# Project SUCCESS:
# Sustaining Undergraduate Careers: a Computer Engineering Support System

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Abstract

Learning Communities, a growing initiative at Iowa State University, aid freshmen in the transition to college life as students live in the same residence hall and attend a common block of classes. By combining learning communities with the concept of student-centered active learning, students will gain control of and adjust more quickly to their new environment, experience increased achievement, and persist in the program. First year computer engineering students involved in the learning community participated in two new courses during the 1998/1999 academic year. The new courses were framed within the context of active learning to better prepare students for continuation in computer engineering by increasing their skills in group work and providing essential life-long learning skills. Students completed their freshman year with a greater awareness of computer engineering, knowledge and skills for successful teamwork, and experience a quicker and more satisfying acclimation to the university and college life.

The goal of project SUCCESS is: "To provide every student interested in Computer Engineering an opportunity to succeed at Iowa State University and to prepare him or her for their future careers." Engineering students take an academically challenging program of study beginning with rigorous courses in calculus, chemistry, and physics during their freshman year. While these courses are essential for providing a foundation upon which all engineering programs are based, many students find the courses difficult and elect not to continue their study of engineering. Project SUCCESS is an effort to help students survive the demands placed upon them as freshmen by providing a collaborative environment in which they will learn to seek assistance from and provide support to peers.

## I. Introduction

Iowa State University is in the midst of a learning community revolution. During the 1998/1999 academic year nearly 1400 ISU freshman students are currently members of 59 learning communities on campus. A learning community is comprised of approximately 15 students within a common academic area of study and they take a core block of classes together. Nearly half of the 1400 students involved have a residential component to the learning community concept. The residential component involves having same-gender students within a learning community live on the same residence hall floor. This experience during the freshmen year helps the student adjust to the personal and social aspects of college life, and surviving the academic demands to which few students are prepared to enter.

During the 1998/1999 academic year, the computer engineering program at Iowa State University

implemented its first learning communities. An additional component of the computer engineering learning community is the requirement that the students involved meet twice each week for an experimental class. Class time is used to develop social skills, teamwork skills, as well as develop their interest in the field of computer engineering. A typical computer engineering student that is not involved in a learning community is not introduced computer engineering concepts until the sophomore year.

This paper will outline Project SUCCESS and will provide insight into how both technical material and student support can be combined to enhance a student's first year experience. Results of student surveys and student feedback are presented.

## II. The Purpose of Project SUCCESS

The goal of Project SUCCESS is: "To provide every student interested in Computer Engineering an opportunity to succeed at Iowa State University and to prepare him or her for their future careers." Engineering students take an academically challenging program of study beginning with rigorous courses in calculus, chemistry, and physics during their freshman year. While these courses are essential for providing a foundation upon which all engineering programs are based, many students find the courses difficult and elect not to continue their study of engineering. Project SUCCESS is an effort to help students survive the demands placed upon them as freshmen by providing a collaborative environment in which they will learn to seek assistance from and provide support to peers.

The primary objectives for Project SUCCESS are:

1. Enhance student learning by:
   - introducing students to basic computer engineering projects,
   - providing an environment for students to practice teamwork skills,
   - connecting students to the computer engineering faculty and facilities through authentic, real-world situations,
   - promoting problem solving, critical thinking, and ethical reasoning,
   - providing an environment for students to practice presentation skills, and
   - developing an understanding of study skills and their learning styles.

2. Provide an environment to facilitate the transition from high school to college and ultimately into society by:
   - developing a learning community of computer engineering students,
   - providing an opportunity for students to develop connections and friendships to aid in their collegiate transition,
   - encouraging persistence in the program,
   - developing a professional identity, and
   - supporting academic progress through the freshman basic engineering curriculum.

3. Provide teamwork and leadership skills through:
   - dealing with diversity,
   - understanding of group/team dynamics, and
   - developing social competence.

4. Meet the demand of society for students in the field of computer engineering by:
   - increasing the retention rate of students in the program, and
   - increasing the number of women and minorities entering the program.

