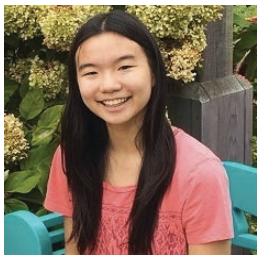
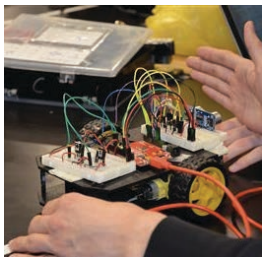
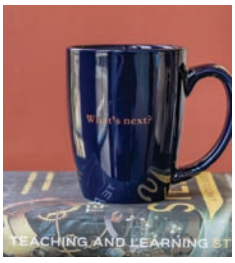
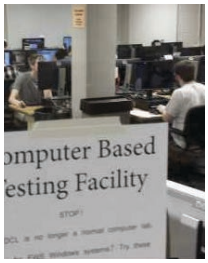
AE3 ACADEMY FOR EXCELLENCE IN ENGINEERING EDUCATION







Advances in Engineering Education @ Illinois

Annual Report

June 1, 2016 – May 31, 2017

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AE3 Mission

AE3 connects faculty and students to innovative teaching in the College of Engineering at Illinois.

* We support faculty-driven communities of practice that aspire to creative changes in curriculum and instruction.

* We provide students with authentic learning experiences that cross departmental borders, building both community and awareness of real-world engineering challenges.

* We publicize successful initiatives in the teaching and learning of engineering.

AE3 Staff

Laura Hahn • *Director*

Laura has been the Director of the AE3 since 2013. With an academic background in language teaching and learning, her work has crisscrossed the fields of applied linguistics, instructional development, and program administration. She is also co-authoring a book entitled, Women and Ideas in Engineering: Twelve Stories from Illinois, to be published by the University of Illinois Press in 2018. Laura earned her BA, MA, and PhD degrees from the University of Illinois.

Joe Bradley • *Lecturer*

Illinois Engineering First-Year Experience

Joe teaches electives in the Illinois Engineering First-Year Experience (IEFX). Prior to joining the faculty, Joe worked in the private sector in the software, consumer products, and defense industries. Joe earned his BSE, MS, and PhD all in engineering and a MBA. He enjoys seeing the students' creativity in his courses and is always amazed by the projects that students deliver each semester. He likes teaching and the great diversity of people he gets to work with.

Gretchen Forman • *Program Coordinator*

Illinois Engineering First-Year Experience

Gretchen has been the Program Coordinator for the Illinois Engineering First-Year Experience since 2016. Prior to joining IEFX, she taught in, developed curriculum, and coordinated programs for international students on campus. In her role as IEFX Program Coordinator, Gretchen helps provide experiences to help freshmen have a successful start in the College of Engineering.

Ann-Perry Witmer • *Instructor*

Illinois Engineering First-Year Experience

Ann has been teaching IEFX electives since 2014, and she's also faculty advisor to the University's Engineers Without Borders chapter. A licensed civil engineer, she previously was a drinking water supply engineer in the Midwest. Before that, she worked as a free-lance writer and newspaper reporter/editor. Ann earned bachelor's degrees in Journalism and Art History for Boston University, as well as BS and MS degrees in engineering from the University of Illinois. She's currently completing an engineering PhD in contextual engineering design.

Crystal Hahnstadt • *Office Support Associate*

Crystal has been with the University since August of 2016. Prior to working at the university, she worked as a customer service representative for a book printer for two years. She is currently attending Eastern Illinois University to obtain her Bachelor of Arts degree. Crystal has a certificate in website design and enjoys both website development and other graphic design projects.

Chris Migotsky • *Coordinator of Faculty Programs*

Chris is a coordinator of faculty teaching programs for AE3 as well as a student advisor. Through AE3, he assists faculty and departments in revising courses and curricula to make them more engaging and learner-focused. Chris also leads the Collins Scholar year-long program for new faculty that focuses on presentation skills, active learning strategies, and multi-faceted assessment of learning objectives. By combining his work with students and faculty, Chris hopes to make the college learning environment exciting, challenging, and captivating.

Valeri Werpetinski • *Visiting Lecturer and Director, Learning in Community*

Valeri has directed interdisciplinary and project-based service-learning courses in the Learning in Community program since 2010. Prior to joining the College of Engineering, she worked in the field of instructional development and specialized in community-engaged scholarship initiatives, faculty consultation, and TA training programs. Valeri is passionate about integrating service-learning and education abroad experiences into engineering education to foster transformative learning and the development of creative, collaborative, and socially responsible global problem solvers.

Sandra Johnson • *Office Manager, Undergraduate Programs & IEFX*

Sandy has been with Undergraduate Programs and IEFX since 2015, and she has been on campus since 2008. She supports the day-to-day operations of IEFX, and helps the Undergraduate Programs Office with course scheduling and greeting students at the main advising desk. Sandy enjoys seeing students evolve from high-schoolers to productive people in the workplace.

In 2016-2017, three iFoundry colleagues found new pathways.

Kelly Cross joined the Department of Bioengineering as a Visiting Research Scientist.

Geoffrey Herman became a Teaching Assistant Professor in the Department of Computer Science and remains involved in AE3.

Karen Hyman moved to Washington DC and is now Senior Vice-President of Policy and Programs at the American Council of Trustees and Alumni.

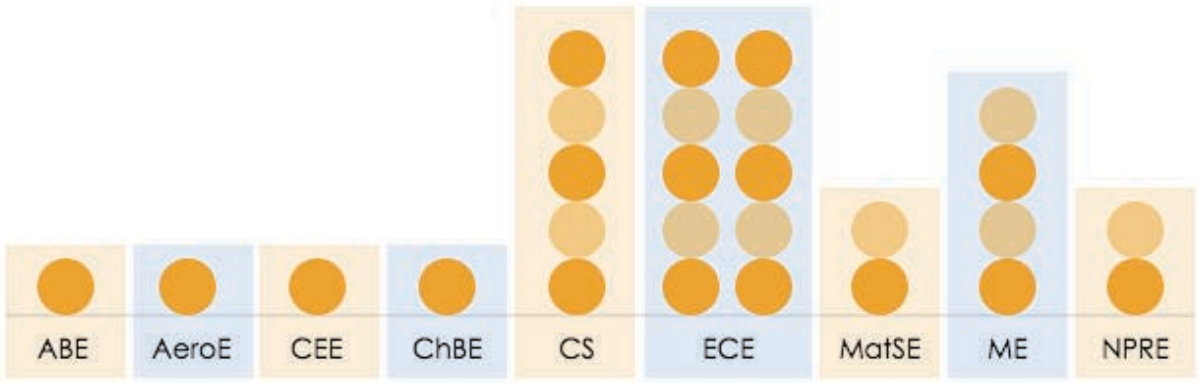
We also said good-bye to **Victoria Woods**, AE3's Office Support Associate. She went on to begin her graduate studies in Labor and Industrial Relations.

