

# Undergraduate Research Initiatives

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**Abstract** - Undergraduate research experience has been established at the department of Electrical and Computer Engineering since August 2006. The goals of this initiative are to enhance undergraduate students experiences through research collaborations with department faculty, attract qualified undergraduate students to assist faculty with their research projects, increase research and scholarly activities within department, and encourage students to attend graduate schools. The department has provided funds from its general expense budget. In addition, faculty with external grants provided summer stipends to student researchers. Students have also been able to secure summer research positions at many universities with grants from NSF Research Experiences for Undergraduates (REU). The initiative has proven valuable in providing capable student assistants to the faculty members with their research activities. It has encouraged faculty to seek more external funding. The undergraduate research initiative has proven to be successful in achieving its initial goals. Department is also seeking to establish a five year BS-MS program.

*Keywords:* Undergraduate research

## Introduction

The department of Electrical Engineering at the Saint Louis University is ABET accredited and fully dedicated to undergraduate teaching and research. The department offers Bachelor of Science Degree programs in electrical engineering and computer engineering. The department was established in 1987 by the generous support of local industry.

Bachelor of Science in electrical engineering and computer engineering offered by the department requires completion of 125 and 126 credits respectively.

Both programs within the department place a greater emphasis on the integration of theory and practice throughout the curriculum starting with introduction to Electrical Engineering (EEP-101) in the freshman year. The final (senior) year culminates with a sequence of two semester senior design experience. During these thirty-two weeks students are engaged in major multidisciplinary design projects. They are expected to adopt engineering design process which includes research and inquiry into a chosen project. Students are also highly encouraged to participate in internship and coop opportunities. In addition, they are encouraged to be engaged in research under the supervision of faculty mentors. In recent years increasing number of students are seeking summer research opportunities in research intensive universities with funding under the NSF Research Experiences for Undergraduates (REU).

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## **I. Research Initiatives**

Saint Louis University has established a highly reputable research track in many of its programs and colleges. The university continues to invest in its research infrastructure. Engineering programs are mostly dedicated to undergraduate education. The need to better integrate into the growing research culture of the university has resulted in increased research activities at the College of Engineering and Aviation.

The Electrical and Computer Engineering (ECE) department has reserved a part of its general expense budget to initiate undergraduate research opportunities for its qualified students. The initiative encourages students with Grade Point Average of 3.0 or better to seek research opportunities with faculty mentors. The budget provides \$1000.00 per academic year stipend for up to five students. During the academic year, selected students are expected to devote no more than ten hours per week to research activities under the guidance of faculty mentors. Department faculty members with external grants are also offering summer research opportunities to students on a full time basis. The main goal of the initiative is to enhance the culture of research which would benefit students, faculty, and the electrical and computer engineering department. The valuable experience gained would provide the department with a better vehicle in making the transition from undergraduate only program to establishing a vibrant research oriented graduate programs. The department is cooperation with other engineering department is working to establish five years BS-MS programs.

### **I.1 Benefits to Students**

For the past two years qualified junior and senior ECE students have been encouraged to be engaged in research activities under the guidance of faculty mentors. There is a great deal of evidence on the benefits to students in being engaged in research both at the graduate and undergraduate studies [1-3]. Undergraduate students participating in research with a faculty mentor will benefit by becoming active learners. It encourages more self directed learning while provides a clearer focus on the student's chosen field. Students learn research methodologies from their faculty mentors and enhance their educational experiences. Students involved in undergraduate research are more excited and motivated with their chosen fields of studies. Undergraduate research provides participants a glance into graduate studies. Hence it may encourage greater number of students to attend graduate school. It also encourages and prepares them for a rewarding life long learning. The ECE department at the Saint Louis University reserved funds to support maximum of five students. Qualified students are encouraged to approach faculty members to seek research opportunities. Upon mutual agreement faculty and students begin working on a research project. The working relation may continue into the summer. During summers, students are supported by the faculty research grants. Over the past two years engineering students have been successful in securing summer research positions in highly reputable universities with funding from NSF Research Experiences for Undergraduates.

The ECE Dept. has six faculty members with sixty undergraduate students. There have been total of seven students engaged in research activities for the past two years. Students engaged in research activities are showing measurable improvements in their academic performance and outlook. Normally less than ten percent of our graduating students attend graduate schools upon graduation. Students engaged in research show more (>20%) interest to continue their education by attending highly reputable graduate schools.

