2017 Georgia Tech STEM Education Research Expo

Friday, December 1st, 2017, 3PM – 6PM

Student Success Center Suites A,B,C,D

Hosted by:

Georgia Tech Student Chapter of the American Society for Engineering Education (GT-ASEE)

With Support from:

Georgia Tech College of Engineering

Center for the Enhancement of Teaching and Learning (CETL)

Expo Schedule:

3:00 PM: Brief Introduction by GT-ASEE Executive Board

3:00 PM – 4:30 PM: Presentations (In order below)

"Community Engagement and Undergraduate STEM Education: Initial Findings from an Institutional Transformation Study"

Alexandra Erwin (School of City and Regional Planning and School of Public Policy)

"Flippin' Fluid Mechanics – Comparison of Blended Classroom vs. Traditional Lecture"

Donald R. Webster (School of Environmental Engineering)

"Observations of the Impact of Involvement in an Academic Makerspace through a Longitudinal Study"

Ethan C. Hilton (G.W.W. School of Mechanical Engineering)

"Why Underrepresented Students Embark Upon "The Perilous Passage" to a Ph.D. in Chemistry"

Aubrie L. Pfirman (Clemson University Department of Engineering and Science Education)

"Social Network Analysis of VIP Teams - Disciplines and Demographics"

Julie Sonnenberg-Klein (Georgia Tech Vertically Integrated Projects Program)

"Peer Assessment and the "Your World is Your Lab" Curriculum"

Scott S. Douglas (School of Physics)

"You Can Learn A LOT from a 6th Grader: [Field] Notes from the Pilot of an After-School STEM Program"

Renee Jordan (Georgia State University)

4:30 PM – 6:00 PM: Poster Breakout Session

Abstract Index

Title: Effective Team Dynamics in the Classroom and Beyond

Authors: Kathryn Narciso (School of Psychology)
Mary Lynn Realff (School of Material Science Engineering)
Juliana Alfonso (School of Psychology)

Presenter: Kathryn Narciso
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Abstract: In order to prepare students for teamwork in future careers, many instructors include team projects within their class. The extent to which these team projects actually teach team skills varies. One challenge to achieving team skills professional development within the classroom is an instructor's lack of expertise with team training. Our project has created team training modules focusing on key teamwork competencies that instructors of any course can use. The goal of these modules is to go beyond small teamwork interventions and focus on the core skills necessary to work in a team. These modules include managing diversity, collective leadership, team norms, and conflict management. This multi-year research project evaluating these modules in diverse classrooms recently began and will examine student/teacher reactions to training and individual collaboration readiness. The modules were created based on recommended competencies for team training. We welcome feedback from instructors regarding our competencies and activities we use for training. Our hope is to also share some ideas with other instructors of what skills they could focus on and how to train those skills. The first semester of data collection concludes this Fall and we should have some preliminary student and instructor reactions and feedback to share.

Title: The K-12 InVenture Challenge: Inspiring Future Innovators & Entrepreneurs

Authors: Roxanne A. Moore (School of Mechanical Engineering, Center for Education Integrating Science, Mathematics and Computing)
Sunni H. Newton (Center for Education Integrating Science, Mathematics and Computing)
Meltem Alemdar (Center for Education Integrating Science, Mathematics and Computing)
Anna N. Holcomb (School of Electrical and Computer Engineering)

Presenter: Sunni Newton
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Abstract: The K-12 InVenture Challenge inspires K-12 educators and students to innovate solutions to real-world problems of the students' choosing. Modeled after Georgia Tech's InVenture Prize, a 'Shark-Tank' style competition for Georgia Tech undergraduates, the InVenture Challenge attempts to deliver the same authentic experience to K-12 schools by providing a framework, curriculum, and competition that can be used by K-12 teachers in a variety of disciplines to foster innovation and entrepreneurial thinking in student inventors. This poster presents two aspects of InVenture Challenge: the overall model of the program, and results from our 2015-2016 academic year research on the program. First, a model is provided for Georgia Tech's InVenture Challenge, which is aimed at empowering underrepresented groups in STEM disciplines by looking further down the pipeline. The second contribution of this poster is a summary of the qualitative and quantitative data collected from InVenture Challenge teachers. In general, teachers perceive the InVenture Challenge as an engaging way of broadening participation in engineering, expanding the students' experiences outside the classroom, fostering teamwork and collaboration, and building a partnership with Georgia Tech.