Collins Scholars Program

> *"The best part of the program was learning new things about teaching, while being part of a genuinely excited community that could not only relate to your experiences, but also offer advice (or at least sympathy)."*
>
> *~ First-Year Assistant Professor, 2016-17*

Since 1998, first-year faculty members in the College of Engineering at the University of Illinois have participated in a program designed to help them get their careers at Illinois off to a successful start. These participants are designated as Collins Scholars (named after W. Leighton Collins, an Illinois alumnus who served as executive director of ASEE for many years). They meet weekly throughout the year for lunch for conversation with AE3 staff, senior faculty, and other invited speakers. Topics focus primarily on teaching principles and best practices, with some time devoted to research and advising/mentoring (see Appendix A). The weekly lunch seminars give participants an opportunity to share classroom experiences and receive input from others as a part of a supportive community of practice.

In the 2016-2017 academic year, we had 27 faculty from the following departments complete the program: ABE (1), AeroE (1), CEE (1), ChBE (1), CS (5), ECE (10), MatSE (2), ME (4), and NPRE (2).



Faculty participants from different departments, AY 2016-2017



Collins Scholars Program activities

August kick-off event

This welcome event introduces new faculty to the College Dean, AE3 Education Innovation Fellows, and key administrators. It also helps kick-start networking within and across engineering departments and shares key resources to get the instructors off to a quick and productive start to the academic year. The agenda also includes a panel of undergraduate students to answer questions and provide examples of their "best" and "worst" classroom experiences.

Weekly Collins Scholar lunch seminars

These sessions include interactions with members of the College -- 24 faculty, 7 students, and 8 academic staff in 2016-17. They provide new faculty with a variety of resources and ideas regarding effective teaching, research, and service. These interactive sessions also open up opportunities to network and collaborate across the College and University.

Classroom observations

AE3-trained observers, both senior faculty and SCOTs, team up with AE3 staff to observe live classroom sessions and provide detailed written feedback to the new instructors. Instructors watch a video recording of their lecture and complete a self-reflection worksheet that elicits critical insights and a plan for improvement.

Excellent teacher visits

AE3 identifies exemplary faculty in a variety of STEM-related fields and organizes visits to their classes. New faculty observe these "excellent teachers" in small groups with AE3 staff. At the end of the classroom visit, they discuss the strengths of the teacher and what they might implement in their own classes. We conducted 11 of these visits this past year.

32 Number of classroom observations

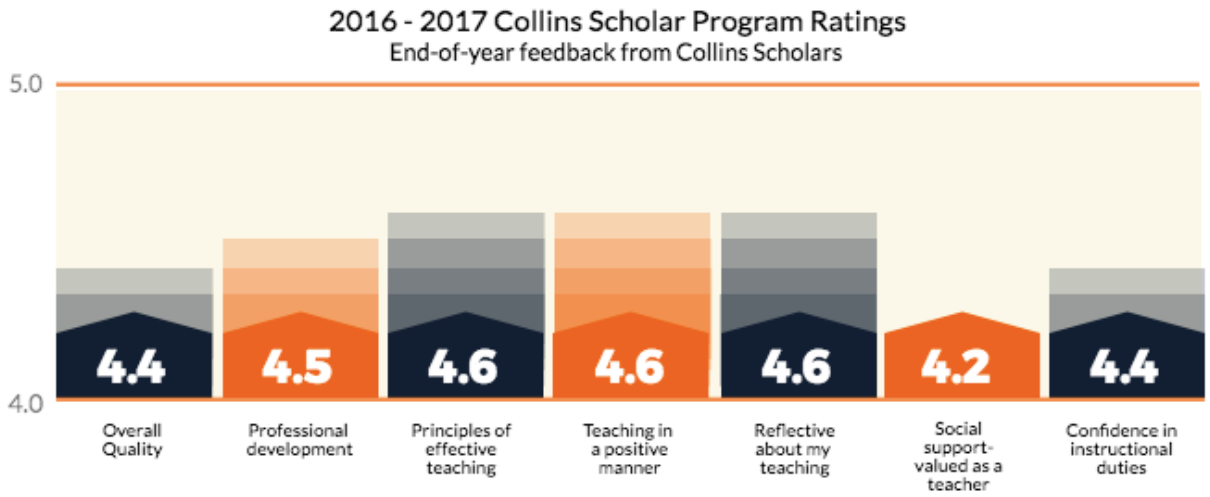
9 Number of SCOTs assisting

11 Number of faculty & staff affiliates assisting

11 Number of excellent teacher visits

Informal Early Feedback (IEF) and end of semester feedback (ICES)

All instructors collect informal early feedback during the first 5-6 weeks of the semester. A Collins Scholar lunch session is devoted to the purpose of IEF, proper creation of a feedback form, interpretation of results, and subsequent debriefing process with students. IEF results are discussed during the classroom observation debriefing. Similarly, the ICES process and related research is discussed in a weekly seminar and results are reviewed on an ad-hoc request basis.



Social events

AE3 holds several social gatherings to informally network and create a sense of community. Each year, we have two dinner socials for the current Collins Scholar cohort and their families. We also host two lunches each year as a reunion for the previous year's cohort. Interactions at these events allow AE3 staff to get a deeper understanding of each new instructor, their background, and concerns.

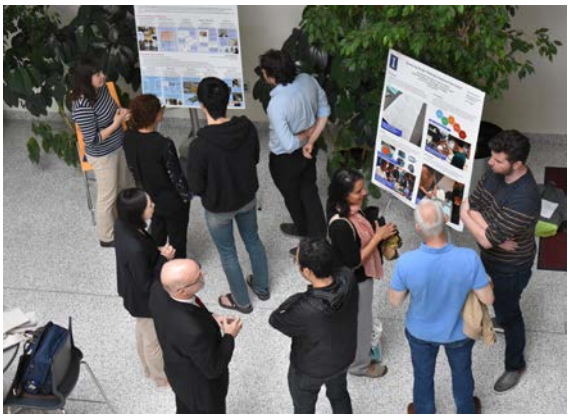
NSF CAREER workshops

In collaboration with the Engineering Office of Research, AE3 co-sponsors three workshops for new faculty to prepare them for the NSF CAREER proposal process. The first workshop is a panel of previous NSF CAREER award winners from the College. The second workshop is a mock NSF proposal review. The final workshop is a panel of educational outreach groups that are interested in collaborating with STEM-related faculty projects on campus or in the community.

Strategic Instructional Innovations Program (SIIP)

Overview

> *"The goal of SIIP is to accelerate the spread of best practices for teaching, develop new best practices, and reimagine what it means to educate our students. These efforts are successful when we teach like we do research: with creativity, collaboration, measurement, and continual improvement."*



SIIP is an effort to establish communities of practice to increase the impact of our educational initiatives. These communities of practice are intended to enable faculty to advance excellence in teaching methods and technologies through an engineering approach to innovation centered around prototyping, evidence-based decision making, learning from failures, and iteration. There are three tracks, with the Adaptation track launched for 2017-18.

SIIP Tracks

Startup

The Startup track is focused on bringing new ideas and faculty into the SIIP community and enabling current SIIP teams to create capacity for new efforts. The primary outcome of startup projects is the creation of a faculty community that is invested in solving a particular problem in engineering education.

Implementation & Exploration

This track brings research and design elements to educational initiatives. I&E proposals are for one year of funding and may be renewed for up to two additional years; they may also continue as SIIP-supported projects in perpetuity without funding, with a project consultant and assessment support.

Adaptation

This track is for faculty wishing to collaborate with a current SIIP team to replicate an innovation in their own course setting.



