Session Number 2150

Students Teaching Students: a Pedagogical Experiment

Gregory M. Dick, Stanley J. Kieta,
Christopher A. Decock.
Jerry W. Samples

University of Pittsburgh at Johnstown

Abstract

How do you fill a course and laboratory instructor vacancy on no notice? What happens when the Adjunct Professor cannot arrange a schedule for the laboratory portion of the course? Peer tutoring has been utilized for years in the sciences, math and humanities. Is it possible to use an upper-class student to assist in an engineering technology laboratory setting under the tutelage of a professor? This paper will address the process of using senior students in a digital electronics lab as the in-class arm of the adjunct. Comments on the process for selecting the students, coordination with the "charge" instructor, the thoughts of the instructor, the thoughts of the senior students and finally the impressions of the students in the class will be presented. The process is not a way to eliminate faculty. Rather it is an effort to provide the best education possible when an immediate need surfaces and to investigate a teaching option that may have value in addition to contributing to the solution of the "last minute resignation" dilemma.

Background: The Problem

August 2002 brought with it the usual set of last minute issues. Students needing to add or drop a class, transfer students needing help with a last minute schedule change. In addition, the unusual and the untimely resignation of a full time faculty member with classes scheduled to start in just a few weeks. The loss of twenty percent of a department on short notice is not a pleasant surprise, but one that must be resolved.

Current full time faculty were not able to absorb the entire teaching load, so a fast search for qualified adjuncts faculty was launched. The search was successful and all lecture courses were assigned to practicing engineers in the local area. However, a problem remained. Because of conflicts with his full time employment situation, the engineer assigned to teach Digital Electronics was unable to meet the lab at the scheduled time.

The problem – a laboratory with no instructor would need to be addressed quickly.

Students Teaching Students: The Solution

Alternative Solutions

Several approaches to this situation were considered; each presented a unique compromise. Existing full time faculty were fully committed to teaching, consulting, and administrative duties. There was no available capacity to allocate to this situation. Dropping the laboratory from the fall schedule was considered. This idea itself was quickly dropped. The negative impact on student progress and learning was unacceptable. Attempts to reschedule the lab during evening hours proved unworkable. The schedule conflicts, which resulted from a number of the students being employed, could not be resolved. The ultimate solution required that we venture outside traditional Engineering Technology boundaries.

The practice of employing student laboratory instructors is foreign to ET education at Pitt-Johnstown. The college's primary mission is undergraduate instruction and full time faculty members teach virtually all classes and laboratories. Only a few graduate classes are offered, and they are outside Engineering Technology. Thus, a pool of graduate students who might be employed as teaching assistants does not exist. However, the severity of *this* situation and the availability of competent, accomplished and well respected senior EET students prompted *Students Teaching Students: A Pedagogical Experiment.*

Logistics

Discussion among several members of the division leadership, the adjunct professor, and two senior students led to the conclusion that the use of well supervised student laboratory instructors was a workable approach to this situation.

The adjunct professor was responsible for all lecture activity – this was no change from the norm. With respect to the lab, the professor would design and write up each weekly experiment and communicate it, in advance of the lab meeting, to the student lab instructors. The advance communication to the student instructors allowed them ample time to review the experiment and consult with the professor if necessary to clarify the requirements. Following the lab period, it was the professor's responsibility to grade the resulting reports. In addition, the professor would use class time to review the lessons learned in the laboratory, relate those lessons to lecture material, and address any lingering questions that the students might have.

The student instructors were responsible for several aspects of the course. Each week they would critically review the experimental write-up. The purpose was both to insure that the student instructors were thoroughly informed about the upcoming lab and to prompt feedback to the professor that might improve the experiment. In addition, the student instructors would insure that the necessary hardware was available and take corrective action as necessary. During the laboratory period the student instructors would monitor the students' work, respond to questions and assist in troubleshooting circuit

problems. When a student's system was working properly, it was the student instructors' responsibility to exercise the system and insure that it was, indeed, functioning as required. This information was communicated to the adjunct professor. This, verification of circuit function, was the *only* direct involvement that the student instructors had in student evaluation.

This was a new venture for Engineering Technology at Pitt-Johnstown. In order to improve the probability of success, the department head made reasonable efforts to be both on campus and available during the lab period. On occasion he would drop-in on the lab to observe. The several times he did, the lab experience was found to be normal.

