshop for faculty, held multiple times a year to train faculty in the use of student centered teaching/learning techniques as a means of developing an entrepreneurial mindset in engineering students.

She pursues two areas of research – one related to mechanical engineering and the other related to engineering education. Many of the Master's level theses and projects she oversees involve validation of Computational Fluid Dynamic (CFD) models for aerospace applications as well as optimizing efficiency of thermal-fluid systems (including wind turbine designs). On the engineering education side, her research focuses on the nontraditional engineering student – understanding their motivations, identity development, and impact of prior engineering-related experiences. Her work dwells into learning in informal settings such as summer camps, military experiences, and extra-curricular activities.

Session and Presentation Timing

Sessions are 75 minutes long. All of the sessions within the same time slot will maintain the same starting time for papers as shown in the table below. This is to enable "session hopping," where papers of interest are in different sessions but are not presented at the same time.

If there is a "no-show" author in a session, the moderator will conduct an open forum on the session's theme between the presenters and the audience during this empty time slot. **Papers MUST be presented at their scheduled time. No papers will be rescheduled.**

Each technical paper session will consist of four or five (4-5) 15-minute segments. Each paper will be allotted 15 minutes for the presentation and questions. The moderator will use part of each of the 15-minute segments for introductions and instructions. Any additional time can be used for a group discussion. The design of the FYEE conference is to promote discussion and interaction. Thus, the sessions are not just people presenting material, but also a place for people to share their insights on an issue. The discussion should be based on the theme of each session. The presentations should present ideas that the group can then discuss. Come to the session prepared to provide your insight.

Paper times for sessions are shown in the table below. H designates the session starting hour: mm designates the session starting minutes. (For example, if the session starts at 3:30 p.m., then H=3 and mm=30.) The starting time of each paper is indicated by H:mm + X where X denotes the number of minutes to add to the session starting time. (For example, in a 90-minute session that begins at 10:30 a.m., the fourth paper, begins at H:mm + 45 so that H=10, mm=30 and X=45; the starting time is 11:15 a.m.)

Sessions	**1 hour 15 minutes**	**Ex. 1**	**Ex. 2**	**Ex. 3**	**Ex. 4**	**Ex. 5**	**Ex. 6**
1st Paper	H:mm	8:30	10:00	10:30	12:15	12:30	16:00
2nd Paper	(H:mm) + 15 min	8:45	10:15	10:45	12:30	12:45	16:15
3rd Paper	(H:mm) + 30 min	9:00	10:30	11:00	12:45	13:00	16:30
4th Paper	(H:mm) + 45 min	9:15	10:45	11:15	13:00	13:15	16:45
5th Paper/ Disc.	(H:mm) + 60 min	9:30	11:00	11:45	13:15	13:30	17:00

1. The time allotted for both full and work-in-progress papers at FYEE is 15 minutes for your talk, including questions. You should rehearse your presentation to ensure that it will fit within these time limits.
2. For sessions with 4 or fewer papers, the final 15 minutes of each session are for group discussion.
3. Each of the session rooms will have an LCD projector, screen, and computer. It is recommended that presenters use the computer in the session room. If you are bringing your own computer, please have the appropriate cables to connect. The session moderator will help presenters load their presentations on the session room computer. Please have a back-up copy of your presentation, just in case.
4. Please be at your session room 15 minutes prior to the scheduled starting time. This will allow time to meet the session chair and other speakers, discuss session procedures, and preload all of the electronic presentations onto the computer in the session room.

Time	Activity			
Wednesday 7:00 AM- 5:00 PM	Registration Location: Chamberlain Student Center			
Wednesday 7:30AM-5:00PM	Exhibits Open Location: Chamberlain Student Center, Enyon Ballroom			
Wednesday 7:30AM-8:30AM	Breakfast Buffet Location: Chamberlain Student Center, Enyon Ballroom			
Wednesday 8:30 AM- 9:00 AM	**Conference Welcome** Dr. Kaitlin Mallouk & Dr. Stephanie Farrell, Experiential Engineering Education, Rowan University Dr. Anthony Lowman, Dean of the Henry M. Rowan College of Engineering, Rowan University Location: Chamberlain Student Center, Enyon Ballroom			
Wednesday 9:00 AM- 10:00 AM	**Morning Keynote** Dr. Jennifer Turns, Professor of Human Centered Design & Engineering, College of Engineering , University of Washington "Reflection and the First-Year Experience" Location: Chamberlain Student Center, Enyon Ballroom			
Wednesday 10:00 AM-10:30 AM	Coffee Refresh Location: Chamberlain Student Center, Enyon Ballroom			
	CSC Room 127	CSC Room 129	CSC Room 221A	CSC Room 221C
Wednesday 10:30 AM-11:45 AM	W301D: Student Success & Development: Focus on Retention	W301A: Student Success & Development: Focus on Academic Support	W301C: Enrollment, Instruction & Pedagogy: Focus on Classroom Practices	W301B: Enrollment, Instruction & Pedagogy: Focus on Design-Based Prrojects

Time	Activity			
Wednesday 11:45 AM-12:45 PM	Lunch Location: Chamberlain Student Center, Enyon Ballroom			
Wednesday 12:45 PM-2:00 PM	Sponsored Workshop: Cengage Location: Robinson Hall 224		Sponsored Workshop: Mathworks Location: Robinson Hall 227	
	CSC Room 127	CSC Room 129	144A	
Wednesday 2:15 PM-3:30 PM	W501C: WIP: Enrollment, Instruction & Pedagogy - Focus on Design-Based Projects	W501A: WIP: Student Success & Development: Focus on Retention	W501B: WIP: Enrollment, Instruction & Pedagogy: Focus on Classroom Practices	
Wednesday 3:30PM-4:00PM	Coffee/Snack Break Location: Chamberlain Student Center, Enyon Ballroom			
Wednesday 4:00 PM-5:15 PM	Workshop: Taking it to the Next Level...Game-Based Learning in Engineering Education Location: Chamberlain Student Center, Room 127		Workshop: Engineering Reasoning - An Approach to Increasing the Appeal of Introductory Engineering Courses to All Students Location: Chamberlain Student Center, Room 144A	
Wednesday 6:15 PM-8:15 PM	**Dinner & Evening Keynote** Maria-Isabel Carnasciali Chair, Department of Engineering & Applied Sciences Education, Associate Professor of Mechanical Engineering Tagliatela College of Engineering, University of New Haven, CT "Is the first-year in Engineering the right time for Entrepreneurial Thinking?" Location: Chamberlain Student Center, Enyon Ballroom			

W301A: Student Success & Development - Focus on Academic Support

Wednesday, 10:30am-11:45am - Chamberlain Student Center, Room 129

An Analysis of Freshman Engineering Student Attitudes

Aysa Galbraith, Brandon Crisel, Leslie Massey, Candace Rainwater, Heath Schluterman,

The Freshman Engineering Program (FEP) in the College of Engineering (CoE) at the University of Arkansas was established in 2007 to improve the retention of first-year engineering students to the sophomore year and ultimately support the CoE long-term goal of increasing graduation rates. Since the establishment of FEP, the second-year retention rates for CoE has increased from 62% to 71%. Identifying the factors which influence retention and using the resultant information to improve the academic and student service support for freshman engineering students is critical to the continual success of our program. Towards this effort, we collect and analyze data in many areas.

This paper focuses on identifying attitudes of freshman students that come from varied backgrounds and preparation then determining the changes in those attitudes during their first semester. For this purpose, students in freshman engineering classes were given the Pittsburg Freshman Engineering Attitude Survey twice as an assignment during their first year; pre-survey at the beginning of fall semester and post-survey at the beginning of spring semester. Typical Freshman Engineering students, who are qualified to take Calculus I (on time) or Precalculus (one semester behind), enroll in Introduction to Engineering I in fall semester and Introduction to Engineering II in spring semester. Some of our students, who are qualified to take College Algebra (two semesters behind), enroll in Fundamentals of Success in Engineering Study in fall semester and move on to Introduction to Engineering I or II in spring semester. High-achieving honors students who are qualified to take Calculus II or beyond can enroll in Honors Research or Innovation Experience and Colloquium. The analysis of survey results showed that students' perception of engineering, persistence in engineering and their desire to be involved in campus all increased from fall semester to spring. Our analysis for differences among the students enrolled in different types of freshman engineering classes revealed that while the confidence levels in science and math differ, the persistence in engineering, perception of engineering, study and social skills did not show significant difference between students of varied backgrounds.

Exploring Issues Faced by Students in STEM Fields: First Year Focus and First Generation Focus

Stephany Coffman-Wolph, Kimberlyn Gray

West Virginia University Institute of Technology (WVU Tech) is a small school that heavily recruits from the local area that consists of very small towns and rural areas (historically Montgomery, WV and currently Beckley, WV). WVU Tech University currently does not have a specific first-year engineering program and is looking for ways to incorporate these concepts into the existing student services, STEM student organizations on campus, or integrating material into existing courses (or designing new courses). The goal of this paper is to identify and investigate the specific issues unique to first-generation STEM students, in particularly, first-generation students from very rural areas (population < 5,000). The authors collected anonymous data from a mixture of first-generation and non-first-generation undergraduate students enrolled at WVU Tech University during the Spring 2018 semester using a twenty-minute online survey (where students self-identify their first-generation status). The survey focused on high school background, areas that students feel they struggle with, issues they are having completing classwork (particularly in STEM courses), and perceived missing student services. Additionally, students were asked about their knowledge of college, their participation in the First-Generation Program and student organizations, and their perception of their support system, whether family, friends, or faculty and staff. Using the data collected, the authors will examine the emerging themes and make suggestions for possible actions for WVU Tech University to take within their STEM program and First-Generation Program to increase the number of STEM students completing their degrees, successfully recruiting more students into the STEM program, and increasing the number of first-generation students pursuing STEM majors. In an early examination of the data, the authors have found differences in the college experience of first-generation students who participate in the First-Generation Program and those who do not. The authors would like to incorporate some of the activities from the First-Generation Program into other programs to help other first-generation students.

The Career Identity Program: Creating a Personalized Academic-to-Career Plan for First-Year Engineering Students

Chester Levern Miller, Lori Ghosal, Rachel Worsham

Many first-year engineering students have limited knowledge in determining the difference between engineering disciplines. Additionally, undeveloped career goals and lack of experience further complicates students' ability to make informed decisions regarding major choice. Given this challenge, it is not surprising that 80% of all college students change majors before graduation1. As a result of this uncertainty, students face increased time to degree completion, additional financial burden, anxiety and doubt about major and career choices, and sometimes, failure to graduate. In response

to this challenge, in 2016, a Career Development Center (CDC) developed the Career Identity Program (CIP). Collaborating with academic units, the partnership set out to help successfully navigate students toward their academic and career goals through intentionally designed workshops to challenge guide students toward personal values and passions. The goal is to reduce the number of major changes, time to degree completion and increase participant career readiness upon graduation.
The CIP is a series of interconnected, activity-based workshops and guest speakers that build on each other to help students design meaningful, values-driven careers. Students also meet with their Career Identity Coach individually throughout the year for customized, intensive academic and career coaching. Coaches help students examine 1) their interests, skills, and motivations; 2) their understanding of career pathways and related majors; 3) their career-related activities and experiences, and how to maximize those experiences in becoming career ready.

In 2016-2017, the CIP served 93 engineering students leading to overwhelming success and support from students and advisors for expansion. In 2017, to reach more students, the CDC launched the Career Identity Coaching Training Program providing training for 12 adviser/staff partners to support workshop offerings for student participants. This paper highlights the CIP program and its incorporation within the program curriculum of an Engineering Living-Learning Community.

The Engineering Living-Learning Village (EV), a residential community comprising 400 first-year engineers, took on a leadership role in expanding the CIP to serve more Village residents. Village staff completed 15 hours of coach training by CDC and provided individual coaching for 35 Village residents and CIP participants, increasing to 123 engineering students in the second year. The addition of the CIP to the Village's extant academic and professional development program offerings has not only increased the added value of the Village experience for students, but has also strengthened the Village's connections with key campus partners like the CDC. Assessments are currently underway to determine the efficacy of the program within the Village and will be available upon conference presentation.