Participants

17	52	22	5	3	7	1
SIIP Teams 2016-2017	tenure-track faculty	teaching faculty	engineering students	staff	faculty from other colleges	graduate student from another college

(see complete list in Appendix B)

Funding

Eleven teams received funding; the others participated through no-cost extensions or without funding.

TOTAL FUNDING **$265,970**

RANGE $3,500 - $66,338

SIIP Activities

SIIP Team Kick-off	Friday, September 2
SIIP Happy Hour	Tuesday, October 18, Tuesday, March 7
Mid-year Reviews	Week of December 12
Information Session for New Teams	Thursday, February 2
New Proposal Reviews	Friday, May 5

Publications

32

Thirty-two publications and conference papers resulted from SIIP projects. *(See appendix C)*

Nurturing Design Thinking in Engineering Courses SIIP

Team: Sam Tawfick (MechSE), Eric Benson (Art & Design), Brian Bailey (CS)

Adapted from a story by Mike Koon: http://engineering.illinois.edu/news/article/21657

This SIIP project focuses on implementing design thinking in technically specific classes. The team has created a one-credit pass-fail fall semester course where 40 students from MechSE and CS departments explored how to incorporate the end user into design thinking for a variety of disciplines. During the spring semester, that idea was for the first time implemented tangibly into the ME 370 class.

"It has leveraged what we have done so far (in other SIIP projects) and taken it to the next level," Tawfick said. "It has lab components that didn't exist before where we have moved beyond theory and focused on the user when approaching actual design." In this class, teams of three or four first developed concepts for pull toys. The second half of the semester focused on building robots run by motors.

"We started with a very open-ended description, any pull 'toy' you can think of," Tawfick said of the development of the specific pull toys. "If they were building it for toddlers, what colors and themes would they like?"

One team worked with the staff at Curtis Orchard to design a custom pull toy for them. After discussions with the staff, that team decided to use a Wizard of Oz theme currently present there and to mount the toy for an existing wagon. Some teams had a pull-toy that uses the energy from being pulled to produce a useful function like making a cup of coffee, other toys are simply hilarious mechanisms.

Through support from computer science, those teams went first through low fidelity prototyping, using cardboard, paper and pens for initial user interface design. This allowed teams to simulate moving elements.

"This was eye opening," Tawfick said. "In the past, students would focus just on the computer aided design and go straight into fabrication. This intermediate step really allows students to better imagine the user in this 3D aspect of design, beyond just plotting it on a computer. It makes the process more efficient."

Tawfick reports, "I have never before seen this level of enthusiasm and excitement from our students for any mechanical engineering class I have taught. When you start thinking about other users, it is only natural you will get engaged and excited. While it is a more relaxed environment, the goal is clear – learn to empathize with the user in transforming these ideas into a mechanism."

While faculty and teaching assistants from the School of Art and Design are playing a big role in developing ME 370, the reciprocal is true for a new A&D class in kinetic sculptures where students will be building art made from machines. MechSE faculty members have given guest lectures and its students have conducted a clinic to advise design students of mechanical concepts.

Information on the ME 370 final robot competition is available here: https://mechanical.illinois.edu/news/me-370-robots-traverse-boneyard-creek

Education Innovation Fellows

Education Innovation Fellows (EIFs) are selected annually to participate in a college-wide community of practice focused on fostering and re-defining excellence and innovation in engineering education at Illinois. Based in the Academy for Excellence in Engineering Education (AE3), this community of practice supports EIFs' individual activities in engineering education, provides structured opportunities for leadership, and brings visibility to their collective efforts.

EIFs engage with AE3 in weekly meetings as a community of practice to share progress, ideas, and experiences. EIFs also participate in:

Collaborative Leadership

Providing external perspectives and feedback to one or more teams with Strategic Instructional Innovations Program (SIIP) grants, and advising the Associate Dean for Undergraduate Programs on policies and programs related to the teaching mission of the College.

Interdisciplinary Initiatives

Taking on a project that benefits multiple departments—such as project-based learning, coordinating cross-departmental changes and innovation, and building community among lecturers in the College.

Scholarly Initiatives

Promoting research and publications on teaching and learning through means such as, engaging in educational research, encouraging and helping others (colleagues, teaching teams, SIIP teams) to do and/or apply educational research, and sharing findings and ideas from teaching and learning conferences.

EIF appointments are for one year and are renewable for up to three years. The appointment includes an annual $6,000 in discretionary funds to support their initiatives.

> *"I've really enjoyed being an EIF these past three years; it's given me a deeper perspective on teaching issues in my own classes, my department, and the college. I've met new people across the college and campus, and have appreciated the opportunity to learn and try new things."*
>
> *~ Dallas Trinkle*

EIFs for 2016-2017

Jenny Amos	Bioengineering
Brian Bailey	Computer Science
Tim Bretl	Aerospace Engineering
P. Scott Carney	Electrical & Computer Engineering
Cinda Heeren	Computer Science
Luke Olson	Computer Science
Dallas Trinkle	Materials Science & Engineering

AE3 Council 2016-2017

AE3 Council Members are committed to instructional innovation in the College of Engineering, and actively support the efforts of AE3.

Jenny Amos	Bioengineering
Brian Bailey	Computer Science
Rohit Bhargava	Bioengineering
Tim Bretl	Aerospace Engineering
P. Scott Carney	Electrical & Computer Engineering
Cinda Heeren	Computer Science
Jose Mestre	Physics
Luke Olson	Computer Science
Jeff Roesler	Civil and Environmental Engineering
Tim Stelzer	Physics
Dallas Trinkle	Materials Science and Engineering
Matthew West	Mechanical Science and Engineering
Craig Zilles	Computer Science

Teaching Professionals Program

The Teaching Professionals Program (TPro2) works to build community and formalize the career objectives of the participants by hosting meetings that provide professional development, facilitate sharing of ideas, and allow general discussion. All specialized teaching faculty (approximately 75 in the College) re invited.

Co-led by Cinda Heeren (CS) and Laura Hahn, TPro2 met monthly this year. Attendance ranged from 6 to 19, with an average of 13.5. One important highlight this year was a meeting with Executive Associate Dean Martin Wong, who provided updates on the newly established teaching-faculty titles and related issues of promotion and evaluation.

With Cinda Heeren leaving the College, we decided to invite three individuals to provide leadership next year. Lawrence Angrave (CS), Yuting Chen (ECE), and Mariana Silva (CS) are planning ways to provide more structure and focused activities for TPro2.

> *"My participation and interactions with the TPro2 community has greatly impacted my career at the University of Illinois. As I started attending the TPro2 meetings, I was able to meet other specialized teaching faculty from different departments, and consequently exchange teaching experiences, challenges and successes. I was able to start collaborating in projects outside my own department, and pursue activities and opportunities that were previously not available to me. In addition, I was able to meet co-workers that I can now call my friends. I am very thankful for the efforts of TPro2 leaders, who were able to organize interesting and fun meetings on a regular basis during the entire semester!"*
>
> *~ Mariana Silva, CS*

Celebration of Teaching

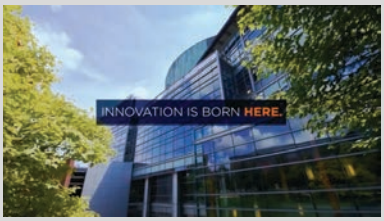
Each April, AE3's Celebration of Teaching acknowledges the faculty who have completed the Collins Scholar program and showcases the SIIP projects with a poster session. This year, Teaching Professor Cinda Heeren and Vice Provost for Undergraduate Education and Innovation Chuck Tucker shared remarks. Collins Scholars Arijit Banerjee (ECE) and Yujie Men (CEE) also talked about their experiences in the program.

