Implementing a Challenge-Inspired Undergraduate Experience

Dr. Marcia Pool, University of Illinois, Urbana-Champaign

Dr. Marcia Pool is a Lecturer in bioengineering at the University of Illinois at Urbana-Champaign. In her career, Marcia has been active in improving undergraduate education through developing problem-based laboratories to enhance experimental design skills; developing a preliminary design course focused on problem identification and market space (based on an industry partner’s protocol); and mentoring and guiding student teams through the senior design capstone course and a translational course following senior design. To promote biomedical/bioengineering, Marcia works with Women in Engineering to offer outreach activities and is engaged at the national level as Executive Director of the biomedical engineering honor society, Alpha Eta Mu Beta.

Prof. Rohit Bhargava, University of Illinois at Urbana-Champaign

Rohit Bhargava is Bliss Faculty Scholar of Engineering and Professor at the University of Illinois at Urbana-Champaign. He is a faculty member with affiliations in several departments across campus (Primary – Bioengineering; Affiliated - Electrical and Computer Engineering, Mechanical Science and Engineering, Chemical and Biomolecular Engineering and Chemistry) as well as the Beckman Institute for Advanced Science and Technology. Rohit received dual B.Tech. degrees (in Chemical Engineering and Polymer Science and Engineering) from the Indian Institute of Technology, New Delhi in 1996 and his doctoral thesis work at Case Western Reserve University (Department of Macromolecular Science and Engineering) was in the area of polymer spectroscopy. He then worked as a Research Fellow at the National Institutes of Health (2000-2005) in the area of biomedical vibrational spectroscopy. Rohit has been at Illinois since as Assistant Professor (2005-2011), Associate Professor (2011-2012) and Professor (2012-). Rohit was the first assistant professor hired into the new Bioengineering department and played a key role in the development of its curriculum and activities. He later founded and serves as the coordinator of the Cancer Community@Illinois, a group dedicated to advancing cancer-related research and scholarship on campus. Research in the Bhargava laboratories focuses on fundamental theory and simulation for vibrational spectroscopic imaging, developing new instrumentation and developing chemical imaging for molecular pathology. Using 3D printing and engineered tumor models, recent research seeks to elucidate hetero-cellular interactions in cancer progression. Rohit’s work has been recognized with several research awards nationally. Among recent honors are the Meggers Award (Society for applied spectroscopy, 2014), Craver Award (Coblentz Society, 2013) and the FACSS Innovation Award (2012). Rohit has also been recognized for his dedication to teaching in the College of Engineering (Rose and Everitt awards) and he is routinely nominated to the list of teachers ranked excellent at Illinois.

P. Scott Carney, University of Illinois, Urbana-Champaign

P. Scott Carney is a Professor in the Department of Electrical and Computer Engineering at the University of Illinois where he has been since 2001. His group website may be found at http://optics.beckman.illinois.edu. Carney teaches the ECE senior capstone course and a rotation of three advanced graduate courses in optics. He holds a Ph.D. in Physics from the University of Rochester (1999) and was a post-doc at Washington University (1999-2001). He is a theorist with research interests in inverse problems, imaging, coherence theory, and other branches of optical physics. Carney is the co-organizer and creator of the Saturday Engineering for Everyone lectures, a popular lecture series for all ages at the University of Illinois. He is an Education Innovation Fellow in the Academy for Excellence in Engineering Education.

Prof. Dipanjan Pan, University of Illinois, Urbana-Champaign

Prof Dipanjan Pan is presently an Assistant Professor in Bioengineering and the Director for M.Eng in Bioinstrumentation Program at the College of Engineering. He is also a full-time faculty member at the Beckman Institute, an affiliate in the Materials Science and Engineering department and faculty with the Institute in Sustainability in Energy and Environment (iSEE). He is a full member of UIC cancer center and also an affiliate of Carle Cancer Center. Prior to coming to Illinois in 2013, he was an Assistant
Professor at the Washington University School of Medicine. His primary area of work is application of nanotechnology in bio-medicine in a broadly defined sense, emphasizing translatable materials development. His group uniquely merge drug discovery, drug re-purposing and materials science with biomedical imaging modalities for translational and pre-clinical application. The other area of his research interest is sustainability through bioengineering. His research has been externally funded through NIH (R01), NSF, American Heart Association, Children’s Discovery Institute, Michael Reese Foundation and other agencies. In close collaboration with clinicians he was successful in translating his work for commercial application (Ocean Nanotech, and others). He is the founder/co-founder of three University Start-ups–Vitruvian Biotech, KaloCyte, Inc. and InnSight, Inc. He is an elected fellow of Royal Society of Chemistry (UK). He is an editorial board member of Scientific Report (Nature Publishing) and also serve as in editorial advisory board member for Molecular Pharmaceuticals (ACS).