Community Reaction: The Assessment

Students End-Of-Term Evaluation

The student's reaction to this experience, while somewhat mixed, was fundamentally positive. A conversational evaluation of the lab was conducted early in the term. The fundamental goal was to determine if there were problems that could be solved with a mid-course correction. This would be superior to a *post facto* evaluation that retrospectively identified problems well after they might have been solved. No significant issues arose at that point.

The students were twice again asked to evaluate the experience. The first was a somewhat traditional end-of-term written course evaluation. The particular instrument used had additional questions that focused on this experimental experience. A second follow-up evaluation was conducted early in the following term.

The results of the end-of-term evaluation are tabulated below. The results of the Follow Up Evaluation are presented at the end of this section. The first table is a set of questions selected from a conventional course evaluation instrument.

Digital Electronics Laboratory Questionnaire	Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)	Very Poor (0)	Average
1. The course as a whole was:	2	2	3				3.9
2. The course content was:	1	3	3				3.7
3. The instructor's contribution to the course was:		3	3	1			3.3
4. The instructor's effectiveness in teaching the subject matter was:		2	4	1			3.1
5. Student confidence in instructor's knowledge was:	1	1	1	4			2.9
6. Instructor's ability to deal with student difficulties and questions was:			4	3			2.6
7. Availability of extra help when needed was:			5	2			2.7
8. Use of class time was:		1	6				3.1
9. Instructor's interest in whether students learned was:	2	2	3				3.9
10. Amount you learned in the course was:		4	1	2			3.3
11. Relevance and usefulness of course content were:	1	4	2				3.9
Overall Average							**3.3**

An examination of these results leads to the following conclusions:

- The students' perceived as very good the course as a whole and the student instructors' interest in their learning. The first result indicates that, overall, the students embraced this approach and were generally pleased with the results. The second result reflects the expected good rapport among a group of students and the seriousness with which the student instructors' took their charge.
- The students' perceived as good student instructors' contributions, student instructors' effectiveness, and the use of class time. This indicates that the student instructors were technically competent and were able to communicate effectively to the students. In addition, these results indicate that the combination, adjunct professor and student instructors, was able to design laboratory exercises that were appropriate and manage the laboratory period in an effective manner. This is reinforced by the students' perception that the course content was very good.
- The students perceived as fair-to-good (average 2.7) their confidence in the student instructors' knowledge, the student instructors' ability to deal with difficulties, and the availability of extra help. These, less than superior, results are not unexpected. It would be unreasonable to expect the students' level of

confidence would be the same for a student instructor as it would for a professor. Similarly, we cannot generally expect student instructors, who have no prior teaching experience, to deal with difficulties as well as a seasoned professor. The limited availability of extra help is a reflection of the fact that the student instructors were, first and foremost, students. Each was carrying a full time academic load and was able to devote only a limited amount of time to this project.

An examination of the overall reaction of the students, as measured by an overall average of all responses, indicates that this experience was good, tending toward very good (3.3). It is reassuring to note that no category received a response less than fair.

Tabulated below are the responses to a set of questions designed to evaluate this specific experiment. The intent is to capture the students' perception of this experience as compared to a laboratory taught by a professor.

Compared to a lab taught by a professor:	Less or Worse (1)	About Same (3)	More or Better (5)	Average
1. I think I learned:	1	6		2.7
2. The instructor was _____ helpful:	2	3	2	3.0
3. I felt _____ comfortable asking questions:	1	4	2	3.3
4. The instructors were _____ available:		6	1	3.3
5. I liked this approach (student instructor):	4	3		1.9
Overall Average				**2.8**
Average without "I Liked…"				**3.1**

The responses are quite interesting. If we isolate the questions dealing with learning and interacting with the student instructors, the result is that the experience was about the same as a traditional professor taught laboratory course. The only item that received a clear negative response was "I liked this approach." This response strengthened our decision to conduct a follow up evaluation early in the following term.