### **I.2 Benefits to Faculty**

In undergraduate only programs faculty members do not enjoy the valuable assistance of qualified graduate students. Hence, undergraduate research initiatives would provide faculty members in undergraduate only programs with the opportunity to engage highly qualified undergraduate students with their ongoing research activities. Qualified and motivated undergraduate students are able to assist faculty members furthering their research goals. It integrates teaching and research as part of the undergraduate experience. Mentoring undergraduate students prepares the next generation of independent learners. Undergraduate students engaged in research activities are shown to be better prepared to accept greater role and responsibility in self directed learning.

It is clear that established graduate programs have advantage over the undergraduate only programs in attracting externally funded research. Great many universities with research intensive graduate programs have established

centers for undergraduate research [4-6]. Involving undergraduate students in research with the goal of establishing a research track will also benefit in attracting more funded research. Tenure track faculty members in the ECE department are expected to devote more of their time in establishing a research track and seeking external funding. Faculty members are expected to be engaged in meaningful research with the aim of publishing in reputable journals and attracting external grants before being considered for tenure. It is evident that programs with established research programs have greater chance of attracting external grants. Faculty members in such institutions highly benefit from the presence of qualified graduate students. In undergraduate programs such as the ECE Dept. at the Saint Louis University, students have the potential of providing valuable assistance to further faculty mentors research goals. It has allowed ECE faculty members to submit more proposals for external funding. Increased proposals have resulted in attracting more funds to carry out meaningful research.

The College of Engineering and Aviation at the Saint Louis University has only one graduate program in the Biomedical Engineering Department. There is an ongoing discussion to establish graduate programs in remaining engineering programs including the electrical and computer engineering. Initial proposals are to establish five years BS-MS programs. The need stems from the desire to further contribute and integrate in the Saint Louis University research culture. There is also higher research and scholarly activity expectation from a new tenure track faculty. The BS-MS programs would be a very positive step forward in establishing a more research capable environment. It is the ultimate goal of the college of engineering to establish Ph.D. programs in all the engineering departments. The evidence collected from the undergraduate research experience clearly shows the valuable role of qualified and motivated students in furthering faculty research goals. It also provides for an excellent argument in establishing engineering graduate programs at the university.

### **I.3 Benefits to Department/Programs**

Undergraduate only programs would benefit from undergraduate research. Undergraduate research would establish an environment of active learning and inquiry. Prospective students and their parents are increasingly inquiring about internship, coop, and undergraduate research opportunities. Presence of active undergraduate research program allows for attracting some of the best and brightest students to our programs. Over the past several years, the ECE Department incoming freshmen average ACT scores have increased from 25 to 28. The aim is to maintain and/or increase the quality of incoming students by offering more research opportunities. University has established an office of undergraduate research which would further enhance educational experiences for all our students.

It is also evident that research oriented programs would be able to attract more research oriented faculty. The more recent hire in the ECE Dept. is engaged more in research and scholarly activities. The department is increasing its externally funded research. The goal for the near future is to provide incentives to double the external research funding. It is clear that the research activities would also enhance students educational experiences. It also allows more resources to be directed towards teaching and research laboratories.

Saint Louis University continues to invest in its research infrastructure by building new facilities dedicated to research activities. Increasingly faculty members are expected to contribute to research momentum at the university. It is essential for the growth of the electrical and computer engineering department to be more engaged in research and further integrate into the research culture of the university. Department would continue to seek additional funding, from internal and external sources, to expand undergraduate research initiative to provide funding for all qualified students seeking research opportunities.

## **II. Conclusion**

Undergraduate research has shown to provide many benefits to all involved in educating next generation of active learners. The initiative at the Electrical and Computer Engineering Department of the Saint Louis University has made positive contributions to the goals of the department in establishing culture of research. In primarily undergraduate programs such as the one at the Saint Louis University the initiative has proven to be valuable in providing capable assistants to the department faculty members with their research and scholarly activities. It also encourages faculty to seek external funding knowing the availability of qualified assistants. The number of proposals by department faculty members seeking external funding has increased. Students involved with

undergraduate research have shown improved academic performance and more interest in applying to graduate programs. It would also be beneficial as the college of engineering is moving to establish five year BS-MS programs for all its programs. The positive results of the initiative encourage the department to continue its support for undergraduate research opportunities for more qualified students.

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