

Performing Research at a Primarily Undergraduate Institution

Carmine Polito, Ph.D., P.E.

Department of Civil Engineering, Valparaiso University, Valparaiso, IN 46383

Doing journal-quality engineering research at a primarily undergraduate institution (PUI) presents a unique set of challenges and benefits, many of which are not experienced at Research 1 institutions. While there are challenges in performing research at a PUI, namely a lack of time, a lack of ready funding, and a lack of Ph.D. students to actually perform the research, these obstacles should not be thought of as insurmountable. Along with the challenges, there are numerous benefits to using undergraduate students as research assistants, both for the student researcher and for the faculty member.

Since the middle of the last decade the author has been working with students to perform research in both the lab and the field. Of the seven undergraduates he has worked significantly with, five have gone on to earn Masters degrees, another is currently working on her Ph.D., and one is in the process of applying to graduate school. This paper will examine the challenges and benefits the author has found in attempting to perform research at a primarily undergraduate university. Additionally, the typical problems associated with this situation and ways of minimizing the difficulties and maximizing the experience for both the student and the faculty member will be discussed.

While both are charged with educating young people, primarily undergraduate institutions differ greatly from their cousins, the Research 1 institutions. The National Science Foundation defines a Primarily Undergraduate Institution as a:

U.S. two-year, four-year, masters-level, and small doctoral colleges and universities that (1) grant baccalaureate degrees in NSF-supported fields, or provide programs of instruction for students pursuing such degrees with institutional transfers (e.g., two-year schools), (2) have undergraduate enrollment exceeding graduate enrollment, and (3) award an average of no more than 10 Ph.D. or D.Sc. degrees per year in all NSF-supportable disciplines.¹

Primarily undergraduate institutions have traditionally focused more on teaching than on research. As a result, professors at PUIs often lack the time and the facilities to dedicate to research that are commonplace at Research 1 institutions. Additionally, they often lack funding and qualified graduate students to perform the research.

The Challenges

Faculty members attempting to perform journal-quality research at a school which only has undergraduate students typically find that they face four major hurdles that must be cleared: a lack of time, a lack of facilities, a lack of funding and a lack of graduate students.

While faculty members at Research 1 universities tend to teach one to three courses a year, the teaching loads at undergraduate universities are typically in the range of six to eight courses per year. When combined with the time required for advising students and service to the university, this leaves precious little time for performing research.

The teaching laboratories found at PUIs are typically not set up for performing research. They often lack the advanced equipment required and they may be only available when classes are not using them.

Without graduate students, funding can be difficult to obtain through the classic “write a research grant, get funding” model. Many years ago, as a fresh-out-of-school assistant professor, the author’s first research grant application was declined with a comment from one of the reviewers saying “This is a very interesting idea, but without graduate students, the investigator will not be able to perform the research”.

The last hurdle that must be overcome is a lack of trained, dedicated researchers, who in academics most often take the form of Ph.D. students. This shortage requires the researcher to either perform the research themselves or to develop a workforce capable of performing the required tasks.

As daunting as these challenges may seem, there are realistic ways of overcoming them, which are available to most faculty members at PUIs. Some of these tactics are presented below.

Solving the Time Problem

Perhaps both the easiest and most difficult of the four challenges to overcome is finding the time to perform the research and write the article. While weekends and evenings may be free for research, they are often taken up by family commitments or work associated with teaching. There are several other solutions to this dilemma:

- The most obvious is to work during summer when school is not in session. Most faculty members at PUIs are on nine- or ten-month contracts, leaving the summer open for research. The summer is also an excellent time to use undergraduate students as

researchers as they are not distracted by their classes and are available for large blocks of time.

- It may be possible to arrange one's teaching schedule so as to maximize the time available for performing research. Over the last several years, the author has worked with his department chair to make this happen. This semester, the author is done with classes by 9:00 AM three days a week and by 11:00 the other two; this leaves large blocks of time available for working in the lab and writing. If one can arrange to have one day a week without classes, this is even the better.
- Get out of the office, especially while trying to write. The office can be a place of near constant distractions. The author has taken to blocking off time once a week (starting in the mid-afternoon) and going to an undisclosed, off-campus location to write and edit, and perhaps most importantly, to sit quietly and think about the research.