Citation
1 About 80 percent of students in the U.S. change their major at least once. On average, college students change their major three times over the course of their college career. (National Center for Education Statistics, Mar 15, 2013)

First-Year Engineering: An Integrative Approach to Student Success and Development

Carmellia Davis-King

Cultivating engineering students who are well equipped to assist in solving the Grand Challenges for Engineering in the 21st Century called for XXX University's College of Engineering to change how students were being educated during their first year on campus. In partnership with corporate theme partners Consumers Energy, Bosch Corporation, General Electric, Tenneco, college faculty and staff, the College of Engineering's CoRe Experience developed academic and co-curricular programming that focused on developing core competencies as a component for student success and development. CoRe is an engineering living and learning program for 1st year undergraduate students.

The curricular piece of this integrated living and learning program called "CoRe" is academic. It consists of two introductory courses. The first provides a set of broad, team-based, hands-on design experiences as well as an introduction to topics common across all engineering disciplines. The second course introduces problem solving and mathematical modeling of engineering problems and systems. The academic courses provide students with a broad introduction to the profession of engineering, problem solving and team building skills. The classes prepare students to advance within the curriculum and potentially see themselves as young professionals capable of succeeding in the field of engineering.

The second component of CoRe is the co-curricular programming within three residential halls on campus that includes the delivery of student service operations, including career services, freshman academic advising, peer tutoring sessions and mentoring by College and CoRe corporate theme partners. Another aspect of the co-curricular programming includes the

development of a faculty speaker series and academic probation presentations. Partnering with industry, college and campus partners during the engineering students' first year on campus has proven to have a positive effect on students seeking co-op and internships during their 1st year of their undergraduate education. To ensure that students develop key competencies, corporate sponsors provide additional opportunities such as mentoring, evening presentations, team based competitions, site visits and professional conferences focused on training and development. CoRe is a unique integrated effort on behalf of the College of Engineering faculty, staff, corporate theme partners and campus departments to ensure that each student has the tools needed in order to be successful.

With the continued program improvement efforts each year CoRe implements academic and Co-Curricular changes to meet the needs of student participants. Academic and Co-Curricular successes and failures are made available through a yearly program survey. Data collected from students, faculty, staff and campus and corporate partners help to shape programming efforts.

Engaging Freshman Engineering Students in the Entrepreneurial Mindset through Disruptive Technology Design Challenge Activity

Hyunjae Park

The freshman engineering discovery courses currently running at Marquette University – Opus College of Engineering offer engineering design challenge activities for new engineering students to experience the engineering design process and to simultaneously practice an entrepreneurial mindset. A six-week long design challenge activity is scheduled for a group of student teams (seven to nine students per team) to conceptually design disruptive products for the underprivileged. After introducing samples of existing products and/or services related to the disruptive technologies to the students, they practice to identify additional existing disruptive products/services in our society or market, and continue to conceptually design the future (potential) various disruptive products or processes related to the given theme of the project through the disruptive technology design challenge activity. At its core, disruptive technologies are strongly linked to the entrepreneurial mindset defined by the 3C's of Curiosity, Connections and Creating value.

W301B: Enrollment, Instruction and Pedagogy - Focus on Design-Based Projects

Wednesday, 10:30am-11:45am - Chamberlain Student Center, Room 221C

Re-imagining a first year design course to incorporate service-learning while minimizing traditional challenges

Jonathan Elliot Gaines

The University of South Florida is exploring the feasibility of a service-learning based first year engineering design course that addresses some traditional service-learning challenges. Some of these challenges include logistical difficulties with community partners, group work assessment and accountability, effectiveness of the course for students with varying skills, and the delicate balance between providing structure to help with project success and freedom to explore meaningful solutions. During the Fall 2017 semester, two sections of 45 students completed service-learning projects as part of their first year engineering design experience through a course uniquely designed to address these challenges. Students were given an adaptation of Gelmon [1] service-learning based pre- post- surveys to evaluate the effectiveness of the course.

Stimulate PRIDE in Freshmen with Reverse Engineering_

BALRAJ SUBRA MANI, I. Rao

New Jersey Institute of Technology at Newark NJ (NJIT) has introduced a systemic change in the first year of the Mechanical and Industrial Engineering (MIE) program since 2011. NJIT has introduced 'Reverse Engineering' as part of the curriculum for the entering freshmen with Mechanical Engineering as their major. The MIE educational staffs have efficiently blended reverse engineering with the existing Fundamentals of Engineering Design-101 (FED-101) curriculum, which has yielded rewarding results. The sense of accomplishment, which the freshmen experience in their Reverse Engineering projects, is propelling them to excel in the next four years of undergraduate education.

The implementation of reverse engineering at NJIT has been refined over the past seven years and is now at a mature stage. The several phases involve, but not limited to the following: team formation, establishing a project plan & PERT, project selection, product acquisition, disassembly, establishing a design task plan, patent search, historical patent research, understanding the product, materials & manufacturing methods, preparing a product description, CAD modeling, producing a comprehensive report, and showcasing to judges from local industry. Some teams indulge in lightning podium presentations. The entire class also publishes a comprehensive showcase brochure consisting of all product descriptions. Each team pursuing a different product for reverse engineering offers ample room for individuality and innovation. Palpable surge in their self-esteem is typically and invariably evident after the showcase presentation.

Incidental course evaluation at the end of the semester has revealed distinct improvement in retention. This program has facilitated students identify their possible aptitude mismatch for their chosen major at an early stage, helping them to initiate corrective action in their first semester. By exposing the freshmen to the values of Purpose, Responsibility, Individuality, Determination and Excellence, this non-pedagogical approach of teaching through Reverse Engineering indeed breeds PRIDE in our students.

This paper presents a time-tested systematic approach to implement Reverse Engineering.

The Impacts of a Human-Centered Design Project on First Year Engineering Student Perceptions of Success

Susan M Bitetti, Ethan E Danahy

This full paper offers an overview of a first year robotics instructor's implementation of a client-driven design project as a means of emphasizing a breadth of engineering concepts. First year courses are employed for teaching fundamental technical content while also exposing students to important non-technical skills within engineering design, such as communication and collaboration. In recent years, the design of first year courses in engineering have fallen under even heavier examination as experts in the field have called for more graduates in engineering fields with more practice-based experiences. Instructors have thus been turning to project-based assignments in order to not only cover technical to non-technical learning goals, but also as a means of capturing student interest early in their undergraduate coursework.

Employers in the engineering field have been cited as seeing a lack of communication and understanding of real-world constraints in newly hired engineers (Lattuca, Terenzini, and Volkwein, 2006; Sheppard, Macatangay, Colby and Sullivan, 2009). Previous research has shown that project-based assignments presented in first year engineering courses can help address this void. Many of these first-year studies focus around a real problem from the surrounding community (Saterbak & Volz, 2012; Simiawski, Luca, Pal & Saez, 2015) or a particular client (Saterbak & Volz, 2014). These types of projects ideally align more closely with what students will experience in engineering careers. Research has captured student growth in the less technical areas of engineering through the implementation of client-based projects (Saterbak & Volz, 2014). However, as engineering students focus on more real world engineering contexts, evidence warns that students may start to dismiss knowledge content from earlier coursework as unimportant, seeing a disunity in what skills are required of

engineers (Jocuns et al. 2008; Korte, Sheppard, and Jordan 2008). There is thus space to further explore:
how a first year course instructor might implement a project in such a way that allows students to define success in engineering more holistically and
what characteristics of "expert" engineers start to emerge as students complete a human-centered design project?

This paper aims to address these questions through detailing the instructor's methodologies in designing and implementing three different projects, the last of which was to design a toy for children aged four to eight years old. The final project included both a prototyping session and final showcase where children tested the toy designs. Through a close examination of student short-answer reflection surveys at the beginning and end of the semester, this work offers how a client-centered project impacted the student's criteria for success in engineering design. In their reflections, students also respond to the question "what they would do differently" if given more time to iterate on their project, thereby offering insight into where their thought processes start to align with that of professional engineers.

From Design to Reality: Guiding First-Year Students from Design to Makerspace Reality

Jack Bringardner, Victoria Bill, Gunter Georgi

An existing introduction to engineering and design course at the NYU Tandon School of Engineering for first-year students was adapted to include guidance for first-year students to grow from early conceptual design to using the makerspace. A Rapid Assembly and Design (RAD) challenge embedded in NYU's culture of invention, innovation, and entrepreneurship was created that allows students to work on their own unique project. Lab exercises, instructional videos, and project working space were developed to support the open-ended projects that required the use of the makerspace. An end-of-semester survey was conducted to see if the participants in the RAD project benefited from the makerspace training and if the projects improved their engineering design abilities. A timeline of events and descriptions of the training are documented for others to reproduce.

W301C: Enrollment, Instruction and Pedagogy - Focus on Classroom Practices

Wednesday, 10:30am-11:45am - Chamberlain Student Center, Room 221A

Development of Inclusive Freshmen Engineering Assignments

Tiago R Forin

At Midsized Northeastern University, freshmen engineering students take an introductory course in the fundamentals of engineering. In this course, students learn the fundamentals of engineering that they will use for years to come. Beyond helpful tools such as CAD and other computer software, the course offers students a chance to explore other topics relevant to engineering. This includes, disciplinary boundaries of engineering, engineering ethics, and the design process. While these topics can be given a cursory lecture, there exists opportunities to expand on these themes and topics. Given practices of inclusive classrooms, a faculty member can create engaging ways to have students explore these topics and encourage the development of good research skills and critical thinking. Inclusive practices can include practices such as decentralizing western examples in engineering, showcasing underrepresented engineers, allowing students to draw connections with their personal lives, enabling different styles of learning, and allowing students to teach themselves. This paper will showcase three such assignments and explore the development, rationale, and results for each as well as how inclusivity is used for each assignment. One assignment allows students to investigate the disciplinary divisions of engineering, allowing students to have the chance to educate one another on the history and nature of engineering disciplines as well as showcase unique individuals that have made some contributions to engineering. Another assignment allows students to explore the design process by comparing engineering design to the design methods used by non-engineering fields. This will allow students to see how design is used across the world and how it can enable cross-disciplinary work. The final assignment involves students exploring ethical, moral, and social issues in engineering through the use of movies that highlight actual events in engineering. The use of visual media to reflect issues in engineering can help engage more visual and reflective students and allows all students to observe the direct implications of ethics to engineering and how it affects society. This paper can be used to stimulate the development and elaboration of other assignments that have similar qualities and objectives.

PathFinder: Affordable and Effective Web-books for First Year Engineering Courses

Jess W. Everett, Scott Streiner

This paper describes the implementation of PathFinder (https://pathfinder.rowan.edu/), a website that facilitates the creation and dissemination of affordable web-books for college students. The purpose of this paper is to describe its implementation in an introduction-to-engineering curriculum at a public university in the north east, and to discuss the use of Pathfinder (or similar websites) in first and second year engineering courses in general.

The PathFinder website allows professors to create, maintain, and access an electronic database of engineering topic folders. Each folder contains information on a single topic and may contain an article and other content, e.g., variables, equations, images, videos, exercises, and references. Articles contain links to content in other folders. Chapters are special articles that aggregate content from multiple folders to communicate complex topics. A PathFinder web-book contains multiple chapters with student exercises for each chapter. Each chapter is easily customized for individual institutions. Thus, professors can easily create additional articles, chapters, and exercises.

When a student accesses a web-book chapter, PathFinder assembles content on the fly from the latest and most up-to-date information in its database. Students easily navigate chapters by scrolling or using links to jump to any heading, table, figure, equation, or example. Chapters are associated with BEFORE and AFTER exercises. Students complete BEFORE exercises before the professor covers the associated chapter in class; thus, PathFinder promotes a flipped classroom. Students complete AFTER exercises after a chapter is covered in class, i.e., AFTER exercises are homework. Exercises can be multiple-choice or calculation-based. They are chosen from banks, so each student gets a different set of exercises. PathFinder randomly selects the input values of calculation-based exercises, so even when two students get the same exercise they cannot simply copy answers. Exercises are graded automatically, freeing graders to spend more effort on higher-level assignments, e.g., reports.