Other AE3 Events and Activities

Videos

In Summer 2016, AE3 collaborated with Surface 51 to produce three videos available to help publicize teaching excellence and innovation in the College.

30-second video



60-second video

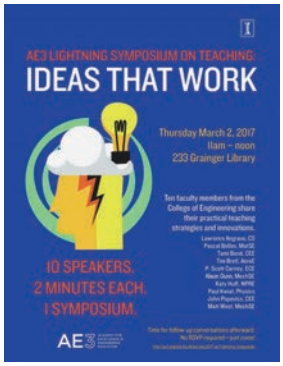
90-second video

Newsletter

In February, AE3 sent out its first newsletter to faculty in the College to provide updates and information about upcoming events.

AE3 Lightning Symposium on Teaching

In March, AE3 held its first annual Lightning Symposium on Teaching. Ten faculty members had two minutes each to share an idea that enhanced their teaching. Approximately 45 people attended.



Distinguished Lecture

In April, AE3 held its first Distinguished Lecture. Professor John Dunlosky from Kent State University spoke on "Helping Students Achieve: Promising Practices and Strategies from Cognitive Science." Approximately 55 people attended the talk.

Appraising and Correcting with the Third-Year Review

In May, Rohit Bhargava led a session for previous Collins Scholars who had just completed their third-year review process. Eighteen faculty attended the session.

Other special lectures

- Alejandra Magana, Purdue University: Toward a Framework for Integrating Modeling and Simulation Practices in Undergraduate Engineering Education. September 23, 2016.

- Joi-Lynn Mondisa, University of Michigan: In the Mentor's Mind: Examining the Experiences of African-American STEM Mentors in Higher Education. Co-sponsored with Industrial and Enterprise Systems Engineering, November 23, 2016.

- Paul Prior, Center for Writing Studies: Designing and Responding to Writing in Engineering: A Teaching Seminar. February 20, 2016.

Student Consultants on Teaching (SCOTs)

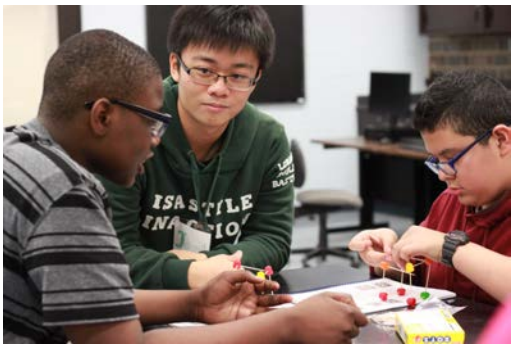
The SCOT program recruits and trains both undergraduate and graduate students within engineering to assist AE3 with classroom observations, focus groups, and SIIP grants. Students work alongside AE3 staff, or experienced engineering faculty, to improve the college teaching & learning environment. The student perspective is extremely valuable when combined with faculty and AE3 staff viewpoints.

Learning in Community (LINC)

LINC is an interdisciplinary service-learning program in the College of Engineering. Through academic courses and co-curricular activities, students collaborate with non-profit partners to address social, environmental, and technical problems to impact local and global communities in positive ways. LINC integrates meaningful service, academic content, and structured reflection to help students develop valuable academic, civic, and lifelong learning skills.

Faculty/Staff:
Valeri Werpetinski
Director of Learning in Community

LINC: Engineering for Social Justice Scholars Program



This pilot program featured a two-semester service-learning course sequence. Through complementary readings, activities, and reflection, the program was designed to help students develop a critical consciousness of gender and racial/ethnic disparities in STEM education and the integral role of social justice in engineering education and practice. The first course, Social Justice and STEM Education, engaged Illinois students as mentors in a STEM education outreach program for middle school youth in Chicago (ICANEXSEL), in partnership with the nonprofit organization Chicago Pre-College Science and Engineering. The culminating project for the course involved the production of a social action performance art event, called STEMposium. Students synthesized course concepts related to identity, power, education, ethics, engagement, and social justice in order to create a series of collaborative performances intended to raise awareness and inspire action.

> *"The ESJ course has had immense personal impact on me, my conceptualization of engineering, my imagined role in society, and my intended future career."*
>
> *"This program has allowed me to grow as an individual more than I could have ever imagined and given me confidence in my own voice."*

In the second course, Leadership in Engineering for Social Justice, students applied their knowledge to manage STEM education outreach programs with local partners--DREAAM House, St. Elmo Brady STEM Academy, and the Don Moyer Boys and Girls Club. The course culminated in a Pecha Kucha event in which students presented individual projects that they implemented during the semester. Projects included a range of social justice issues related to sexism, gender equity, and social climate; cultural identity and visibility of the contributions of underrepresented minorities in STEM, design for social justice, and politics and ethics in engineering education and practice.

I-STEM Education Initiative produced three articles highlighting the ESJ Scholars Program:

"Student spotlight: Hani Awni – Engineer for Social Justice Scholar"

"ESJ Scholars' end-of-semester Pecha Kucha address social justice issues in engineering"

"Engineering for Social Justice Scholars Program helps students rethink engineering's role in society"

Some comments from ESJ Scholars:

"All my other classes provided me with tools; these classes provide me with a goal, with justification, about what to do and why to do it."

~

"Overall I feel the course has had a big impact on me… I have grown as a person over the last two semesters, and the courses have allowed me to use the knowledge and experiences I have gained in all my other courses and activities to actually help others and learn in the process."

"Over the past year, I have been able to broaden my perspectives on social justice in engineering in a way I never thought possible. The class and fieldwork have pushed me to question my views and the views of those around me."

~

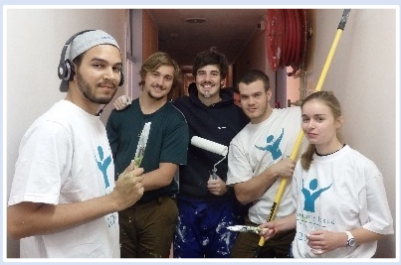
"ESJ has supported the final development not only of my education but also of my career and personal goals… Thank you ESJ for expanding my worldview on distinct beliefs and cultures, for strengthening my communication, and allowing me to be important."

LINC: STEM Service-Learning Projects in South Africa

Students participated in this new 8-week spring course with a short-term faculty-led education abroad program during summer 2016. The course focused on the context for service-learning engagement, including exploration of the history of apartheid, challenges of its legacy of inequalities and poverty, and the role of civic engagement in post-apartheid transformation. Illinois students joined teams of students from the University of Pretoria to work on service-learning projects for non-profit organizations in Pretoria. They also participated in historical, educational, and cultural excursions in Pretoria and Johannesburg such as visits to the Apartheid Museum, Mandela House, Hector Pieterson Museum, the Cradle of Humankind World Heritage Site, and the Council of Scientific and Industrial Research to learn about Aerospace Engineering in South Africa.

