

An Internship Program that Promotes Student Success in Engineering and Engineering Technology

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Abstract - STEM education has been given much attention in recent years. A major concern, however, is that success rates in U.S. colleges and universities are still low. While a number of factors affect student success, active learning approaches such as research and internship experiences, hands-on experimentation and projects, challenged-based instruction and problem solving, and peer-tutoring, have been identified as high impact activities that improve student retention and success. This paper describes a successful internship program that has been in place for several years at Penn State Harrisburg. Survey results show that the program is helping students increase their abilities to succeed after graduation.

I. Introduction

Science, technology, engineering, and mathematics (STEM) education is crucial to innovation, progress, and national competitiveness. A major concern, however, is that success rates in U.S. colleges and universities are still low. The National first- to second-year retention rate in 4-year public institutions averages 65.6% and the mean for the National 5-year graduation rate of 4-year public institutions is 37.9% [1]. In the case of engineering, the overall four-year graduation rate is 22% in public schools and 45% in private schools [2].

Internships have been used at many institutions of higher education to improve student retention [3], enhance student learning [4], or offer hands-on practical experiences [5-8]. This paper provides details about an internship program in the School of Science, Engineering, and Technology (SSET) at Penn State Harrisburg that has been in place for several years. Survey results show that the program has contributed to student retention and success and has influenced their future career goals.

II. Background Information

The mission of SSET is to provide excellence in undergraduate, graduate and professional educational programs. The School pursues and supports research, development, and scholarly activities through traditional and innovative means as well as through cooperative relations with regional industries and professional communities. SSET offers 10 Bachelors of Science STEM degree programs in Biology, Civil Engineering, Computer Science, Electrical Engineering (EE), Electrical Engineering Technology, Mathematical Sciences, Mechanical Engineering, Mechanical Engineering Technology, Structural Design and Construction Engineering Technology (SDCET), and Science.

Engineering and engineering technology students in SSET have the opportunity to participate in an internship program where they are exposed to real-world learning experiences. Students work

under the direction of industry professionals, with overall guidance from a faculty advisor who coordinates the program.

The internship program was triggered in 1998 by the electrical engineering program faculty's decision to develop a curriculum that includes a required one credit internship program while promoting early internship during the timeframe spanning the second semester of the sophomore and the first semester of the junior year. Gradually, as the program gained acceptance by local companies, the program faculty decided to build upon the success of the early internship program by allowing the substitution of an additional optional three credits of internship in place of one of the program's technical electives. While EE and SDCET are the only programs that require an internship, the optional internship approach has now been expanded to the other programs in SSET with each program applying its own approach to granting internship credit to its students.

At the same time, local employers have started to recognize the importance of establishing and maintaining their own internship programs in cooperation with the local colleges and universities creating an atmosphere of cooperation that benefits all parties involved. In fact, many have reached a point where a significant number of the interns no longer rely on college credit and consider either summer or year-long internships an integral part of their educational activities. The data presented in this paper is based on responses received from a sample based on the three most recent semesters while in fact, the majority of students holding internship positions in area companies choose not to register for credit. One can therefore argue that the internship culture has now been established among our students and with or without credit, a significant number of our students now recognize its critical role in their academic and professional growth.

Benefits to students:

- Interns are paid at a \$9 to \$30 per hour rate. The program strongly encourages students to seek paid internships as much as possible
- Interns work on real-world projects/research
- Interns gain experiences that help them find employment after graduation
- Interns have the opportunity to present their research results at professional conferences and regional student competitions sponsored by professional societies such as IEEE and ASME
- Even in cases where the intern doesn't get hired by the host company after graduation, the internship provides a great learning experience and serves as a significant resume booster
- The internship often leads to a relevant employer-sponsored capstone design project.

Benefits to employers:

- Sponsoring organization has the opportunity to train future employees. On a consistent basis, many local companies hire interns upon graduation.

- Interns work on significant portions of projects for the employers, providing for a cost effective supplement to their engineering workforce
- The employers build a stronger relationship with the local colleges and their programs, and gain direct access to local talent
- Provides the employer with the opportunity to help create a linkage between the employer's technical needs and the college program's curricular content.
- Provides employers with greater access to local talent
- Provides for better visibility for the employer while helping local economy by placing more emphasis on hiring local talent.