Title: Science and Astronomy Outreach programs at the American University in Cairo

Authors: Ramy Imam (G.W.W. School of Mechanical Engineering)

Presenter: Ramy Imam
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Abstract: There is an increasing need for raising scientific awareness in Egypt, this would help establish a knowledge based society and change Egypt's economics. The American University in Cairo (AUC) has established many initiatives to help mitigate that issue. One of those initiatives is the AUC's Fun Lab, which is a Physics laboratory that helps engage students using hands on experiments and demonstrations that help motivate students to learn more about the subject. Fun Lab conducts many events, including on and off campus events, to help attract the general public to learn more about science. Furthermore, astronomy had been a big part of the outreach program at AUC, with stargazing events happening both on and off campus.

Title: Using Graphing Materials to Improve Undergraduate Biology Students' Graph Choice, Construction, and Interpretation in an Upper-Division Animal Behavior Lecture Course

Authors: Aakanksha Angra (School of Biological Sciences)
Emily Weigel (School of Biological Sciences)

Presenter: Emily Weigel
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Abstract: Science policy documents at the K-12 and undergraduate levels emphasize graphing skills. However, previous literature has shown that although students are competent at plotting and identifying data points, they struggle with graph choice, construction, and interpretation. The objective of this study was to assess students' graphing skill progression by utilizing evidence-based graphing materials (Angra and Gardner, 2016). Graphing instruction and implementation of graphing materials was guided by the cognitive apprenticeship model which makes the context of student learning relevant and allows numerous opportunities for the student to practice skills, which guide them towards expertise. The context of this study was an upper division animal behavior lecture course taken by biology majors at a large research-intensive university in the Southeast (N=21 students). Students worked individually and in small groups to design experiments, collect and analyze data, present their findings in graphical formats, and interpret published experiments in animal behavior. Student usage of the instructional materials was noted in the instructor's field notes and through classroom observations, and students were encouraged to use these materials in all aspects of the course, including on exams which contained graphing components. The effectiveness of the graphing materials and students' graphing abilities was evaluated by: pre/post survey on graph knowledge, and the attributes and quality of student-generated graphs throughout the semester. Data from this preliminary study are promising with students demonstrating improved graphical abilities by the end of the semester.

Title: The Impact of a Middle School Engineering Course on Students' Academic Achievement and Non-Cognitive Skills

Authors: Meltem Alemdar (Center for Education Integrating Science, Math and Computing)
Jeremy Lingle (Center for Education Integrating Science, Math and Computing)
Stefanie Wind (University of Alabama)
Roxanne Moore (Center for Education Integrating Science, Math and Computing)
Jeff Rosen (Center for Education Integrating Science, Math and Computing)
Marion Usselman (Center for Education Integrating Science, Math and Computing)

Presenter: Meltem Alemdar
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Abstract: As part of the Advanced Manufacturing and Prototyping Integrated to Unlock Potential (AMP-IT-UP) project, funded in 2012 by the National Science Foundation through the Math and Science Partnership program, middle school engineering curriculum was developed. The engineering courses are based on a hypothesis that applied engineering experiences that require active engagement with foundational math and science practices will lead to increased engagement, self-efficacy, persistence in STEM, and improved academic achievement. The purpose of this study was to investigate the impact of Science, Technology, Engineering, and Mathematics Innovation and Design (STEM-ID) courses on middle school students' achievement in engineering design, science and math achievement, and 21st-century skills. Specifically, the Engineering Design Process (EDP) conceptual model is used as a framework for the STEM-ID curriculum to explore impacts on the outcome variables. This paper describes the development, implementation, and results from STEM-ID courses developed for students in 6th, 7th, and 8th grade and implemented in four middle schools. The results suggest that the courses increased achievement in engineering design, science knowledge, and certain 21st-century skills across grade levels.

Title: Observations of the Impact of Involvement in an Academic Makerspace through a Longitudinal Study

Authors: Ethan C. Hilton (G.W.W. School of Mechanical Engineering)
Megan Tomko (G.W.W. School of Mechanical Engineering)
Robert Nagel (James Madison University)
Kimberly G. Talley (Texas State University)
Julie S. Linsey (G.W.W. School of Mechanical Engineering)

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Abstract: Academic makerspaces provide a space for students to develop their design ability through building, testing, evaluating, and rebuilding their ideas through an informal learning environment unmatched by any classroom setting. This physical application of the design process can have a great impact on how students view their own competency in engineering design and they begin to self-identify as a "maker". The inclusion in the makerspace culture also allows students to develop their identity as designers. To better understand how involvement in such a space impacts students' self-identity over time, a longitudinal study has been conducted in the Mechanical Engineering department at Georgia Tech using design self-efficacy and makerspace involvement surveys over the course of several years.