> *"I am very grateful that this course has taught me ways to research and study complex histories and topics as well as how to make international connections… skills I would not have otherwise known how to comfortably approach on my own."*
>
> *~ LINC student reflection*

> *"I realized that the purpose of the trip was for me to gain valuable soft skills working with international partners. I know I can't make a significant difference in any community in just two and a half weeks, but I can make a difference in my own community. With this trip, I'd develop vital skills that I can bring back home to help make positive changes. Similarly, the students from the University of Pretoria would also be developing important skills that they can use to help their communities."*
>
> *~ LINC student reflection*



LINC: International Service-Learning Projects in Uganda

Two student teams participated in education abroad projects in Uganda with the community partner, COVE (Children's Outreach and Vocational Education) Alliance. These service-learning project opportunities were connected to two courses, Social Innovation and Sustainable International Development and Undergraduate Research Abroad. The summer 2016 travel team implemented several complementary storm water management interventions to mitigate soil erosion on a school campus such as the construction of bioswales and rain gardens and also improved the school's capacity for rainwater harvesting. During winter 2016-2017 intersession, a second team traveled to expand and evaluate the effectiveness of the storm water management projects, provide oversight for new projects, and collect data for future project development. Projects included school and health clinic back-up power solutions, water quality and access expansion, agriculture business plan development, and an animal husbandry income-generation project for local families.

> *"This LINC class has been a huge learning experience for me, in many more ways than I expected…I honestly thought that I had a good working knowledge of international development, having read a fair bit about the problems that arise in this field of work. However, this semester has really reinforced the fact that book knowledge is completely different from field applications, and that I have a long way to go in terms of learning how to actually implement development theory."*
>
> *~ LINC student reflection*

> *"I am so very glad I took this class – I really count my experiences here as among the most valuable in my undergraduate career."*
>
> *~ LINC student reflection*

LINC: Papers at ASEE Regional Conference

Papers featuring the LINC program were presented at the 2017 American Society for Engineering Education (ASEE) Zone II Conference in San Juan, Puerto Rico:

> *"Developing critical consciousness to promote engineering for social justice: A pilot program to enhance STEM outreach and engineering education through service-learning"*

> *"Engaging engineering students with non-engineering majors in interdisciplinary service-learning projects: A model for engineering everywhere for everyone."*

Illinois Engineering First-Year Experience (IEFX)

The Illinois Engineering First-Year Experience is an interdisciplinary program designed to enhance the learning experience of every first-year student in Engineering at Illinois. Our goal is to support students' aspirations by building community and laying a solid foundation for their collegiate career.

Faculty/Staff

Gretchen Forman
IEFX Program Coordinator

Joe Bradley
Faculty

Ann-Perry Witmer
Faculty

New Directions for IEFX

In Fall 2015, the Associate Dean for Undergraduate Programs requested a comprehensive review of the IEFX program. As a result of the committee's recommendations, IEFX has implemented the following changes:

Departmental Liaisons to IEFX

Developing critical consciousness to promote engineering for social justice: A pilot program to enhance STEM outreach and engineering education through service-learning"

New ENG 100

An ENG 100 Working Group reviewed the curriculum of the course to examine consistency and assessment. As a result, ENG 100 has been revised to enhance the experience for freshmen taking the course and to provide consistency across sections/ departments (see Appendix D for syllabus). Clear objectives for each day of the course as well as more detailed Lesson Guides have been developed so that ELAs (Engineering Learning Assistants) can focus on implementing the curriculum.

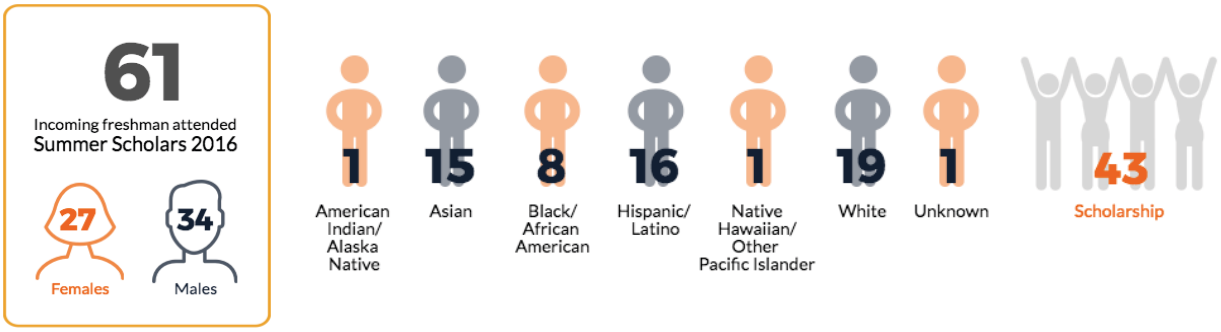
New ELA Training

As a result of the ENG 100 curriculum changes, a new training course for ELAs was also developed. It is now an 8-week course (ELA Leadership Training, ENG 398) in the spring semester in which ELAs focus on delivering the content effectively, including a mock teaching element.

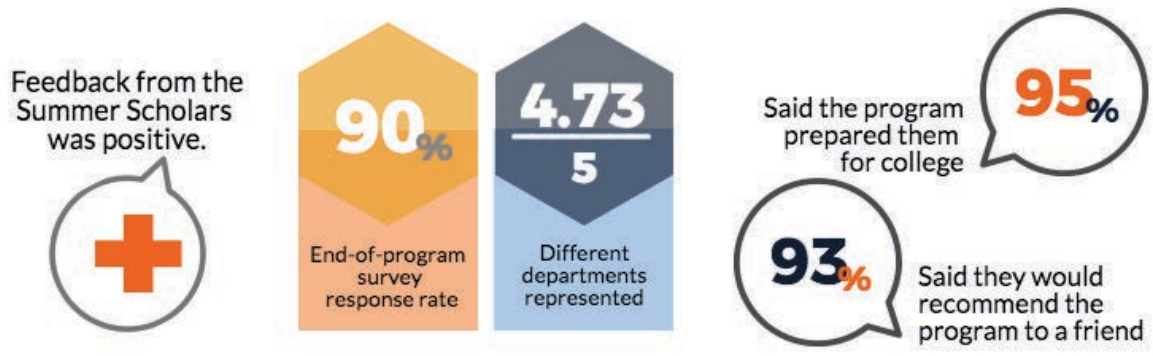
IEFX: Summer Scholars

The Summer Scholars program is designed to help incoming Engineering freshmen get a head start on their collegiate career. Corporate sponsors are Chevron and Ethicon.

Summer Scholars take two Summer II courses before freshman year a required course (usually calculus, computer science, physics, or a Gen Ed), and an engineering-oriented IEFX course (Projects, Research, Professional Development). Key components of the program are community building and mentoring (by senior Engineering students).



Eight Resident Program Advisors served as mentors and coordinated visits to Caterpillar, Blue Waters, and Beckman, as well as social activities and a service project with Habitat for Humanity.



The Summer Scholars were surveyed at the end of their freshmen year and respondents confirmed the value of the Summer Scholars program – and all reported keeping in touch with at least one other student from their cohort. One Summer Scholar commented,

> *"I think Summer Scholars is the direct reason for my success this semester and last."*

IEFX Launch

All incoming freshmen were invited to attend this welcome event held on August 20, 2016 at the Krannert Center for the Performing Arts. Dr. Yemaya Bordain, ECE alum and Innovation and Pathfinding Program Manager of the Internet of Things Group at Intel, was the keynote speaker. After Launch, the students headed to FreshmenFest, sponsored by the College of Engineering Advancement team, for food and games.

