AC 2012-3165: PARTICIPATION IN AN UNDERGRADUATE TEACHING ASSISTANTSHIP: EXPERIENCES, INFLUENCES, AND OUTCOMES

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Abstract

For the past decade, the First-Year Engineering Program at a medium sized, Midwestern private institution has utilized undergraduate students as graders / teaching assistants for their Introduction to Engineering Systems course sequence. Anecdotally this has always been a well-functioning program in which students and faculty have a positive, mutually beneficial relationship that likely led to the selectivity of the program in its current form. The number of applicants has varied from year to year, but there have always been significantly more applicants than positions available and there is a high return rate (students continuing in the role over multiple semesters or years). For this reason, it was determined that a more formal assessment of the program was needed to better understand the factors contributing to its success both from the perspectives of the student assistant as well as the students they serve. This study data is from 2005-2011 and takes a dual approach of: (1) historical categorization of the demographics and performance of the student assistants and (2) qualitative assessment through open ended responses to a survey questions relating to their experiences and future plans. There were a total of 29 respondents that were a mix of: current student assistants, former student assistants (students that are still undergraduates but no longer student assistants), and post-graduate student assistants (students that have graduated from the study institution and are now working in industry or are in graduate programs). Results reveal that student expectations are met by the program and the majority of students self-rated their performance as good or very good. Student assistants indicated that working with first-year students either in class or outside of class was the aspect of the job they enjoyed the most and grading was the aspect they enjoyed the least. All respondents indicated some positive benefit from participating in the program, either direct or indirect in terms of listing it on a resume or discussing it in an interview. Candid feedback (good and bad) on the program is reported by both students that continued over multiple semesters and those that did not continue. Finally, plans for the future of the program and changes such as additional training and recognition are discussed.

Introduction

With the wide range of research citing the need to transform traditional lecture courses into more interactive and responsive environments^{1,4,7,10}, many colleges and universities have found it necessary to transform courses through the use of additional sections and discussions. However, these changes often require additional instructor hours and pay acting as a strong limitation to the modifications. Therefore, many colleges and universities have opted for the inclusion of undergraduates as teaching assistants working across many disciplines^{2,12} to defray the costs of instructors and graduate student staffing. Similar to peer assisted learning systems, this can often

be a useful practice for the students taking the course by: (1) allowing the class to be broken down into smaller sections for additional one-on-one attention, (2) creating more opportunities for appropriate feedback which encourages students to work at a regular pace⁶, and (3) providing them with role-models in their choice disciplines¹³. In many cases, undergraduate assistants are able to establish a better connection to the students which we believe results in higher retention rates. And while the use of undergraduate teaching assistants at many universities was initially established to address staffing needs, many schools have reported anecdotal evidence for added benefits to the student assistants as well, including^{2,5,11,12}:

- (1) By having an opportunity to teach others the material, undergraduate assistants also benefit. In learning to explain topics, the assistants often reveal their own misunderstandings and are able to expand on their own knowledge.
- (2) Undergraduate assistants are often faced with describing many sections of the course material, and therefore, their communication skills develop much more quickly due to constant practice with students. They also develop excellent teaching skills that can serve them well depending on their future career paths.
- (3) When acting as an authority figure for the course, the undergraduate assistants gain valuable practice in leadership skills.
- (4) By participating in a selective and rigorous program, the shared experience often creates a strong connection between the assistants, providing a useful support system during their education and leading to increased retention in their chosen discipline.

And further, the students enrolled in the course are believed to receive higher quality instruction (through smaller class sizes) and a more relaxed classroom environment in which students are more likely to ask questions^{2,3,11}.

In short, while undergraduate teaching assistants may arise for pedagogical or monetary reasons, there are significant benefits to the university and student assistants. This study aims to profile the successful program developed for the Introduction to Engineering course, and to assess the attitudes of student assistants who are serving (or have served) in this role.