The longitudinal study was conducted using 3 required courses at different classification levels in the Mechanical Engineering curriculum. Using unique identifiers for each student, the authors were able to track students as they advanced through the curriculum and establish when they became more or less involved in the makerspace on campus and the changes in each student's design self-efficacy. Through tracking the students over the first two years in the curriculum, the authors were able to identify students who became highly involved in the in the time between the two points of data collection and compare them to students who were always highly involved and students who were never highly involved. Comparing these three groups allowed conclusions to be drawn on how makerspace involvement impacts design self-efficacy.

Results have found that students who become involved in the makerspace experience significant improvements in certain design self-efficacy components when compared to students who do not become highly involved. These improvements include a higher expectation of success and a lower amount of anxiety when conducting engineering design. These results help support the need for academic makerspaces and are a step towards understanding what students are learning as a result of becoming involved in the culture associated with these spaces.

Title: A Mixed Methods Study on The Different Ways Mid-Year Engineering Students Conceptualize Their Future Careers

Authors: Catherine McGough (Clemson University Department of Engineering and Science Education)

Presenter: Catherine McGough
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Abstract: Students attend college primarily to prepare for their future careers; therefore, career goals determine many of their academic decisions, and in turn, those decisions and actions affect their career goals. Understanding the dynamic between engineering students' perceived future career goals and their engineering coursework will help educators, academic advisors, and researchers design effective learning experiences at a crucial point in students' academic careers—sophomore and junior year (mid-year). The research question for this study: How are mid-year engineering students thinking about their future careers?

This multi-phase mixed methods study uses the theoretical frameworks of future time perspectives, future possible selves, and contingent goal paths, to both quantitatively and qualitatively explore student's perceptions of their future careers.

Results from the interviews (N=28) and survey data (N=1,010) showed four characteristic ways student think about their future careers: 1) one well-defined ideal and realistic future goal that extends deep into the future, 2) a conflicting ideal and realistic future goal that are well-defined and extend deep into the future, 3) a broad, yet positive, conception of the future that does not extend past graduation, and 4) a broad and more negative conception of the future. Students with a more positive conception of the future are not exactly sure what they want to do, but they believe that they will enjoy whatever they will be doing.

Characterizing the different ways students think about their future careers is a step towards understanding what motivates students in the classroom, and how to reach out to students with different motivations. Future studies will explore in more depth how these ways of thinking influence academic behaviors and decisions and how these ways of thinking shift over time.

Title: Community Engagement and Undergraduate STEM Education: Initial Findings from an Institutional Transformation Study

Authors: Alexandra Erwin (School of City and Regional Planning and School of Public Policy)
Jason Borenstein (School of Public Policy)
Wendy C. Newstetter (Wallace H. Coulter Dept. of Biomedical Engineering)
Colin Potts (Vice Provost)
Ellen Zegura (College of Computing)

Presenter: Alexandra Erwin
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Abstract: The Culture of Disengagement study by Erin Cech has shaken the academic world in many ways [1]. It raised the concern that American engineering institutions might be failing to nurture students in ways that would encourage them to make public well-being a foremost priority. Presumably, students may become "disengaged" for many reasons including worries about paying off student loans. Thus, our research team wanted to investigate what may combat, or at least mitigate, the problem that Cech seems to have identified. More specifically, our project aims to identify the types of community engagement activities that contribute to the concern that engineering and other STEM students have for the public's well-being. Our team is in the process of embarking on a five-year grant funded project to study the effects of a broad range of community engagement activities.

In this presentation, we will describe our assessment efforts for our five-year community engagement and ethics grant project. The focus here will be on the project's quantitative components, which involve using an assessment instrument to collect data about how undergraduate students perceive their responsibilities related to the public's well-being. The survey that we have utilized is a modified version of the Engineering Professional Responsibility Assessment (EPRA); it was created by Angela Bielefeldt and her team at the University of Colorado Boulder. The EPRA survey was modified so that it would be relevant to students in all STEM fields and not just engineering majors. We will share initial findings from the first stage of data collection obtained from our primary study cohort, the Fall 2017 undergraduate class.

