Promoting Student Success in Engineering and Science through Reseach and Internship Programs

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Abstract

Science, technology, engineering, and mathematics (STEM) education has been given much attention in recent years. While a number of issues affect student success, the area of greatest concern is student retention. Standardized-test scores, study habits, and living on- or off-campus are not the only factors that affect retention rates. Students are more likely to stay in college if they have clear goals, are active learners, and are active participants in campus activities. This paper discusses student success in engineering and science, with a focus on active learning through a research and internship program that provides students with mentoring and financial support.

I. Introduction

STEM education is crucial to innovation, progress, and national competiveness. A major concern, however, is that success rates in U.S. colleges and universities are still low. In 2008, for example, China's engineering degrees were about 10 times the U.S. number and represented a much higher share of all bachelor's degrees (30%) than in the U.S. (5%) [1]. Standardized-test scores, study habits, and living on- or off-campus are not the only factors that affect retention rates. Surprisingly, the primary causes include poor service and treatment (22%), the feeling that college education is just not worth it (23%), and the indifference students perceive from the college or university (27%) [2]. A study conducted at West Virginia University concludes that one of the major reasons students transferred from engineering to other majors is inadequate advising [3], and a survey administered at the University of Maryland shows that the students' positive or negative attitude towards the institution strongly influences whether they stay or leave, respectively [4].

Data compiled by ACT (American College Testing) demonstrates that currently, the National first- to second-year retention rate in 4-year public institutions averages 65.6%. Meanwhile, the mean for the National 5-year graduation rate of 4-year public institutions is 37.9% [5]. Regarding STEM degrees, overall four-year engineering graduation rate is 22% in public schools and 45% in private schools [6]. The rate varies greatly from one institution to another. At the University of Texas at Austin for example, the rate was 31.0% in 2012 [7], while it was 51.5% at Texas A&M University in 2010 [8], and 66% at Santa Clara University, also in 2010 [6].

According to Dr. Camille Preus, Commissioner of Oregon Department of Community Colleges and Workforce Development, "Every college or university is perfectly designed to achieve the outcomes it currently produces. If nothing changes, nothing changes [9]." Therefore, institutions must change in response to students' needs and other developments. Many universities are responding by implementing programs to improve retention of entering STEM students. For example, two campuses in the University of Wisconsin system, Madison (research-oriented) and Platteville (teaching-oriented), have made attempts to improve the retention of students who enter first-year engineering. Platteville's project, entitled "Improving Student Success through a

Model 'Introduction Engineering Course," consisted of designing a freshman orientation course which addressed five objectives: community building, academic success strategies, personal development, professional development, and orientation. Similarly, Madison devised an Introduction to Engineering Design course with outcomes for students such as: carry out a basic design process, learn and use skills in a team environment, and develop confidence, among others. While some students find these courses very motivating, others still leave for different reasons [10].

Another approach to STEM retention and success was put into action by Grand Valley State University. The results of this NSF funded S-STEM project have been remarkable, with nearly 100% of "at risk" students finishing their degrees in a timely manner. To qualify for this program, applicants are required to have completed the first two years of a STEM discipline with a GPA of 3.0 and demonstrate financial need. The program involves need-based scholarship support of $500-$5,000 per year, mentorship by a faculty member, networking with high impact programs, financial support to engage in research and scholarly activities, group activities to engage with other S-STEM participants, and advising and graduate school preparation activities. These elements combine to reduce the likelihood that students will decrease their course loads, work too many jobs, or even "step out" to earn sufficient funds to finish their education [11]. Experiential learning, engagement, mentoring, and scholarships are the four components of this successful program.

This paper provides details about the internship and research assistantship programs that are being implemented at Texas A&M International University (TAMIU), a Hispanic Serving Institution, located in Laredo, Texas.