Student Laboratory Instructors

The student instructors' reactions were, not unexpectedly, mixed. Both positive and negative aspects of the project were identified. The student instructors were pleased to be able to help students. They experienced the satisfaction that comes from a successful teaching experience. (Perhaps we're recruiting future professors?) For many of us, the best experience that a university career has to offer is the sense of pride and satisfaction that comes with realizing that "they get it." Our student instructors shared that

experience. In addition, they indicated that *their* knowledge was enhanced. Preparation for the laboratory experience enhanced their grasp of the material. Those of us who have chosen engineering education as our profession recognize only too well the learning that occurs when we prepare to teach. Another positive aspect of this experience was improved rapport between these student instructors, and the faculty. In spite of the fact that meetings with the professor were less frequent than might be ideal, a clearer appreciation of the professor's teaching role and improved student-to-professor feedback resulted. This can only contribute to improved rapport with the student body as a whole.

The student instructors' perception was that the students were, in some ways, more comfortable with *student* instructors. There was a lessened sense of anxiety when approaching a student instructor vis-à-vis a *regular* professor. Perhaps students were more willing to admit what they didn't understand to a fellow student than to the professor. Student instructors might better understand that other students do not always grasp the material after a single exposure. This increased level of comfort appears to be primarily the result of close rapport between students. This also has its negative side.

The student instructors found it somewhat difficult to distinguish between professional and personal boundaries. Several of their *students* were also close friends. Early in the term the student instructors discussed this situation with the department head, appropriate boundaries were outlined, and this issue was put to rest.

The student instructors were asked, after the fact, what changes they would suggest to improve the experience. The only substantial thought was for increased contact with the professor. It is clear that this would improve the level of student instructor preparedness and therefore their performance during the laboratory period. The adjunct professor also mentioned this as a weakness in the system. However, if the professor had been able to spend several additional hours on campus, then this entire experiment would not have been necessary.

Adjunct Professor

The professor's involvement with the laboratory included the development of the laboratory exercises, grading of laboratory reports and discussions with the student instructors and the engineering technology students to review lab requirements and to address technical issues. The professor's opinion of the experiment is that it provided a reasonable solution to the problem at hand. The laboratory reports received from the students were generally well written and provided evidence that the students understood the objectives of the labs and that they were able to successfully complete the assignments. The results of quizzes and examinations also provided evidence that the students understood the material. However, there were several issues with this experiment that resulted in a less than optimal experience for the students taking the class and for the student instructors.

Training the Trainers

A key factor to the success of this experiment was in maintaining open communication between the professor, the student instructors and the engineering technology students. The laboratory assignments had to be written sufficiently ahead of lab time to allow the student instructors enough time to understand the objectives and methods of each lab exercise. Effective communication between the professor and the student instructors was hampered because of the professors normal work schedule. He was unable to spend as much time with the student instructors, on campus, as he would have liked. Therefore, much of the communication with the student instructors involved the exchange of e-mail. The professor e-mailed each laboratory exercise to the student instructors. The student instructors would spend time reviewing the exercises to understand the objectives and methods required to complete the work. Any questions requiring input from the professor were asked via e-mail or telephone discussions. All of this work had to be completed before each weekly laboratory and involved a significant amount of extra work for both the student instructors and the professor in addition to the communication delays with e-mail.

Reduced Lecture Time

The professor also used class time prior to each lab in reviewing the laboratory exercises and class time following each lab to review lessons learned by the students. This review time amounted to approximately 30 minutes each week and reduced the lecture time available.

Circuit Troubleshooting

The professor attended the laboratory sessions as his time allowed. The general feedback that was received from the students indicated that they preferred having the professor available to answer questions "in real time" rather than waiting for the next class period for the answers. Many of the problems encountered in this laboratory involved improper selection or wiring of devices. Although the student instructors were able to resolve most of the problems encountered by the students, several problems were not able to be resolved during the laboratory period. These problems were reviewed with the professor during the next class period but required additional laboratory time for the students to complete the work.

