

Baton Rouge Community College/Louisiana State University: A Partnership for STEM Student Success

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Adrienne Steele has over 15 years experience in STEM education. Currently, Adrienne works at Louisiana State University in the College of Engineering, managing all aspects of the STEP project that consists of a large-scale peer mentoring program. Previously, she coordinated the Scope-On-A-Rope Outreach Program (SOAR) in the Department of Biological Sciences for 10 years with funding from the Howard Hughes Medical Institute. In this position, she led over 175 professional development workshops for K-12 teachers. Prior to her positions at LSU, Adrienne was the Science Education Curator at the Louisiana Art and Science Museum in Baton Rouge. Adrienne has a Master of Science degree in zoology from LSU, where she studied in the Museum of Natural Science, and an Education Specialist Certification in science education.

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Warren N. Waggenspack, Jr. is currently the Mechanical Engineering Undergraduate Program Director and holder of the Ned Adler Professorship in the Department of Mechanical & Industrial Engineering at Louisiana State University. He obtained both his baccalaureate and master's degrees from LSU ME and his doctorate from Purdue University's School of Mechanical Engineering. He has been actively engaged in teaching, research and curricula development since joining the LSU faculty in 1988. Over the last 12 years, he acquired funding from NSF to support the development of several initiatives aimed at improving student retention and graduation rates as well as supporting faculty with development of effective learning and teaching pedagogies.

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Charles is a PhD student in Environmental Sciences at Louisiana State University. In 2012, he earned his master's degree in Medical and Health Physics and has since been working towards a PhD. During his studies, he has worked actively with the LSU STEM Talent and Expansion Program and LSU Center for Academic Success helping with different methods that aim to improve how STEM college students learn including tutorial centers, PLTL, SI, and recitation programs.

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Introduction

This NSF STEP Type 1B project enhances the existing partnership between Baton Rouge Community College STEM Division and Louisiana State University College of Engineering to foster students' completion of Associates Degrees at BRCC and Bachelor of Science degrees at LSU. Particular emphasis is placed on Engineering and Construction Management (E/CM) disciplines. This project builds upon the success of LSU's STEP 1A project. The main goal of the STEP 1A project was to increase the number of engineering graduates through the development of several programs targeting incoming freshmen and faculty members to create a sense of community. These programs included a weeklong bridge camp for incoming freshmen, an introduction to engineering course, and training opportunities for faculty and for student mentors. The freshmen camp and introductory course have been fully assimilated into the College of Engineering, allowing for development of additional opportunities in the STEP 1B project. In this project, new emphasis is placed on assisting incoming transfer students and in providing Supplemental Instruction for engineering courses; faculty and student development continue to be offered and were expanded to BRCC to incorporate a broader range of participants.

One project goal is to increase the number of BRCC AS/AAS engineering and construction management graduates by five per year to an annual rate of 25 students, all with strong academic foundations for further E/CM study at LSU. At LSU, the goal is to improve the overall 2nd-3rd year retention and ultimately improve the cumulative 6th year graduation rate by 2-3% per year so that it approaches the current university average for all entering freshmen (59%). Building upon the lessons learned from the first STEP grant, these goals will be accomplished through the following actions: 1) development and implementation of a pre-engineering learning community at BRCC; 2) integration of Supplemental Instruction/academic support in core STEM/Engineering courses at both institutions; 3) provide the environment and training necessary to develop mentoring relationships between students (particularly transfer students entering LSU); 4) provide opportunities for faculty development and engagement across institutions; and 5) establish mechanisms for effective monitoring and continual improvement. This paper will describe in detail the activities conducted as of the recent completion of the third year of this project (organized as items 1-4 in the list above) followed by the assessments of these activities that have taken place so far.

Activities

In order to meet the project's goals, several activities were developed and are continuing to be implemented. At Baton Rouge Community College, it was important to create a community of learners, as many of these students are non-traditional students having full-time jobs, families, and other factors that distinguish them from the traditional incoming freshman. Pre-engineering learning communities at BRCC initially consisted of students at BRCC who would meet in the STEM Conference Room, the BRCC library, and off-campus to study together. Currently, formal

learning communities have been created for calculus, physics, trigonometry, circuits, statics, and biology where students can come for homework assistance and ask general questions about course content. In addition to help with their coursework, students in the STEM Division also reported that they needed more information on STEM careers. Therefore, a BRCC STEM magazine was created via Flipboard where they found articles already written in career journals and popular magazines and flipped them into our magazine. The link to the magazine was distributed via email to students enrolled in gateway courses in the STEM Division.