IEFX Electives

IEFX offered a variety of freshman elective courses for the Fall 2016 semester. These courses are designed to expose students to interdisciplinary and real-world engineering experiences early on in their academic careers.

IEFX Electives Course Numbers/semester

Course	Instructor	# Students
Grand Challenges (8 small sections each based on a different NAE Grand Challenge)	Joe Bradley	74
Projects 1	Joe Bradley	30
Projects 2	Joe Bradley	32
Intro to Research	Matt Goodman (MatSE)	21
Inspiring Interacting Informing: The Secret Weapons of an Engineer	Ann Witmer	26
Renaissance Engineer: Connecting Art, Science, and History	Joe Bradley Ann Witmer	21
Introduction to Sustainability	Ann Witmer	14
Personal Mobility Innovations (with POETS)	Joe Bradley	17
	Total Students	235

Course Highlights: Projects 1 and 2

by Joe Bradley

The goal of the IEFX Projects elective is to give the students and hands-on and highly interactive learning experience. Student teams in this course took a product or service idea from concept to prototype. The teams worked on approximately 21 projects this year. They gained valuable experience in market research, engineering design, and user-center approach to design.

The students showcased their project deliverables at the annual IEFX Expo in December, where attendees included their peers, faculty members, and local business people. This provides a great forum for the students to practice their communication and presentation skills.

Some highlights:

Two teams entered the campus-wide Cozad business plan competition. Team "Your Turn" developed an Android app that syncs with traffic signals, and Team "RolyPoly" developed an RFID system that tracks cyclist activity on campus and rewards cyclists with incentives.

The "Get Shifty" team worked on an automatic gear shifter for multi-gear bikes. They won the All-Freshman Design award at the Illinois Engineering Open House and presented at the NSF site visit for the Center for Power Optimization of Electro-Thermal Systems (POETS).

IEFX Engineering 100

FALL 2016

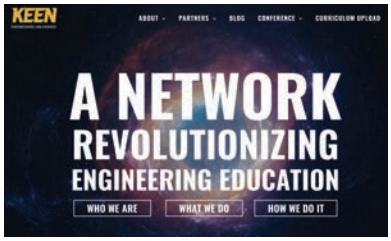
101 ELAs taught 1632 students ENG 100 in the Fall 2016 semester. Of these ELAs, 93 were on the campus List of Teachers Ranked as Excellent by their Students for this class.

SPRING 2017

Gretchen Forman taught two sections of the new ENG 398, ELA Leadership Training, with assistance from the Head ELAs. The 79 ELAs taking this class will teach ENG 100 in Fall 2017.

Other AE3 Activities

KEEN



AE3 has been a part of the College's recent engagement with the Kern Entrepreneurial Engineering Network. Laura Hahn attended their conference in January, and AE3 has identified three faculty members (Joe Bradley, IEFX; Yuting Chen, ECE; Neal Davis, CS) to attend upcoming workshops.

Grand Challenges Scholars Program

Laura Hahn, Joe Bradley, and Valeri Werpetinski have been serving on a college committee to develop a certificate program for students to explore the fourteen "grand challenges for engineering in the 21st century." This program is an initiative of the National Academy of Engineering.

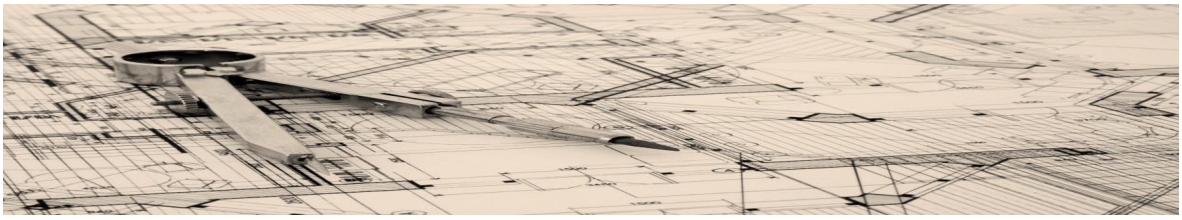
NAE GRAND CHALLENGES FOR ENGINEERING
NATIONAL ACADEMY OF ENGINEERING

APPENDIX A: Collins Scholar Program Overview

AE3 ACADEMY FOR EXCELLENCE IN ENGINEERING EDUCATION

AE3 Collins Scholar Program 2016-2017

Friday Lunch Sessions, 2405 Siebel (fall), 3403 Siebel (spring)



AE3 Staff

Laura Hahn
Chris Migotsky
Victoria Woods
Web: http://ae3.engineering.illinois.edu/

Philosophy

The Collins Scholars Program for new engineering faculty and instructors exists to help you get your career off to an efficient and productive start. The program provides a culture of support for teaching, research and service in a relaxing and collegial environment.

Goals

1. **Plan, implement, and manage effective in-class and out-of-class instruction**
2. **Develop and use instructional materials**
3. **Apply research-based techniques of effective instruction**
4. **Plan and implement evaluations of learning and instruction**
5. **Mentor students and be mentored by senior faculty colleagues**
6. **Make effective use of departmental, college, and campus instructional resources**

Program Activities

- **Participate in weekly lunch seminars**
- **Classroom observation (of you)**
- **Observe an excellent teacher**
- **Collect early feedback and ICES**
- **Read Piazza posts and announcements**

Collins Graduation Requirements

- **Regularly attend Friday seminars**
- **Observe an excellent teacher**
- **Be observed in your class**
- **Collect and review IEF**

Book (AE3 buys this for you!)

Teaching and Learning STEM: A Practical Guide (2016)
Richard Felder and Rebecca Brent

We won't focus all of our energy on this one book, but it will provide a framework for background readings and serve as a valuable resource on a variety of topics.

Weekly Lunch Seminars: Fridays, Noon-1:00pm

Fall 2016 (2405 Siebel)	
Aug 18	Collins Scholar Kick-Off Event
Aug 26	Bloom's Taxonomy/Objectives
Sept 2	Active Learning
Sept 9	Questioning (in 3405 Siebel)
Sept 16	Assessing Students
Sept 23	Early Feedback Engr IT (research and teaching)
Sept 30	Student Motivation (in 106B3 EH)
Oct 7	7 Principles for Good Practice
Oct 14	Classroom Management
Oct 21	Academic Integrity + FAIR
Oct 28	Teaching with Tablets (Rm 3405)
Nov 4	Research Resources
Nov 11	Storytelling
Nov 18	Flipped Classroom
Nov 25	*Thanksgiving break!*
Dec 2	Creating a Course Syllabus
Dec 9	*Debrief & Collect Collins Feedback*
Spring 2017 (3403 Siebel)	
Jan 20	What is an engineer?
Jan 27	Science of Learning
Feb 3	Evaluation of Teaching
Feb 10	ABET & Assessments
Feb 17	Creativity: Having Ideas
Feb 24	OTM patents/licenses plus IEF
Mar 3	Student Engr Ambassadors
Mar 10	Diversity and the Classroom
Mar 17	Review Session Jeopardy Game!
Mar 24	*Spring Break!*
Mar 31	Movies & Teaching
Apr 7	Mentoring Graduate Students
Apr 14	Teaching Philosophy Statement
Apr 21	Collins Scholar Graduation!
April 28	P&T panel

IMPACT IS IMPERATIVE.
Education at Illinois–research, teaching and service–is all about impact.