Requirements:

It is the responsibility of students to secure internships prior to registering for the internship credit. However, Penn State's Career Services Office offers a significant number of opportunities including internship fairs, on-campus interviews and recruiting, and an extensive online resource for connecting students with employers (Nittany Lion Career Network). In addition, individual programs utilize their own alumni resources for assisting students with securing internships and full-time employment. As an example, the EE Program uses a 250 strong loyal alumni pool for this purpose.

Once an internship is secured, the steps listed below are followed.

- Intern submits a request to the internship coordinator including supervisor and company information in addition to the required tasks.
- Internship coordinator registers the intern and directs the intern and the supervisor to a web link listing forms for three sets of evaluations that need to be submitted periodically during the internship. The link also points to a file that provides additional information for the supervisor. This is posted at <<https://harrisburg.psu.edu/science-engineering-technology/internships>>. Every evaluation is followed by a response from the internship coordinator including any necessary feedback.
- Upon successful submission of the final evaluations, the internship coordinator provides instructions for a brief final report that would need the supervisor's endorsement. After the report is submitted and reviewed by the internship coordinator, a satisfactory grade is submitted to the University Registrar.
- Periodic or emergency communication between the internship coordinator and the intern and/or the supervisor happens when there is a need identified by one of the parties.

III. Student Feedback

In academic year 2014-2015, a total of 64 students earned internship credit while holding internship positions. Their assignments included projects in industrial automation; new products design for the connector industry; assisting in the design and fabrication of Digital Survey

Vehicles for surveying pavement conditions; maintenance, rebuilding, repair, and troubleshooting generator and generator systems; learning proprietary software and systems in order to inspect and analyze pavements for various distresses; simulation and production of connectors and cables; waste water management; project estimation and engineering; mobile application development for linguistics and speech-based audio software; inspection of materials and workmanship on highway or bridge construction projects; process/manufacturing engineering; and quality engineering.

The subsequent charts present results of a survey completed by 42 students (see Appendix A). As seen in Figures 1-4, each chart covers several survey questions.