Secondly, a peer-led team-learning program was developed and implemented at both institutions. The Supplemental Instruction (SI) model was chosen because it was already being utilized at LSU through the Center for Academic Success (CAS) and, therefore, was familiar to students. The courses typically selected for SI are large introductory courses and gateway engineering mechanics courses with high drop and fail rates (DFW). Supplemental Instructors, otherwise referred to as SI Leaders, are undergraduate students who have recently taken, and done well in, one of these courses. Students are chosen based on instructor recommendations, peer nominations, and involvement in the student leadership program at LSU (to be discussed further in the following paragraphs).

Historically, LSU's CAS has supported SI in large introductory courses such as biology, psychology, and physics. For this project, the STEP team worked with CAS to begin offering SI in sophomore-level, gateway engineering courses. A STEM graduate student was hired (20 hours/week) as SI Coordinator to develop and supervise all elements of this program in the College of Engineering. Table 1 shows all courses where SI has been offered at BRCC, and Table 2 lists the suite of engineering courses where SI has been offered since the beginning of this project.

Course #	Course Name	Semesters SI Offered
Engineering 245	Statics	Fall 2013 – Fall 2015
Engineering 295	Circuits	Fall 2013 – Fall 2015
Physics 110	Intro to Physics	Spring 2014 – Fall 2015
Physics 221	Engineering Physics I	Spring 2014 – Fall 2015
Physics 223	Engineering Physics III	Spring 2013
Math 210	Calculus I	Spring 2014 – Fall 2015
Math 211	Calculus II	Spring 2015
Chemistry 101	Chemistry I for Science Majors	Spring 2015
Construction Management 210	Construction Estimating	Fall 2015
CSCI 192	Computer Science	Fall 2015

Table 1. STEM courses with SI offered at BRCC (2013-2015).

Course #	Course Name	Semesters SI Offered
CE 2200	Fluid Mechanics (CE)	Summer 2013
CE 2450	Statics (all engineering)	Spring, Summer, & Fall semesters 2013-2015
CE 2460	Dynamics and Vibrations (CE)	Spring & Fall 2013, Spring 2014, Spring 2015
CE 3400	Mechanics of Materials (all)	Spring 2014, Spring & Fall 2015
EE 2120	Circuits (EE)	Spring & Fall semesters 2013-2015
EE 2950	Circuits (Non EE)	Spring, Summer & Fall semesters 2013-2015
ME 2334	Thermodynamics (ME)	Spring, Summer & Fall semesters 2013-2015
ME 3333	Thermodynamics (Non-ME)	Fall 2013; Spring, Summer & Fall 2014-2015
ME 3834	Fluid Mechanics (ME)	Spring & Fall 2014
PETE 2031	Rock Properties	Spring 2015
PETE 2032	Petroleum fluids	Spring 2015

Table 2. Engineering courses with SI offered at LSU (2013-2015).

SI Leaders for these courses have several responsibilities: they must plan and lead two weekly review sessions for the students in the course; they hold weekly office hours for students to get one-on-one assistance; they attend the course lectures so that they know what the instructor is covering in the course; and they communicate with the instructor regularly. In addition to these duties, SI Leaders attend an introductory training workshop at the beginning of the semester as well as weekly meetings with the coordinator. These weekly meetings are important to let the SIs talk through issues and ideas with their peers and to go over pedagogical strategies and active learning techniques. SI Leaders are also required to observe each other at least once per semester so that they can pick up new ideas and give peer feedback.

SI Leaders at LSU are also required to be part of the peer mentor program. Engineering's peer mentoring began with the STEP 1A project eight years ago (2008) when a handful of upperclassmen were selected to work with the first Encounter Engineering bridge camp. From here, the program has grown substantially, with 120 mentors active today. Figure 1 depicts collectively the peer mentors and peer mentor leaders. Peer Mentor Leaders (PMLs) are selected yearly by the STEP staff from those who have served at least one year as a mentor and who have gone above and beyond their primary mentor duties. PMLs are given broader responsibilities such as developing activities for and assisting with the leadership trainings, serving as program chairs, and presenting at conferences.