Prof. Andrew Michael Smith, University of Illinois, Urbana-Champaign

Andrew M. Smith, Ph.D., is an Assistant Professor of Bioengineering at the University of Illinois, Urbana-Champaign (UIUC). Dr. Smith received a B.S. in Chemistry in 2002 and a Ph.D. in Bioengineering in 2008, both from the Georgia Institute of Technology. As a graduate student he was a Whitaker Foundation Fellow. He continued his postdoctoral studies at Emory University as a Distinguished CCNE Fellow and NIH K99 Postdoctoral Fellow. Dr. Smith’s research interests include nanomaterial engineering, single-molecule imaging, and cancer biology. He teaches undergraduate and graduate courses in Bioengineering.
Implementing a Challenge-Inspired Undergraduate Experience

Introduction

This work in progress describes the development and implementation of challenge-inspired undergraduate experience. Improving the undergraduate experience while increasing the number of Science, Technology, Engineering, and Mathematics (STEM) trained professionals is a recurring goal\(^1\). While efforts to recruit pre-college students to STEM may increase initial interest, many students choose engineering to “change the world” and become disillusioned or lose interest\(^2\) when faced with learning foundational concepts, which are presented without connecting the use of concepts to real-world problems. Currently, less than half of the three million students entering higher education to pursue a STEM field persist to earn a STEM degree\(^3\). The drop-out rate from STEM is even more prominent in minorities and women\(^4\); however, participating in undergraduate research and developing a strong peer network has been shown to increase persistence\(^5,6,7,8,9\). While we seek to engage students in research experiences to encourage persistence, in the University of Illinois at Urbana Champaign’s (UIUC) Bioengineering Department attrition is not a major problem, but by engaging students in focused research experiences we seek to increase persistence in scientific research after graduation, whether that be in industry, academia, or clinical settings\(^7,10,11\).

We propose to connect student learning to engineering practice by interweaving a grand challenge problem throughout multiple courses and experiences in the curriculum. By interweaving the problem throughout the undergraduate curriculum beginning freshman year, we treat student engagement and retention as a process instead of an event\(^4\). To implement this concept, we developed the Cancer Scholars Program (CSP), a challenge-inspired experience focused on an overarching societal problem: cancer. Traditionally, students learn engineering skills in isolated coursework without a connection to real-world problems, facilitating loss of interest. Additionally, students are rarely exposed to co-curricular development activities in the first year of their undergraduate program. The CSP is designed to address these issues through dedicated coursework and early exposure to research experiences. As the program is designed on a cohort basis, we anticipate that a community of students will develop. In the challenge-inspired model, students progress through the curriculum while also learning how to apply concepts in courses (curriculum and CSP courses) to solving the real-world problem. By doing this, we connect students to their end goal (solving real-world problems) at the beginning of their undergraduate education and seek to increase enthusiasm by engaging students in training opportunities\(^6\) focused around the real-world problem.

In fall 2014, the first cohort of twelve students (all bioengineering) was accepted, and in fall 2015, the second cohort of twelve students (consisting of bioengineering, electrical and computer engineering, and computer science) was accepted. Herein, we describe our work in developing and implementing the (CSP): [http://cancer.illinois.edu/csp](http://cancer.illinois.edu/csp).
Pedagogical Basis for Program Structure

The CSP is designed to promote persistence in STEM, allow students to develop their identity as scientists and engineers, and excite students to be intrinsically motivated to continue in STEM. The Persistence Framework\(^3\) identifies several concepts which positively support persistence in STEM, especially for minorities and women. Table 1 illustrates how the CSP employs the four Persistence Framework concepts (motivation, confidence, learning, and professional identity). Through incorporating these concepts, the CSP naturally promotes active learning, introduces undergraduate research in freshman year, and develops peer and faculty mentors to support a learning environment.

Table 1. Four concepts positively correlated to persistence in STEM are core to the CSP.

