AC 2008-2019: IMPROVING RETENTION AND CONTINUING EDUCATION THROUGH UNDERGRADUATE RESEARCH PROGRAM

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Improving Retention and Continuing Education through Undergraduate Research Program

Abstract

Undergraduate student retention and progress to graduate school is a critical issue among underrepresented minorities. North Carolina A&T State University has implemented an undergraduate research program with support from corporate partnership to enhance this goal. The Intel Undergraduate Research Program involves qualified undergraduate students in hands-on research experience. Key features include a multidisciplinary student cohort that is exposed to a variety of research topics under close mentoring from interdisciplinary faculty. Over its offering in the past two years, this program has become a prestigious avenue for obtaining research experiences. Students are admitted based on competitive standards that include high GPA requirements and strong recommendations from faculty. Unique aspects of this program include active participation from the industry for the initial semesters bridged by continuing support from federal programs including the NSF NC-LSAMP. In this paper we discuss the experiences and insights drawn via qualitative assessments. Program monitoring via monthly meetings, presentations, faculty assessment and research reports provide consistent feedback on the progress of the students. We propose to present findings from this preliminary study with ongoing evaluation using longitudinal data analysis. Introduction of undergraduate research programs with symbiotic support from corporate and federal agencies have positive implications for student retention and continuing education.

1. Introduction

Retention of undergraduate students in BS degree programs within minority engineering schools is important towards higher graduation rates[1]. In addition, exposure to undergraduate research experiences is pivotal in attracting undergraduate students towards graduate degrees in engineering. The Intel Undergraduate Research program is a mechanism which facilitates both the retention and continuing education efforts at North Carolina A & T State University. The Intel Foundation and Intel Corporation currently invest over $100 million per year in over 50 countries to promote education in mathematics, engineering and science areas. The Intel Undergraduate Research Program (IURP) was created with the intent of encouraging minority undergraduate students to pursue advanced degrees in a field concentrating in science, technology, engineering and math (STEM). Students selected into the program must have completed one year in course work and must be enrolled as full-time students in STEM program during Fall and Spring semesters. This program is open to US citizens or permanent residents who are a member of underrepresented minority group as defined by National Science Foundation (NSF) standards.

North Carolina Agricultural and Technical State University (NCA&T), was established in 1891 and is a public, comprehensive, land grant university committed to fulfilling its fundamental purposes through exemplary undergraduate and graduate instruction, scholarly and creative research, and effective public service. NCA&T is a Historically Black College and University (HBCU), located in Greensboro, North Carolina and enrolls over 10,000 students with about 89% of them being African Americans. It is the leading producer of African-American engineers

in the nation. The university offers programs at the baccalaureate, masters and doctoral levels with emphasis on engineering, science, technology, business, education, agriculture, and other academic areas. Basic and applied research is conducted by faculty in university centers of excellence, in inter-institutional relationships, and through significant involvement with several public and private agencies. The university also conducts major research through engineering, transportation, and its extension programs in agriculture.

2. Intel Undergraduate Research Program (IRUP) Guidelines

Selected students are required to complete the IRUP application and participation agreement. Each student submits an official university transcript and recent resume with their application. Students submit an abstract describing the work to be completed in consultation with faculty mentors assigned to respective students. On the onset of research activities students are expected to supply participation logs documenting the progress of research conducted which is signed by their mentor. Students are required to attend scheduled meetings, information sessions, workshops, seminars or conferences during the academic year.

3. Student Recruitment

Students are selected for the Intel Undergraduate Research Program based on a minimum GPA of 3.0 (scale of 0 to 4.0) and faculty recommendations. Over the past year this program standards have risen with average student GPA around 3.3 of 4.0. Students have been selected from different disciplines including computer, industrial, mechanical, electrical, and chemical engineering. On an average the cohort size for this program is around 8 students per semester. The intent of choosing an interdisciplinary group is to share their experiences across different departments. Students are recruited primarily on faculty recommendations within respective departments as they work closely with faculty in their research projects.

4. Faculty Mentoring

Active faculty researchers from College of Engineering were involved in mentoring undergraduate student researchers. Over the past year faculty from Industrial, Mechanical, Electrical, Chemical and Computer Science departments were involved in this effort. Faculty research expertise ranged from nanomanuacturing, catalysis, VLSI design, and traditional manufacturing.

4a. Example of Research Project within micro and nano technology (Industrial & Systems Engineering)

An example of research project within the micro and nano technology area is described below. Undergraduate students were teamed with MS and Ph.D. students in their respective thesis and dissertation topics. As an example they were introduced to current research in inkjet based micro fabrication techniques. They were also introduced to computational models (as shown in Figure 1) from the author's research in direct-write based micro/nano fabrication. Further they conducted ultra high speed photography experiments to validate the numerical model results (shown in Figure 1).