Dealing with a Lack of Facilities and Funding

- The lack of suitable facilities and funding are very often linked (if one lacks funding, it is difficult to get facilities). There are some ways to minimize the impacts of this situation.
- Collaboration with other faculty members, especially at Research 1 universities can alleviate the need for facilities and can even provide funding. The NSF's National Earthquake Engineering Simulation (NEES) research program required that each grant application included a faculty member from a PUI.
- There may be grant money set aside specifically for researchers at PUIs. For example, NSF's Major Research Instrumentation (MRI) program sets aside a portion of their \$90 million annual award pool specifically for PUIs. Additionally, the NSF's Research in Undergraduate Institutions (RUI) program exists specifically to foster research at PUIs.²
- Find research that doesn't require a lot of resources. Prior to obtaining laboratory equipment through NSF's MRI program, the author published two journal articles based on statistical modeling of cyclic triaxial tests. These papers required little more than a computer and a data set (composed of data left over from his dissertation and data found in the literature).
- Lastly, while the faculty member may not have funds to support a student, they can always pay them with course credit. Most engineering programs have mechanisms in place that allow students to receive independent study course credit for performing research.

Finding Qualified Research Assistants

Most university research is carried out by doctoral students under the guidance of their thesis advisers. At a PUI, finding suitable research assistants can be difficult and it may actually be quicker and more efficient for the faculty member to perform the work themselves rather than train a student. That said, undergraduate researchers can be trained and made valuable members of the research team.

- The first and most obvious source for suitable candidates is the faculty member's classes, especially upper division classes which are often full of students who are already thinking of attending graduate school.
- While freshman and sophomores may be suited for many tasks, juniors and seniors are typically better suited for the more complicated tasks. One excellent pool of candidates is students who graduate in the spring and plan to attend graduate school in the fall. These students are typically intelligent, motivated and often have their summer available.
- Birdsong and Schuster³ recommend developing and maintaining a cadre of student researchers who support and train each other. Given the relatively short time that an undergraduate student has to serve as a productive research assistant, developing a pipeline of students where the experienced researchers help train the new researchers can both increase productivity and lower the faculty member's time commitment.

The Benefits

Given the difficulties outlined above, a reasonable question might be "Does performing research have any benefits?" The good news is that performing research at a PUI has benefits for both the student performing the research and the faculty member overseeing the research.

For students the most tangible benefit of performing is the improved analytical and problem-solving skills they develop, which will benefit them whether they matriculate to either graduate school or industry. Additionally, when compared to their peers, students who perform research have a higher retention rate and are more likely to continue on to graduate school.²

Additionally, students who perform research and are allowed to take part in the writing process and who present their findings publically, develop writing and speaking skills that are crucial to success in their post-baccalaureate careers. These improved skill sets and experiences will likely increase the opportunities for the student in terms of being accepted to graduate school or being hired by an engineering firm.

For the faculty member the benefits are even greater, both in terms of their career and their personal sense of satisfaction.

In terms of the faculty member's career, two of the biggest benefits are publishing with the student (which is typically looked upon very favorably by both tenure and promotion committees) and the fact that performing research gives the researcher new knowledge and new outlooks, both of which tend to improve one's classroom performance.

Most faculty members at PUIs are there because they want to focus on teaching. In the author's opinion the greatest benefit of working with undergraduate students is that it is teaching at its purest form: one on one. Another bonus is that one is typically teaching about a topic that one is excited about, but may not get to teach in their classes. Finally, it is a chance to serve as a mentor to the student and potentially have a significant, positive impact on the life and their career.

Conclusions

The author has been performing research utilizing undergraduate research assistants for the better part of a decade. Along the way he has found many challenges and many benefits as well as potential ways to overcome those challenges. The challenges include finding time, resources and students. The benefits include teaching and mentoring students as well as publishing and improving teaching skills.

Acknowledgements

This paper is dedicated to my students Braden Katterheinrich, Rachel Husfeld Calafell, Jeff Travis, Jeff Macke, Changbum "David" Sohn, Erin Dillon and Andrew Bain, each of whom taught me at least as much (and often more) than I taught them. Vaya con Dios, mis amigos.

References

- [1] National Science Foundation, <http://www.nsf.gov/pubs/2000/nsf00144/nsf00144.htm>
- [2] Coyne, R. "NSF's RUI Program, Perspectives from the Inside" Council on Undergraduate Research Quarterly, December 2004, pp. 62-66.
- [3] Birdsong, C and Schuster, P. (2006). "Research in the Undergraduate Environment" *Proceedings of the 2006 ASEE Annual Conference & Exposition: Chicago, IL*, June 18, 2006. Paper 2006-1447. 11 pages.