SB^{3}C2019
Summer Biomechanics, Bioengineering and Biotransport Conference
June 25 -28, Seven Springs, PA, USA

BROADENING RESEARCH EXPOSURE AND RESEARCH PARTICIPATION IN MECHANICAL ENGINEERING: FINDINGS FROM THE UMBC ME S-STEM SCHOLARSHIP PROGRAM

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INTRODUCTION

Since 2008, many public universities have undergone continuous and substantial budget cuts, while the number of students enrolling in Mechanical Engineering (ME) programs continues to grow. Financial difficulty has forced some community college students to forego pursuing a 4-year BS degree. Many of our students pursuing a BS degree in the ME program have to seek employment outside of engineering to pay for their education. This limits their time available to focus on their course work. For the 2010 cohort of our ME freshmen, the 4 year retention rate was around 50% and the 4 year graduation rate was 23%. The retention and graduation rates were even worse in underrepresented minority (URM) students and transfer students.

Studies[1-3] have demonstrated that integrating a research experience into a student's education program improves retention rates, and plays a role in increasing the percentage of students pursuing graduate degrees. Despite efforts at the university level, very few undergraduate students on our campus attend regular research seminars in the STEM departments and less than 10% of the undergraduate students actively participate in research. This may be due to lack of information, conflict of schedules, as well as the depth of the research topics. We believe that providing students with research opportunities and actively exposing them to STEM advancements would lead not only to more students applying and/or transferring to our ME undergraduate program, but also retaining them through graduation. Extra effort is needed to inspire students' interest in research, especially interdisciplinary research.

Starting in 2010, the ME department at UMBC has been awarded three NSF S-STEM grants to increase student diversity, improve retention, and provide successful paths toward job placement and graduate study in our department. In addition to scholarships and faculty mentoring, we implemented approaches to integrate research into various aspects of our curriculum, including visiting community colleges, giving research seminars to community college students and UMBC students, organizing lab visits for undergraduate students, and providing undergraduate research opportunities. In this study, we asked students to complete a survey after specific research related educational activities. Data analyses were conducted to evaluate whether the perceived experiences from exposure to research differed by ethnic group, family educational background, whether they are community college transfers, and whether the students are part of a scholarship program. The survey results were also used to measure the satisfaction of the participants from the research related activities, and to collect feedback for future improvements.

METHODS

Two short surveys were designed, one for community college visits, and the other for ME lab tours. An ME faculty member visited a community college and gave a seminar typically consisting of three parts: a description of the ME S-STEM Scholarship Program at UMBC, the transfer process to the ME program, and ongoing research projects in the faculty's lab at UMBC. The lab tour at UMBC was scheduled during a University "free-hour" so that all ME undergraduate students could attend. During the lab visit, the faculty gave a Powerpoint presentation, and then a show and tell session, followed by a Q&A session to answer their questions. The surveys were given to all participants after the events and were collected on the site. Both surveys were similar, with only 15 questions covering information about their demographic background, their previous exposure to research and research experience, and their satisfaction to the event. All survey results were entered into EXCEL for data analyses. Not all participants answered every question in the survey. Percentages of participations were calculated based on the sample size of individual groups stated by the participants.

RESULTS

We received 27 surveys after the community college visit and 58 surveys after the ME lab tour. Figure 1 gives the demographic data of the participants. The percentages of any specific group were higher than 19%, and thus provided good sample sizes for analyses. In both surveys, more than 30% of the participants were female or URMs defined as African Americans, Hispanics, and Native Americans.

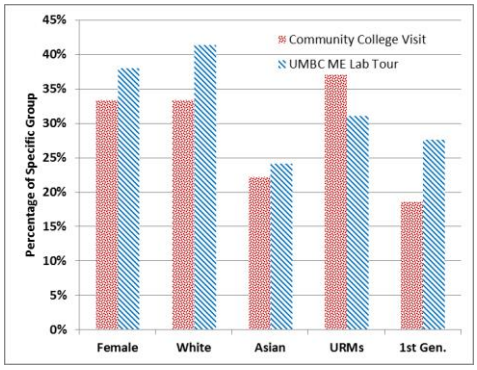

Figure 1: Percentages of participants' demographic data.