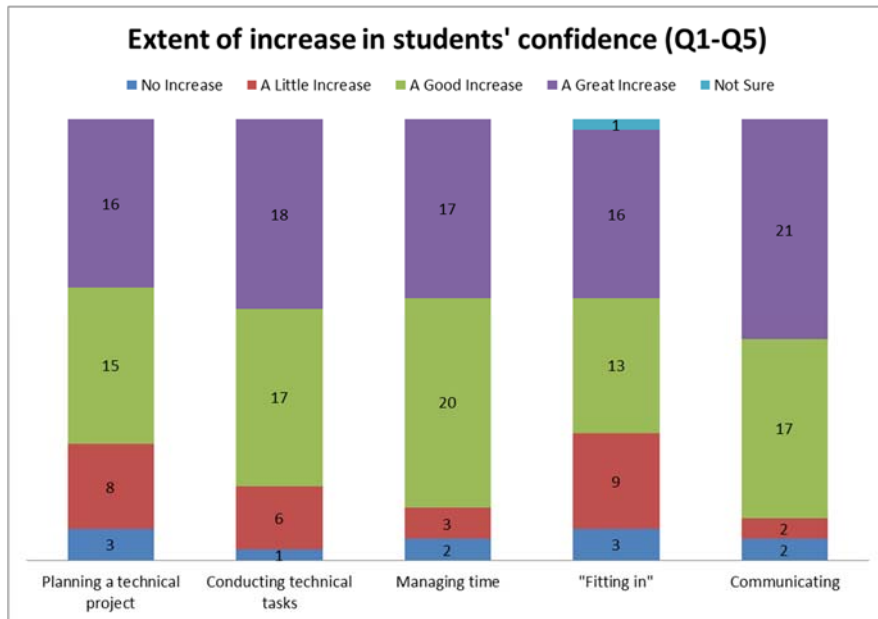


Fig. 1. Feedback on questions 1 through 5

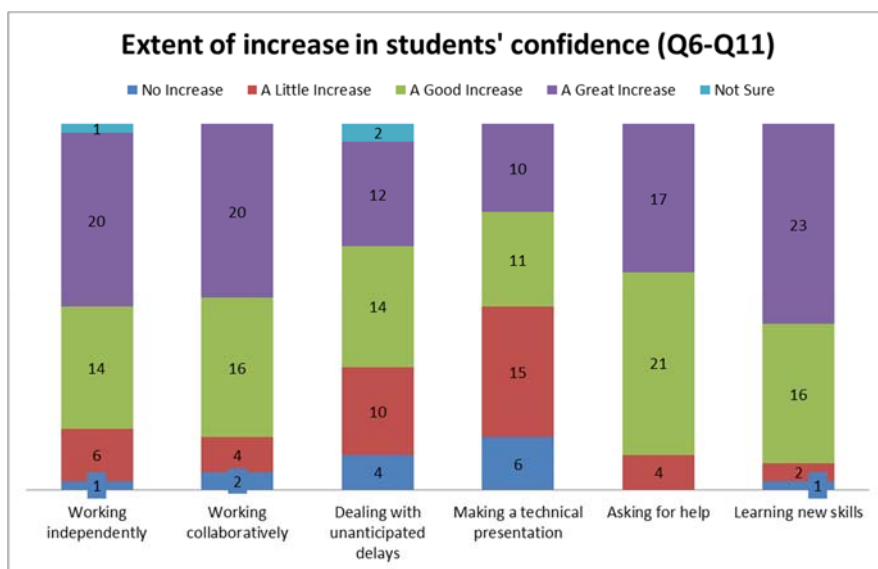


Fig. 2. Feedback on questions 6 through 11

Figures 3 and 4 show the results of two additional questions regarding their future academic plans and career choices.