Program Background and Methods

During the 2000-2001 school year, a new approach to the Introduction to Engineering course sequence at the University of Notre Dame was developed involving cross disciplinary hands on design projects. Since inception, the course sequence has enrollments that have ranged from ~350-450 first-year engineering students and involves large group lectures that introduce the background / theory of the projects and small group learning center sections. The learning centers are groups of ~25-35 first-year students led by an instructor and an undergraduate student assistant. The student assistant is responsible for grading homework assignments, helping to facilitate / answer questions during class, and staff evening office hours. Student assistants for the course are engineering students that are sophomores, juniors, and seniors who complete an

application and interview process to be considered for the position. They are hired for the entire school year and are typically asked to return for subsequent years. There is some attrition, student assistants may not return for another year due to graduation, study abroad programs, research opportunities, or other time conflicts. On average there are six (out of fourteen) available positions for new hire or re-hire (students who did not work as student assistants the previous year) each school year. We know that overall student assistants have a positive impact on the students they interact with, this is evidenced by the number of applications that mention how their positive experience with their student assistant motivated them to apply for the position themselves. In fact, in the past 5 years 47%¹ of applicants have indicated that interaction as a motivating factor for pursuing the position (this is in a free response section of the application, so students are not prompted specifically -- they volunteer it).

All student assistants that have served in the course from 2005-2011 were invited to participate in the survey. Regardless of the duration of their service or the circumstances under which they discontinued service they were invited to provide feedback. Table 1 shows the number of potential and actual respondents. Respondents fall into three categories: (1) current student assistants that work on the course during the 2011-2012 school year, (2) students that discontinued service to the course but are still undergraduates, and (3) students that previously served as a student assistant but have since graduated with their Bachelor's Degree. Overall, there were 29 respondents (out of a possible 48) for a 60.4% response rate. Of those, 11 were female, 17 were male, and 1 did not report. As shown in Figure 1, the average duration of service of a student assistant was 4.14 semesters.

Table 1. Potential and Actual Respondents to the Student Assistant Feedback Survey

	Actual Number of Respondents	Potential Number of Respondents	Response Rate
Current Student Assistants	11	14	78.6%
Former Student Assistants	8	10	80.0%
Post Graduate Student Assistants	10	24	41.7%

¹ 2011-2012 School Year 18/38 applicants, 2010-2011 School Year 17/39 applicants, 2009-2010 School Year 17/32 applicants, 2008-2009 School Year 6/14 applicants, 2007-2008 School Year 8/17 applicants.

Figure 1. The Number of Semesters of Service as a Student Assistant

The surveys were sent out during November 2011 as three slight variations of each other (mainly verb tense changes so that the survey made sense depending on if they were current students). The survey was sent out via the web using Survey Monkey®, with one reminder to complete the survey sent out 1 week later. The current students were contacted via their university e-mails. The e-mail addresses for the students that had already graduated were obtained through the Alumni Association. There were e-mail addresses on file for all but one of these former student assistant, however it is not clear if the accounts provided is actively used, and there was a lower response rate for that group. Qualitative analysis to the open ended survey questions involved the researchers meeting to discuss the findings, and through triangulation came to agreement in the themes that emerged from student responses. For the quantitative data analysis, data were coded such that a more positive response was a higher value, and a less positive response was coded as a lower number. The survey questions are outlined below:

Survey Questions:

1. Please tell us why you originally applied to be a student assistant.
2. What were your expectations for working as a student assistant?
3. Has the student assistant position met your expectations? Yes or No. Please Explain
4. Please rate your level of satisfaction in working as a student assistant.
Extremely Satisfied Somewhat Satisfied Neutral Somewhat Dissatisfied Extremely Dissatisfied
5. Has any aspect of the job surprised you? Please explain
6. How would you rate your performance as a student assistant?
Excellent Very Good Good Significant room for improvement Poor
7. Please describe at least one skill or ability that you hoped to improve upon through this role.
8. & 9. What do you enjoy most / least about this position?
 - Interaction with first-year engineering students during class
 - Interaction with first-year engineering students during evening hours
 - Interaction with other student assistants
 - Interaction with course instructors
 - Grading
 - Pay Check
 - Special Events
 - Other
10. How could we make this a better experience for future student assistants?
11. Has your experience as a student assistant ever been of benefit (direct or indirect) in helping you to achieve longer term career or educational goals? Check all that apply.
 - Listed on a resume (currently or previously)
 - Discussed in a job interview
 - Discussed at a job fair
 - Listed in a portfolio
 - Indicated on an application (graduate school or employment)
12. Have you ever seriously considered leaving engineering? Yes or No
13. How likely is it that you will be working in an engineering-related field 3 years post-graduation? (Including engineering graduate studies)
Definitely will Almost definitely will Probably will Probably will not Almost definitely will not Definitely will not
14. How many semesters have you worked as a student assistant? (Including the current semester) 1- 7
15. Gender Male Female
16. Any final thoughts on your experience as a student assistant