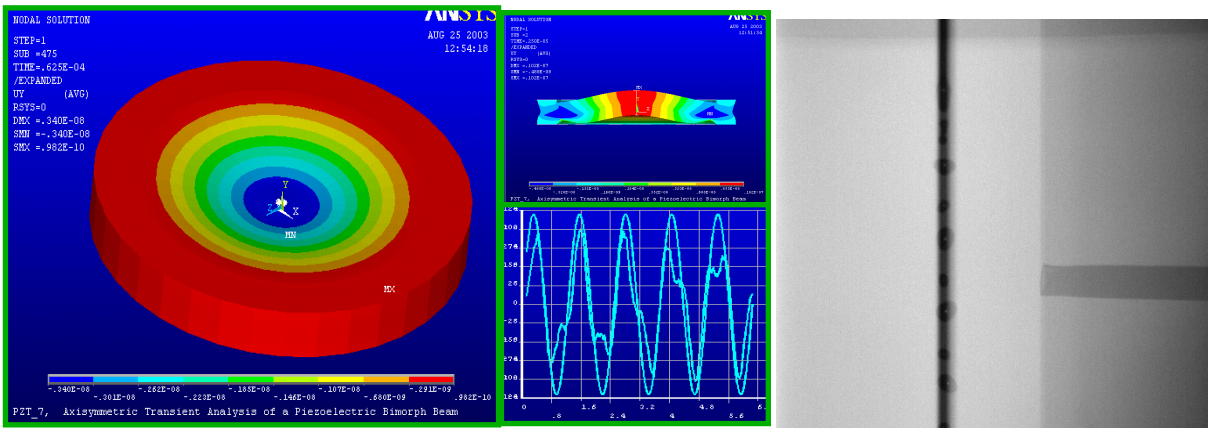


Figure 1: (Left) 3D deformation of Piezoelectric Bimorph Disc in micro fabrication process. (Center-top); Exploded 2D view piezoelectric deformation at disc center (Center-bottom); Superimposition of excitation voltage and PZT displacement (Right); Ultra-high speed photography of micro-drop formation (Exposure: 10μs) [2].

Students were also exposed to micro-capsule based drug delivery and regenerative tissue scaffolds using customized microfabrication process (shown in Figure 2) [3].

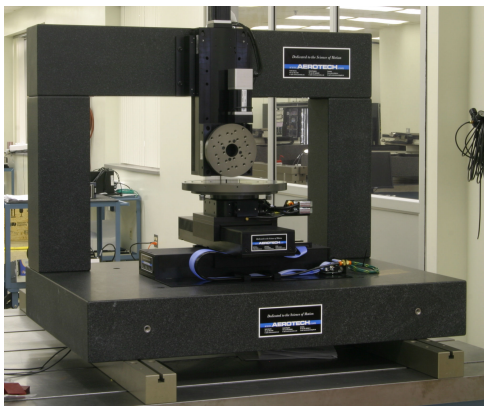
Figure 2: Micro capsules and tissue scaffolds using inkjet based microfabrication process [3]

4b. Laboratory component for undergraduates in micro and nano manufacturing

Students were exposed to laboratory experiments at the Integrated Nano/Micro Manufacturing Laboratory at the Center for Advanced Materials and Smart Structures (CAMSS) at NCA&TSU. This type of a hands-on-experience enabled students to appreciate the use of state-of-the-art equipment (ultra high speed photography, precision micro position stage, customized inkjet system as shown in Figure 3) which are involved in the development of micro and nano fabrication processes.

(a)

(b)



(c)

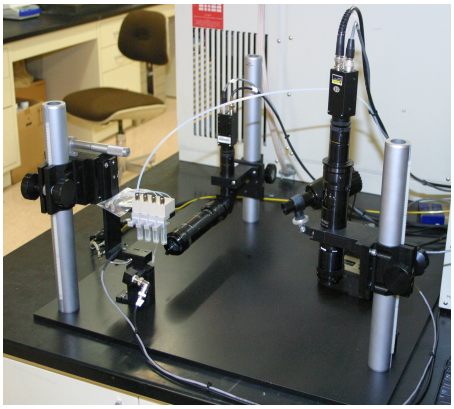


Figure 3. Infrastructure exposure to students (a) Ultra high speed camera (b) 5-axis precision stage (c) Customized inkjet system

5. Program Evaluation

The Intel Undergraduate Research program was evaluated based on qualitative feedback from students, faculty and program administrators. Students reported their research findings at weekly meetings to faculty mentors. Also an end-of-semester report was required for students participating in this program. The results of their research were presented at the NC-LSAMP conference via poster and power point presentations to universities from around the state of North Carolina. Faculty mentors were interviewed for feedback on student participation and interest in the program. In addition, administrators for this program held monthly meetings with students to evaluate their progress. Students were also interviewed on a one-on-one basis to gauge their motivation level to pursue graduate studies. The interviewed students showed interest and commitment to enrolling in graduate school on completion of their BS degrees. The program administrators held monthly teleconference meetings with the corporate sponsor. In addition, an end of semester report was submitted to Intel Corporation. Based on last year's performance, Intel has expressed high level of commitment for this program at NC A&T SU.