In 2010, the students in this program created their own student organization, the Society of Peer Mentors¹. The coordinator of the STEP project at LSU serves as the staff advisor for this organization. One of the peer mentor program goals is to create a sense of community among engineering students, bringing together all majors in the college including construction management and computer science. In addition to monthly meetings, mentors guide K-12 robotics teams, serve as supplemental instructors, perform STEM outreach activities, are hired as team leaders for the freshman bridge camp, and have the opportunity to assist with several introductory engineering courses.

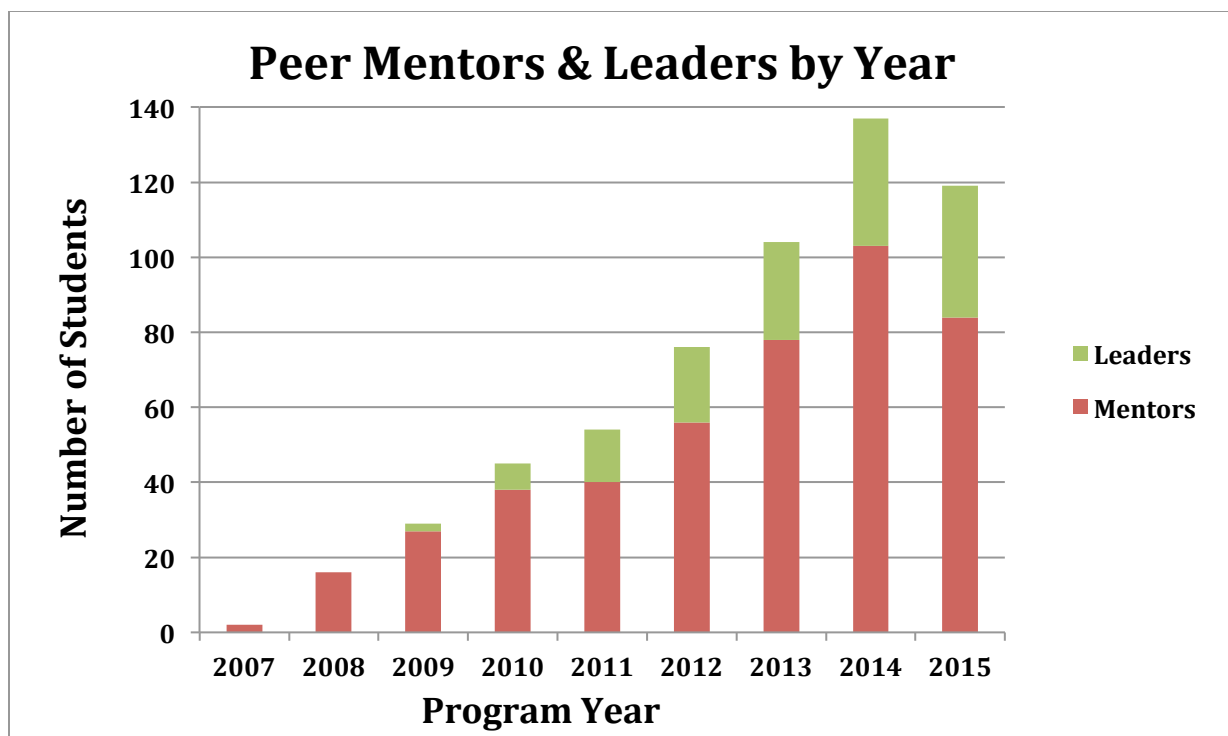


Figure 1. Number of peer mentors at LSU since the beginning of the program.

To join the Society of Peer Mentors (SPM), students first complete an online application that opens in January each year. Once applications are received, the officers and a team PMLs conduct “formal” interviews for each prospective member. These interviews are conducted in a manner modeling LSU’s career center interviews complete with setting appointments, requiring professional wardrobe (business casual here), resume, statement of purpose, etc. This setting gives the new mentors experience they can later apply to interviews for internships, and provides SPM leaders with the perspective of “sitting on the other side of the table.” Upon acceptance, participation is required in two leadership workshops offered later in the spring semester.