Results

In response to why they applied to be a student assistant a few themes emerged: (1) helping others --many indicated that they wanted to help First-Year students in their transition into engineering since it was difficult for them, (2) resume builder --others also indicated they needed a job anyway and it was related to engineering, and (3) they looked up to their student assistant when they were first year students:

“Honestly, I was mainly looking for an on campus job and something to build my resume. I decided to pursue the student assistant job because I have always enjoyed explaining things to other people, and I thought I would most likely be able to help the freshmen a lot with their intro class.” – Current Student Assistant

“I originally applied to be a student assistant to have an opportunity to work with students who were going through some of the same experiences that I did as a freshman engineer, including adjusting to the rigorous curriculum, developing college-level study strategies and time management, and evaluating whether or not engineering was right for me. I thought it would also be a good way for me to work on my communication, leadership, and teamwork skills while learning new technical things.” – Former Student Assistant

“I applied to be a student assistant because I thought I could do a good job instructing freshman engineers. I admired the SA's when I was a freshman, which helped convince me to apply. I also expected that I would learn a great deal about teaching and leading my peers.” – Post Graduate Student Assistant

All of the survey respondents indicated the position met their expectations and they were either satisfied or extremely satisfied with the position. The explanations from students ranged from the nuts and bolts of responsibilities to the rewards of helping others.

I expected to grade homework, be available during office hours, and answer student's questions about homework and engineering in general. – Former Student Assistant

I expected that helping the freshmen would be a rewarding experience and help me to always keep the fundamentals of engineering in my mind. – Current Student Assistant

I loved it! My experience with being a student assistant actually encouraged me to be a TA in graduate school as well. I loved the camaraderie with the other student assistants and getting to know the "behind the scenes" for the class that I took. The pay was good, I liked the professors, and I liked my students. – Post Graduate Student Assistant

Although respondents indicated it met their expectations, when asked if there were any surprises we did get some very important feedback that students did not feel adequately trained or were not given adequate guidance on grading.

“I think I was slightly surprised at the kind of "lack" of training we received for new modules that I did not necessarily do when I went through the program. I thought rather than having weekly meetings in the board room, the time could have been better served by having the meetings in the computer lab where we could actually go through the learning center at an elevated speed”. – Former Student Assistant

“The only thing that has surprised me is the difficulty while grading homework. I never know exactly how many points to take off or what to do if they just didn't understand the question in the first place.” – Current Student Assistant

“I have been surprised by how much I have learned from this job that I have been able to use in my classes.” – Current Student Assistant

Survey respondents were asked to evaluate their performance as a student assistant, and the breakdown of responses is shown in Figure 2. All of the student assistants rated themselves somewhat favorably (good, very good, or excellent) and by the authors’ assessment not unrealistically so – the vast majority of them perform very well. Many students indicated that could have improved if they had greater experience / expertise in the subject area as they did not always have the answers (which we don’t expect from them).

Figure 2. Student Assistant’s Self-Assessment of their Performance

“I think that I am very good at being present for and attentive to student's needs. However, I am not always able to answer their questions, due to unfamiliarity with some of the programs being used this semester.” – Current Student Assistant

When asked what skill they felt the improved most upon, many of the survey respondents indicated they improved their technical skills, communication, teaching, or their ability to explain things multiple ways:

“I became much better at helping others look at problems in new ways.” – Former Student Assistant

“My ability to connect and explain problems to someone who did not have as strong a technical background.” – Former Student Assistant

Several of the post graduate survey respondents were able to look reflectively at the experience gained from their role as a student assistant and recognized how it helped them in their classes or in their job – just as was cited by other prior studies¹¹⁻¹³:

“I feel that my ability to program improved greatly in my role as student assistant.” - Post Graduate Student Assistant

My role as a student assistant forced me to prepare and rehearse the subject material in a way I was unaccustomed to. This still helps me today in my current job with the army.
- Post Graduate Student Assistant

When asked about job enjoyment, the student assistants rank the interactions with the first-year students as the most enjoyable part of the job: working with students during class 54% and working with students in the evening hours 46%. On the flip side, 92% of student assistants said grading was the least enjoyable part of the job. In order to improve the program there were many students that suggested that they would like additional training for grading as well as projects and programming.

*“I think doing more hands on training would have helped to do the job more effectively.”
- Former Student Assistant*

“More pre-job training. Maybe more of a meeting once a week to really identify what is going on in class/the center that week.” – Post Graduate Student Assistant

Other student assistants indicated that another form of recognition or opportunity to teach / lead would make the program better.

“Continue to appreciate the work done by the student assistants and looks for their opinions/input when possible.” - Former Student Assistant.

“Give student assistants more ability to lead, either by fully instructing their class section or helping develop content.” - Former Student Assistant.

For those students that did not continue as a student assistant we asked them to share the reasons for that decision, and for most students it was a decision to participate in a different program such as study abroad or to be a residence hall assistant. In a few cases, students felt that they needed to focus on academics or conduct undergraduate research.

I had to stop being a student assistant when I took an RA position. – Former Student Assistant

I left the student assistant role to study abroad in the fall of my junior year. I had an opportunity to be a teaching assistant in a different class when I came back, and decided to take that opportunity. – Former Student Assistant

I stopped being a student assistant so I could have time to do undergraduate research instead. I would have liked to be a student assistant for longer, but I didn't think I'd have enough time to do it on top of classes, research, and my other activities. – Post Graduate Student Assistant

All 29 respondents indicated that they received some benefit from the program, either direct or indirect. Everyone indicated that they had listed the work experience on their resume (either currently or previously). And many indicated they used it as an example in discussions at job fairs or job interviews.

Participants were also asked if they had ever seriously considered leaving engineering when they were an undergraduate and 31% (7/29) said they had considered it. This was lower by comparison the National WECE study for women engineering students across 53 institutions reported 2 out of 5 students (40%) had seriously considered leaving engineering⁷. The following are the comments from those students:

“I did not do very well on my first two exams for engineering required classes. I was quite discouraged, but decided to suck it up and re-ordered my priorities to understand that I do not need to have a 4.0 to be successful.”

“I knew I wanted to do medicine, not engineering, but I stayed because engineering is such a great way to learn problem solving. I also really enjoyed the friends that I met through engineering.”

“I struggled a lot my freshman and sophomore year and was contemplating whether I should try Business Management instead. But I know I could persist through the difficult times and with the support of my friends and family, I stayed in engineering.”

“I was taking freshman physics (2nd semester) and was completely lost. I didn't have a great physics class in high school. Luckily, I got my dorm RA to tutor me a few times, then it all clicked. If I had not gotten help, I probably would of left the program.”

“I've thought about going to business several times”

“The stress of classes such as math and physics (which I do not necessarily use as a Computer Science major) have been frustrating, as the workload of such classes and the difficulty of the exams are definitely frustrating to me.”

Beyond persistence through undergraduate studies, considering professional persistence students were asked their intention to persist in engineering 3 years post-graduation and the results are summarized in Figure 3. Most of the students regardless of their status (current, former, or graduate) had plans to continue in an engineering related field 3 years after graduation. This was more positive than other studies such as Lichtenstein and associates which reported only 42% of students definitely will or almost definitely will work in engineering 3 years post-graduation⁸.

Figure 3. Professional Persistence Summary

Discussion

The current study was focused on assessing a program for undergraduate students serving as teaching assistants. The assessment was from the perspective of the teaching assistants to better understand the benefits to them in participating in the program in addition to finding the areas that the program needs for improvement. Students generally report applying to be a student assistant themselves because they liked their student assistant and want to help first year students adjust to college and engineering. All of survey respondents reported that the position met their expectation and they were either satisfied or extremely satisfied with the position. The reason for their high satisfaction was stated as the interaction and connections made with fellow students, both the first year students taking the course and the community of student assistants.