II. Internship and Research Assistantship Programs at TAMIU

STEM degrees at TAMIU are offered by the Department of Engineering, Mathematics, and Physics (EMAP) and the Department of Biology and Chemistry (B&C). The STEM faculty is devoted to serving students and integrating their scholarship into teaching and service. The main goal is to prepare students to successful professional careers through the provisions of high quality educational programs and excellent learning and research environments. To promote this objective, the following two programs have been recently developed:

(a) Internship Program

The purpose of the Internship Program is to offer real-world learning experiences to outstanding STEM minority students. Intern duties consist of conducting research or performing work on real-world projects in an area related to Mathematics, Engineering, Physical Science, Chemistry, Environmental Science, or Biology under the direction of a local industry professional, with overall guidance from a TAMIU supervisor. This should invariably increase retention of talented students in the STEM disciplines and accelerate their pace toward obtaining their undergraduate degrees. It should also improve students' preparedness and employability through career planning and industry experience. Additional details about this program are listed next.

Benefits to students:

- Interns are paid $12.00/hour (up to 19 hours per week)
- Interns work on real-world projects/research

- Interns gain experience that help them find employment after graduation
- Interns have the opportunity to present their research results at professional conference

Benefits to employers:

- No cost to the sponsoring organization
- Interns are paid by TAMIU
- Sponsoring organization has the opportunity to train future employees
- Interns work up to 12 months per year

Requirements:

- Interns submit a monthly report describing tasks performed
- Monthly report must be signed by the intern and supervisor
- Interns work up to 19 hours per week
- Interns participate in periodic meetings and their present research/project results

In summer 2012, a total of 14 STEM students held internship positions. All 14 students were Hispanic and 10 of them were female. Their assignments included projects in system management, monitoring and testing water quality, summer camps, intelligent systems, surgical support, medical studies, petroleum operations, soil and foundation analysis, robotics, pediatric dentistry, and engineering surveying. Eight of the interns resigned at the end of summer 2012 due to graduation or going back to school. The subsequent charts present results of a survey completed by these eight students (see Appendix A). As seen in Figures 1-5, each chart covers five survey questions.