<table>
<thead>
<tr>
<th>Persistence Framework concept</th>
<th>Pillar of the CSP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motivation</strong>: the intention or desire to pursue a goal(^3,7,8)</td>
<td>Using a personally relevant, societal grand challenge (cancer) as a driving topic for education</td>
</tr>
<tr>
<td><strong>Confidence</strong> or self-efficacy: the belief that one is able to succeed at a given task(^3,9,10)</td>
<td>Engagement in research from freshman year(^10,11); supportive peer and mentor network to provide a “can-do” attitude</td>
</tr>
<tr>
<td><strong>Learning</strong>: broadly, the acquisition of knowledge and skills(^3)</td>
<td>Formal coursework merged with skill-building activities, workshops, and symposia</td>
</tr>
<tr>
<td><strong>Professional identity</strong>: the “feeling” that one is a scientist, technologist, engineer, or mathematician(^3,10,11,12,14,15)</td>
<td>Communities of peers, researchers, entrepreneurs, and actively participating in the program</td>
</tr>
</tbody>
</table>

Program Structure

The CSP is designed to engage students from first semester on campus until graduation. In a traditional education, few, if any, first year students have the opportunity to participate in research, yet in the CSP, research opportunities are available and required beginning freshman year. An overview of the core elements of the CSP and differences from traditional model are shown in Figure 1. Note the central role of research at all levels.

**Figure 1.** (Bottom) Core elements of the CSP. In addition to disciplinary training, inspiration from cancer as a grand challenge and research apprenticeship in a community of scholars are added. (Top) Contrast with the traditional “linear” undergraduate curriculum.
While integration of research from freshman year provides one difference between the CSP and the traditional model, there is another aspect which further establishes a difference: a series of CSP courses (Table 2). With the exception of capstone design (senior year) being for every student in a department, CSP students enroll in one CSP course each year: Frontiers in Cancer Research (freshman year), Healthcare Innovations (sophomore year), and Innovation and Engineering Design (junior year). The structure is organized so each cohort of CSP students enrolls in a CSP course (or senior design) in fall semester; spring semester consists of research, mentoring, and skills training (as a cohort group). Summer is available for research continuation, immersion experiences, or an elective to further develop the student’s portfolio.

In addition to developing technically sound students with abundant experiences, the CSP develops a close knit group of students in each cohort. Each cohort progresses through the CSP experiences together thus facilitating the development of a community of support, mentoring, and intellectual pursuit.

Table 2. CSP course descriptions and student activities for each year in the program.

<table>
<thead>
<tr>
<th>Year</th>
<th>Course Description (credit hour)</th>
<th>Activities and Development</th>
</tr>
</thead>
</table>
| Year 1: Focus on introduction to cancer research, research initiation | BIOE 199: Frontiers in Cancer Research (1 credit hour), meets weekly for 2-hour lecture/discussions. Course and invited faculty lecture on their own research in cancer, followed by discussion. Early lectures cover foundations of engineering process and the scientific method, scientific writing and presentation, and literature research skills. All lectures are heavily weighted toward discussion and student participation. Students produce two videos (5 min each) in a team for a broader audience. Students identify a faculty member as research mentor to begin research in the spring. | • Begin research in spring semester  
• Interact with research mentor and CSP mentors and peers  
• Complete a research boot camp (training on research skills, scientific writing, presentation, ethics, team-building and laboratory safety)—first offering was in conjunction with existing REU boot camp  
• Participate in research experience in summer |
| Year 2: Focus on expansion of knowledge, practical experiences, especially clinical research | BIOE 298: Cancer Healthcare Innovation (1 credit hour), a weekly 2-hour lecture/discussion, focused on topics needed to bring research to impact (e.g., FDA, ethics, and policy). Several lectures, with discussion, will begin to explore pathways to research translation, including entrepreneurship. Another lecture will cover graduate school preparation. Students create a mock FDA document for a new device submission. | • Continue research throughout year  
• Interact with research mentor and CSP mentors and peers  
• Assist/guide first year students as they complete research boot camp  
• Participate in a clinical immersion experience in summer to grasp the impact their research may have |
| Year 3: Focus on research design capabilities | ECE 398 Innovation and Engineering Design (2 credit hours) provides the tools needed for problem identification, solution assessment, market evaluations, resource requirements, and initial design process, including requirement and verification development. Students develop project proposals suitable for either their senior | • Continue research throughout year  
• Interact with research mentor and CSP mentors and peers  
• Participate in a summer industrial, clinical, or research internship (student’s choice) |
<table>
<thead>
<tr>
<th>Year</th>
<th>Course Description (credit hour)</th>
<th>Activities and Development</th>
</tr>
</thead>
</table>
| Year 4: Focus on senior design and independent research | BIOE 435 (2 credit hours) and 436 (2 credit hours) or equivalent senior capstone course from their home department. Seniors return to the freshman Frontiers course to present their projects and share their experiences in the program. | • Continue research throughout year  
• Interact with research mentor and CSP mentors and peers  
• Prepare (applications and interviews) for next step in career (industry, graduate school, medical school) |