Some aspects that the student assistants did not expect with this position were the time and difficulty in grading the homework. Several indicated they were pleasantly surprised with how much they gained from the experience, specifically in problem solving, gaining a better understanding of programming, understanding/ explaining multiple approaches to solving a problem, and improving their own communication skills which helped them in their own classes. Finally, they also indicated they felt valued that their input was often sought and used by the faculty teaching the course.

In rating their performance, most felt they were very good at their job with 20% rating themselves as good, 70% rating themselves very good, and 10% evaluating themselves as excellent. This is a realistic evaluation from the faculty perspective. To substantiate their evaluation, the student assistants stated that they spent a good amount of time preparing for class and would help student outside their scheduled work time when approached. Student assistants realized how they improved their abilities from year to year. They also noted that programming was an area that they could improve in themselves to be more effective student assistants.

The student assistants felt that the position improved their skill set. The skills most student assistants cited that improved were their problem solving ability and their communication. They had to adjust their perspective on approaching problems so that it could be explained/ understood by first year students with a variety of backgrounds preparation levels. By grading the homework and working evening office hours, the student assistants also saw various methods of approaching the same problem. This, in turn, helped them to approach their own homework from different directions if their initial approach did not work.

There were two reoccurring messages from the survey. The first was the strength of the one on one interaction between student assistant and first year student. The most enjoyable part of the job was working with the students either during class or in the evening hours. The bonds formed with the first year students lasted. Other studies, for example the WECE report indicated that all students, but women in particular, attach an importance to giving help to others which is believed to help affirm students to continue in engineering (persistence)⁷.

The second message was the difficulty of the grading and need for training. When asked about ways to improve the program many suggested that more pre-job training should be implemented with the lab material, programming, and grading. Some suggested that student assistants should be evaluated by the students to give the accountability (faculty input as to their re-hire status is the current evaluation). It was also suggested that the student assistants could use some time management training and there should be some type of recognition given to outstanding student assistants.

The following are some final (unprompted) comments from the student assistants (entered optionally at the end of the survey).

“I am very happy the program exists. I would never get rid of it. Undergrads interact best with other undergrads. Replacing them with grad students or nothing (just professors) would be detrimental.”

“Although I personally don't like my engineering major, I still feel like the student assistant is vital for the intro engineering. Student assistants are a great way for students to get better insight into the other types of engineering and can see that engineering is tough but possible.”

“I think this job is a very marketable skill for a resume - you may want to emphasize this when asking for people to apply.”

“Being a student assistant helped me be better prepared for grad school. As a grad student, I've had to TA 2 chemical engineering classes (one involving some MATLAB), and I use MATLAB every day for data analysis so grading all those MATLAB homework sets was very useful.”

“Thank you for the opportunity to help out. This has been a great experience for me and I think that having undergraduate SA's is a great thing for this College. I feel that this experience is something that I will look back on in the years to come and be proud of all the students I have helped and have had the opportunity to meet.”

Conclusions

Even prior to conducting this study the student assistant program was recognized as a strong and effective program for the course, faculty, and first year students. Practically speaking, the student assistants free up faculty time by grading homework and holding evening office hours which addresses a staffing need for a large, multi-section course. But this assessment was intended to understand what the benefits are for the student assistant and to gather collective feedback on ways to improve the program. As recognized by other studies^{2,5,13}, benefits to undergraduate teaching assistants include learning material through teaching it, improved communication skills, leadership skills, and relationship building with the students as well as the shared experience with other undergraduate teaching assistants – all of which are believed to have positive implications for persistence. And while this study cannot confirm conclusively increased retention numbers it is believed to be an added benefit. For our course we believe the leadership opportunity involves more than giving student assistants the opportunity to lead other undergraduate students but also the opportunity to lead faculty-- with the exception of the course coordinators, the faculty teaching the course changes annually, and this puts the student assistant in a unique situation of potentially being more experienced with the course than the faculty. As a result, they often have the opportunity to help guide the instructor.