<u>Students - Follow Up Evaluation</u>

A final evaluation was conducted early in the term following this project. The purpose was to reinforce, clarify, and correct conclusions drawn the previous student feedback. The evaluation was conducted conversationally during a laboratory session. The results generally reinforce prior conclusions. However, some additional information was gleaned from the session. Specific broadly shared views include:

- The students understand the problem and agree that this was a reasonable solution. (Reinforces prior conclusion.)
- When probed about the "I didn't like … " response, the students indicted that the assistance in lab, while adequate, was not as cogent as could be expected from a professor. This is what they didn't like. In addition, they missed the direct student-to-professor contact that both enhanced their learning and improved the professors awareness of student learning. The really do appreciate *small* classes taught by *real* professors. (Clarifies prior conclusion.)
- The students commented that they were *not* necessarily more comfortable with student instructors than they might have been with a professor teaching the lab. They indicated good rapport with professors and little or no inhibitions about asking questions. This contradicts a perception of the student instructors. (Corrects prior conclusion.)
- The students commented that the relatively straightforward nature of digital systems contributed to the success of this experiment. They speculated that if this approach had been necessary in an electrical machines lab, the results would have been far less acceptable to them. (New observation.)

Conclusions: Lessons Learned

Summary

This experiment was a success:

- The Students, while they didn't favor this approach, felt that their learning was not compromised. They judged the experience "about the same" vis-à-vis a professor taught lab.
- The Adjunct Professor concluded that the students did achieve an appropriate level of mastery. He agreed with the student instructors' perception that more time spent in face-to-face discussion would have improved the experience – but the absence of on-campus time was the root of this problem.
- The Student Instructors were, perhaps, the greatest beneficiaries of this experiment. They experienced, by their assessment, an enjoyable project during which they learned technical material, were introduced to the joys (and challenges) of teaching, and developed a closer relationship with faculty.

The success was not without flaw. Learning, while adequate, was not ideal. The absence of a fully qualified professor in the lab did have negative impact. This was, while not ideal, a reasonable solution created with very short notice to a perplexing problem. The results do not, however, suggest that this is an approach that we would like to adopt as a permanent approach to laboratory instruction at Pitt-Johnstown.

Looking Forward

While this experiment does not suggest that student laboratory *instructors* should be permanently incorporated into the ET Division pedagogy, it does indicate that the use of student lab *assistants* might have significant benefit. If an accomplished upper class student could be assigned to *assist* a professor during lab periods, many of the benefit we

observed might be obtained while avoiding the difficulties. Student assistants would still learn about both technology and teaching. An improved rapport with the faculty can be expected; it is likely that that rapport would be contagious among the entire student body. The laboratory students' learning experience can only be enhanced. They can direct "easy" questions, which they might hesitate to ask a professor, to the more approachable assistant. The professor is always there to handle more difficult situations. The presence of two teachers, professor and assistant, means that all questions should be handled in a more timely manner, thus improving the pace of the lab. This would be particularly appropriate in larger laboratory sessions.

These results have caused us to consider modifying and extending this project. We may experiment with undergraduate student lab assistant in the future.

Biography

GREGORY M. DICK – Associate Professor and Head of Electrical Engineering Technology. Dr. Dick holds degrees from the University of Pittsburgh, Stanford, and the Pennsylvania State University and is licensed in the Commonwealth of Pennsylvania. He has taught at Pitt-Johnstown for 28 years. His areas of interest include Computing, Systems and Controls, Digital Signal Processing and the interface between technology and society.

STANLEY J. KIETA – Adjunct Professor. Mr. Kieta holds both BS and MS degrees from the University of Pittsburgh in Engineering disciplines. He has twenty years of electrical engineering design experience and has taught as an Adjunct Associate Professor at the University of Pittsburgh at Johnstown for the past year. Mr. Kieta is President and CEO of REAL Controls, a consulting firm specializing in process control, automation and data acquisition applications.

CHRISTOPHER A. DECOCK – Student Laboratory Assistant. Christopher is a senior graduating with his BSEET in May of 2003. He is a Presidential Scholar, the recipient of the Johnstown Chapter IEEE Scholarship, and President of the Campus Electronics Club. Of professional interest, he enjoys working with a variety of Digital and Electronics Systems as well as Power Systems.

JERRY W. SAMPLES – Professor and Director of Engineering Technology. Dr. Jerry Samples holds a BS ChemE. from Clarkson College, MS and Ph.D. in ME from Oklahoma State University and is licensed in the Commonwealth of Virginia. Dr. Samples served at the United States Military Academy as an Academy Professor for nine years before assuming the position of Director of the Engineering Technology Division at the University of Pittsburgh at Johnstown in 1996. He is currently serving as the Interim Vice President for Academic and Student Affairs at the University of Pittsburgh at Johnstown.