[1] Cech, E. A. (2014). "Culture of disengagement in engineering education?" Science, Technology & Human Values 39(1): 42-72.

Title: Affordances that Enhance Learning in University Makerspaces for Female Students

Authors: Megan Tomko (G.W.W. School of Mechanical Engineering)
Wendy C. Newstetter (Wallace H. Coulter Dept. of Biomedical Engineering)
Julie S. Linsey (G.W.W. School of Mechanical Engineering)

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Abstract: Recognizing the value of diversity and inclusivity in learning, recent engineering education initiatives have worked to encourage all types of students to pursue engineering while also facilitating the construction of makerspaces on university campuses. Herein are two types of diversity and inclusion in learning: in the people who are engineers and in the pathways for engineering. While these two initiatives are aiming to improve the quality of an engineer's education, the reality settles in when we begin to question whether these makerspaces are, in fact, encouraging learning in engineering for all types of students.

In this work, we focus on investigating the relationship between makerspaces and women. We are completing a series of three 90-minute semi-structured interviews with four female undergraduate students involved in different makerspaces at a single university. The purpose of these interviews is to engage the students in their experiences with the makerspaces and the projects that they work on in the space in order to articulate how these spaces afford learning and their impact on female student engagement. All interviews were conducted by the same female graduate student. The interview transcriptions result in roughly 20 single-spaced pages per interview. Using qualitative data analysis methods and multiple cycles of coding, themes of learning are expected to emerge in multiple forms: social learning, technical learning, individual learning, and communicative learning. Within each theme for learning, we further analyze the challenges that the female students face in the makerspaces. While makerspaces are often labeled as "open, learning environments," this work demonstrates the how these spaces facilitate and open, learning environment for women and suggests means to generate open environments for all students.

Title: The Teaching Practices of TAs Facilitating Instruction in a Blended Synchronous Learning Environment

Authors: Asad Abbas (Coulter Department of Biomedical Engineering)
Greg Mayer (School of Mathematics)

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Abstract: Preliminary results from an ongoing exploratory project aimed at characterizing the teaching practices of teaching assistants (TAs) will be presented. The TAs who participated in our study facilitated instruction in a blended synchronous learning (BSL) environment for a linear algebra course offered through the Distance Math Program at the Georgia Institute of Technology, which offers undergraduate level courses to over 400 high school students in Georgia. Our research explores two research questions: 1) what teaching practices do TAs who facilitate instruction in a BSL environment use in their recitations, and 2) from the perspective of TAs, what are the benefits and challenges of facilitating synchronous recitation sessions in a BSL environment? Using an exploratory mixed methods sequential study design, we collected teaching observation and interview data over two semesters to gain insight into their teaching methods and perspectives on TAs who facilitate instruction in a BSL setting. Study participants consisted of eight undergraduate and graduate teaching assistants from the Fall 2015 and Fall 2016 semesters. Semi-structured interview data was collected from each of the study participants to explore our research questions. Teaching observation data was collected using a modified version of the Classroom Observation Protocol for Undergraduate STEM (COPUS) tool. Preliminary study findings offer insight into the goals, challenges, and their perspectives on the training and support that our study participants received. For example, Fall 2016 TAs were observed to rely on active learning strategies more frequently than the Fall 2015 TAs, and were more satisfied with the structure and support that they had. Changes made to TA training and support between these two study cohorts may explain these differences. Study data offers evidence that providing an adequate level of structure, community, and autonomy for teaching assistants affect TAs sense of success and satisfaction in their instructional roles.

Title: Impact of Course Policy Changes on Calculus I DFW Rates

Authors: Paran R. Norton (Clemson University Department of Engineering and Science Education)
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William C. Bridges (Clemson University Department of Mathematical Sciences)

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Abstract: This work explores the impact of departmental policy changes on the trend in DFW rates for introductory calculus at a large research university. Calculus I and II have been shown to be barrier courses for STEM majors, so increasing student success in these courses is imperative to retaining more students in STEM fields. A study was conducted to investigate how the DFW proportion trends for introductory calculus changed in response to the policy changes. We defined three distinct policy periods: Traditional (2002-2005), Active Learning (SCALE-UP) (2006-2013), and Return to Traditional (2014-2015). Regression analysis showed DFW proportions were increasing during the Traditional period, significantly decreased after the switch to SCALE-UP, remained fairly consistent during the SCALE-UP period, and then significantly increased during Return to Traditional. These trends were not consistent across demographic subsets of students. Specifically, white female STEM students typically had the lowest changes in DWF rates corresponding to policy changes, whereas non-white male non-STEM students had the highest changes in DFW rates. Individual trends for D, F, and W proportions were also analyzed. The two policy changes had the greatest influence on the trend in F and W proportions. Potential factors that could influence a student to withdraw from the course were examined. Students who withdrew had midterm averages similar to students who failed the course during the SCALE-UP period, but their averages were significantly lower than the F students during the Return to Traditional period.