PathFinder provides web-books to three introductory, multidisciplinary engineering courses, each with 16 or 17 sections. This paper outlines the creation of PathFinder content, the implementation of PathFinder in courses, the merits of its use, and how it or similar web-book systems can be adopted by first year engineering programs.

Effectiveness of Ethical Interventions in a First-Year Engineering Course: A Pilot Study

Richard Cimino, Scott Streiner

For most students, college is “a time during which they define themselves in relation to others, and experiment with different social roles…” (Gurin, 1999). Students may begin to question their usual social norms as they begin to experience a larger and more diverse population and are exposed to new social situations such as communal living, class schedules, ‘free time’, part-time jobs, and parties. For many, this may be the first time they confront the ethics and morals by which they were raised.

Engineering students are tasked with the additional challenge of reconciling themselves with the ethical codes that are integral to the profession of engineering. Students must learn to make engineering decisions that take into account ethical and moral concepts and must learn to resolve serious ethical dilemmas – often with the knowledge that people’s lives may depend upon those decisions. While it is mandated that ABET accredited engineering programs provide their students with education about engineering ethics (outcome 4, formerly outcome f), the form that education takes varies considerably with each program. Further, there is continual debate at the university level about the efficacy of engineering ethics education (King & Kitchener, 2004). In particular, at least one prominent study (Colby & Sullivan, 2008) has documented skepticism amongst faculty with respect to the (positive) nature and influence of the ethics education provided.

The purpose of this pilot study is to characterize the moral development of first year engineering students and examine how ethical and moral outlooks change throughout the first year engineering curriculum when exposed to a set of specific ethics-based interventions. The ability of first year engineering students to make ethical decisions is assessed using two related instruments – the Defining Issues Test (DIT-2) and the Engineering Ethical Reasoning Instrument (EERI) that are designed to assess moral decision making via the Kohlbergian model of moral development. These instruments were implemented via a pre-post testing model, with instructional interventions taking place between the tests. Instructional effectiveness was also analyzed in relation to moral development and ethical problem resolution by means of a focus group.

While mixed, the results of this pilot study indicate that 1.)The instructional methods have an effect on student thought processes (though not necessarily the intended one) 2.) Engineering students tend to score higher on the EERI than on the DIT-2 and 3.) Engineers taking the DIT-2 may outscore students in other professional and technical majors.

Citations

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Examination of the Development of Grit in First-Year Engineering Students

Jenahvive K. Morgan

The effect of a first-year engineering course on student grit was examined. Students in an introduction to engineering design course worked in teams to complete design projects. Design prototypes and reports were completed as part of the course, while lectures were presented covering the topics of grit, project management, and interpersonal team building. Students completed a grit survey in the beginning of the course, and again after materials and activities used to develop grit were presented. Since both completing the requirements for an engineering degree and going on to work professionally as an engineer are not easily achieved, it is important for students to develop grit to ensure success in accomplishing these goals. Unfortunately, how a student develops grit can be difficult to understand. A self-reporting measure of grit was given to the students to examine their ability to sustain effort and interest in activities which span months or longer to complete. These traits have been found to predict achievement in challenging environments. The effectiveness of the course material on student grit was evaluated using a comparison of the students' responses to the two surveys. After material on grit was presented, students who reported a high school GPA below a 3.0 were found to be less discouraged by setbacks, and less likely to be distracted from pursuing their long-term goals. Overall, female students reported more grit than male students.

W301D: Student Success & Development - Focus on Retention

Wednesday, 10:30am-11:45am - Chamberlain Student Center, Room 127

Improve Recruitment and Retention Based on Student Interests

Julia Keen, Katie Zoe Loughmiller, Katherine Benton

Undergraduate retention rates for those majoring in engineering are typically lower than other non-technical majors. Several factors play a role in the student retention rates within respective engineering majors: class load, internship experience, technical content, etc. To examine interest levels of Architectural Engineering (ARE) and Construction Science & Management (CNS) several semesters of students were surveyed at the beginning and end of their orientation class. The survey consisted of questions regarding demographics and personal interests, as well as the student's confidence in their choice of major. Data collected identified commonalities in hobbies and interests of students who were retained versus students who have left the program. This information is important as the department determines the more effective ways to improve retention, as well as better targeted recruitment efforts in Architectural Engineering Construction Science and Management. With this information the department can emphasize specific aspects of the program in the literature and advertising used when recruiting prospective students. These preferences can be used when planning course content modules and social or technical events for current students to increase interest and participation. This data allows the department to help provide more opportunity for current and future students to form relationships with other students based on shared interests outside of the curriculum and engineering groups. The anticipated result will be students within the Department of Architectural Engineering and Construction Science and Management who are more excited and engaged in their major during their collegiate and professional career.

Scale-up and Sustain a Cohort Program for First-Year Engineering Students Who Are Placed in Algebra II

Edmund Tsang, Dannielle Curtis, Katherine Fox, Lindsay Gove, Rebecca Scheffers, Lenore Yaeger

First-year students who are placed in Algebra II in the first-semester in college based on ACT or SAT math sub-scores are considered under-prepared in engineering and have been identified as an at-risk population. First-time first-year students who are enrolled in Algebra II in the first semester in the College of Engineering and Applied Sciences (CEAS), University XX, number 75-100 annually, forming 20-25% of the first-year CEAS student population. Improving the success and retention of these Algebra II students is important to university enrollment. Placing students into cohorts has been identified as a high impact practice by the National Survey of Student Engagement (NSSE) of Indiana University that positively affect student success and retention. In this paper, the details regarding the scale-up and sustaining a cohorts program -- the EXEP Cohorts -- for first-year Algebra II students at University XX will be described. In an EXEP Cohort, ~24 students are enrolled in the same section of 3-to-4 courses in fall semester and in the same section of 3-to-4 courses in spring semester. Progressing through the first-year as a cohort allows students to make connection with peers, faculty and staff, and to form study groups. Cohorts also form a focal point through which student success services and information can be channeled. This paper will describe how to create a cohort program that involves ~100% of Algebra II students, together with details of a two-credit-hour "First-Year Engineering Seminar" that focuses on successful transition from high school to college in engineering, and a 1-credit-hour recitation "Introduction to Engineering Analysis" that links Algebra II topics to applications in engineering. Student performance in Algebra II will be presented, with comparison to baseline performance; as well as performance in subsequent Precalculus, with comparison to baseline performance; and retention rates to engineering and to university, with comparison to baseline retention rates. Students placed in cohorts are tracked by their university identification number. Each subsequent fall semester, the identification numbers by cohort year are run against enrollment data kept by the Office of Institutional Research, to determine the students' status of enrollment in engineering, enrollment at institution but with a non-engineering major, or non-enrollment, to determine the retention rates. Results so far indicate that the EXEP Cohorts program is correlated to statistically-significant, positive improvements in Algebra II performance and in retention to university. Other improvements, though not statistically-significant, include retention to engineering, and all changes compared to the baseline are positive and never negative. Factors that positively impact sustaining the EXEP Cohorts program for Algebra II students at University XX will be described, together with an estimated cost of the program. University XX is a state-assisted regional institution of higher learning, and it belongs to the CSRDE (Consortium for Student Retention Data Exchange) "Less Selectively" category. Engineering programs with similar student demographics may learn lessons from this project on how to build and scale-up a cohorts program to support the success and retention of Algebra II students and how to sustain the practice.

Evaluating the Perceived Value of a First-Year Engineering Experience

Todd France, Brittney Masters

The national effort to remain a leader in scientific exploration and technological development has redoubled educational efforts to not only introduce students to the field of engineering at younger and younger grade levels, but also to place more effort on retaining the students who ultimately choose engineering as a career path. As a result, more institutions are placing a higher value on first-year engineering introductory courses, a key component of retention.

However, with engineering being an incredibly broad field, there is relatively little agreement from institution to institution on the content and skills to address in a first-year course. Moreover, previous studies have shown that students more often leave their engineering degree programs due to a lack of interest and/or a poor classroom environment than for reasons related to challenging technical content. To address these issues, researchers have investigated best practices for retaining students through tutoring and mentoring and identified positive correlations between classroom practices and student confidence and commitment. Yet gaps still exist in our understanding of the value students place on their first-year coursework, particularly as they relate to their later experiences in engineering classes and professional work.

At a private, Midwestern university's college of engineering, all students are required to complete a two-course (six total credit hours) first-year engineering sequence. While this course sequence is expected to provide a common foundation upon which all students are able to build their knowledge bases and skillsets, little is known of the students' true perceptions of their first-year experiences. To address this knowledge gap, four focus groups were conducted with a total of 12 juniors and seniors in the college. During these focus groups, students discussed their first-year engineering courses and how these experiences supported their later coursework and professional work (e.g., internships). Sixteen juniors and seniors completed surveys to gather further supporting evidence.

Outcomes from the subsequent analysis are intended to provide deeper insight into the value that students place on their initial experiences with engineering at the college level, allowing educators to better involve first-year students in class while at the same time prepare them for their chosen professional pathways. The following research questions drive this study:

After experiencing higher-level engineering coursework . . .

1) What value do students place on their first-year engineering experiences?
2) What connections do students make between their first-year engineering experiences and subsequent engineering courses and professional experiences?
3) What technical content and skills do students suggest for a first-year engineering experience?

Putting UNIV 101 Back Into the Classroom Where it Belongs

Roger J Marino, Alison Stoute, Rosie Sullivan

The subject of what strategies are most effective to help students successfully make the ease of transition from high school into the first year of their engineering education has been well considered. At the core of the issue is the retention rates that universities desire in order to survive. At Drexel University, due to logistical and budgetary considerations, "first year orientation" courses were historically presented in either large lecture halls, or online. A change in this policy was implemented in the Fall quarter of 2017, whereby 783 first year engineering students were placed into classroom settings for an orientation course, University 101 (UNIV 101). Although UNIV 101 is a university-wide initiative with general requirements, the College of Engineering modified the course content to accommodate incoming engineering students. The average class size was 27 students. Topics taught in the course varied weekly and included: navigating the campus; finding available resources at the University; how to schedule classes; defining what sub-disciplines of study were available in each of the specific engineering disciplines; and interacting with Professors who came into the classroom as Guest Speakers to talk about their research or how they became professors. The courses were taught by Undergraduate Advisors (typically matching the Advisors with their Advisees in the classroom). The results of the Policy change are presented herein. As was anticipated, the students (57% responding) reported an overall positive experience, and the Advisors reported fewer required transactional meetings with the students because their general questions were answered in the classroom. As a result, those transactional meetings between students and Advisors shifted towards more conversations in alignment with the Advising Center's developmental philosophy which is focused on behaviors and long-term planning.
Ten to fifteen deliverables were required of the students during the quarter to assure that they were retaining the information presented. Additionally, students were asked to perform an exercise in reflection at the end of the quarter to compare their actual experience in the course with their initial expectations, and to indicate what additional information they thought should be provided to the next class of incoming engineering freshmen. Student success improved after the quarter (Fall 2017) compared to the cohorts taught by the on-line method of instruction used in the two years prior (2015 and 2016) considering both Failures and Withdrawals. Peer (Student) Mentors were utilized in 5 of the 29 course sections and, as can be expected, student satisfaction scores were markedly higher in these sections. Data supporting these findings is contained within this paper, as well as a recognition of individual historically-recognized factors that lead to students' success, and how the in-class UNIV 101 experience satisfies those factors.