At present the Intel Undergraduate Research program supports students for two consecutive semesters. Based on students' response and faculty insight we believe that students could benefit from an extended research experience. To support this activity we plan to continue their research exposure through the NSF supported NC-LSAMP program throughout their undergraduate program. The National Science Foundation's Louis Stokes Alliances for Minority Participation (LSAMP) program is a comprehensive, multidisciplinary, undergraduate program designed to increase substantially the quantity and quality of students, especially African American, Hispanic,

and Native American students, who successfully complete science, technology, engineering, and mathematics (STEM) baccalaureate degree programs, and increasing the number of students interested in, and academically qualified for and matriculating into programs of graduate study[4]. Students are chosen for the NC-LSAMP program based on recommendations from faculty.

6. Results

Figure 4 shows student participation within the Intel Undergraduate Research program over 3 years. It can be seen that there has been a steady growth of students in this program and the anticipated student participation in year 2008 is higher than in previous years.

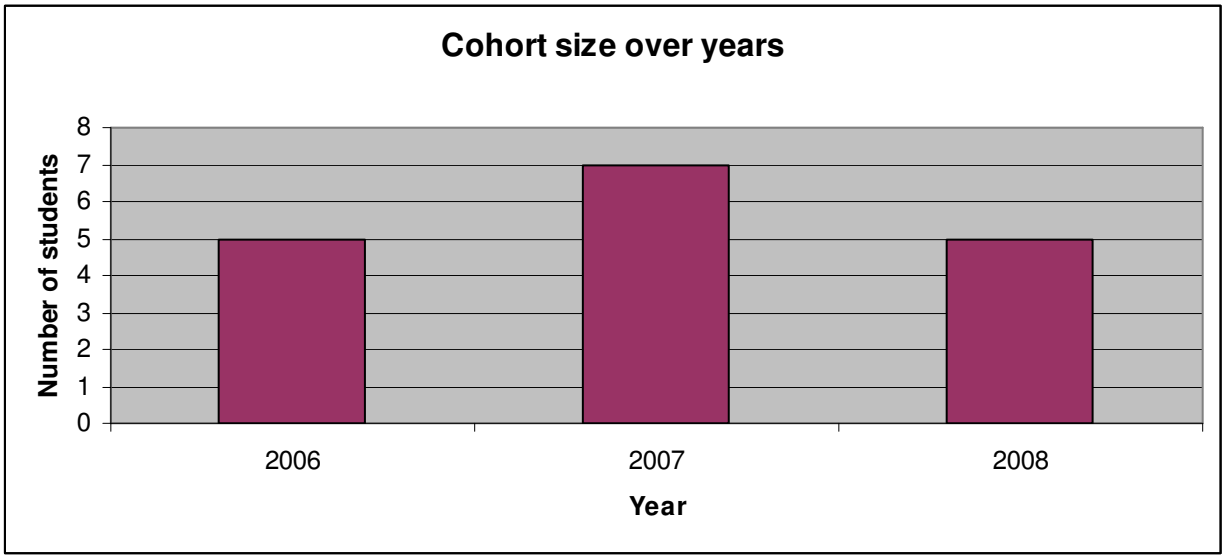


Figure 4. Student participation in Intel program over three years

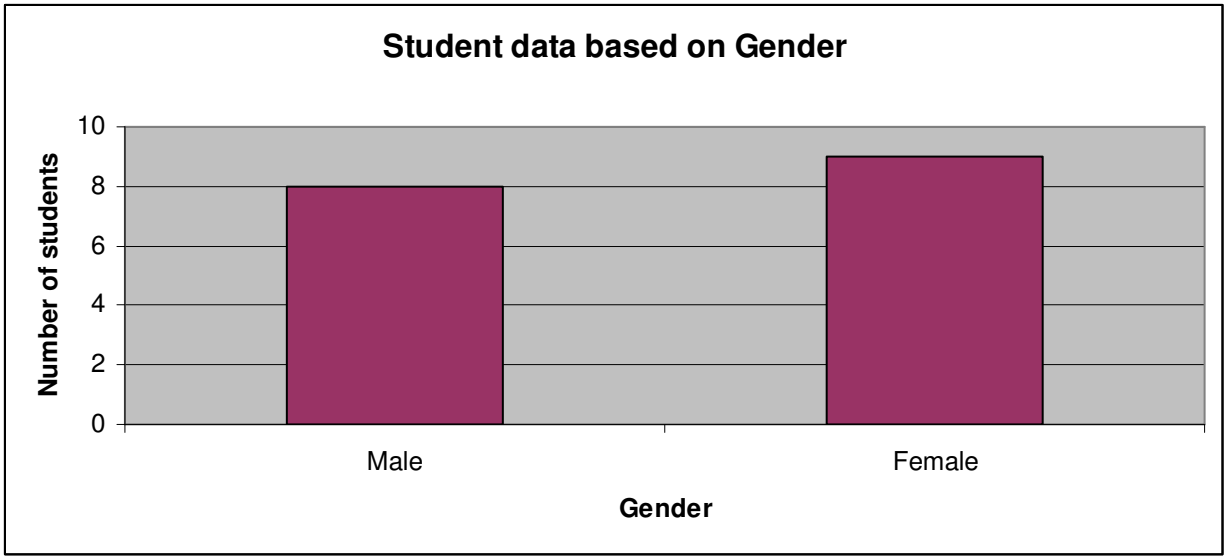