Title: Paving the road into STEM for Latino students

Authors: Diley Hernandez (Center for Education Integrating Science, Math and Computing)
Analia Rao (Center for Education Integrating Science, Math and Computing)
Shaheen Rana (Center for Education Integrating Science, Math and Computing)
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Presenter: Diley Hernandez
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Abstract: The purpose of this study was to evaluate the multiyear effectiveness of a program designed to strengthen the pipeline of Latino students into post-secondary science, technology, engineering, and mathematics (STEM) education. The program includes a suite of interventions aimed at students, families, and teachers and implemented in a school cluster with a high Latino population in a southeastern metropolitan area. Our interventions include a high school and middle school mentoring program, robotics competitions, STEM-focused extracurricular activities (summer camps, research and community service opportunities), college and STEM career-focused community events for families, and professional development opportunities for teachers. Our research question is: What is the effectiveness and impact of these interventions on study participants with regards to college readiness and other STEM related outcomes? The poster presents the results related to the third year of implementation of the initiative.

Results show that the mentoring program components of this initiative have a positive impact on students' college readiness and STEM career awareness outcomes. The other extracurricular programs support this effort by increasing students' STEM-related content learning and increasing awareness of STEM careers.

Title: Why Underrepresented Students Embark Upon "The Perilous Passage" to a Ph.D. in Chemistry

Authors: Aubrie L. Pfirman (Clemson University Department of Engineering and Science Education)
Khushi Patel (Clemson University Department of Engineering and Science Education)
Eliza Gallagher (Clemson University Department of Engineering and Science Education)

Presenter: Aubrie L. Pfirman
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Abstract: Although there are many factors affecting the quality of a Ph.D. experience, scholars agree the single most important factor is the relationship between the faculty advisor and the graduate student. There is little literature aimed at understanding graduate students' experiences; there is even less literature about the conceptualizations of underrepresented doctoral students. As a multi-institutional investigation of students' experiences and perceptions throughout their doctoral journey, this study is intended to expand and change current understanding of student-faculty relationships in order to improve graduate education in the sciences. This paper reports partial results from a larger phenomenography designed to answer the question, "What are the different ways underrepresented doctoral students in chemistry perceive their relationship with their faculty advisor?" In this paper, we focus specifically on the reasons sixteen chemistry doctoral students decided to pursue a Ph.D. We found that three main categories emerged: avoidance, attainment, and inevitability reasons. These results provide direct evidence regarding mentorship and student development at both the undergraduate-level and the transition stage for new doctoral students.

Title: A Mixed Methods Study Documenting the Impacts of Cooperative Education on Student Academic Performance

Authors: Katherine Ehlert (Clemson University Department of Engineering and Science Education)

Presenter: Katherine Ehlert
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Abstract: There has been a call for improved educational practices within the world of engineering centered around developing authentic engineering tasks and practices. Many educators argue that providing more authentic engineering experiences in the classroom will promote deeper learning and prepare students for engineering in the 21st century. Co-operative education (co-op) immerses engineering students in the field of engineering and allowing them to practice as an engineer on a daily basis. Students who have participated in co-op programs typically graduate with higher GPAs, have an easier time transitioning into full-time work, and begin working at higher starting salaries. Although there are many documented benefits to co-op experiences, there is little documented on the ways in which co-op provides these benefits. The purpose of this budding explanatory mixed methods research is to document the ways in which participation in a co-op program improves or inhibits academic performance. The first step of the study will quantitatively determine previously graduated student performance patterns (with and without co-op experience) at a public, 4-year institution in the Southeast. The second, qualitative part of the study will interview current students with extensive co-op experience (multiple co-op rotations) in hopes to connect specific aspects of their co-op experience to the patterns observed in their academic behavior. The results of this study will refine our understanding of the ways in which co-op experiences impact academic performance. Positively impacting ways can then be translated into the classroom to ensure more students can benefit from these types of experiences.