Currently, freshmen engineering students have no direct exposure to their major area of study until the sophomore year. Project SUCCESS provides an opportunity for students to begin the process of networking and interacting with peers and computer engineering faculty during the first year. Students work on team projects related to the field of computer engineering and their subsequent courses. Analysis of departmental data supports the belief that few students change majors from computer engineering once they begin taking computer engineering courses during the sophomore year. Through Project SUCCESS, students will begin to internalize a professional identity as a computer engineer.

Another aspect of Project SUCCESS is an effort to help meet the growing demand for students in the information technology fields. We are using Project Success as a marketing tool to help increase the number of students coming to the ISU computer engineering program. By providing an environment where students can succeed and learn we hope to increase the number of women and minorities entering our program. The recruitment does no good if we can not provide the environment where students can do well. The components of Project SUCCESS will help ensure that students do succeed.

Typically, the electrical/computer engineering department has shown a recruitment effort of 10% female among incoming freshmen students. Recent history of the department shows that 7.5% of all electrical engineering undergraduate students are women while 9.5% of the computer engineering undergraduate program are women. At the conclusion of the enrollment period for the learning communities, only one female had signed up to participate. As the prospective freshman female students were personally contacted during the summer of 1998, it was learned that the females did not want to become involved in the learning community because of the residential requirement. In order to attract more women to the learning community project, the requirement of living in the designated residence hall was dropped for the women. At the conclusion of the efforts, 8 of the 23 students involved in the computer engineering learning community were women, which represents 40% of the women in the freshman computer engineering class.

Current studies are underway to learn more about the apparent differences between the male and female (social, emotional, academic) needs of computer engineering freshman undergraduates. A qualitative study is being planned to explore the reasons why the women chose or did not choose to become involved in the computer engineering learning community. Testing of the freshman electrical/computer engineering class using the Myers-Briggs Indicator will be conducted this fall to begin a longitudinal study of electrical/computer engineering freshmen and the distribution of the different types of personalities and, consequently, their duration/retention in the program.

III. Implementation of Project SUCCESS

The first year we planned to have 30 students in the learning community, 15 men and 15 women. They would live in two resident hall floors in a dorm that is about 1 mile from the department. The students in the learning community took several classes together including, calculus, chemistry, engineering problem solving, and physics. While the Office of the Registrar coordinated the scheduling of freshman participants, the cohesiveness of the project depended on the ability of the Computer Engineering faculty to work with the participants in fostering the social interaction skills and academic confidence that will lead to success. The development of the introductory Computer Engineering course to aid in those areas is critical to the success of the project. Table 1 shows the first year course load for a typical student in the learning community. Other courses in the first year were up to the student.

Table 1

| Fall | | Spring | |
|---|---|---|---|
| Course | Credits | Course | Credits |
| Intro to Computer Engineering I | 1 | Intro to computer Engineering II | 1 |
| Chemistry | 4 | Physics | 5 |
| Calculus I | 4 | Calculus II | 4 |
| Engineering problem solving | 3 | | |

In order for this project to work several people from different disciplines were needed to provide support. Dr. Barb Licklider provided support in the form of two graduate students to help with the cooperative learning aspects of the project. The Electrical and Computer Engineering (ECpE) Department provided graduate student support for the technical aspect of the project. The University funded part of the project through a faculty fellowship awarded to Dr. Jacobson of $25,000 and the ECpE department purchased the robots for $10,000. The support from Dr Licklider and the staff of Project LEA/RN [1] turned out to be a critical component for the success of the project. They brought in activities for the students that helped build community and foster a sense of belonging. They also helped the students overcome many social problems that most first year students encounter. This combination of technical material and student interaction coupled with cooperative learning was not only continued into the following year's project, but helped drive several changes which will be discussed in the conclusion section.

We offered many evening help sessions for different classes depending on what the students were having trouble with. The help sessions were run by the graduate students and consisted of primarily working problems and sample tests. The help sessions were offered in either the residence halls or in the departmental building.

Another key component of the project was the recruitment of students into the program. 235 letters were mailed to the students that had been admitted to the department during the spring of 1998 and they were asked to respond by May of 1998. We had 15 men sign up by May and one women. We talked to several of the women we mailed the information to and discovered that one

of the concerns was the housing. We dropped the requirement that the women all live together and were able to attract 8 women into the program.