W401A/B: Sponsored Workshops

Wednesday, 12:45pm-2:00pm - Robinson Hall 224

Sponsored by Cengage: MindTap for Engineering: Propel Students from Memorization to Mastery

Tori Sitcawich, Tim Anderson

Learn how to provide engaging content, challenge every individual and build student confidence with MindTap for Engineering—the platform that gives you complete control over your course. MindTap for Engineering comes equipped with features like algorithmic problem sets and step-by-step tutorials that accelerate student progress. During this workshop, you'll see the benefits of MindTap's Learning Path and other capabilities that enable you to teach your course, your way.

Wednesday, 12:45pm-2:00pm - Robinson Hall 227

Sponsored by Mathworks: MATLAB Online Learning Resources for First-Year Engineering Courses

Balaji Sharma

This session would facilitate a discussion around the challenges of first-year engineering education and its impact on student performance over the rest of the program. We will explore how technology can be leveraged to better support student learning, engagement and retention while preparing them for competitive job markets. We will present the latest resources and tools that educators can leverage for developing engaging MATLAB-based courses while exposing students to real-world problem-solving. This session would focus on: Auto-grading, instant feedback and learning analytics for large classrooms. And Project-Based Learning using smartphone sensors and low-cost hardware (Arduino/Raspberry Pi).

W501A: WIP: Student Success & Development - Focus on Retention

Wednesday, 2:15pm-3:30pm - Chamberlain Student Center, Room 129

Encouraging First-Year Engineering Retention through Course Help and Campus Community Engagement

Rebecca R Essig, S. Scott Moor, Kimberly O'Connor, Sara Thomas

> This work-in-progress paper describes a freshman engineering design course that incorporates coding and manufacturing engineering concepts through an autonomous robot vehicle project. The course itself is part of a three-course engineering design sequence that introduces incoming freshman engineering students to the fundamental concepts of engineering design that will be applied throughout their undergraduate engineering education. The project's learning objectives are that students will be able to successfully integrate digital and physical design, develop a navigation algorithm, and implement it in Arduino C, in order to allow an autonomous robot vehicle to successfully navigate a course. Students use modern, industry-standard fabrication and prototyping tools in the design process, and demonstrate a working autonomous robot vehicle, including student-designed, 3D-printed protective components. Two faculty instructors with backgrounds in mechanical and manufacturing engineering and electrical and computer engineering team-teach the course and provide a systems approach to design and engineering with specific expertise in different aspects of the course.

Comparing First Year Engineering Students' Math and Verbal ACT scores and Performance in Introductory Engineering and Composition Courses

Michelle E Jarvie-Eggart, Laura Fiss

> Much attention has been given to the link between incoming engineering students' math readiness and their performance in first year engineering programs. To promote retention in engineering programs, many first year programs now have separate classes for students in need of math skill development. But little is done to assess in-coming student verbal or written communication abilities as it relates to their success as engineers, although communication is included in the new ABET program Criteria 3. Student Outcomes 3, "ability to communicate effectively with a range of audiences" (ABET, 2017). Many programs focus on assessing communication within the context of a final report or senior design project, at the end of a student's experience.

In fact, engineers spend a majority of their time communicating. It has been shown that engineers spend over half their working days (55-60%) communicating both orally and in writing (Passw & Passaw, 2017). Additionally, communication is in the top three most important competencies ranked by engineering graduates (planning & time management is first, problem solving is second). Yet communication remains one of the skills engineering students struggle with the most, often failing "to appreciate that written words, not just calculations, express engineering content" (Conrad, 2017).The assumption is that engineers communicate with numbers, graphs and diagrams, not words.

This work in progress is examining the data behind first year engineering students' performance in introductory engineering and composition courses, as well as their math and verbal ACT scores, to determine if there is a link between communication abilities and success in engineering curricula. Our ultimate intent is to determine if a similar remedial path might be needed for some engineering students when it comes to communication skills.

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Innovative Classroom Experiences and Peer Mentor Support Systems for First Year Engineering Students

Sheila Erin Youngblood Johnston, Tyler Bishop

The engineering program is growing exponentially and the department needs to capitalize on that growth in order to sustain it. The program's ability to retain students past the first year is essential. The course load is heavy with approximately 18 hours per semester expected for a student to stay on track. The Engineering Program utilizes both innovative classroom experiences and peer mentor support systems in the first year engineering program. First year engineering students experience ENGR 1411 (Introduction to Engineering) and ENGR 2113(Statics). First, freshman engineering students are provided with four real world engineering experiences during ENGR 1411. The first experience includes an environmental engineering field day where students learn what engineering looks like from a field engineering standpoint. Furthermore, students join a manufacturing engineering tour and learn about the numerous engineering disciplines that are needed in a manufacturing setting. The third trip is to a military installation where students see mechanical and electrical engineering in action through simulators. On the fourth trip students participate in a field experience with city engineers. This experience includes both in process and built city projects, roadway design, low impact development structures and more. Students gain an understanding of the entire process from project request to design to permitting and finally construction. These experiences allow students to feel “part” of the program and begin to make connections with their cohorts and professionals whose endorsement will be vital when entering the workforce. The interaction with industry from day one provides high impact learning, student engagement, and connect the classroom experience to the profession of engineering. Second, ENGR 2113 students are presented an open ended project where they are tasked to demonstrate a concept from statics. This requires the student team to design and build in order to demonstrate. This open-ended project concept is further developed in ENGR 2223 (Fluids), ENGR 2533(Dynamics) and ENGR 2213(Thermodynamics). The primary goal for this classroom adaption is to focus on the concepts and in doing so ensure more students are able to progress successfully through their engineering curriculum. With a greater focus on concepts and application, the expectation is that students will be better prepared for industry. Third, chapter exams have been revamped into 50/50 competencies. These competencies are content based versus chapter based which enhances a student’s connection within content. This method encourages students to focus on the overarching concepts of the material, with the expectation that students will have greater retention. Finally, the development of the Engineering Learning Laboratory for Statics allows upperclassmen to mentor and support first year engineering student. Preliminary data supports this laboratory as scores on exams are higher for those that use this laboratory versus those that do not. These methods have been assessed in two student cohorts and the data to be presented is preliminary with a sample size of approximately 15 per cohort.

Pipeline Development through Middle School, High School, and Community Enrichment Opportunities

Sheila Erin Youngblood Johnston, Tyler Bishop, Irene Corriette

The Engineering Program utilizes three pipeline development opportunities annually to develop and strengthen the link between K-12 and the university. The primary goal of the opportunities is to provide Southwest Oklahoma middle school and high school students with an enrichment program which will excite their interest in engineering and mathematics and attract them to engineering and mathematics related careers as they matriculate into college and select college majors. It is imperative that high school students learn about the application of engineering and mathematics prior to entering college. It is equally important that students find ease and comfort on a college campus prior to their first day of class as a tradition freshman. The three opportunities are as follows. First, CU Engineering hosts a 1-week Engineering and Applied Mathematics Summer Academy for high school students. First year engineering students serve as counselors and leaders at this academy. Additionally, a junior counselor program has been developed where two to four previous academy attendees apply and are selected to serve as leaders for a subsequent academy. Students work in teams and use the engineering design process to research, design, test, and redesign their projects. Final projects include a design competition and PowerPoint presentation for students to reflect on their experience. Previous academy projects have been rockets including the safe landing of a quail egg, windmills to charge a cell phone, and portable water systems. Secondly, It's MathE is a middle school enrichment program. This program bridges the gap from college to high school to middle school with the older students (first year engineering and high school students) functioning as leaders and mentors to the respective younger groups. This model allows middle school students to see options for their future, especially at a time when many students begin to become frustrated with math and fail to see its practical applications. The primary goal of the It's MathE Middle School Enrichment Program will be to engage students and encourage them to work diligently in school, choosing to take all the mathematics they can as they move through middle school and high school. Finally, the Engineering Club hosts an annual Engineering Week Program. This is an opportunity to invite high school students to campus to participate in "fun" events while interacting with first year engineering students and faculty.

W501B: WIP: Enrollment, Instruction and Pedagogy - Focus on Classroom Practices

Wednesday, 2:15pm-3:30pm - Chamberlain Student Center, Room 144A

Electrical Engineering Laboratory Activities for First-Year Students: How to form TIES (Teach, Inspire, Engage, and Stimulate) to STEM

Ramakrishnan Sundaram

This work-in-progress paper examines the use of hands-on STEM-centered electrical engineering laboratory activities in the critical entry-level course, First-Year Seminar in Engineering, for undergraduate engineering majors. At our institution, the First-Year Seminar in Engineering is offered once each year during the fall term. One component of this course comprises hands-on laboratory activities in sessions of short duration (fifty-five minutes apiece) in engineering disciplines such as Biomedical Engineering (BME), Electrical and Computer Engineering (ECE), Environmental Engineering (ENV), and Mechanical Engineering (ME). The challenge confronting the instructor is to teach, inspire, engage, and stimulate (TIES) to STEM-centered learning given the fact that student motivation, commitment, and level of engagement in such a short interval of time can be non-existent. Laboratory experiences which focus on system-level assembly, test, and validation of concepts must be emphasized over detailed conceptual analysis. Toward this end, the hands-on STEM-centered laboratory activities for ECE comprised the design, assembly, test, and validation of design projects titled (a) electronic timer circuit, and (b) digital logic gate circuits. The students used the Snap Circuits Pro electronic circuit assembly kit from Elenco, Incorporated. The kit contains electrical components that are placed onto the circuit assembly board using snap connectors, and are connected to create basic and advanced circuits. Learning how to use these kits is very intuitive. Consequently, the first-year engineering students consumed less time on any tedious assembly process and were able to focus more on the purpose of their actions and the capture of the desired outcomes. Since these students are just being introduced to the disciplines of engineering, the laboratory experiences are driven more by their powers of observation i.e. following the 'seeing is believing' paradigm rather than any rigorous analysis of the circuit and its outcomes. Subsequent engineering courses will address the M in STEM aspects of observations. However, it is fervently hoped that these laboratory experiences will serve to whet the appetite for the STEM experiences to follow.

Implement Hands-on Activity for Statics Course into Student Success Program

Xiaohong Wang

The University of Wisconsin-Platteville (UWP) has been educating engineers for more than 150 years, earning a national reputation as a prestigious institution. The College of Engineering Math and Science Student Success Programs (EMS SSP) plays a crucial role in helping students become the next generation of successful engineers. The mission of this program is to equip students for academic success by providing innovative learning strategies and to encourage students to connect with campus resources and to each other.

In EMS SSP program, there are three Living Learning Communities (LLC) for students pursing a degree in STEM fields. The Explore EMS LLC is available to all incoming freshman within the College of EMS. The Women in STEM LLC has two options available, one for incoming freshmen and one for sophomore and transfer students.

In this proposed project, a faculty from the Department of General Engineering and people from
EMS SSP programs will work as a team to integrate some fundamental engineering hands-on activities related to statics course into these three LLCs.

Statics is the first course taken by students from the fundamental engineering courses. It will be a beneficial practice to implement some hands-on activities based on some fundamental principles of mechanics into the LLC programming. These hands-on activities will allow students to engage and explore the subject they will study in the near future. It will also be another beneficial opportunity to develop connections and networking between students and faculty members.

Through these activities at the LLC for first-year engineering students, it will provide a bridge between the formal academic program and out-of-classroom learning of students. It will also promote personal and intellectual growth and development of students through contact with members of faculty. In addition, it will provide a transition between classroom and residence hall life leading into higher student retention, satisfaction, and success.

Creating an Active Learning Classroom with an Engaging Online Platform

Dan Burleson, Erin McCave

This Work in Progress paper will describe how we created an active learning environment utilizing an online platform in a first year engineering course. The first year engineering computing course, required for all engineering students at a southern, four year institution, became common for all engineering disciplines through the Engineering First Year Experience in Fall 2016. In this class, students learn how to problem solve using MATLAB, a coding language free to students. The class is traditionally taught face-to-face in a lecture hall with a mix of instructor-led problem solving examples and tutorials and students working individually, in pairs, and in groups on in-class work. In order to provide the illusion of small class sizes for our students, academic support assistants (ASAs) are utilized to assist students both in and out of class. These ASAs assist students with hands-on activities and course projects, as well as provide help during office hours on assignments outside of class. Interaction between the instructor, ASAs, and students is critical in engaging students during the process of problem solving with this new programming language.