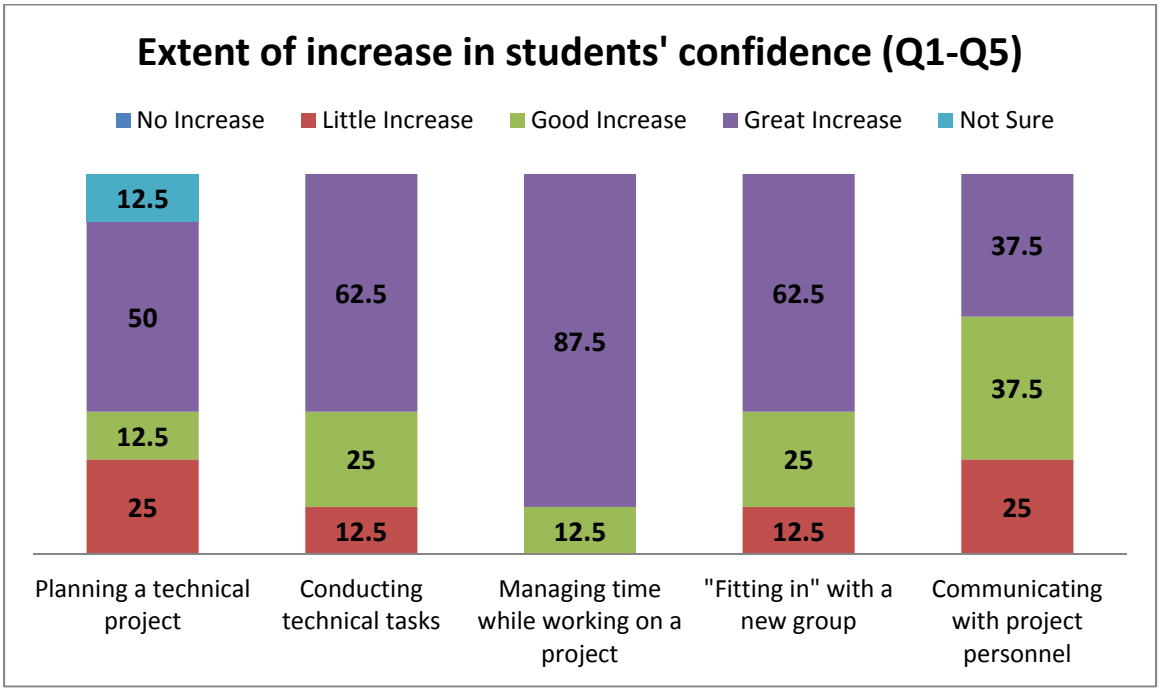

Fig. 1. Feedback on questions 1 through 5

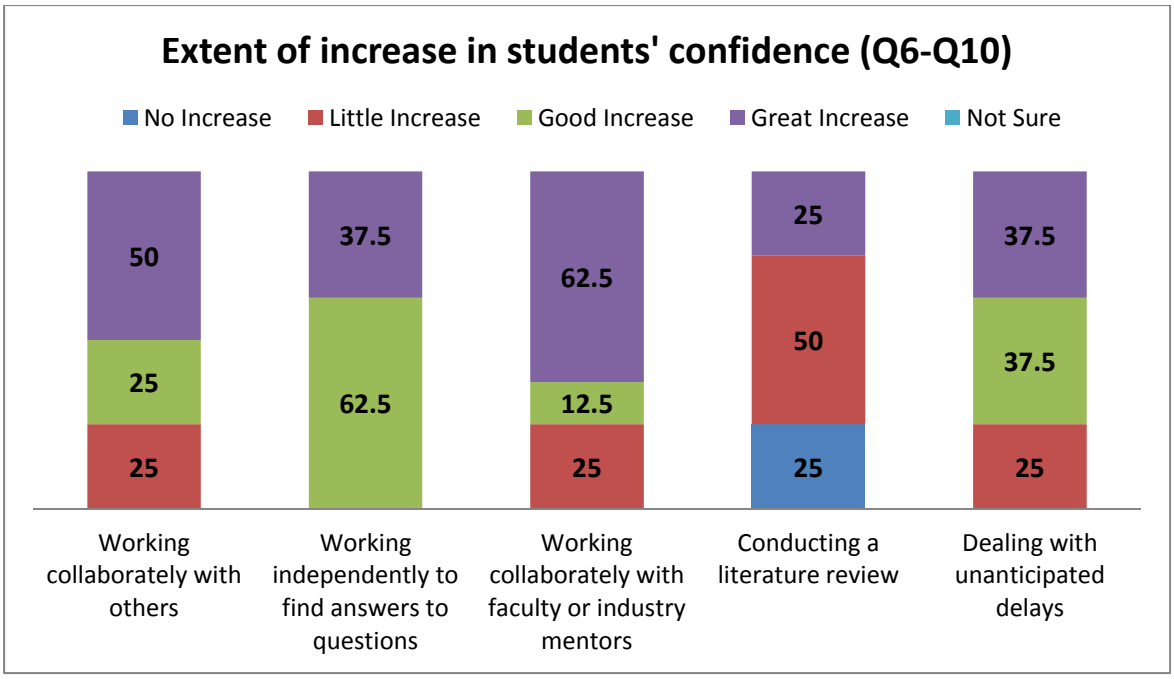

Fig. 2. Feedback on questions 6 through 10