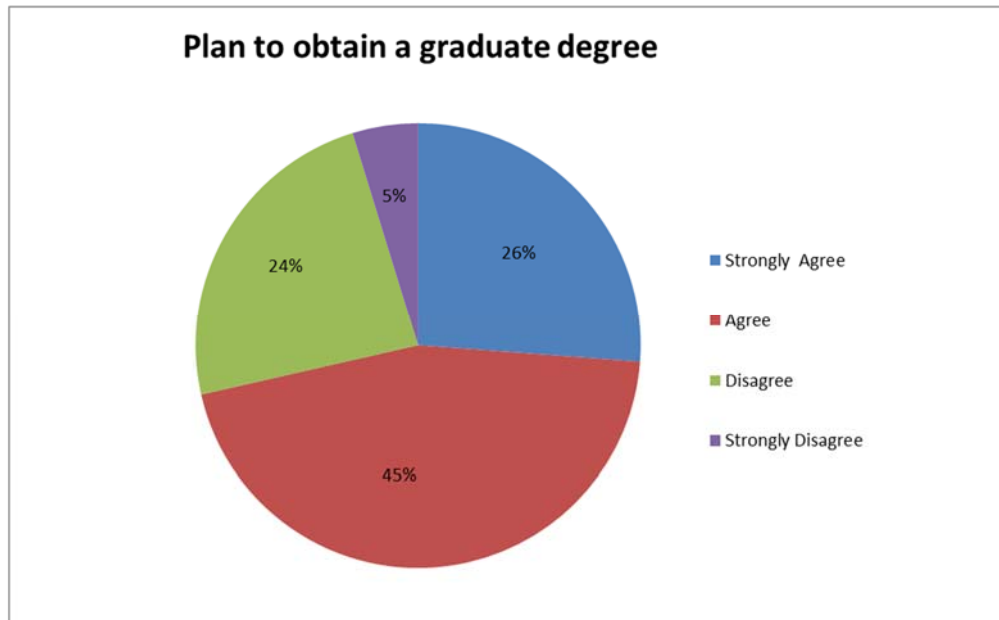


Fig. 3 Student responses regarding their plans to pursue graduate studies

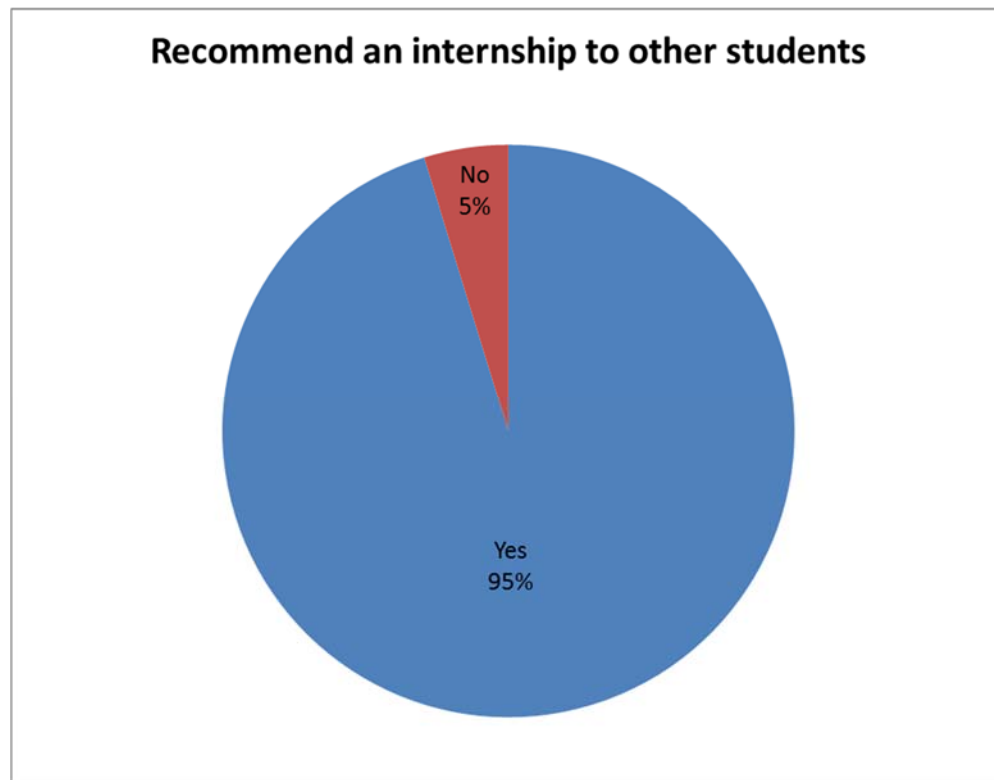


Fig. 4. Student responses regarding recommending the internship program to others

The following paragraphs summarize student responses to the following open-ended question:

Question: How could the internship experience be improved for future participants?

Student responses:

1. *A good internship is based on personal desire and internship location. Personally speaking, the internship wasn't really worthwhile, but I did do and learn something.*
2. *The technical internship aspects of the internship helped the research for my thesis.*
3. *We should advocate for students to apply multiple internships during their academic career and also to take internship earlier than taking SETT 295 or 495.*
4. *We should continue to encourage students to seek internships.*
5. *We should let more students know there is SSET 495. Being able to achieve credit hours will encourage students to seek internship.*
6. *Having more employers to offer internships and at higher levels. Some companies just look for cheap free labor and others don't want to train interns for just few months.*
7. *We should have more projects prepared to work on.*
8. *We should get a little more hands on work.*
9. *More update through the semester and a rubric for the final report will be helpful for students.*
10. *We should give students more opportunities to work on Professors' projects.*
11. *Employers should be clear on what students should gain through an internship experience, and help student accomplish that.*
12. *Intro level of signal integrity is enough for future students, and don't need to be changed.*
13. *Research/paper seminars should be earlier in the program.*
14. *Needing to pay for the program seems inappropriate. Students that are already employed should be exempt from the requirement. The program needs to be geared more towards each student's situation and not a one size fits all requirements.*
15. *Employer should use the intern to the best of their ability.*
16. *Company has more work related to design would be beneficial.*
17. *University should acquire partnerships with companies for routine internship opportunities. University should guarantee the company quality students to fill the intern positions. More internal internship opportunities in university will be better.*

18. *Any more oversight would be a burden while doing the internship.*
19. *Having good time management.*
20. *This internship was not very valuable for a student who worked for doing similar job a couple of years before.*
21. *Getting hired was the hardest part.*

IV. Conclusion

Active learning approaches, including internships, have been identified as high impact activities that improve student retention and success. This paper provided details about an internship program that has contributed to student retention and success. The internship is beneficial to both employers and participating students. Survey results show that 95% of students would recommend the internship program to others.

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Appendix A. Student Internship Survey -- 2015

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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Conducting technical tasks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Managing your time while working on a project	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. "Fitting in" with a new group	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Communicating with project personnel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Working independently to find answers to questions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Working collaboratively with faculty, industry mentors, and others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Dealing with unanticipated delays	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Making a technical presentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Asking for help when I don't understand something	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Learning new skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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

Statements	Level of Agreement/Disagreement			
	Strongly Agree	Agree	Disagree	Strongly Disagree
12. I plan to obtain a graduate degree.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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

14. Would you recommend this internship position to other students? ___ Yes ___ No