This southern university has many non-traditional students that commute and have professional and personal commitments off-campus that make scheduling courses difficult. In order to provide an alternate class option, an online version of the course was created. The significance of this work is developing online strategies so these students do not miss out on an engaging environment of a face-to-face class while still having the opportunity to succeed amidst the challenges they face outside of the classroom. In addition, for courses that are centered on active learning approaches, online platforms are not typically considered an alternative due to the traditionally passive approach to learning. This barrier needs to be elucidated so that students who benefit from the flexibility of an online course can still have the opportunity to thrive in an engaging environment. Therefore, the research question for this study is, how do engagement and achievement levels of first-year engineering students differ between online and face-to-face classes?

A single section with a capacity of 40 students will be offered as a synchronous online class. A survey using both quantitative and qualitative measures will be given midway through the semester and at the end of the semester to all students enrolled in both the normal (face-to-face) and online sections of the computing course. Following the conclusion of the semester, survey data will be analyzed using pairwise comparisons of the group of students from the two different course offerings.

This project aims to develop an online delivery method that will equally engage students in an online platform without negatively impacting grades. Preliminary results for a small pilot section show promising results compared to the face-to-face sections with further analysis and implementation planned.

How to Use Flipped Advising to Promote First Year Success

Matt Williams

Introduction:
Providing developmental advising to first year engineering students often presents a number of challenges due to high student-to-advisor ratios. Our objective was to design and implement a student centered “flipped” advising experience using the University of Florida’s learning management system (LMS) to promote developmental advising and encourage student self-authorship.

Methods:
The Herbert Wertheim College of Engineering requires mandatory advising through the use of holds to prevent registration. Each First Year Engineering student is assigned an advisor that they will work with throughout their first year.
During the spring semester of 2016 we began requiring all first year engineering student to complete a five-semester plan before their mandatory meeting with their advisor during the registration period. Originally we had students upload their plan to Microsoft SharePoint, which was not part of our university’s LMS. For the fall 2016 semester we created a section for all entering first year students in Canvas, our LMS. Students already use Canvas for all of their university courses and therefore are familiar with its design and structure. The benefit of using an LMS is that it allows users to “organize content and multimedia resources into modules” (Steele, 2016). Our First Year Engineering module included basic information from advisors such as the First Year Engineering Advising syllabus and required students to upload their plan along with answering basic questions concerning their involvement with the university.
In the spring 2017 semester, we required students to update their plan, and added a series of short answer questions designed to help students reflect on their college experience and promote introspection about their values, i.e. who they are, who they want to be and what motivates them.
We have also developed a new orientation module for our newly admitted freshmen on Canvas. This will focus on presenting them with FAQs and other needed information pertaining to the college, as well as prompt students to begin the process of self-authorship.

Results:
97% Completion Rate of Canvas assignments during the 2016 – 2017 academic year and a 94% completion rate in the 2017 – 2018 academic year.

Reduction in number of students on probation from 25% down to 15% during the 2016 - 2017 academic year. A further reduction in the probation rate from 15% down to 12% during the 2017 - 2018 academic year.

W501C: WIP: Enrollment, Instruction and Pedagogy - Focus on Design-Based Projects

Wednesday, 2:15pm-3:30pm - Chamberlain Student Center, Room 127

Fundamentals of Engineering Design for Chemical Engineering 1st Year Undergraduates

Irina Molodetsky, Robert Barat

An introductory course in chemical engineering for 1st year students is based on the industrially relevant and real-world example of an air and water flow system including pipes (empty and packed), pump, valves, fitting, etc. The students learn about design, construction, and testing within the context of scale-up. Comparison between measured and calculated pressure drops introduces students to design validation.
We employ a teaching methodology that emphasizes:
• fundamental fluid mechanics concepts using high school physics;
• the importance of the measurements and understanding of the underlying principles;
• a real-world approach to successful design through managing technical, environmental and quality requirements.
In this work-in-progress paper, our teaching methodology and specific examples of its integrated application in the classroom and laboratory are discussed.

On the Mechanical Properties of 3D Printed Parts for Design Optimization

Louie Elliott

This paper reports on a work-in-progress student funded research program to measure the mechanical properties of parts created through additive manufacturing or 3D printing. It is difficult to predict the final performance of 3D printed parts due to the large number of technologies, materials, and print parameters which result in a layered, composite structure that differs considerably from a "solid" part. Our research focus includes print parameters such as infill density and the number of exterior shells. We print parts in our 3D print lab with PLA filament and test them in our materials lab in accordance with ASTM standards for tension and compression testing. An analysis of the stress-strain diagram gives the strength of the part in the elastic region as well as the yield and ultimate stresses. An overall goal of this research is to understand the correlation between print parameters and overall strength to weight ratio to determine the optimal print parameters when designing parts. Additive manufacturing is introduced to freshmen mechanical engineers through experiential learning projects in 2D/3D Modeling and Intro to Engineering Design courses. The knowledge of 3D printing the students acquire in their first year benefits the students for their remaining college years as well as their futures in industry and academia. A further goal of this research program is to enable funded research opportunities at the first year level which is critical to the development of successful student research methodologies and achieving scholarly publications.

Synthesizing design challenges to improve student effectiveness in first year engineering design courses

James R McCusker, Aaron Carpenter

Engineering Design is a common component of first year engineering curriculums. Various methods have been employed and studied to improve the overall effectiveness of the activities in design courses, including modifying the makeup of student design teams, integrating real world design problems, and employing student design competitions. However, the challenges and uncertainty of real-world practice are difficult to emulate in an academic exercise. In order to address this, synthesized design challenges are integrated into a first-year engineering design course.

In Introduction to Engineering Design the evaluated university, all first-year engineering students work in teams to develop a solution to a societal need that is identified and researched by the student team. Over approximately 8 weeks of the semester, students formulate their design objectives, identify required functions and design constraints, propose a realistic solution, and implement and evaluate their solutions. Throughout this process, all students must maintain a design notebook that documents all aspects of their design development. This notebook details the students brainstorming processes, technical details, and overall design progress, particularly using iterative design methodology. The synthesized challenge to emulate uncertainty and change in project goals takes the form of a sudden modification to the design objectives and functions by reassigning teams to alternate projects. In approximately the fourth week of the project, all design notebooks are collected and provided to another team in the course. Students are told they are now in charge of this other project, and their own project will be completed by another team. Students must utilize the other team's notes to propose a plan to implement and evaluate the design that is documented, as though they will complete it. Along with the proposed plan, students are also required to provide feedback on the quality of the design notes and indicate areas for which there are deficiencies. At the conclusion of the exercise (approximately one week), students are returned to their original project for the duration of the semester, possibly incorporating the feedback from the temporary team. This is meant to emulate a real-world workplace, where employees are often reassigned to new projects with little advanced notice. Similarly, employees often need to rely on the previous team members notes and documentation, here focusing on the engineering design notebook.

The effectiveness of this approach is assessed by evaluating the quality of student design notes before and after the project-switch exercise. Student feedback is also solicited to allow for self-reflection and to assess the projects plan for the design team that was temporarily assigned to their project. The authors hope to engage in a spirited discussion on employing similar methods to challenge students in first year design.

Autonomous Robot Vehicle: Incorporating Coding and Manufacturing Engineering Concepts in a Freshman Engineering Design Course

Lunal Khuon, M. Eric Carr, Yalcin Ertekin

This work-in-progress paper describes a freshman engineering design course that incorporates coding and manufacturing engineering concepts through an autonomous robot vehicle project. The course itself is part of a three-course engineering design sequence that introduces incoming freshman engineering students to the fundamental concepts of engineering design that will be applied throughout their undergraduate engineering education. The project's learning objectives are that students will be able to successfully integrate digital and physical design, develop a navigation algorithm, and implement it in Arduino C, in order to allow an autonomous robot vehicle to successfully navigate a course. Students use modern, industry-standard fabrication and prototyping tools in the design process, and demonstrate a working autonomous robot vehicle, including student-designed, 3D-printed protective components. Two faculty instructors with backgrounds in mechanical and manufacturing engineering and electrical and computer engineering team-teach the course and provide a systems approach to design and engineering with specific expertise in different aspects of the course.

W601D: Workshop

Wednesday, 4:00pm-5:15pm - Chamberlain Student Center, Room 127

Taking it to the Next Level...Game-Based Learning in Engineering Education

Cheryl A Bodnar, Daniel Anastasio, Daniel Burkey, Scott Streiner

The use of games within engineering classes has steadily increased, as evidenced by increasing numbers of publications on their implementation and effectiveness. Games within engineering classes can take on a variety of different forms ranging from classroom games (board, card, live action) to digital games and even to gamification elements. In gamification implementations, faculty will leverage principles associated with game-based learning such as storyline, points, leaderboard and badges to help motivate students towards completion of classroom activities. Despite these increases in published implementations of games within engineering, there are still many faculty members that aren't aware of this pedagogy.

This workshop will provide participants with an understanding of game-based learning and how it can be used within engineering, and will conclude with providing references to help support individuals' use of this pedagogy. Upon completion of this session, participants will be able to:

- List the key properties of a game or game-based learning exercise
- Describe different types of games that can be applied in engineering classes
- Identify games that match specific learning objectives
- Discuss differences in facilitation approaches
- Provide ideas for debriefing questions that allow the game to be linked back to technical content

Games and gamification implementations can be very powerful experiences for students as they provide them with an opportunity to learn experientially and then connect their time in game play back to technical course material. Research has shown that implementation of these types of activities leads to a general trend in improvement in both student attitudes and learning. As such, this workshop will provide faculty with the necessary skill sets that will allow greater use of these pedagogical tools in first year engineering classes.

W601F: Workshop

Wednesday, 4:00pm-5:15pm - Chamberlain Student Center, Room 144A

Engineering Reasoning - An Approach to Increasing the Appeal of Introductory Engineering Courses to All Students

John Krupczak

Purpose: In this workshop participants will learn to incorporate the theme of engineering reasoning into Introduction to Engineering courses. Engineering reasoning is the set of practices engineers use to create technological systems. Incorporating this framework makes it possible to appeal to the needs of both students already anticipating a major in engineering and those that have a more tentative interest in the subject. The workshop will outline the approach, describe some results that have been obtained, and conduct a hands-on session to help participants adapt this framework to some of their current Introduction to Engineering course materials.