Most SPM participation is on a voluntary basis. However, programs and activities requiring a significant time commitment, such as robotics mentoring and Encounter Engineering Camp, provide a modest hourly wage. For a mentor to qualify for paid positions, he/she must be considered an active member in SPM that requires a minimum of 20 participation points (25 for officers). Students earn points each year through participating in outreach events, attending meetings, participating in training workshops and by proposing and developing new SPM activities/programs of their own choosing. The point system was developed by the officers¹ and has successfully increased participation from all members since its inception two years ago. In order for a student to become a leader, more than just attending leadership training is needed—they need to actually get experience leading things.

SPM is about developing students professional skills to be leaders, thus the leadership training workshops are a key component of the peer mentor program. Two six-hour workshops are held each spring; both are mandatory for new mentors, while returning mentors can choose to attend only one. These workshops are designed to be collaborative, active, and engaging. STEP

staff partner with other faculty and staff members, student leaders, and engineering industry representatives in order to cover the most useful topics and to ensure that the students will be better prepared for their future careers. Each workshop includes icebreaker activities coordinated by the PMLs and team building activities. For example, representatives from the Navy officer recruiting office were asked to lead several team-building activities such as “plank walking” and building spaghetti marshmallow towers (Figure 2).



Figure 2. Peer mentors participated in a “plank walking” activity led by Navy recruiters.

Participants also took a version of the DiSC[®] leadership style assessment² then played a Family Feud-like game to test their understanding of their particular leadership style. Other topics have included *The 7 Habits of Highly Effective People*³, intergenerational communication, conflict resolution, and cultural awareness. Having the students come together to participate in these workshop activities helps to create a more cohesive group as well as giving the PMLs additional chances to practice their leadership skills. For Spring 2016 with corporate funding from Baker Hughes, one of these training workshops will include an overnight retreat at a LA state park.

Peer mentors are involved in many hours of STEM outreach to local K-12 schools. These range in scope from small class activities, career talks and family STEM nights to mentoring the longer-term robotics teams. Mentors assist in developing engineering-themed activities to present at these events with the goal of encouraging K-12 students to pursue STEM disciplines. Activities represent the different fields of engineering offered as majors at LSU and include: non-Newtonian fluids, Gluep, Snap Circuits, computer programming using Arduinos, marshmallow towers, and a well blowout simulator. Students also go back to their high schools to give introduction to engineering presentations and to perform hands-on activities. In the three years of this STEP 1B project, peer mentors have completed over 300 hours of outreach in the local community.

This is the sixth year that LSU’s STEP has had mentors advising K-12 robotics competition teams. Beginning with just two high schools a few years back, there are now

mentors working with eight schools ranging from elementary to high school. The growth of this program is attributed mainly to word of mouth; for example, students who participated on high school robotics teams often become robotics mentors when they start LSU. Although experience with robotics in high school is not a requirement to work as a robotics mentor, these students go through a specialized training in addition to the leadership workshops. Robotics training workshops are held once each semester for new mentors, and these trainings are developed and implemented by the Robotics Chairs in the Society of Peer Mentors. Unlike the other officer positions that are elected by their fellow SPM members, the staff advisor selects chairs, taking into consideration recommendations by the officers. The robotics mentoring program has been so successful, that these mentors received a special award from the East Baton Rouge Parish School Board recognizing their service to local schools.

Two years ago, STEP at LSU instituted the first bridge camp for engineering transfer students. Many transfers are non-traditional students with different requirements and concerns than incoming freshmen. As such in the first year of this grant, incoming transfer students were surveyed to ascertain their needs and interests, and those results guided the choices made for this program. Instead of a weeklong bridge camp as offered to freshmen, the transfer students are invited to a Career Day that takes place between late orientation and the first day of school. It has the same goal as the freshman camp—to connect incoming students to upperclassmen and each other, as well as exposing them to available resources, faculty and staff members, and industry representatives. Transfer Career Day activities include: team-building, interaction with a panel of student leaders who discuss engineering organizations and internship experiences, an extended Q&A with a panel of engineering industry representatives who share advice on college experiences as preparation for their futures, lunch with these industry representatives and department faculty members, and a resume building workshop with information about how to apply for internships through LSU's Olinde Career Center.

The final STEP 1B sponsored activity is continuation of the faculty development initiated in STEP 1A that is offered to members of both BRCC and LSU communities with each institution alternating as host. These annual joint faculty workshops focus on active learning techniques with plans in the future to include metacognition and diversity topics. Since 2013, over 60 faculty, staff, graduate students, and supplemental instructors have participated in these workshops.