A key component to the success of the project was the creation of the two courses for the students. The students took these courses in addition to the 123.5 credits needed to graduate. The courses were designed to enhance the student's experience at Iowa State University and to provide an insight into the field of computer engineering. During the first semester the course met twice a week for one hour. The first part of the semester dealt with survival skills and building community among the group. The later part of the first semester dealt with academic support and robots.

The robots [2] were chosen as a method to provide insight into computer engineering and problem solving because they encompassed almost everything a computer engineer would do while in the workforce. We could design simple problems that could be described in a few sentences, but would require both creative thought and logical thinking to solve.

During Fall 1998, students in the computer engineering learning community participated in the first semester course, CprE 181X Introduction to Computer Engineering I. Formative evaluation was conducted on an ongoing basis throughout the semester to determine students' current skills, attitudes, and knowledge and progress toward reaching the objectives of the project.

CprE 181X Course Description:

1 credit: Introduction to computer engineering and teamwork. Project based examples from computer engineering. Group skills needed to work effectively in teams. Group problem solving. Individual interactive skills for small and large groups. Team based group skills.

CprE 182X

During Spring 1999, students in the computer engineering learning community participated in the second semester course, CprE 182X Introduction to Computer Engineering II. CprE 182X was designed with special emphasis on the supporting laboratory experiments and interactive activities. The instructional approach focused on introducing cooperative learning strategies and teaming concepts in the context of hands-on laboratory experiments. Students designed, implemented and tested computer based projects in an interactive, team oriented approach.

CprE 182X met once a week for 2 hours and we spent most of the time working with the robots and providing support for the other courses the students were taking. Most of the sessions revolved around building and programming the robots, however every class started with an opening go round and ended with a closing go round. The two go rounds allowed us to assess where the students were and what problems they were having.

CprE 183X Course outline:

| Date | Activity | Date | Activity |
|---|---|---|---|
| | | | |
| Aug. | Community building; Pizza party | Oct | Plane crash ( team building) |
| | Scavenger Hunt | | Tee shirt design |
| | Interactive Skill:<br>(playing and winning together) | | Tee shirt design & study time. |
| | Survey | Nov | Student conferences |
| | Math and Chemistry help session | | Time management |
| Sept. | Time management | | Pizza & more surveys |
| | Review session for Calculus test | | Robot introductions |
| | Interactive Skill: (Active listening) | | Building the robots |
| | Group ground rules | | Chemistry Help session |
| | Resume workshop | Dec | Building robots |
| | Lunch together in residence hall | | Building robots |
| | Conflict Resolution | | Building robots |
| | Building Trust (blind folds and peanut butter sandwiches) | | Study time for finals |
| Oct | Learning Styles | | Study Time for finals |
| | Study Session for Chemistry | | End semester Party |
| | Leadership | | |
| | Student conferences | | |
| | Pizza Lunch Meet the Computer Engineering faculty | | |

IV. Student Reaction and Results

While it is difficult to quantify the results of the first year we have some data and many comments from students that indicated the learning community was a success. The first question we are often asked is what was the retention rate. While retention is not a primary goal of the project it is a something that can be measured. The university retention rate was 22 out of 24 came back in their sophomore year to ISU. One of the two students left within the first week of school. The rate is higher than the university average.

The students formed very strong bonds that are still in place today. One interesting situation was observed when Dr. Jacobson walked back to one of the high tech clusters in the department's active learning center where a group of five students were working. These students were all part of the learning community in 1998/1999. The students were working on a circuit problem for the beginning electric circuits course. One student was writing on the whiteboard while the other students were talking through the solution. This course uses a web based tutorial to help with homework assignments. The students can submit their answers to be checked by the computer.

These five students were observed working on the problem for a couple of minutes in a very collaborative environment. Once they thought they have the right answer one of them typed it into the computer and when they found out the answer was correct they were very excited and then proceeded to go on to the next problem. It was at that moment we saw true learning taking place. This group spends a large amount of time working on problems together.