**Implementation**

In fall 2014, the CSP enrolled its first cohort of twelve, high achieving bioengineering freshman students (average ACT = 33.80) with five being female and four being first generation students. The first cohort was selected from 2014 incoming freshman bioengineering students based on (1) admittance to bioengineering, (2) ACT score, and (3) interest in research indicated on admission’s essay. A control group (average ACT = 33.92) of twelve students was also selected and includes five females and three first generation students. As bioengineering is a very selective program, the ACT averages for both CSP and control are also representative of the 2014 incoming bioengineering population (average ACT = 33.86). The first CSP cohort completed the *Frontiers in Cancer Research* course and began their research experiences, based on their interest/selection, in spring 2015.

In summer 2015, the continuing CSP students completed a research boot camp and summer research experience. The CSP partnered with an existing Research Experience for Undergraduates (REU) program at UIUC to deliver the boot camp content (training on research skills, scientific writing, presentation, ethics, team-building and laboratory safety). Eight of the CSP students continued research at UIUC while two students completed research experiences at other institutions: one earned an REU position and one worked at a university near her permanent residence.

In fall 2015, the CSP enrolled the second cohort of twelve students (average ACT 34.8) and expanded the major composition to include: bioengineering, electrical and computer engineering, and computer science. Six (50%) of the second cohort are female, and one is first generation. The CSP expanded its invitation to other majors as a first step in developing a multidisciplinary cohort to mimic how problems are solved in the real world—through multidisciplinary teams. By including other majors in the invitation to join, the pool of potential applicants was greatly increased. Students from this pool were selected based on (1) ACT score and (2) interest in research with a cancer focus demonstrated in an application essay. The average ACT of all students invited to apply to the CSP was 34.53, and a control group of twelve students representative of the cohort was established (average ACT = 34.75) consisting of six females and one first generation student.

Also in fall 2015, the first CSP cohort (enrolled 2014) continued research experiences and participated in the *Healthcare Innovations* course (Table 2). In spring 2016, the first cohort...
continued research projects and finalized summer clinical immersion plans while the second cohort entered laboratories, began research projects, and planned summer experiences.

**Evaluation**

To assess and continuously improve the CSP, the CSP development team works closely with an on-campus engineering education focused group, the Academy for Excellence in Engineering Education (AE3). The CSP received start-up funding through UIUC’s College of Engineering’s Strategic Instructional Innovations Program (SIIP) which requires a mid-year and end-of-year review by an AE3 panel. As part of the funding, the CSP is assigned a delegate from AE3 who is tasked with attending CSP development team meetings and serving as an educational resource. Overall program Performance Criteria (PC) with associated metrics for success are detailed in Table 3. PCs are organized around three categories: program design and startup (early years), steady state, and outcomes (long term). To evaluate the success metrics, qualitative (surveys, focus groups) and quantitative (retention rates, diversity percent, publications) data is required. An Institutional Review Board (IRB) approval is active for all bioengineering.