LEARNING IS AN ACTIVE PROCESS WHERE STUDENTS CONSTRUCT KNOWLEDGE.
Instruction must facilitate this construction of knowledge by the learner.

LEARNING AND TEACHING CAN BE SCIENTIFIC ENDEAVORS.
Consider your classroom a research lab.

PEOPLE HERE CARE ABOUT YOUR SUCCESS.
Stay connected.

WHAT DO PAST COLLINS SCHOLARS SAY ABOUT THE PROGRAM?

"It was really great and very informative. It's very surprising how many instructors don't apply many of the ideas we learned about. I'm looking forward to positive changes in my future classrooms."

"I really learned a lot. As a result, my teaching is much better and richer."

"The program has made me a better instructor. I'm more confident, more efficient, and connect with my students better as a direct result of practices and lessons learned in the Collins Scholar program."

QUICK RESOURCES
Center for Innovation in Teaching & Learning (CITL)
http://citl.illinois.edu/
Engineering IT
https://it.engineering.illinois.edu/

CONSIDER JOINING ASEE
http://www.asee.org/

Have you reflected today?
What's next in your teaching, research, and service?

APPENDIX B

2016-2017 Strategic Instructional Innovations Program projects

Implementation & Exploration Track

Nurturing Design Thinking in Engineering Courses
This team is developing multidisciplinary activities that engage students from Mechanical Engineering, Computer Science, and Art & Design in design thinking and the studio critique method.
Sam Tawfick (MechSE), Brian Bailey (CS), Eric Benson (Art & Design). Liaison: Luke Olson

Just-in-Time Presentation Skills for Senior Design
Graduate students in the Communications department run clinics for senior design students in Electrical and Computer Engineering and Agricultural and Biological Engineering.
P. Scott Carney & Jonathan Makela (ECE), Grace Giorgio & Ann Bryan (Communications), Steve Zahos (ABE), Kelly Cross (AE3). Liaison: Tim Bretl

Introducing Computational Methods into the Physics Curriculum
This project aims to develop a sequence of courses that integrate computational methods into the curriculum so that students are equipped to solve physics problems that cannot be solved analytically.
George Gollin, Jon Thaler (Physics). Liaison: Dallas Trinkle

A Project-Based Introduction to Aerospace Engineering
This project is the beginning of an effort to implement project-based learning and student portfolios across the curriculum. Initial changes are in AE100 (Introduction to Aerospace Engineering).
Brian Woodard, Tim Bretl, Phillip Ansell, Steve D'Urso, Laura Gerhold. Liaison: Jenny Amos

Creativity, Innovation, and Vision: Online course development
This team is creating modules and materials for an online course on creativity.
Bruce Elliott-Litchfield, Esteban Gast, Keilin Deahl, Marianne Alleyne, Arif Nelson. Liaison: Scott Carney

Optimizing Collaborative Team Formation and Learning of Team Skills in Project-Based Engineering Courses
The vision of this project is to integrate, study, sustain, and champion the use of a criterion-based algorithmic method for organizing students into effective teams in large project-based engineering courses. The CATME software tool will provide the team formation testbed.
Brian Bailey, Darko Marinov, Tao Xie, Ranjitha Kumar, Wai-Tat Fu, Karrie Karahalios. Liaison: Luke Olson

Adaptive Learning (PrairieLearn)
This project aims to project an Algorithmic Adaptive Learning (AAL) system. This in a computer-mediated learning environment that adapts to a student's performance, giving weaker students the support they need while challenging stronger students with engaging material at an appropriate level.
Matt West, Geir Dullerud, Wade Fagen, Sewoong Oh, and Craig Zilles. Liaison: Luke Olson

Computer-based Testing Facility (CS)
This project is focused on designing and implementing a computerized testing facility to improve the quality of assessment in large courses. Infrastructure includes web-based exam sign-up, random student seat assignment, icard scanning proctor station, PrairieLearn compatibility, and automatic grading.
Craig Zilles, Brian Bailey, Wade Fagen, Bill Chapman. Liaison: Dallas Trinkle

Improving Students' Learning and Experience in ECE 110 and ECE 120
This project focuses on re-designing methods and materials for a large, introductory ECE class. The team will execute research-based instructional strategies to develop a community of instructors who agree on the metrics and goals of the course. Through this course revision, the project aims to excite students about the breadth and scope of ECE.
Chris Schmitz, David Varodayan, Serge Minin, Lynford Goddard, Michael Loui, Erhan Kudeki, Patricia Franke, Hyungsoo Choi, Geoffrey Herman. Liaison: Cinda Heeren

MatSE Curriculum Reform
This project aims to reform the Material Science and Engineering undergraduate curriculum by integrating computational materials modeling in sophomore and junior-level core courses, by developing a capstone senior materials modeling elective, and by recording and disseminating course content online.
Dallas R. Trinkle, Andrew Ferguson, Cecília Leal, André Schleife, Kris Kilian, Shen Dillon, Jessica Krogstad, Pascal Bellon, Robert Maass. Liaison: Tim Bretl

iDesign: Integrated MechSE Design Curriculum
This project aims to encompass and integrate MechSE design courses for freshmen through seniors. The objectives are to: (1) Produce engineers with competitive design skills, (2) Increase student/faculty interaction, (3) Increase student satisfaction with design courses, (4) Enlarge the pool of faculty willing and able to teach design, and (5) Facilitate ABET accreditation for design classes.
Elizabeth Hsiao-Wecksler, Steven Downing, Alison Dunn, Bruce Flachsbart, Emad Jassim, Blake Johnson, Seok Kim, Ralf Moller, Hae-Won Park, Michael Philpott, Sam Tawfick, Aimy Wissa. Liaison: Scott Carney

(BioE Cancer Scholars) Challenge-inspired Learning: A Flipped Apprenticeship Model for Education
In this project, cohorts of undergraduate student scholars complete activities centered on cancer research to stimulate purpose-inspired learning. The scholars' activities include taking classes, meeting with a faculty mentor, conducting research, and participating in clinical immersion.
Rohit Bhargava, P. Scott Carney, Andrew Smith, Dipanjan Pan, Marcia Pool. Liaison: Brian Bailey

TAM 210/211/212/251
This project focuses on the gateway theoretical and applied mechanics classes, which serve approximately 2500 student-enrollments per year. This project has applied state-of-the-art pedagogical and technology solutions to improve student engagement and enthusiasm.
Matt West, Geir Dullerud, Elif Ertekin, Randy Ewoldt, Blake Johnson, Mariana Kersh, Mariana Silva, Dan Tortorelli, Gabe Juarez. Liaison: Brian Bailey

Start-Up Track

Developing Instruction in Technical Writing for Freshman Engineering Students
P. Scott Carney (ECE), Lance Cooper (Physics), Celia Elliott (Physics), Karin Jensen, Yanfen Li, Marcia Pool, Andrew Smith (BioE), Athena Lin (MatSE), Kelly Ritter (English). Liaison: Dallas Trinkle

Improving the Writing Skills of Undergraduate Students: Identifying Common Challenges and Scalable Solutions
Julie Zilles, John Popovics (CEE), Celia Elliott (Physics), Paul Prior and Nicole Turnipseed (Center for Writing Studies). Liaison: Jenny Amos