Title: Possible Theoretical Framework for a Comparative Case Study on Various Course Structures and Its Effects on Student Achievement

Authors: Khushikumari Patel (Clemson University Department of Engineering and Science Education)

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Abstract: General chemistry is offered in many institutions and is often a course requirement for many STEM majors. There have been a few different course structures for general chemistry such as flipped and hybrid. Studies have shown that student achievement in chemistry courses varies depending on the course structure and student work patterns. Motivation, behavior, and learning and/ or teaching styles from both the students and the instructors influence student achievement. Many studies focus or discuss various learning styles in STEM courses. Though learning behaviors as well as teaching styles can effect student achievement, there are other factors such as student work patterns to consider.

In my study, I will be investigating student work patterns and how students navigate in general chemistry courses, especially in both traditional lecture and hybrid course styles. Little to no studies have focused on student work patterns, which could help in understanding student achievement in general chemistry. As I am developing my research question, I have also looked into possible framework models that would best align with my research question.

I am building a theoretical framework that pulls from other existing frameworks in the literature. Rovai focuses on persistence on distance learning. Rovai has merged Tinto's well-known persistence model with Bean and Metzner's persistence model; I would like to expand Rovai's model to various course structures and incorporate the theory of student work patterns. This will allow me to examine any potential impacts on student progress and conceptualization, specifically in hybrid course structures for general chemistry.

Title: Flippin' Fluid Mechanics – Comparison of Blended Classroom vs. Traditional Lecture

Authors: Donald R. Webster (School of Environmental Engineering)
Rob Kadel (Assistant Director for Research in Education Innovation)
Wendy C. Newstetter (Wallace H. Coulter Dept. of Biomedical Engineering)

Presenter: Donald R. Webster
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Abstract: We conducted a study of student performance in and perceptions of a blended classroom delivery of a junior-level fluid mechanics course. In the blended pedagogy, students watch short on-line videos before class, participate in interactive in-class problem solving (in dyads), and complete individualized on-line quizzes weekly. Comparisons are made among four sections of the blended classroom delivery in the period of 2013-2017 to eleven sections delivered in a traditional lecture-style format by the same instructor in 2002-2012. The results reveal dramatic improvement in student engagement, perceptions, and achievement in the blended pedagogy. For instance, the withdrawal/fail/barely-passing (WFD) rate is significantly lower for the blended classroom (8.6% vs. 16.3%; $p < 0.05$). The average course total (i.e., aggregate of exam and assignment scores) is significantly greater in the blended classes ($p < 0.001$) with a medium size effect (Cohen's $d = 0.42$). Further, we regressed students' course total on a dummy variable for the blended classroom, as well as with controls for gender, students' major, and prior achievement as measured by incoming GPA. The regression model (for all students) explains a strong amount of variation in final course grade with an R-squared of 0.563, and the blended class variable is significant ($p < 0.001$) with a coefficient of 4.437 (100-point scale). Regarding student perceptions, surveys reveal significantly greater enthusiasm, stimulation, self-perception of how-much-learned, perception of the value of the course activities, and the overall effectiveness of the course and instructor in the blended classroom.

Title: Transforming for Inclusion: Fostering belonging and uniqueness in engineering education and practice

Authors: Joseph M. Le Doux (Wallace H. Coulter Department of Biomedical Engineering)
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Presenter: Joe Le Doux
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Abstract: There is a consensus that engineering needs to be more diverse and inclusive to better find and solve compelling problems. Our vision is to develop engineers who are capable of leading this change. To achieve our vision, we will form pedagogical incubator teams of faculty, students, and learning scientists to design and infuse inclusive practices at multiple scales within our classrooms and department. Two frameworks guide our work: Brewer's (1991) optimal distinctiveness theory (ODT) and Caporael's social configuration theory (SCT). ODT shows that people have a fundamental need to belong on the one hand, and to be unique on the other. SCT posits that humans repeatedly form a set of core social configurations of distinct sizes (e.g. dyads, teams, demes, and macrodemes), each of which require a distinct set of communication skills. In applying SCT to our situation, we recognize that our department's culture emerges from the constellation of social interactions that take place every day at multiple scales. Therefore, we must equip our students and faculty with the skills they need to realize the inclusion dividend at every social scale.

As a first step, a climate study was carried out within out department to help us understand our students' sense of belonging and uniqueness. A concurrent nested mixed method approach was used, with primacy given to the quantitative method. We will report our key findings and their implications for achieving our long-term vision. This project serves as a case study for how to change the culture and curriculum of a large research-active engineering department, and represents a first step towards broadening the perception of engineering as a profession, and towards diversifying the image of the ideal engineer so that interested students do not feel compelled to fit a specific mold.