We used several instruments to try and measure the student's reaction to the learning communities. The consensus was that they felt this was a good experience and well worth the extra time. It helped them develop a community and to give them insight into computer engineering. Quoting some of the students from answers on the survey sheets can best summarize the results. Listed below are a few responses to the question should the learning team experience be provided for first year students next year.

- *Yes, I got a lot out of it and I definitely think that other kids should have the same opportunity that I had.*
- *Yes, definitely, This was a great experience and I would love to continue it of possible*
- *Absolutely. Everyone I talked to (college bound seniors) I told to try to get into a learning team.*

The response from every student was positive. It was so positive that several of them have been working with the students from the 1999/2000 learning team. We have also observed that many of the students in the learning community have become active in other department and student organizations. They have become positive role models for other students.

## V. Conclusions and Lessons Learned

We learned several things that have helped shaped the learning community for 1999/2000. The 1999/2000 learning community has almost 60 students. The major lessons and issues are provided below.

One issue that came out of this first year experience was that we ended up helping students make a discussion that computer engineering was not the right major for them, so our retention rate in the department was slightly lower than other first year students. However we suspect that the second year retention rate will be much higher. We struggled with this at first when we had several students switch majors during the first year, but in talking with them they made the right decision. One negative side effect of the learning community is that at least one student was worried about changing majors because she felt she would disappoint the group and the staff. We had to have a talk with all of them about making choices that were best for them. Several of the students who changed majors stayed in the group during the spring semester and were still very much part of the community. In a couple of cases we found out while talking with the students one on one about changing majors, that they were pushed into computer engineering by their parents. The learning community and support from the staff helped these students make the difficult decisions.

We learned we need to use different recruitment methods for women that for men. The men signed up for the community while the women did not. After making personal contact with each potential women we were able to get several signed up. For the 1999/2000 year we contacted each potential women students directly after send out the mass mailing. We made these contacts before the deadline, and we got 13 women to signup, which is about 75% of the incoming women in

computer engineering. We also developed a color brochure to be mailed to each potential student that indicated computer engineering as a major. This brochure has also been handed out to any potential student visiting the department.

A major change was proposed for the 1999/2000 learning community as a result of the 1998/1999 learning community. The two one credit courses was changed into two course each with two credits. This two course sequence replaced the 3 credit engineering problem solving course. We decided we needed a stronger academic component to the course and that using the robots for problem solving was better than using pure programming at the computer screen. The courses have gone through a major redesign with a stronger coupling between the academic material and the cooperative learning material from Project LEA/RN

The last lesson we learned was it is difficult to stay on top of social and personal problems the students have since many revolve around their residential life. For the 1999/2000 learning community we have hired two live-in peer mentors that will be there to help support the students. One of the peer mentors is a student from the 1998/1999 learning community. We hope the peer mentors can help the students even more than we are able to.

Project SUCCESS [3] is an integrated approach to engineering education that illustrates the university's goal of strengthening undergraduate teaching, programs, and services. The project is a model for developing a student-centered learning environment that supports innovation and excellence in teaching and advising while increasing student retention in the engineering program. Student outcomes for the project are driven by the promotion of critical thinking, teamwork, and promotion of life-long learning in an environment that enhances improved teaching techniques and experiential-based course content. The project also supports the College of Engineering's Blueprint for Excellence for engineering education as it conforms to the Model for Educational Experience by adhering to the principles of learning based, practice-oriented, and active involvement by and for the students. The underpinnings of the project lie in the concept of integrating experiences from the freshmen foundation courses into a coherent program to support the challenges and celebrate the successes of the participants as they live and learn in a safe, collaborative environment.

Bibliography

1. http://www.educ.iastate.edu/ess/LEARN.htm Project LEA/RN's home page
2. http://www.akpeters.com Rug warrior home page
3. http://www.lc.ee.iastate.edu Learning community web site

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Barbara L. Licklider is an Associate Professor in the Department of Educational Leadership and Director of Project LEA/RN at Iowa State University. With a background in secondary teaching and administration she brings practical experience to her goals of moving learning theory into practice in the classroom. Her research revolves around the development and implementation of models of faculty development to promote cultural change in approaches to learning in post-secondary education institutions.