While the feedback from this study was primarily positive, there were areas for improvement. Based on the feedback from the student assistants, additional training will be provided. Specifically, we are developing a workshop for the student assistants prior to the start of each semester which would allow them to practice and prepare before the demands of their own courses begin. The first workshop will take place in August and will cover all the hands on material for the fall semester as well as tips for guiding students to solve problems and answering questions. A second workshop is planned for just prior to the start of the spring semester to cover the material for the upcoming semester. As the projects are similar year to year, a list of frequently asked questions/frequent problems encountered will be generated to be distributed to the student assistants. Next, student assistants asked for more guidance on grading homework assignments. In the past they have just been given a solution and a very general rubric that applies to all homework assignments wherein a proportion of homework points is devoted to correctness, organization, and effort. In the future, students will be given a specific point break down for each assignment. We were in many ways happy to see that student assistants wanted more training because it is an indication to us that we are hiring the “right students” that have a genuine desire to do a good job and not just collect a paycheck. We will continue to solicit feedback and ways to improve the course overall and the program for future student assistants.

References:

1. Bonwell, C.C., and J. A. Eison, Active Learning: Creating Excitement in the Classroom. ASHEERIC Higher Education Report No.1, George Washington University, Washington, DC , 1991.
2. Decker, P. Ventura, and C. Egert. Through the Looking Glass: Reflections on Using Undergraduate Teaching Assistants in CS1. *SIGCSE'06* (Proceedings of the SIGCSE technical symposium on computer science education), March 1–5, 2006, Houston, Texas, USA.
3. P. Dickson. Using Undergraduate Teaching Assistants in a Small College Environment. *SIGCSE '11*(Proceedings of the SIGCSE technical symposium on computer science education) March 9-12, 2011 Dallas, Texas.
4. R.M. Felder and R. Brent. Active Learning: An Introduction. *ASQ Higher Education Brief*, 2(4), 2009.
5. L. Fingerson and A. Culley. COLLABORATORS IN TEACHING AND LEARNING: UNDERGRADUATE TEACHING ASSISTANTS IN THE CLASSROOM. *Teaching Sociology*, Vol. 29, 2001 (July:299-315).
6. G. Gibbs, Using assessment strategically to change the way students learn. In *Assessment Matters in Higher Education: Choosing and Using Diverse Approaches*, edited by S. Brown and A. Glasner, 1999 (Society for Research into Higher Education/Open University Press: Buckingham).
7. Goodman, C. Cunningham, C. Lachapelle, M. Thompson, K. Bittinger, R. Brennan, and M. Delci. FINAL REPORT OF THE WOMEN'S EXPERIENCES IN COLLEGE ENGINEERING (WECE) PROJECT. April 2002. http://www.grginc.com/WECE_FINAL_REPORT.pdf
8. G. Lichtenstein, H. Loshbaugh, B. Claar, B. Chen, S. Sheppard, and K. Jackson, An engineering major does not (necessarily) an engineer make: career decision-making among undergraduate engineers, *Journal of Engineering Education*, 2009.
9. L. O'Moore and T. Baldock. Peer Assessment Learning Sessions (PALS): an innovative feedback technique for large engineering classes. Division of Civil Engineering, University of Queensland, St Lucia, Brisbane, QLD Australia 4072. *European Journal of Engineering Education*. Vol. 32, No. 1, March 2007, 43–55.

10. M. Prince. Does Active Learning Work? A Review of the Research. *Journal of Engineering Education*, vol. 93(3), 2004.
11. S. Reges. Using Undergraduates as Teaching Assistants at a State University. SIGCSE '03(Proceedings of the SIGCSE technical symposium on computer science education) Feb 19-23, 2003. Reno Nevada.
12. E. Roberts. Meeting the Challenges of Rising Enrollments. ACM Inroads. Sept.2011 Vol. 2, No. 3. Pages 4-6.
13. E. Roberts, J. Lilly, B. Rollins. Using Undergraduates as Teaching Assistants in Introductory Programming Courses: An Update on the Stanford Experience. SIGCSE '95 3/95(Proceedings of the SIGCSE technical symposium on computer science education) Nashville, TN.