Assessment

In order to improve STEP activities and to evaluate their impact, both formative and summative assessments are conducted. Evaluation data include surveys, focus groups, and retention statistics from the university registrar. This section will highlight each program component's assessment that has been completed as of the writing of this manuscript.

The Supplemental Instruction program has been highly successful at both institutions. At BRCC, students who regularly participated in supplemental instruction have a passage rate of 73%. In contrast, the students who do not attend SI sessions had a passage rate of only 42%. Surveys distributed to those attending SI sessions reported that the sessions helped students understand course content better and aided them in improving their grades. SI Leaders reported

that being an SI Leader built up their self-confidence and allowed them to improve their understanding of course material as they prepared for their study sessions.

Grades were compiled and correlated with session attendance for all courses where SI was offered at LSU since the beginning of this program (Spring 2013 through Fall 2015) and normalized by subtracting student passing rates from the course average; see results in Figure 3. Students who regularly participate in supplemental instruction at LSU (defined as attending four or more SI sessions per course) are over 23% more likely to pass a course than students who do not participate at all⁴.

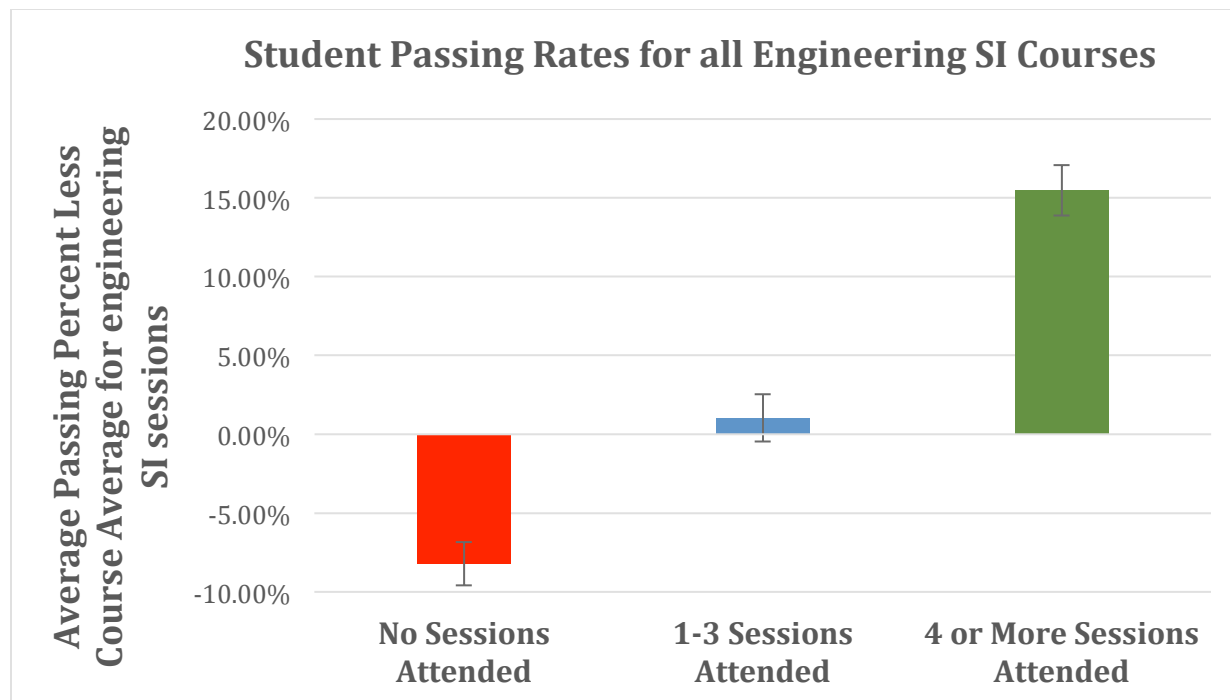


Figure 3. Passing rates compared to course averages for students who went to no SI sessions, few (1-3) sessions, or 4 or more sessions.

Surveys distributed to SI session attendees indicated that close to 100% of participating students ranked their SI's abilities as good or excellent in every category ($n > 200$). An online survey was distributed to all students enrolled in courses where SI was offered in Fall 2015 in order to obtain feedback from students who do not attend SI sessions or just were not present during the session where surveys were distributed. These results are currently being analyzed. Additionally, serving as a supplemental instructor seems to have a positive impact on the SIs themselves. The GPAs of SI Leaders have improved overall, and focus group results indicated that SI Leaders felt that they have improved their communication skills and increased their own understanding of the material being taught (which helps them in more advanced courses), among other benefits.