**Table 3. Metrics to measure program success at start-up, steady-state operation, and in long term outcomes.**

<table>
<thead>
<tr>
<th>Performance criteria</th>
<th>Metrics for success</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Design and Startup</strong></td>
<td></td>
</tr>
<tr>
<td>Trainee recruitment</td>
<td>High-quality students applying to the program with innovative research directions</td>
</tr>
<tr>
<td>Faculty participation</td>
<td>Faculty co-mentors and student teams formed</td>
</tr>
<tr>
<td>Effective leadership</td>
<td>Regular and effective meetings of the Program Leadership Team (PLT)</td>
</tr>
<tr>
<td>Collaborative environment</td>
<td>Establishment of peer networking and mentoring programs, scientific monthly discussions, and social events</td>
</tr>
<tr>
<td>Program resources</td>
<td>Regular program blog, newsletter</td>
</tr>
<tr>
<td><strong>Steady-State Operation</strong></td>
<td></td>
</tr>
<tr>
<td>Student progress</td>
<td>High retention rates; time to graduation should not be longer than for the control group</td>
</tr>
<tr>
<td>Active research program</td>
<td>Number and quality of publications, and particularly number and quality of interdisciplinary publications among both faculty and students in the program</td>
</tr>
<tr>
<td>Diversity of the program</td>
<td>Fraction of trainees who are underrepresented, disadvantaged, or disabled</td>
</tr>
<tr>
<td>Institutional/external impact</td>
<td>Books, research, and review papers that are used for education; new courses and materials disseminated</td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td></td>
</tr>
<tr>
<td>Career success of students and faculty</td>
<td>Students: placement in research careers, including academia, industry (research and development, clinical trials, etc.), and government (e.g. FDA) and entrepreneurial ventures related to translational research. A graduate degree may be beneficial but is not required for staff academic positions, industry, government, or entrepreneurial ventures. Faculty: younger faculty tenured and promoted, awards, publications,</td>
</tr>
</tbody>
</table>
In addition to the high level assessment of program success (Table 3), evaluation of the program in relation to the pedagogical structure employed is important. The Persistence Framework creates the foundation for the CSP, and within the Persistence Framework are four key factors to measure: motivation, confidence (or self-efficacy), learning, and development of professional identity. The control group for each cohort is representative of each respective cohort in diversity and in ability (determined by average ACT score). Therefore, comparisons between each control and respective cohort can be determined for each of the four areas in the Persistence Framework. Surveys, focus groups, observations, and “self-reports” will be used to characterize the motivation, confidence (self-efficacy), and professional identity of students in the control versus cohort groups. In addition to the qualitative assessment, learning in the sense of broad knowledge and skills can be evaluated through performance of students in laboratory skill exams and course related projects—for classes in which both control and cohort complete.

**Feedback and preliminary assessment**

All students are highly engaged in the program and have formed a close community of supportive peers. For instance, by spring 2015, the first cohort met for dinner once a week; this was discovered in one of the mentoring meetings with the cohort. While each cohort community has been natural in its establishment, we want to further promote the development of a cross-cohort close community. The Frontiers course and the Healthcare Innovations course were scheduled back to back in fall 2015 to provide the two cohorts time to interact. In one session there was a “speed dating” style event where the first cohort (enrolled 2014) rotated through all the new students. After this event the first cohort invited the second cohort to their private social media page.

At the end of their first year, the first cohort participated in a focus group (n=11) to identify positive aspects and areas of improvement. Responses demonstrated the first cohort wanted to support the second cohort by vertical mentoring, providing laboratory tours and technique training, and social events; the goal of these recommended efforts was to welcome a new group and reduce the stress of entering a laboratory as a freshman. Additionally, the first cohort recommended including the program in university recruiting material to serve as a recruitment tool and establishing recognition for completing the CSP which would appear on a university transcript.

In addition to the general program feedback, the focus group provided feedback on the first offering of the Frontiers course and the entry into research experiences. Positive aspects of the Frontiers course were: (1) breadth of research topics and (2) relaxed atmosphere promoted more discussions. Areas of improvement for the course were mostly due to this being the first offering: (1) more detailed schedule and (2) more project feedback. Overall students enjoyed the
facilitated opportunity to participate in research experiences with positive feedback centered around: (1) personal connection with faculty, graduate students, and peers and (2) flexibility to choose research opportunities. Areas of improvement for research experiences were also mostly due to this being the first year of the program and included: (1) add a session to train students in basic laboratory techniques and (2) distribute the summer schedule earlier.

Finally, the first cohort was asked to provide free responses about the CSP. Based on the feedback provided, the students feel the CSP has provided them with research experiences which are typically not attainable until late sophomore or junior year. In addition, there is some indication that students are feeling empowered and connected to the research. While this is a small sample, it is encouraging as seen in the following quotes:

“The CSP has helped me be able to see the potential I hold.”