Time	Activity		
Thursday 7:15AM-8:15AM	Shuttles from Housing to Engineering Hall Location: Courtyard Marriot Parking Circle		
Thursday 7:00 AM-10:00 AM	Registration Location: Rowan Hall Atrium		
Thursday 7:30 AM- 8:30 AM	Breakfast Buffet Location: Rowan Hall Atrium		
Thursday 8:00 AM-8:30 AM	Tour of Engineering Facilities Location: Rowan Hall Atrium		
	Engineering Hall 319	Engineering Hall 320	Engineering Hall 321
Thursday 8:30 AM-9:45 AM	R101A: WIP: Student Success & Development: Focus on Academic Support	R101B: WIP: Enrollment, Instruction, & Pedagogy: Focus on Classroom Practices	R101C: WIP: Enrollment, Instruction, & Pedagogy: Focus on Classroo, Practices
Thursday 10:00 AM-11:45 AM	R201B: Workshop: Problem Definition and Concept Ideation, An active-learning approach in a multi-disciplinary setting	R201C: Workshop: Activities that Help Students Maintain and Develop Interest in Engineering During the First Year of College: A Collaborative Sharing and Brainstorming Activity	R201E: GIFTS: Great Ideas for Teaching Students
Thursday 11:30 AM-12:30 PM	Lunch Location: Rowan Hall Atrium		
Thursday 12:00 PM-12:30 PM	Tour of Engineering Facilities Location: Rowan Hall Atrium		
	Engineering Hall 319	Engineering Hall 320	Engineering Hall 321
Thursday 12:30 PM-1:45 PM	R401A: Enrollment, Instruction, & Pedagogy: Focus on Classroom Practices	R401B: Enrollment, Instruction, & Pedagogy: Focus on Design-Based Projects	R401C: Enrollment, Instruction, & Pedagogy: Focus on Design-Based Projects
Thursday 1:45 PM- 2:30 PM	Wrap Up Session Location: Rowan Hall Auditorium		
Thursday 2:00PM-3:00PM	Shuttles from Engineering Hall to Housing Location: Between Engineering Hall and Rowan Hall		

R101A: WIP: Student Success & Development - Focus on Academic Support

Thursday, 8:30am-9:45am - Engineering Hall, Room 319

What's your major? First-year engineering students' confidence in their major choice

Katherine M Ehlert

In this work-in-progress study, the engineering identities of students enrolled in a first-year engineering (FYE) program were surveyed to investigate whether students identify with engineering (in general or with a specific engineering major) during their first year and how differences in identities impact intent to persist in engineering. Literature suggests a strong engineering identity is linked to student retention and can positively impact a student's trajectory within an engineering program. To investigate these interactions, a survey was distributed at a large public institution in the southeast at the beginning and end of the Fall semester. Most students reported they had decided on a specific engineering major even in the beginning of their first engineering course. While students are relatively confident in that major choice at the beginning of the year, their confidence increased by the end of the semester. Future work will invite students for interviews to elucidate understanding in how a student's views of the engineering profession affect their FYE experience and the role the FYE curriculum has in their anticipated engineering major and themselves as engineers.

Assessing the impact of a first-year experiential learning course on women and underrepresented students

Liang Li Wu, Gregory Washington

This work in progress describes the implementation of a two-quarter first-year engineering program and the course impact on women and underrepresented students. The first-year engineering course focused on team-based experiential learning and taught the concept of engineering design through two hands-on projects, where students acquired engineering skills in CAD, basic machining, fabrication, circuitry and microprocessor programming. In addition, the course provided instructions on project management and teamwork, and opportunities to interact with faculty and industry speakers from different engineering disciplines. A control group was solicited among students who were not enrolled in the course during their first-year. Self-assessed student surveys were administered to both groups evaluating their motivation in engineering at the beginning of Fall quarter, and at the end of Winter quarter during their freshmen and sophomore year respectively. Survey results were compared between the cohort enrolled in the first-year course and the control group, among women and underrepresented students, to examine the impact of the course on student motivation.

Growing Pains of a First-Year Engineering Summer-Bridge Program

Stephen Roberts, Sarah Grigg, Marisa Orr

Since 1993, the University of Florida's Herbert Wertheim's College of Engineering has conducted a first-year bridge program for underrepresented students entering the college. The program, entitled the Successful Transition through Enhanced Preparation for Undergraduate Program (STEPUP), consists of two major components which take place during the students' first academic year; a six-week summer residential program and an eight-month, non-residential program. The residential component of the program is the most rigorous and intensive and was developed to address challenges that negatively impact first-year student success. The summer component includes abbreviated classes in General Chemistry, Calculus, Project Design, Introduction to Research, Health and Fitness and Machine Learning. Additional activities include, evening study halls, corporate tours, a corporate speaker series and student development workshops aimed to promote the holistic development of the student (An Academic, Professional and Personal Holistic Development Model). The non-residential component of the STEPUP program takes place during the fall and spring semester and involves peer mentoring, academic support and additional A.P.P Holistic Development programming.

Documenting the Redesign and Scaling-up of an Ill-Structured Problem

Courtney June Faber

Engineering education strives to prepare students to solve complex problems within rapidly changing, multi-disciplinary environments. One approach to address this need is to provide students with the opportunity to experience ill-structured problems throughout their undergraduate studies. The goal of this work was to redesign and scale-up an ill-structured problem within a first-year physics for engineers course with 130 students. The ill-structured problem assignment was initially piloted in the spring of 2017 with a smaller group of students. The outcomes of the pilot informed revisions to the problem and development of a robust assignment packet to scaffold students as they tackled the problem. One of our major concerns with scaling the assignment for a larger course was the ability for the instructor to assess all of the students' work in an appropriate amount of time. As such, we looked to the problem solving literature where we identified and modified a rubric to assess each step of the problem solving process. The outcomes of this work can provide other instructors with steps, resources, and ideas about how to incorporate ill-structured problems in their classes.

R101B: WIP: Enrollment, Instruction and Pedagogy - Focus on Classroom Practices

Thursday, 8:30am-9:45am - Engineering Hall, Room 320

A Novel 2D Vectors Hands-on Lab Exercise for a First Year Engineering Mathematics Laboratory

Jaskirat Sodhi

Studies show that teaching mathematics using an application-oriented, hands-on approach helps students grasp and understand the topics much better as compared to a lecture-based mathematics course. Starting Fall 2016, New Jersey Institute of Technology (NJIT) offers such a course loosely based on the Wright State University model to engineering students placed in pre-calculus courses. Throughout the course, students are introduced to engineering problems and applications that rely on concepts of mathematics. This course has lecture, recitation and laboratory components. The lecture provides an overview of relevant topics in engineering analytical methods that are most heavily used in the core sophomore-level engineering courses. These topics are reinforced through solving problems in a lab environment. For the first two offerings of ENGR101 at NJIT, the lab projects done were virtual simulations (on computer). Starting Fall 2017, we started moving gradually towards more hands-on physical labs. This paper will discuss a new hands-on lab project that is being introduced this semester to help students understand the concept of two-dimensional vectors. A model of a human arm has been designed to demonstrate the application of two-dimensional vectors and calculation of reaction forces. The same model can also be used to demonstrate the application of the law of cosines to measure the bicep muscle length and applications of direct and inverse kinematics for a two-link robot. The model consists of two 3D printed rigid links connected by a pin, a 3D printed bucket, stand, weights, and a string. The string connecting the two links represents the muscle. One end of the string is attached to a bucket, which when loaded with weights causes the arm on the opposite end of the string to move. Knowing the weight added to the bucket, the component string tension and joint reaction forces can be calculated. Use of a simplistic model that must be manually loaded and measured provides a visual demonstration of the concepts and applications of mathematics as discussed in the lecture as well as presented in the textbook. The model has the additional advantage of being inexpensive as it is 3D printed in- house. We plan to assess the effectiveness of this activity using student surveys. We also look forward to gathering feedback from other conference attendees about this hands-on lab exercise and hope to refine it further for future semesters.

Using ePortfolios to Showcase Student Projects

Jaskirat Sodhi, Swapnil Moon

An ePortfolio is a collection of personal work on a website that can be used by students to showcase their work as a supplement to their resume. The idea stems from a paper portfolio used frequently in both art and architecture fields. This paper portfolio is a collection of creative work that can be used to demonstrate one's proficiency in certain skill sets. The authors propose to include designing such an online ePortfolio as a part of an introductory freshman level course where students start building their ePortfolios. As they progress in their major, more skill sets/projects developed in the later academic years can be added. ePortfolios can be a very effective way for students to market their talent to potential employers and even to graduate programs. For engineering students, this is also a great opportunity to demonstrate their understanding of technical concepts by showcasing key engineering projects or work experiences that they have done for various courses across their curriculum or as part of their internship experiences. The process of creating an ePortfolio can aid in increasing engagement of students in their learning process and encourage them to take responsibility for their work. The creation of the ePortfolio itself also develops skills such as website creation which add to the student's personal and professional development.

As the authors teach mechanical engineering, they have implemented this idea in junior/senior level mechanical engineering courses that teach students Computer Aided Design (CAD) and Computer Aided Engineering (CAE), but this can be implemented in any major. Also, a freshman class, such as a Fundamentals of Engineering Design (FED) class, where they do a cornerstone design project, would be more appropriate to introduce such an idea. This way the students can start early and build a comprehensive ePortfolio by the end of their undergraduate degree. It would also help them to make connections among courses as well as between theoretical and real-life problems. In our talk, we look forward to sharing more details about them, a few examples of ePortfolios created by our students, and some qualitative feedback received from students about them.

Hands-On Engineering Design Activity for First Year Engineering Students Using Lego Pieces

Ashish D Borgaonkar, Thomas Jaworski, Jaskirat Sodhi

Engineering students are required to take several mathematics and science course along with other general university requirements during their first and part of second year. They have to wait for several semesters after admission before they get to work on engineering design activities. This can have a demoralizing effect on some students and they will start losing interest in and passion for engineering. Introductory first year course, such as Fundamentals of Engineering Design (FED101), presents the perfect opportunity to get students to participate in hands-on engineering design related activities. The challenge though is the lack of background knowledge of these students in engineering design principles and process. We used a concept design activity using Lego pieces to get students to participate in various stages of engineering product design process. Students were divided into groups of Four (4) per team and were handed 10 regular random Lego pieces plus one fancy Lego piece. Students were asked to work together to design a widget – an abstract unit of production, such as manufactured device or other product (Wikipedia Definition). We provided student groups with several ideas of products to pick from, although, they were free to come up with their own ideas. The engineering design activity (labeled as the Widget Activity) was conducted in two parts. In part 1, students were asked to design a product and make a model using the Lego pieces. They were encouraged to utilize the fancy Lego piece to demonstrate creativity. Student groups submitted a two-page report highlighting key information about their widget along with a digital design sketch. In part 2, student groups were asked to prepare list of parts and assembly instructions for their product. All groups then randomly exchanged their widgets with other groups and all groups then tried to put together the widget they received using assembly instructions. We timed the groups as they assembled the products and it served as an additional motivation to finish quickly and accurately. The overall Engineering Design activity served several learning outcomes including getting students to work as a team, introduction to product design process, applying problem solving skills among others. We have successfully implemented this with Civil Engineering and General Engineering cohorts. The activity was very well received by the students. We plan to assess the effectiveness of this activity using surveys and focus groups and hope to expand this initiative to all other FED101 sections.

Collaborating with Librarians to Help First Year Students Explore Engineering Disciplines and Improve Research & Writing Skills

Ashish D Borgaonkar, Davida Scharf, Jaskirat Sodhi

The ease of Googling on the open web makes it increasingly unlikely that our incoming students will make the extra effort to search for good quality sources through the library website. Few if any first year courses focus on finding good quality information within the majors. Thus, students struggle to catch up in subsequent years when assignments require more sophisticated research. In order to get students to learn about engineering research, we introduced a two-part assignment through our required first year Fundamentals of Engineering Design (FED101) course. These students are still deciding which engineering major to pursue. So, we created a library assignment that would help widen their knowledge and understanding about various engineering innovations, but also strengthen their research skills. In part 1, students chose one online article from a list created by instructors and librarians. Students were asked to find the article though the library website, read it carefully and write a one-page summary. For part 2, students conducted their own research and found two more articles from the library website that either supported or opposed the views presented in the first article they had selected. Students submitted a final two-page report describing the innovation and why it is important. They had to use evidence from all the articles to support their main ideas, use in-text and full references correctly, conclude by synthesizing the issues and suggesting possible future research needed. This activity was made possible by collaboration between university librarians, FED101 instructors, and the engineering dean's office. Students received clear instructions, guidance and help every step of the way. This activity was well-received by the students and achieved the instructional goals set by faculty. Students became interested and excited about a particular area of engineering and familiar with innovative research areas. They demonstrated basic information literacy, and practiced writing a report in a precise and concise style. This activity will become a permanent part of the FED101 course syllabus for general engineering students and in other FED101 sections offered by all engineering departments. Assessment using a validated rubric for information literacy and a survey to measure student engagement is planned.