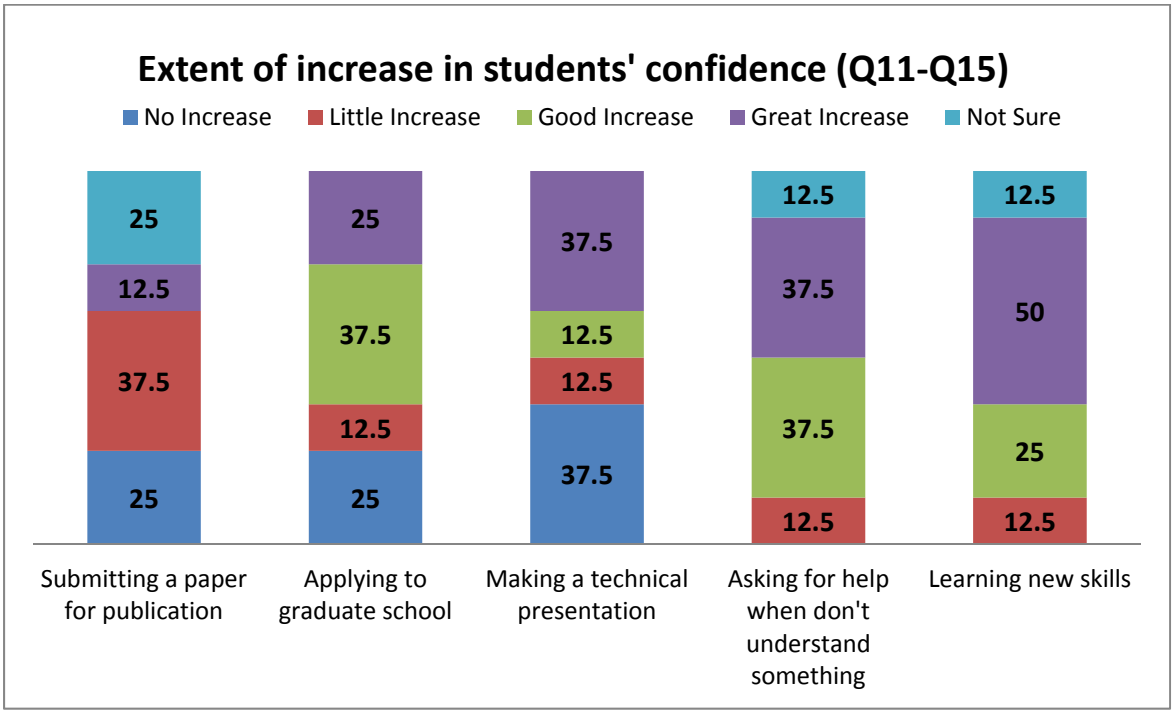

Fig. 3. Feedback on questions 11 through 15

Figures 4 and 5 show the results of two additional questions regarding their future academic plans and career choices.