Teaching Assistant Training: Engineering Leadership Initiative for Teaching Enhancement (ELITE)
Yuting Chen (ECE), Matthew Goodman (MatSE), Blake Johnson (MechSE), Lucas Anderson (Center for Innovation in Teaching and Learning, Chris Migotsky (AE3). Liaison: Cinda Heeren

Developing Intervention Methods that Improve Visuospatial Skills of Engineering Students
Wai-Tat Fu, Helen Wauck, Yi-Chieh Li (CS), Jim Leake (ISE), Brian Woodard (AeroE), Angie Wolters (Women in Engineering). Liaison: Geoffrey Herman

APPENDIX C

Publications from AE3 and SIIP Projects

Bentsman, J.	2016	Introduction to Signal Processing, Instrumentation, and Control: an Integrative Approach	World Scientific
Faulkner, B. E., Herman, G. L.	2016	Espoused faculty epistemologies for engineering mathematics: Towards defining "mathematical maturity" for engineering	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16914). New Orleans, LA, June 26-29.
Essick, R., Silva Sohn, M., West, M., Mercier, E., Herman, G. L.	2016	Scaling-up collaborative learning for large introductory courses using active learning spaces, TA training, and computerized team management	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #17099). New Orleans, LA, June 26-29.
Sanders, J., West, M., Herman, G. L.	2016	Scaling-up project-based learning for a large introductory mechanics course using mobile phone data capture and peer feedback	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #17119). New Orleans, LA, June 26-29.
Herman, G. L., Johnson, N. E.	2016	Studying students' understanding of engineering concepts through their sketches	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #17007). New Orleans, LA, June 26-29.
Herman, G. L., Hahn, L. D., West, M.	2016	Sustaining innovation in engineering education through faculty communities	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16921). New Orleans, LA, June 26-29.
Cross, K. J., Mamaril, N., Herman, G. L., Johnson, N. E.	2016	Understanding how a culture of collaboration develops among STEM faculty	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16917). New Orleans, LA, June 26-29.
Mansbach, R., Herman, G. L., West, M., Trinkle, D., Ferguson, A., Schleife, A.,	2016	Work-in-progress: Computational modules for the MatSE undergraduate curriculum	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16940). New Orleans, LA, June 26-29.
Pool, M., Bhargava, R., Carney, P. S., Pan, D., Smith, A. M.	2016	Implementing a challenge-inspired undergraduate experience	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16477). New Orleans, LA, June 26-29.
Chronopoulou, A., Cross, K. J., King, D., M., Salimi, E.	2016	Using case studies to enhance the critical thinking skills of IE students	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #17027). New Orleans, LA, June 26-29.

Amos, J. R., Pool, M., Jensen, K., Vozenilek, J.	2016	Work in progress: Immersive first-year experience for bioengineering curricula	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16066). New Orleans, LA, June 26-29.
Amos, J. R., Choi, H. H., Long, K. D., Rusch, A.	2016	Work in progress: Assessing intercultural competency in an E-learning environment	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16077). New Orleans, LA, June 26-29.
Faulkner, B. E.	2016	Leading team learning: Reflections of a teaching assistant	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16862). New Orleans, LA, June 26-29.
Hahn, L. D., Heeren, C.	2016	Building community for teaching faculty	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16915). New Orleans, LA, June 26-29.
Pulford, S., Cutler, S., Hahn, L. D., Harris, E. C., Kappers, W. M.	2016	Faculty developers on faculty development: Join the conversation	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition. New Orleans, LA, June 26-29.
Witmer, A.-P., Jahnke, K.	2016	Drawing upon non-engineering disciplines to research sustainability of engineered infrastructure in South America	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #14757). New Orleans, LA, June 26-29.
Jahnke, K., Witmer, A.-P., Tan, M., Witmer, G. F.	2016	Bridging a cross-disciplinary, contextual approach to international service engineering learning	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #14756). New Orleans, LA, June 26-29.
Johnson, B. E., Morphew, J. W.	2016	An analysis of recipe-based instruction in an introductory fluid mechanics laboratory	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16990). New Orleans, LA, June 26-29.
Pool, M., Bhargava, R., Jensen, P. A., Jensen, K.	2016	Work in progress: Reviving a transport phenomena course by incorporating simulation and laboratory experiences	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16776). New Orleans, LA, June 26-29.
Zilles, C., West, M., Mussulman, D.	2016	Student behavior in selecting an exam time in a computer-based testing facility	In Proceedings of the 2016 American Society for Engineering Education Annual Conference and Exposition, (Paper ID #16655). New Orleans, LA, June 26-29.
Tomkin, J., West, M., Herman, G. L.	2016	A methodological refinement for studying the STEM grade-point penalty	In Proceedings of the 46th ASEE/IEEE Frontiers in Education Conference
Minin, S., Varodayan, D., Schmitz, C., Faulkner, B., Herman, G. L.	2016	Minority merit: Improving retention with cooperative learning in a first-year electronics course	In Proceedings of the 46th ASEE/IEEE Frontiers in Education Conference

Ma, S., Herman, G. L., Tomkin, J., West, M., Mestre, J.	2016	Studying faculty communities of practice through social network analysis	In Proceedings of the 46th ASEE/IEEE Frontiers in Education Conference
Minin, S., Varodayan, D., Schmitz, C., Faulkner, B., Herman, G. L.	2016	Minority merit: Improving retention with cooperative learning in a first-year electronics course	In Proceedings of the 46th ASEE/IEEE Frontiers in Education Conference
Ma, S., Herman, G. L., Tomkin, J., West, M., Mestre, J.	2016	Studying faculty communities of practice through social network analysis	In Proceedings of the 46th ASEE/IEEE Frontiers in Education Conference
Herman, G. L.	2016	Studying how digital logic instructors solve canonical problems	In Proceedings of the 46th ASEE/IEEE Frontiers in Education Conference
Herber, D., Deshmukh, A., Mitchell, M., Allison, J.	2016	Project-Based Curriculum for Teaching Analytical Design to Freshman Engineering Students via Reconfigurable Trebuchets	Education Sciences, 6(1), 7
Mansbach, R., Ferguson, A., Kilian, K., Krogstad, J., Leal, C., Schleife, A., Trinkle, D. R., West, M., and Herman, G. L.	2016	Reforming an Undergraduate Materials Science Curriculum with Computational Modules	Journal of Materials Education, 38(4), 161-174
Deshmukh, A., Mitchell, M., Allison, J.	2016	Integrating model-based design and physical design evaluation for improved design education	In Proceedings of the ASME 2016 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference IDETC/CIE 2016
Gao, J., Pang, B., Lumetta, S.	2016	Automated feedback framework for introductory programming courses	21st Annual Conference on Innovation and Technology in Computer Science Education (ITiCSE), July 2016
Herman, G. L., Loewenstein, J.	2017	Evidence-based change practices	Journal of Engineering Education, 106(1), 1-10
Herman, G.L., Goldberg, D.E., Trenshaw K.F., Somerville, M., & Stolk, J.	2017	The intrinsic-motivation course design method	International Journal of Engineering Education, 33(2A), 558-574
Jahanbakhsh, F., Karahalios, K., Fu, W.T., Marinov, D., Bailey, B.P.	2017	You want me to work with who? Stakeholder perceptions of automated team formation in project-based courses	In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems

AE3

ACADEMY FOR EXCELLENCE
IN ENGINEERING EDUCATION