Figure 5. Student participation in Intel program based on gender

Figure 5 shows student participation based on gender. It is important to note that the number of female students participating in this program is higher than male counterparts bringing strong diversity to the program.

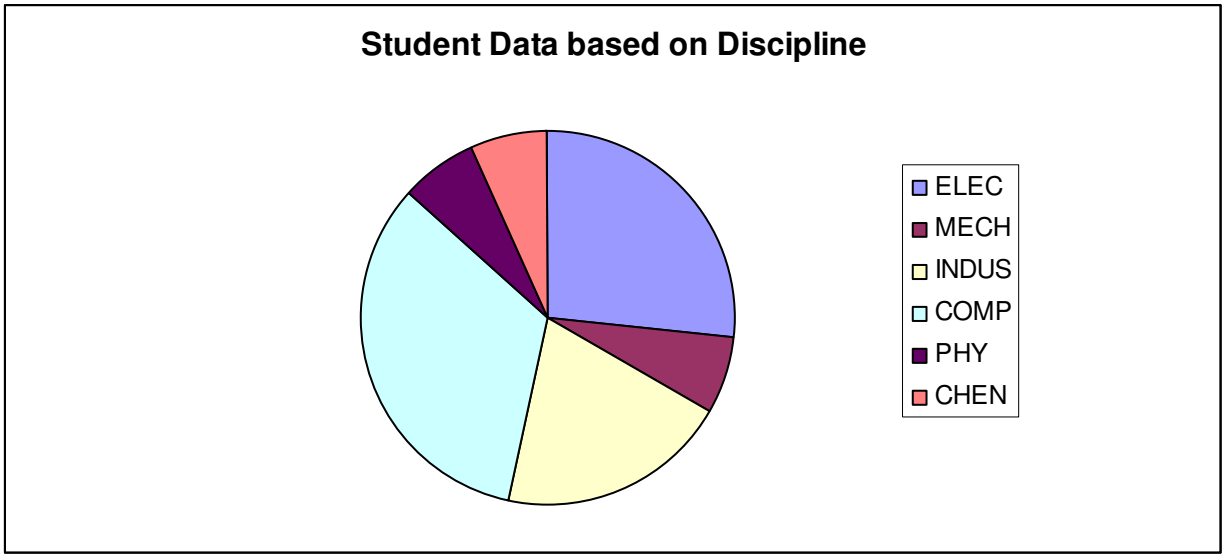


Figure 6. Student participation in Intel Program based on discipline

Students from six (6) departments were represented in the Intel program as shown in figure 6. The departments of computer science, industrial and electrical engineering had higher student participation.

7. Conclusion

Although the Intel Undergraduate Research program is still ongoing, it has the potential to significantly impact the retention and graduation rates of underrepresented STEM students. However, in order to fully assess the effectiveness of the program, we need to continue to follow student performance and collect longitudinal data for analysis upon completion of the program. Nevertheless, it is safe to say this program is very promising. Furthermore, this program will have positive impact on the number of underrepresented STEM students who enroll in the graduate programs.

8. Acknowledgement

We would like to acknowledge the Intel Corporation and the National Science Foundation NC-LSAMP project for supporting this program at North Carolina A & T State University.

9. Bibiography

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