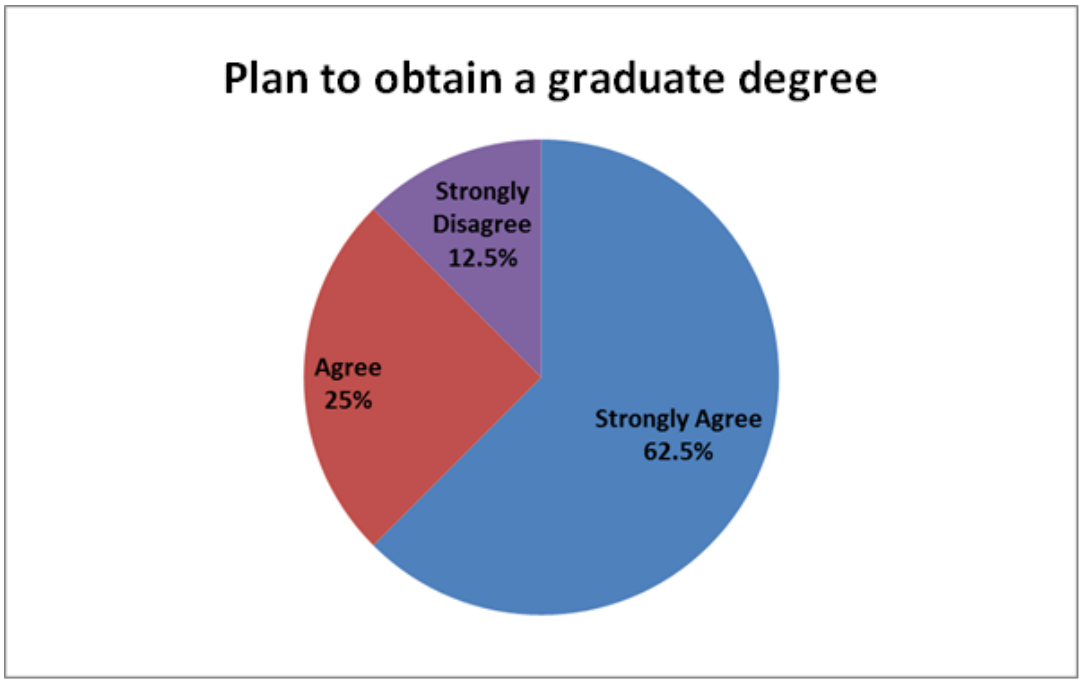

Fig. 4 Student responses regarding their plans to go to college

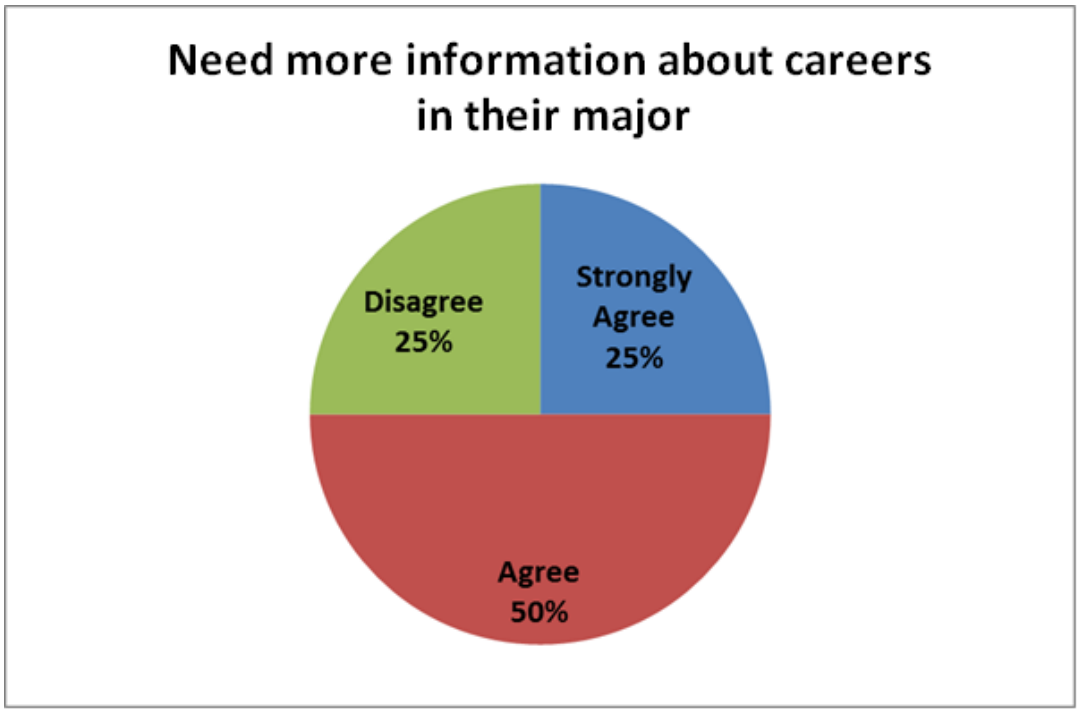

Fig. 5. Student responses regarding the need for additional career information

The succeeding paragraphs summarize student responses to the four open-ended questions.

Q18. Identify what was most valuable to you about the internship experience and explain why you believe it was valuable.

Perhaps the most valuable aspects about the internship were the first-hand experience, knowledge, and diversity gained in the field. These elements helped students to feel comfortable with working with faculty, improve personal work habits, understand real world scenarios, increase ability to work with children, become more responsible and independent, and be inspired by employers who are passionate about their profession. The internship also benefited students academically by giving them an idea of what to expect in the future, to learn about their major before starting to take core classes, to expand their knowledge in the STEM field, and even giving them the opportunity to work in a position they might consider later in their lives.

Q19. How could the internship experience be improved for future participants?