“I did not believe it possible for me to be part of a research group till later on [after freshman year]. But by the end of my freshman year, I have already been a part of two labs.”

“I see my peers also succeeding in the research groups they have joined, which helps me see that we, the students, can also make an impact, even from day one.”

At the end of the first year, the CSP retained ten of the twelve inaugural students. One of the students who left the program became unresponsive to everyone and ceased participating in events; the other student indicated that while he enjoyed the peer interaction he did not want to continue if research was a component of the program. From a diversity standpoint, the CSP is appreciated by females as all females in the first cohort continued in the program, and of the second cohort of twelve, females represented fifty percent. In the first cohort, all students were selected from the incoming bioengineering class, and as bioengineering typically consists of a higher percentage of females than other engineering disciplines, the strong female representation is not surprising. However, for the second cohort—the one composed of electrical and computer engineering, bioengineering, and computer science, of the students invited to apply, 18.8% were female, and of the students who submitted an application, 28.6% were female.

While the first cohort of students is only in their sophomore year, each has been associated with a research laboratory since freshman year allowing some to demonstrate good progress on projects. Of the remaining ten inaugural CSP students, four have authored conference publications. One student won a regional ASEE poster competition, and three other students presented their work, as undergraduate research posters, at the national Biomedical Engineering Society (BMES) Annual Conference fall 2015. In comparison, for the BMES conference only one non-CSP student at the same level (year two in the bioengineering program) presented a poster; the remaining five students presenting at BMES were all seniors in the bioengineering program. Finally, one of the students in the first cohort of the CSP program was declared the Engineering Freshman of the Year at UIUC. While the student who won this award is a high achieving student, so are many other non-CSP bioengineering students; this can be seen from the average ACT of the 2014 incoming class (33.86). However, many first year students, even though considered high achieving, were not afforded the research experiences provided to students in the CSP program as faculty typically choose upperclassmen for positions in research.
Having the additional experience complements an already high achieving student and potentially increases likelihood of selection for campus awards.

**Discussion**

The CSP invites twelve new students each year which limits the size and naturally creates a close community. This community may promote retention and support students, but the program also seeks to develop student’s interest in bioengineering research and provide experiences which allow each student to develop professionally throughout a four year undergraduate curriculum. By doing so, participants gain multiple experiences to make them competitive in their future career. Additionally, multiple experiences allow each participant to identify the best career path for him/her and understand the wide spectrum of research related careers—not only in academia. CSP students realize the benefit of the development opportunities but have indicated interest in having the CSP be a formal university certificate program. At this point, we have not pursued steps to create a formal certificate program.

Many individuals have expressed interest in the CSP program. Students who have been admitted as freshmen for fall 2016 have contacted the program team indicating interest and asking about joining. Other departments on campus have expressed interest in the four year structure of the program, but would focus on a non-cancer topic. Finally, individuals outside the university have expressed interest. Some of the external individuals are familiar with similar programs, but many similar program focus only on the undergraduate research aspect—not the added experiences and coursework. From interacting with these individuals we have been able to exchange ideas and create dialog.

While the CSP program is new, preliminary results have been encouraging. The development team has witnessed the first cohort grow, personally and professionally, and expect the second cohort to do the same. A challenge to fully characterizing the impact of this program is the small sample size, with each cohort enrolling twelve students. While the first invitation was open only to bioengineering students, the second invitation (2015) was opened to three additional majors, two of which are represented in the second cohort.

Discussions to moderately increase the program size have been entertained, yet having a stable, well-established, and funded program prior to increasing the size would be preferable. Additionally, the program is not designed to be open to all incoming students for several reasons: (1) not every student possesses the maturity and ability to begin research in their first year, (2) the program requires students to join a research laboratory and even though the CSP assists in identifying these opportunities, there is a saturation point at which related cancer research laboratories would be full, and (3) the CSP provided a modest stipend in summer to the students, but the budget is small. Having external funding would benefit the expansion and increase the sustainability of the program, and the development team is actively pursuing these options. Even though the CSP is only in its second year, the development team is focused on evaluating the components, quickly and continuously improving processes, and working towards developing an established program that operates at steady state.
Acknowledgement: We thank our colleagues in AE3 for their guidance as we implement the CSP. And, we are thankful for funding in part through the University of Illinois at Urbana-Champaign’s College of Engineering’s Strategic Instructional Innovations Program (SIIP).

References