R101C: WIP: Enrollment, Instruction and Pedagogy - Focus on Classroom Practices

Thursday, 8:30am-9:45am - Engineering Hall, Room 321

Life Cycle Assessment and Economics in First Year Engineering

Suzanne Keilson, Lynne Elkes

Approximately three years ago, a module on life-cycle assessment was incorporated into an Introduction to Engineering course that is open to all first-year undergraduate students at Loyola University Maryland. This paper will describe the module, its development, and subsequent revision. Future work will be conducted with a colleague from the Department of Economics. The module begins with a viewing of "The Story of Stuff," produced by Annie Leonard of Greenpeace. This video is a robust critique of the lifecycle of consumer products. A second video with a tough opposing view introduces students to two fundamentally different political and philosophical viewpoints. Students are asked to write immediate in-class, anonymous responses to both viewpoints. The instructor collects and collates these responses, highlighting major themes and utilizing student quotes. Discussion in the following class session is based upon these responses with the intent to initiate deeper insight and critical analysis. For example, given the common issue of how budgets and percentages are presented in both videos, there is a natural segue into the ways data is presented and the "problem with percentages." A document unique to this module is introduced referencing the data in full and discusses the important idea that data needs to be referenced with appropriate proportions and units (per capita, per mile, per GDP, etc.) and can be easily distorted when the reference base is changed (e.g. from total budget to discretionary budget). Another major theme in both videos is that of growth and its limits; this is again a natural starting point to introduce students to the foundational concepts in macroeconomics of the question of commodities, an s-curve of development with creative destruction, and the Ehrlich-Simon bet. The conclusion of the module requires students to write a reflective essay where they analyze the presentations more formally for the intended audience, author biases, and methodologies. The students are asked to find one thing they agree with and disagree with on both sides of the debate. Current students (2017) seem to readily accept ecological concerns about consumerism and show a desire for fairness and equity. This author believes those attitudes are well established in current K-12 education. This provides a nice frame, as time allows, to introduce principles from sustainability engineering and design, which are intended to analyze rigorously the externalized costs of products, consumption, and necessary infrastructure. This then lends itself to the application of a rapid "ecoaudit" to assess areas of impact under different design scenarios. This can be accomplished using materials selection software CES Edupack 2017 (Granta Design Limited, 2017).

Mapping Entrepreneurial Minded Learning with the Longitudinal Model of Motivation and Identity in First-Year Engineering

Krista M Kecskemety, Monica Cox, Renee Desing, Deborah Grzybowski, Rachel Kajfez

The traditional engineering design process taught in universities across the country focuses on several common design steps. Often these experiences place little emphasis on creating value by defining a market opportunity or communicating the overall economic and social impact. In collaboration with KEEN, a network of thousands of engineering faculty working to unleash undergraduate engineers so that they can create personal, economic, and societal value through the entrepreneurial mindset, a large mid-western university is adding multiple entrepreneurial minded learning (EML) elements to an existing first-year course. This Work-in-Progress paper represents the first phase of a four-phase, 18-month pilot, during which we explored the impact of EML in first-year engineering classrooms on motivation and identity.

This phase used a mixed methods investigation into the current practices of five KEEN related first-year engineering programs currently incorporating EML elements into their curricula. Researchers visited each school or program and collected data via focus groups with first-year engineering faculty who implement EML in the classroom, surveys of first- and fourth-year students to assess the short- and long-term impacts of EML at it relates to motivation and identity, and observations of EML classrooms to note current engagement in courses with EML practices.

We mapped the findings from the information collected to the KEEN engineering mindset and skillsets along with the Longitudinal Model of Motivation and Identity (LMMI), which combines self-determination theory (SDT) needs (autonomy, competence, and relatedness) with possible-selves theory (PST). The LMMI served as a lens for considering the motivational and identity impacts that EML experiences have on engineering students' motivation and identity. Our analysis included deductive coding of the focus groups followed by open coding to break down the items to better understand exactly what is contributing to student motivation and identity. We triangulated these findings with our observations and student survey data to identify common trends. Additionally, we used descriptive statistics to analyze the survey data. As this is a mixed methods study, we also employed mixing to find connections between all of our data sets.

Once mapping is complete, the results from this phase will be used to develop a set of best practices that will be incorporated into EML projects, courses, and curriculum during future phases to encourage autonomous motivation and identity development. A significant contribution of our project is the operationalization of LMMI in the context of EML along with the future curriculum that will be developed out of our work.

Does Practice Make Perfect? How First Year Students Develop Reflective Learning Skills

Natalie C.T. Van Tyne

The U.S. Department of Labor and the American Association of Engineering Societies developed the Engineering Competency Model in 2015. [1] This model contains five tiers of competence: Personal Effectiveness, Academic Competencies, Workplace Competencies, Industry-Wide Technical Competencies, and Industry-Sector Functional Areas. The competencies have been identified as necessary for success and advancement in the engineering profession. It appears as a pyramid, where each tier contains an increasingly wider variety of specific competencies when viewed from the top to the bottom. [1] Within these tiers, we assert that specific competencies in Adaptability and Flexibility, Lifelong Learning, Critical Thinking, Creative Thinking and Engineering Ethics can be enhanced through practice in reflective thinking and judgement.

While reflective learning skills often take time and maturity to develop, and are recognized as metacognitive, first year engineering students are already involved with metacognition as they consider and evaluate their own place in the engineering community through their sense of engineering identity and self-efficacy. [2] We apply reflection to the learning experiences of our first year engineering design course through five individual written assignments that prompt students to reflect on what they have learned in the course, why it is important to them to learn it, and in what other context could they use their knowledge. These assignments are intended to contribute to their intellectual development to whatever extent is possible during the first year, with the assumption that they will have opportunities for further intellectual growth later on, as they build the competencies identified in the Engineering Competency Model. [1] Our goal is to identify where the "starting point is for

We will measure individual progress in reflection over the course of a semester by using a repeatable and internally developed rubric for grading the assignments, and comparing participants' responses over time to the intellectual development scales found in the Perry Model [3] and in the Reflective Judgement Stages of King and Kitchener. [4] Our results will inform our course content and delivery by indicating whether feedback through a repeated rubric is sufficient for students to progress beyond a superficial level of reflection, indicating little or no intellectual growth, or whether additional guided practice in reflective learning is necessary. In addition, our results may also provide some indication of whether today's engineering students could progress any farther in their intellectual development than those studied by Pavelich and Moore in the early 1990's. [3]

Entrepreneurial Mindset in First-Year Engineering Courses

Gretchen L. Hein, Mary Fraley, Mary Raber

One challenge faculty face when working with first-year engineering students is how to "hook" them into being interested and motivated in introductory courses. Many universities are experimenting with programs in entrepreneurship that focus on upper division students, but there are fewer examples of this in first-year programs. In the fall of 2017, first-year engineering students at our university completed a design project to help them develop an entrepreneurial mindset. The student had the freedom to develop a product that would improve upon an existing design in an innovative way or to develop a new product with a designated purpose. Student teams self-selected their project and the projects developed encompassed seven classifications (University-Related Devices, Assistive Technologies, Outdoor Activities, Appliances, Personal Use Conveniences, Environmental/Road Management/Office Arrangement, and Phone/Portable Technologies). Over the course of the semester student teams completed project deliverables that included:

- Team Contract
- Design Thinking-Based Deliverables (Empathy Map, Problem Statement and Ideation, and Prototype/Test)
- Project Proposal
- Physical Concept Model (NX 3D model), along with a prototype constructed in the University's Makerspace
- Hazard Analysis
- Resource Budget
- MATLAB Product Marketability Analysis
- Design Project Poster, student teams defended their work to evaluators from the university community at a session similar to the University's annual Design Expo
- Final Project Book

When researching other institutions where entrepreneurial design projects had been completed, there was little information on what or how students or teams self-select design ideas. Although most of the ENG1102 teams had good ideas, some of their design ideas already existed or were poorly implemented. Only six teams had a truly innovative idea with a viable path to implementation. This suggests that in future courses, the design project would be improved if additional constraints were incorporated. Possible constraints include targeting:

- A specific population (i.e.: children, adults, physically/mentally challenged)
- A geographical region
- A global/regional issue

This paper not only describes what was observed and analyzed for this introductory engineering course, but it also outlines key lessons learned during this semester, next steps to improve the course, and suggestions for how others could start this type of project in their own FYEE program.

R201B: Workshop

Thursday, 10:00am-11:15am - Engineering Hall, Room 319

Problem Definition and Concept Ideation, An active-learning approach in a multi-disciplinary setting

Robert Gettens, Harlan Spotts

This workshop integrates an Active Collaborative Learning (ACL) approach to class management with ideation techniques. Participants will have a hands-on experience, acting as students in a “train the trainer” format. Three topics will be introduced: 1) The Gallery Walk method, 2) Problem Decomposition, and 3) The Brainsketching ideation technique. A brief preview of next steps will be presented as well.

Workshop Overview The five step process covered in the workshop will allow participants to experience and ACL approach successfully used with freshman engineering students. Participants will be divided into teams of four or five to engage in the workshop activities. In Step 1, each team will be given “bugs” or “pain points,” which are instances of frustration, annoyance, dissatisfaction or suboptimal solution people experience on a frequent basis. These “bugs” were previously generated by students enrolled in the workshop facilitators’ courses. In Step 2, teams will fashion these bugs into Point of View statements for simulating design discussion. Step 3 involves an interactive Gallery Walk, while Steps 4 and 5 address issues related to problem decomposition and design solution ideation.

In addition to the ACL and ideation techniques presented in the workshop, a formal out-of-class meeting approach will be presented that includes agenda and record keeping methods. This approach is used to facilitate student team self-management.

R201C: Workshop

Thursday, 10:00am-11:15am - Engineering Hall, Room 320

Activities that Help Students Maintain and Develop Interest in Engineering During the First Year of College: A Collaborative Sharing and Brainstorming Activity

Nora Honken

Interest has been established as a primary reason students choose engineering as a field of study (Honken & Ralston, 2013; Anderson-Rowland, 1997; Microsoft, 2011). Lack of interest has also been stated as a reason for leaving engineering (Seymour & Hewitt, 1997 : Shuman et al., 1999). Millions of dollars have been spent trying to increase interest in engineering at the K-12 level for all students and in particular students from groups who are underrepresented in engineering. For example the National Science Foundation's ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers grant (National Science Foundation, 2013) specifically supports efforts and research focused on increasing the number of women in engineering and science.

This proposed workshop is focused on helping students maintain interest in engineering during their first year of college when many engineering students are taking courses such as calculus and chemistry versus courses more closely related to their discipline of study. The purpose of the workshop is for educators to share ideas on how they currently, and could, help students maintain and develop interest in engineering during the first year. The goal of the workshop is for all in attendance to leave the workshop with a renewed commitment to helping students maintain interest in engineering and some practical ideas to implement in their classrooms.

Proposed schedule

- 10 min: Establish the importance of maintaining interest in engineering by presenting research findings related to interest and college and career choice
- 25 min: Break out groups of educators discussing the following two questions
  - What are you currently doing to help students maintain and increase interest in engineering?
  - What could you be doing to help students maintain and increase interest in engineering?
- 10 min: Each group shares the results of their group's discussion
- 5 min: The top three ideas are voted on.

R201E: Great Ideas for Teaching Students (GIFTS)

Thursday, 10:00am-11:15am - Engineering Hall, Room 321

Getting Students to Make Fact-Based Presentations in a First Year Engineering Course

Ashish D Borgaonkar, Jaskirat Sodhi

First Year Engineering collaborations with traditional engineering departments, to introduce students to foundational concepts, through hands-on laboratory exercises

Kadri Akinola Akanni Parris, Krista Kecskemety

Preparing First Year Engineering Students for a Career where Communication Skills Matter!