Participants noted that this internship program could be improved by giving it more publicity since some students do not know about it. Also, providing students with more deadlines would facilitate turning in the work on time, having a list of different employers along with what is expected, and hosting meetings with all the interns to share experiences and advice.

Q20. Share any other information/comments that you believe project management should know.

Overall, project management is doing a great job in preparing students for their careers. Students agree on the fact that they learned more than what they expected and that this experience provided them with confidence and certainty about what they wish to do in the future. Internship is a great experience and an opportunity that every student should have. It is a great way to gain more experience in the field by applying it to real life.

Q21. Will you recommend this internship position to other students?

All of the participating students indicated that they would recommend this internship program to others, mainly because of the work experience gained and the career information received.

(b) Research Assistant Program

The undergraduate research program provides STEM students with laboratory research experience. Research assistants are supervised by EMAP and B&C faculty members, conducting research in computer science, mathematics, biology, chemistry, engineering, or physics. Qualifications for this position include a GPA of 2.8 or higher (preferably), MATH 2413—Calculus I with a grade of C or higher, and PHYS 2325—University Physics I, also with a grade of C or higher. This is a paid position with an average of 10 hours per week. In spring 2012, a total of 18 STEM students participated in this program.

Both of these programs are very popular among TAMIU STEM students and have so far produced good results. Whether students choose a practical experience (Internship Program) or lean towards discovery and research (Research Assistant Program), they have opportunity to learn more about their careers while earning extra cash. There is no doubt that these programs

help student retention by keeping participants focused on their field of study and requiring them to take classes and maintain good grades.

III. Conclusion

Students are more likely to succeed if they have clear academic goals, are active learners, and are active participants in campus activities. To contribute to student success, faculty members must be proactive in their approaches while focusing on conditions and approaches that promote student learning. The ultimate goal is to improve the graduation rate without lowering standards while meeting objectives by monitoring progress and making adjustments. TAMIU, along with many other universities across the U.S., is implementing student retention and success strategies to improve student success. It is important to keep in mind, however, that student motivation is key and must be given top priority.

Acknowledgements

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Appendix A

Student Internship Survey -- 2012

Please indicate the best descriptor of the extent to which your participation in the Internship has increased your confidence in your ability to accomplish each of the following tasks.

Task	Extent of Increase In Your Confidence				
	No Increase	**A Little Increase**	**A Good Increase**	**A Great Increase**	**Not Sure**
1. Planning a technical project	❒	❒	❒	❒	❒
2. Conducting technical tasks	❒	❒	❒	❒	❒
3. Managing your time while working on a project	❒	❒	❒	❒	❒
4. "Fitting in" with a new group	❒	❒	❒	❒	❒
5. Communicating with project personnel	❒	❒	❒	❒	❒
6. Working collaboratively with others	❒	❒	❒	❒	❒
7. Working independently to find answers to questions	❒	❒	❒	❒	❒
8. Working collaboratively with faculty or industry mentors	❒	❒	❒	❒	❒
9. Conducting a literature review	❒	❒	❒	❒	❒
10. Dealing with unanticipated delays	❒	❒	❒	❒	❒
11. Submitting a paper for publication	❒	❒	❒	❒	❒
12. Applying to graduate school	❒	❒	❒	❒	❒
13. Making a technical presentation	❒	❒	❒	❒	❒
14. Asking for help when I don't understand something	❒	❒	❒	❒	❒
15. Learning new skills	❒	❒	❒	❒	❒

Consider each of the following statements. Please indicate which category best describes your agreement or disagreement with each statement.

Statements	Level of Agreement/Disagreement			
	Strongly Agree	**Agree**	**Disagree**	**Strongly Disagree**
16. I plan to obtain a graduate degree.	❒	❒	❒	❒
17. I need more information about careers in my major	❒	❒	❒	❒

18. Identify what was most valuable to you about the internship experience and explain why you believe it was valuable.
19. How could the internship experience be improved for future participants.
20. Share any other information/comments that you believe project management should know.
21. Would you recommend this internship position to other students? ____ Yes ____No