Data from the previous STEP 1A program indicated that peer mentors are 30-60% more likely than other students to persist (defined as retention plus graduations) and to graduate in an engineering discipline (Figure 4).

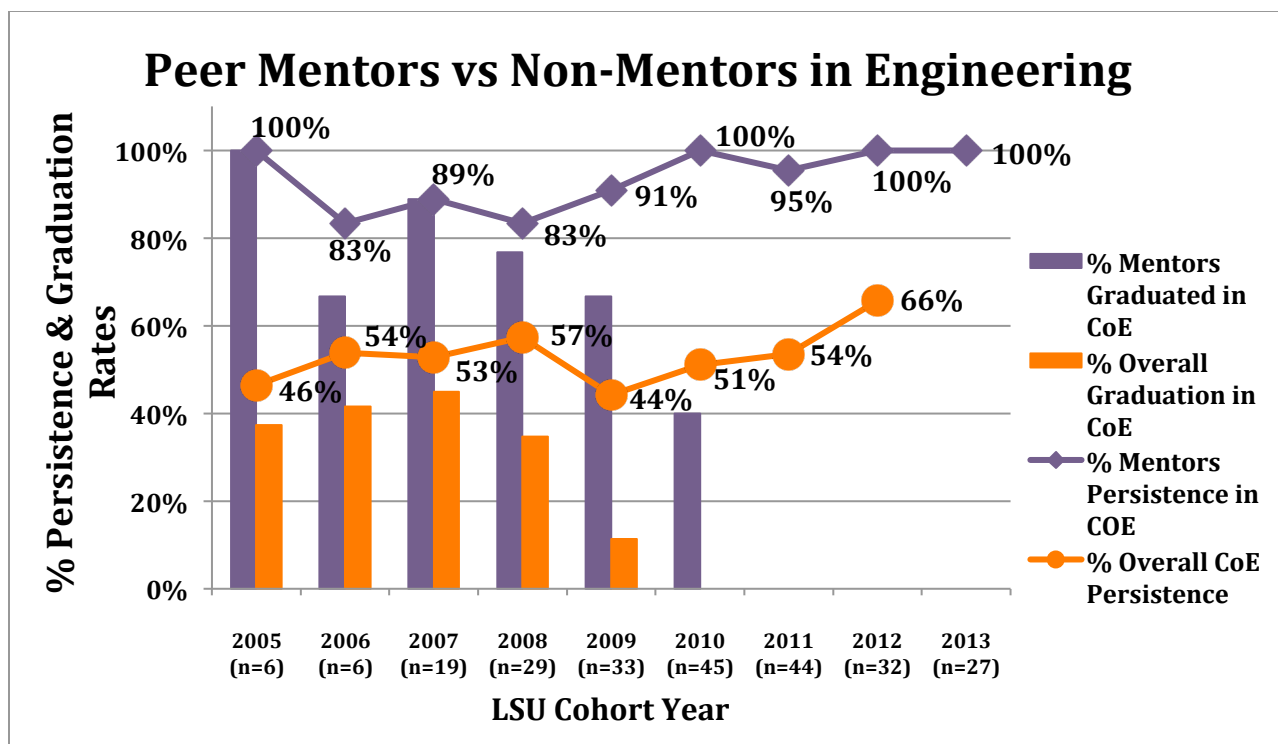


Figure 4. Graduation and persistence rates for LSU peer mentors compared to non-mentors in the College of Engineering.

Recent analyses show that peer mentors are representative of the college population, so it is not only the best students who become mentors, as some have assumed. Results from anonymous online surveys administered after leadership training workshops indicate that most peer mentors find the leadership training to be both valuable and enjoyable (4.1 and 3.7 out of 5 point scale); only two responses were negative for enjoyment, all found it at least somewhat valuable. The vast majority of survey participants indicated that they have a better understanding of their role as a leader in the College of Engineering (90%), that they learned more about working with different types of leaders (86%), and that the training met their expectations (90%). There were no negative responses, only a few indicated a neutral response.