Kathryn Schulte Grahame, Leila Keyvani Someh

Developing Students Through a Design a Lab_ Exercise

Roger J Marino, Gabriel Burks, Brandon Terranova, Matthew VanKouwenberg

Using Discussion Boards in First-Year Engineering Class and Student Perceptions

Krista M Kecskemety

R401A: Enrollment, Instruction and Pedagogy - Focus on Classroom Practices

Thursday, 12:30pm-1:45pm - Engineering Hall, Room 319

Design Practica as Authentic Assessments in First-year Engineering Design Courses

Christopher McComb, Catherine Berdanier, Jessica Menold

This paper describes the design and evaluation of a novel assessment for first-year engineering design courses that is rooted in an authentic design challenge. This approach modifies the traditional written-exam approach typically found in engineering courses, which is inherently inauthentic and cannot easily capture the exploratory nature of engineering design. Our assessment improves alignment with common learning objectives found in first-year engineering design courses and additionally prepares students for the type of case study interviews that are increasingly common for entry-level engineering jobs. To evaluate our assessment, 50 first-year students completed the engineering design self-efficacy instrument once before beginning the assessment and a second time approximately 48 hours later upon completion of a reflection assignment. In addition, students retrospectively reported their perceived change in self-efficacy during the assessment. Analysis shows that students perceived a large retrospective increase in skill level, despite only a small increase in directly measured self-efficacy. These results are analyzed in light of the Dunning-Kruger effect and we posit that the assessment helps to align students' self-efficacy with their actual skill level. Increased alignment of self-efficacy with skill level may minimize student frustration when encountering challenging tasks in the future, potentially increasing retention of engineering students as well as facilitating the development of lifelong learning attitudes.

Art for All Design Collaboration

Cecelia M. Wigal

The formal Art for All (AfA) project was initiated in the fall of 2016 with the goal to team first year engineering students with second year art students to develop assistive devices that help persons with disabilities express themselves in art. An additional AfA goal is to illustrate to engineering students the benefit of collaboration outside of their discipline.

The AfA project requires that the engineering and art students work together to understand the boundaries of the client when creating the art product and to brainstorm and select the best solution. The engineering students then 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.

The courses included in this project are the freshman Introduction to Engineering Design course and the sophomore Figure Drawing course. At first glance these courses have little in common. However, the art students and the engineering students work through similar design processes to develop their end products and thus can work together to develop solutions. The courses are also complementary. Due to course curriculum, the art students think about how the body interacts and how to communicate this interaction. Thus they can help expand the engineering students' design space by providing an understanding of how those with disabilities may use their bodies or extensions of their bodies to create art.

This paper reports on the progress of this project over the last 1.5 years. During this time the project has moved from initiating the activities to completing and delivering 11 art tools to various clients in the community. The project also presented the student created art tools, the associated client created art products, and examples of the student team design process products in a spring Art for All Art Gallery. In addition, two student teams presented their work at the ASEE Zone II Conference and one more team, that includes engineering students and an art student, will present a design solution at the spring 2018 ASEE SE Conference. This paper also reports on the effects this collaboration has had on the engineering and art professors involved in the project, especially how it has affected their presenting the topic of design to their students.

Completing a Lab in 50 Minutes: Optimizing Student Attention Span

Doug Tougaw, Jennifer Marley

Accommodating students' relatively short attention spans is a significant challenge when designing a first-year engineering course. It is increasingly difficult for first-year students to maintain their focus throughout a 150-minute laboratory session. An alternative is to create laboratory experiences that provide students with self-contained hands-on experiences that can be completed within a traditional 50-minute window. In electrical and computer engineering, this is challenging, since so many of the laboratories require extensive wiring and, possibly, programming.

We describe a set of 24 hands-on laboratories in which students perform a significant experiment within a 50-minute period. The labs are written to explore analog circuits, digital circuits, and programming embedded microcontrollers. Completing these experiments in 50 minutes is made possible by making just a few adjustments to the lab exercises and by providing a few key supporting structures for students.

These one-period labs were taught for the first time last academic year, and they are currently being used for a second time with a few small revisions. Assessment results are presented that demonstrate these labs are beneficial to students' achievement of course learning objectives.

R401B: Enrollment, Instruction and Pedagogy - Focus on Design-Based Projects

Thursday, 12:30pm-1:45pm - Engineering Hall, Room 320

Are Post-Millennials Enrolled in Engineering Majors Inclined to be Socially Active?

David Gee

As part of a curriculum redesign for AY2009-10, university faculty and administration created a new course –Freshman Year Seminar– which is required of all incoming first year students. A service learning component is included as a part of the course. For FYS students in the College of Engineering, their freshman year seminar course includes the engineering design and construction of a service project which serves a community need and also takes advantage of their particular skill set. For AY2017-18, the faculty team broadened the idea of community to include the global community in response to a joint United Nations/Institute of Electrical and Electronic Engineers Humanitarian Technology Challenge Sustainable Development Goal for food security. The goal of this year's project was to produce a working model of a solar-powered food dehydrator which, theoretically, could be used to combat hunger in communities far removed from our local one. In principle, a dehydrator can extend the shelf life of food by preserving them for consumption at a later time, thereby addressing one aspect of the availability and accessibility of food. The feasibility of the idea was demonstrated in the current designs, while future iterations will stress the global aspect by restricting the designs to include only parts and components easily accessible in the local environment. Finally, using an end-of-semester survey we found that not only were engineering students enthusiastic about working as a member of a multidisciplinary team (69% of respondents agreed that participating on a multidisciplinary team was beneficial to their educational experience), but they also indicated a willingness to contribute their time and (future) money in support of social issues like global hunger.

Embedding Core Skills in First-Year Engineering Students with Applications in Embedded System Design

Michael Cross, David Feinauer

Engineering students at the University have the opportunity to gain hands-on experience throughout their studies. This begins in the first semester as students engage in a common-engineering experience built around a 2-hour lecture and 3-hour laboratory course. In this course, students explore the engineering profession and develop competency with professional and technical skills that unite all engineers across all disciplines. They practice these skills in lab exercises with applications drawn from the disciplines of the institution: Civil Engineering/Construction Management, Electrical and Computer Engineering, and Mechanical Engineering. During their second semester, students take a discipline-specific 2-hour lecture, 3-hour lab course where they delve deeper into their chosen program of study and career path. In this paper, we will discuss how an embedded systems approach is used to further showcase fundamental and future areas of study for Electrical and Computer Engineering students at the University. In the laboratory portion of the course, students develop technical and professional lab skills as they use simple benchtop equipment and the Arduino microcontroller to explore fundamental areas of electrical engineering including circuits, electronics, electric machines, power electronics, control systems, signals/sampling theory, programming fundamentals, and basic logic. Examples of such exercises include: sampling a basic DC voltage divider output, sampling analog time-varying signals and converting PWM digital signals to analog voltages, controlling the operation of a brushless DC motor, exploring the use of a boost converter and automatically compensating for voltage input fluctuations, and developing a portable spectrophotometer to study water quality in third-world countries. These experiences provide a foundation of skills to support the students in their more advanced courses; they are a rich common set of experiences for instructors to reference throughout the more advanced courses, they connect students to the School of Engineering, and they serve as motivating, mastery experiences for the students early in their academic careers. Following the presentation of the pedagogical course design, a discussion of student attitudes and lessons learned from multiple course executions will be presented.

Future Design Studio Building a Growth Mindset and a Path to Persistence Through Improvisation and Design Fiction

Aubrey Wigner, Megan Halpern, Isaac Record

Future Design Studio is a multidisciplinary two-day workshop combining science, technology, history, improvisation, design, and making. The workshop seeks to enhance retention in STEM by helping students form a develop a growth mindset and the communal traits necessary for success. To accomplish this, the workshop provides an environment where students engage in improvisation exercises to build community, practice communication skills, and develop critical thinking by examining scientific and technological progress. During the workshop, students explore ethical and societal issues surrounding science and technology through the physical prototyping of imagined artifacts from 100 years in the future and through watching and discussing an improvisational performance by professional actors using the artifacts the students have created. Approximately 50 underrepresented and/or at-risk first year students participated in Future Design Studio in 2017. Initial results show students are developing the foundations of a growth mindset through their experience in Future Design Studio. Students also reported an increase in their comfort levels with communicating in their classes, a greater sense that they will succeed in STEM fields, and the creation of a positive community to grow with during their time at college.

R401C: Enrollment, Instruction and Pedagogy - Focus on Design-Based Projects

Thursday, 12:30pm-1:45pm - Engineering Hall, Room 321

A First-Year Computer Engineering Lab Project: Driving an LCD with an FPGA Embedded Processor

Rod Foist, Timothy Gage, Matthias Schmidt, Seth Truitt, Xuping Xu

> Recent National Science Foundation (NSF) research, aimed at improving the Electrical and Computer Engineering (ECE) curriculum across all four years, makes strategic use of laboratory projects. The “spiral model”, adapted from other research, introduces certain lab component themes (in the freshman year) and revisits them with increased sophistication and interconnection in the following years. Thus, labs are used as a “cohesive framework” that connects and integrates individual courses. The three themes used in this research are centered on video (and image), sound, and touch sensors. In this paper, and a companion paper, we present our own design of two new lab projects (within the video/image theme). Specifically, this paper reports on the use of a Field-Programmable Gate Array (FPGA)-based embedded processor to control a liquid crystal display (LCD). This approach is contrasted with using a state-machine for LCD control. The companion paper presents the design of a microcontroller-based voltmeter with measured voltage values shown on an LCD. The contribution of this paper is to provide a fully-working, easy-to-use, first-year lab project within the video/image theme of the spiral model approach to improving the ECE curriculum. The project design code will be made available for downloading on the internet, via the Bitbucket web-hosting service.

A First-Year Electronics Lab Project: Design of Basic Voltmeter plus Soldering Tutorial

Rod Foist, Timothy Gage, Matthias Schmidt, Seth Truitt, Xuping Xu

> Recent National Science Foundation (NSF) research, aimed at improving the Electrical and Computer Engineering (ECE) curriculum across all four years, makes strategic use of laboratory projects. The “spiral model”, adapted from other research, introduces certain lab component themes (in the freshman year) and revisits them with increased sophistication and interconnection in the following years. Thus, labs are used as a “cohesive framework” that connects and integrates individual courses. The three themes used in this research are centered on video (and image), sound, and touch sensors. In this paper, and a companion paper, we present our own design of two new lab projects (within the video/image theme). Specifically, this paper reports on the design of a microcontroller-based voltmeter with measured voltage values shown on a liquid crystal display (LCD). The companion paper presents the design of a Field-

Programmable Gate Array (FPGA)-based embedded processor to control an LCD. Both projects can include a soldering tutorial/review session—and simple videos were made to illustrate soldering of the voltmeter components. The contribution of this paper is to provide a fully-working, easy-to-use, first-year lab project within the video/image theme of the spiral model approach to improving the ECE curriculum. The project design code will be made available for downloading on the internet, via the Bitbucket web-hosting service, and the soldering tutorial videos via YouTube.

Tangible Electricity: Audio Amplifier and Speaker

John Edward Miller, Brandon Herrera

Projects help students connect concepts to physical reality and allow students to experience the process of design, construction, and testing. Finding suitable projects can be difficult. They should be challenging yet enjoyable, demonstrate the concepts in an understandable way, tangible (hands-on), not cost too much, and not require too much time of either students or instructors. This paper describes one such project: soldering an audio amplifier and building a speaker. The primary goal of this project was to make electrical engineering tangible, as early students (or those in other disciplines) often complain that they cannot “feel” or “see” electricity. This project allowed them to feel, see, and hear the movement caused by an electrical signal and to interact with it through a volume knob. Concepts addressed included circuit theory, operational amplifiers, and electromagnetic fields but could be extended to other topics as well, such as spherical wave propagation or system modeling. This project was implemented with 190 first-year students at Baylor University during the 2017 fall semester. Students were given all of the necessary parts, including a printed circuit board (PCB), electrical components, magnets, and wire. Each student soldered the components onto the PCB and constructed his or her own speaker from household materials, like plain paper, cups, plastic bottles, paper plates, etc. Amplifiers were tested for operation. Speakers were tested for frequency response and loudness. The initial, one-time equipment cost is $5-10 per student, depending on equipment already available, and the recurring materials cost is $10 per student. The students were enthusiastic about their designs both before and after they completed their projects. This paper includes more detail about the project, examples of student designs, speaker testing results, student feedback, and future plans.

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