We wanted to know whether the students had any exposure to research by attending any research seminar before the event. Overall, 37% (community college students) and 21% (UMBC participants) of the participants attended at least one research seminar. The percentages of participants in specific groups are shown in Figure 2. Exposure to research in the URM group and the group of the 1st generation of college students is better in the community college students; however, in the UMBC ME participants, those two groups' exposure to research is much lower than the White group. Contrary to stereotype, exposure to research for Asian students in community colleges and in the ME department also trailed that for the White group.

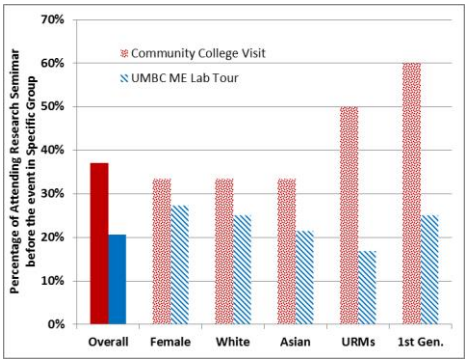

Figure 2: Percentages of attending at least one research seminar before the event in individual groups

The ME undergraduate students can apply for scholarships at UMBC. Three scholarship programs identified by the participants are the ME S-STEM Scholarship Program that our team is managing, the Meyerhoff Scholarship Program at UMBC, and the CWIT Program by the College of Engineering and Information System at UMBC. All three scholarship programs not only provide financial assistance, but also engage their scholars in research. Our program also promotes community college transfer students to pursue research.

Overall, among the 58 participants in the UMBC survey, 21% attended a seminar, and 19% did research in a lab. The positive impacts of those scholarship programs on the research participations of students in the ME department at UMBC are illustrated in Figure 3. Note that the solid bars represent participation percentage of their previous attendance of a research seminar, while the pattern bars represent participation percentage of the students who actually did research in a research lab before the event. As shown in the bars on the left, for all the 34 participants in at least one scholarship program, 29% of the 34 participants attended a seminar and had at least one research experience in a lab, both exceed the overall averages of 21% and 19%, respectively. However, among the 23 participants who were not in any scholarship program, only 9% attended a research seminar and 0% worked in a research lab. The data from the 15 participants who originally transferred from a local community college illustrate similar trends. Among the 11 community college transfer students who are in at least one scholarship program, 9 of them (or 82%) attended a research seminar and 3 of them (27%) had an opportunity working in a lab. However, for the 4 community college transfer students not in any scholarship program, only 1 of them (25%) attended research seminars, and none of them worked in a research lab.

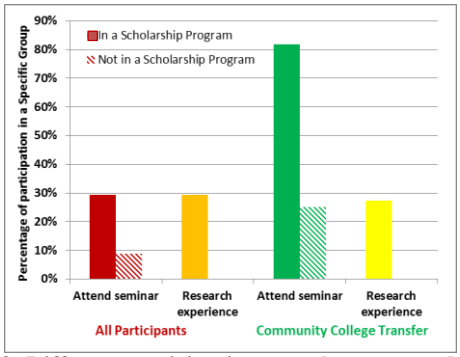

Figure 3: Different participation rates between students in a scholarship program or students not in any scholarship program in the ME department at UMBC.

More than 88% of the participants after the community college visit and 100% of the participants after the lab tour stated that they understood more of the technical content of ongoing research projects. More than 70% (community college) and 88% (UMBC lab tour) were satisfied with the overall event. 71% of the community college students would like to attend future seminars offered by ME faculty. For the UMBC ME students, 86% stated that the experience made them more interested in pursuing undergraduate research, and 97% of them are interested in attending another lab tour in the future.

SUMMARY

Survey data were collected after several research related events sponsored by the ME S-STEM Scholarship Program at UMBC. Exposure to research measured by attending a research seminar was low for the participants, around 37% in community college students and 21% in ME students at UMBC. There is little correlation between students' demographic background and their research exposure and their opportunity of working in a research lab. The results show the positive impact of the scholarship programs at UMBC on the research exposure and research experience, while the impact is more evident in students originally transferred from a community college. The overall satisfaction rates to the events were high, suggesting rationale to continue to offer those research related events to students.

ACKNOWLEDGEMENTS

This research was supported by an NSF S-STEM grant (DUE-1742170).

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