Other indicators of peer mentor program success are the development of spin-off activities and the increase of mentor leadership roles in other student organizations. For example, building off the success of the freshman engineering bridge camp, the former president of the American Institute of Chemical Engineers, who was also a peer mentor, developed and implemented the first sophomore boot camp for chemical engineering students in Fall 2014. STEP helped to support the first iteration of this camp, with AIChE fully supporting this program through corporate sponsorship the following year. Two other peer mentors also brought the first hack-a-thon (GeauxHack) event to Louisiana in August 2014. With support from STEP and Major League Hacking, they planned and carried out all logistical aspects of this event, including raising over \$11,000 from industry and personal donations. Over 70 students from 10 different universities participated in this 24-hour computer programming event. The second GeauxHack event is being planned for Fall 2016. Peer mentors have also become officers in almost every other engineering student organization, such as American Society of Mechanical Engineers and

Society of Women Engineers, lending credence to the success of the leadership training workshops and the experiences offered within the program.

Surveys are distributed at the end of each Transfer Career Day program. All items were rated between 4 & 5 on a Likert scale, with 5 being the highest rating. The activities rated highest by participants are the student panel, industry lunch, and career services resume session. Participants rated the overall Transfer Career Day experience 4.9 out of 5 for both value and for enjoyment. Surveys were also distributed at the end of the Faculty Development Workshop in January 2015, and responses were tallied for the 34 participants from LSU and BRCC. Nearly all participants rated the workshop as excellent (94%) and increased their understanding of active learning concepts based on the workshop's objectives.

Each program component seems to be on track to meet its goals, but STEP is also seeking to improve overall retention and graduation rates at both BRCC and LSU. The number of AS/AAS E/CM graduates at BRCC has grown by over five students on average per year since the beginning of the project, so far meeting its goal. At LSU, students who participate in some facet of STEP are 8-13% more likely to be retained from their second to third year than students who do not participate. Currently the 6-year graduation rate at LSU is also 8-11% higher for STEP 1A participants than non-participants. Regression analyses were conducted to ascertain whether participation in any facet of STEP at LSU influences persistence, while controlling for demographic variables. Persistence was defined as retention plus graduation rates. Results showed that along with higher financial contributions (FISAP) and ACT scores, STEP participation does predict persistence at LSU overall, in a STEM discipline, and in engineering. Future analyses will be conducted to examine each type of STEP participation separately (peer mentors, supplemental instruction participants, transfer program, etc.). These overall retention and graduation rates will be continually monitored as the granting period progresses.

Best Practices

We are in the fourth year of the STEP 1B project after six years of NSF funding for LSU's STEP 1A project⁵, so there are several recommendations that can be offered to other institutions. Firstly, for partnerships between 4-year institutions and community colleges, it is imperative to have articulation agreements between institutions in order to make real, lasting changes. Also, support personnel are essential to the success of these activities. At the beginning of this project, several personnel were hired: a full-time coordinator at each institution, a part-time transfer counselor to work between both institutions, and graduate student assistants. It is also important to have open communication between staff and institutions. This is not an easy task and it continues to present challenges, but all participating parties benefit most when communication is continuous and frequent. The transfer counselor has also been an important addition, as she is familiar with the policies of both institutions and can be a very helpful resource to students transferring from one institution to the other.

It is also important to build relationships between faculty, staff, and students. Both full-time program coordinators have developed a rapport with students that helps to encourage participation. Surveys were administered at the beginning of this project and are ongoing to ascertain what needs, concerns, and interests the students have. Not only is feedback collected

from students, but also program staff does their best to incorporate students' suggestions in activities to ensure buy-in; students are also given the opportunity to help to plan and deliver program elements. The LSU SI Coordinator is in regular communication with the program manager and holds weekly meetings with the SI Leaders. These SI Leaders have a lot of respect for the coordinator, which gives them a higher degree of motivation to give their best efforts. Students are also recognized in various ways for their participation.

Officially recognizing successful student leaders has also played a part in the program's success. Any LSU peer mentor who has actively participated for two or more years receives honor cords to be worn at commencement, and the top PMLs in the program graduating each semester are awarded the Leadership Legacy Award. Students who participate at the highest levels are also given the opportunity to attend and present at national conferences, such the American Society for Engineering Education, and they assist with writing the research papers for these conferences^{1, 4, 6}. The Society of Peer Mentors has also recently implemented a "Peer Mentor of the Month" spotlight award to recognize the students who are working hard behind the scenes.

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