Title: Social Network Analysis of VIP Teams - Disciplines and Demographics

Authors: Julie Sonnenberg-Klein (Georgia Tech Vertically Integrated Projects Program)
Randal Abler (School of Electrical and Computer Engineering)
Ed Coyle (School of Electrical and Computer Engineering)

Presenter: Julie Sonnenberg-Klein
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Abstract: Twenty-two colleges and universities have implemented the Vertically Integrated Projects (VIP) model, which consists of multidisciplinary teams, long-term large-scale projects led by faculty, the enrollment of students from different academic ranks, and the ability for students to participate for multiple years. At Georgia Institute of Technology, analysis of university exit surveys found VIP participation correlated with a meaningful effect size on three questions: the degree to which students' education contributed to their ability to work in a multidisciplinary team; their ability to work with individuals from diverse backgrounds; and their understanding of technology applications relevant to their field of study. Motivated by these findings, the VIP coordinators conducted a retrospective study of peer evaluations, applying social network analysis to quantify student interactions and identify patterns across the program. Results indicate that within the VIP Program, students interact more often with other majors and other races/ethnicities than their own major and race/ethnicity. Results support the findings of the previous study, providing evidence of VIP experiences related to working in diverse groups and in multidisciplinary teams.

Title: Inferring Student Success Predictors for CS1301x Online Course at Georgia Tech

Authors: Karan Shah (School of Physics)
Maxwell Bach (School of Mathematics)
Amy Liu (College of Computing)
Nina Qin (H. M. S. School of Industrial and Systems Engineering)
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Abstract: Massive Open Online Courses (MOOCs) are expanding their presence not just for online learners, but also for traditional students in universities. Georgia Institute of Technology runs an EdX (an online MOOC provider) course on CS1301x (Introduction to Python), which is an online course open to non-institutional online learners and traditional students on-campus. Using tools such as MongoDB, we aggregate and analyze the data provided by EdX to determine metrics to define and predict student success. We take a set theory approach and organize students into four different classes based on intersecting features. The classes are: Overachieving students, Median students, Underachieving students and Disinterested students. These classes are determined by engagement during video lectures, performance in assignments and tests, and presence of prior coding experience. Using this system, we will propose changes to the course, with the goal of making it more accessible to underachieving students and more challenging to the overachieving students. We also propose automated solutions for addressing specific challenges such as figuring out which assignment questions have faulty answers in the autograders. We present results achieved by the system on a dataset consisting of the on-campus population over a time period of three semesters. Once we formalize these results, we plan on making the system modular so that it can be applied to other online courses and scaled up to larger datasets.

Title: An Investigation of the Impact of Different Freshman Housing Experiences on a Student's Self Efficacy

Authors: Andrea Santiago (School of Biomedical Engineering)
Caroline Decherd (College of Computing)
Rebecca Brannen (School of Industrial Engineering)
Katerin Kwan (College of Computing)

Presenter: Andrea Santiago
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Abstract: The transition from high school to college is fraught with intellectual, social, and academic challenges that may threaten a student's sense of self efficacy. The Georgia Institute of Technology offers three different housing models to smooth the transition throughout the freshman year, the Freshman Experience, Grand Challenges, and the Honors Program. These living learning communities were designed in different ways, but share the same goal to create an environment where students can thrive academically by fostering relationships with peers and upperclassmen. The main purpose of the project is to determine whether or not participation in these programs has an effect on self-efficacy, in comparison to each other. In order to quantify these effects, we will administer a survey using the scales of self-efficacy based on the Bandura Model. The data and conclusions of this project will guide the Institute to determine whether or not the Freshman Experience Program, Grand Challenges, or Honors have an effect on freshman students' sense of self efficacy.

Title: Peer Assessment and the "Your World is Your Lab" Curriculum

Authors: Scott S. Douglas (School of Physics)
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Abstract: The Schatz Lab has developed the "Your World is Your Lab" introductory physics curriculum, featuring animated physics lecture videos, peer assessment, and real-world laboratory exercises requiring no special equipment. Since 2013, we've administered this course several times in different classroom contexts: a large-enrollment MOOC on Coursera, large-enrollment "blended" on-campus section, and small-enrollment online-only summer courses for enrolled Georgia Tech students. We present the development and implementation of a large-scale peer assessment system for student-produced lab report videos, describe how and why students became more reliable peer assessors as the semester progressed, and examine the potential application of our peer evaluation system to other courses at Tech and beyond.

Title: You Can Learn A LOT from a 6th Grader: [Field] Notes from the Pilot of an After-School STEM Program

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Brendan Calandra (Georgia State University)

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Abstract: As a means of supporting efforts to diversify the STEM education pipeline, the AMAYS program serves populations underrepresented in STEM fields. AMAYS is an after-school enrichment program where middle school students use the program's custom Content Management System (CMS) and MIT App Inventor to build mobile applications. The purpose of the program is to give students the opportunity to use, develop, and enhance Information and Communication Technology (ICT) skills, 21st-century skills, and computational thinking. Within the CMS, students have the resources they need to create the mobile applications. They also have the opportunity to complete a series of experience quizzes that allow them to collect coins when they demonstrate the desired skills and attributes. At the end of the program, students receive certificates with the badges they earn as a result of their experience coin collections that recognize the associated skills and attributes. After an alpha and beta test, the research team piloted the program at one school and served 41 different students during the 2016-2017 school year. During the exchanges made over the course of the pilot year, the research team not only learned about student skills, but they also learned about student interests, the connections they make to technology, and what it means to run a program when students have other options and obligations. Therefore, as a way to share out what facilitators learned to the broader research community and engage in dialogue on how to serve students in STEM programs better, this presentation will highlight the top ten lessons learned and discuss actions on how to move forward. The information shared and discussed during this talk will be used to inform the redesign of the AMAYS program as it prepares to enter the final iteration at nine schools.

Title: Buildings and Biology: Biologically Inspired Design and the Living Building Challenge in K-12 Science Classrooms

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Abstract: CEISMC, in partnership with the Center for Biologically Inspired Design (CBID), developed middle school lesson plans integrating sustainable building challenges with biologically inspired design methods. The intersection of building and biology is fundamentally integrative, and represents an opportunity for students to make connections with designed and natural environments. These connections ground new knowledge to everyday experiences (buildings and nature), while wiring the learning across separate epistemic domains (architecture and biology). We theorize that in these courses, acts of designing and building (constructionism) activate embodied learning, enabling students to engage with the materials in deeper ways that yield significant, lasting increases in science and math learning. Supported by Living Building Challenge (LBC) data and design challenges, lesson plans were developed for and released to Georgia science and engineering teachers, including schools with underrepresented populations in STEM fields. The team translated sustainable building challenges into suitable middle school biologically inspired design challenges, which were synchronized to coincide with grade-specific science learning objectives; for example while students in 8th grade learn about thermoregulation and energy in physical science, LBC lesson plans will focus on HVAC and energy issues in the LBC design challenge. The curriculum is due to be implemented in the Spring of 2018.

Title: Card-based Tool Development to Facilitate Small-group Bio-Inspired Design Activities

Authors: Ann Gerondelis, College of Design, School of Industrial Design
Ken Kirtland, College of Design, School of Industrial Design
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Abstract: Bio-inspired Design (BID) principles and processes are increasingly valued by high school science teachers. Our work with Atlanta Public Schools under an Improving Teacher Quality Grant established a Bio-inspired Design Learning Community that aligned Georgia Performance Standards with BID themes and developed curricula. K12 educators value BID for its ability to:

- Stimulate student engagement of biology knowledge

- Develop fundamental skills for problem solving, and

- Enhance the classroom experience.

However, engagement in the cognitive work of bio-inspired design requires a broad and diverse range of skills. In order to move students beyond the common challenge of design fixation, teachers need specific tools to scaffold multiple ways of thinking in order to facilitate the analytical, analogical and generative processes of bio-inspired design.

Graphic design and visualizations play a significant role in students' design understandings, especially in regards to BID. They not only increase student engagement, but support important problem solving and design skills. They also strengthen students' abilities to abstract information – leading to transference of knowledge and the significant analogical thinking of bio-inspired design.

Our team is developing a card-based game tool to facilitate small group BID activities with particular emphasis on the role of visual representation. Their design is structured to scaffold important cognitive steps in bio-inspired design including:

- Making and testing hypotheses

- Reasoning with evidence

- Understanding biological structures, behaviors and functions

- Identifying patterns and making connections between biological problems and human problems

- Generating possibilities and alternatives for solutions

This project is being funded by the College of Design Dean's Internship Program.