

Learning Partners in an Engineering Class

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Introduction

Prior to the fall 1995 semester at Penn State Berks Campus, a program was presented to faculty on “active learning techniques for the college classroom.” This program involved examples of working together to learn, and faculty participated in these procedures as if they were the students. The speaker was Mel Silberman, who has written a book on “active **training**”¹. Of all the techniques of active learning that were presented, the one saved for the end of that presentation, and deemed by the speaker to be the most effective technique, was that involving having a partner in the learning process.

The education literature includes words of support for collaborative (or cooperative) learning, in principle. For example, a book by Kenneth A. Bruffee recommends that college and university teachers organize students to learn collaboratively in order to facilitate a process of “cultural change.”

Shlomo Sharan, the editor of a collection of 12 papers on cooperative learning states³:

“Investigators of cooperative learning methods and their effects appear to be expressing the position that significant improvement in the processes of teaching and learning in school can be achieved.”

In engineering education, industrial advisors sometimes indicate the need for engineers to be capable of good teamwork. The increased use of collaborative learning may be an appropriate response to that need.

By the time the fall semester started, this instructor decided to try the idea of having learning partners in an engineering class. The class was Introduction to Digital Systems, in the Computer Science and Engineering Department of the College of Engineering of Penn State University. The course was given at the Berks Campus.

Pairing

There were 14 students taking this course, so seven pairs were formed. This was done on the first day of class, based on the students’ choice of seats. The partners sat next to each other.

After about six weeks of the 15-week semester, the students were asked to vote whether the learning partners should be assigned by the instructor, or whether the pairing should be voluntary. The students’ choice was clearly for voluntary pairing. The students were asked to form their voluntary pairs. Five of the original seven pairs remained the same, and two switched partners.



Homework and Problem Solving

At the beginning of a typical class period, learning partners were asked to compare and discuss their homework and to resolve any differences. This instructor noticed several changes that seemed to be due to this use of learning partners for homework.

First, attendance seemed better than in past years. This effect may have been due to feelings of loyalty between the partners.

Another positive change that seemed to occur in this class was the degree of compliance with homework assignments. Even though homework assignments were not graded, it appeared to this instructor that students generally did their assignments more conscientiously than in years past. Possibly the potential embarrassment of not having good work to compare with one's learning partner was behind this effect.

After students compared and discussed homework assignments with their learning partners, and resolved any differences, there seemed to be fewer questions concerning the homework.

Learning partners were asked to jointly work problems in class. This provided additional support for some students.

Collaborative Take-Home Exams

Apart from the final exam, students took three collaborative take-home exams and two individual in-class exams. (There was insufficient time for the third individual in-class exam, before the final exam.) In the collaborative take-home exams, students were asked to work on the exams with their learning partners. Each pair of learning partners had to submit a single joint exam paper. The collaborative take-home exams were part of the grading scheme. The intention was that these collaborative exams would stimulate discussion and learning.

Student Feedback After First Exams

After about five weeks, which was after the students had taken one collaborative take-home exam and one individual in-class exam, their comments on learning partners, and especially on taking a collaborative exam with a learning partner, were sought.

Here is a sampling of students' views.

"I think joint exams can be very helpful. They give you a chance to work [with] someone else and help them or be helped by them. It also gets rid of, or lessens, the possibility of simple errors that are so often made on exams by [oneself]. It is also good to have [separate] exams . . . to test individual knowledge. I would suggest you continue this helpful practice. Although there is a possibility of one person not doing any work, that will show in an individual exam. "

"I think that the collaborative exams are good because if you don't understand something fully maybe your learning partner does and he could possibly explain it to you. "

"One partner may do much more than the other, or one partner may simply not care about the test. Then the other is forced to do all the work, and share credit with his partner. I never liked taking tests in a group, and [felt] that it's hard to make sure the work is divided evenly in such tests. I think they should

not be continued. The take-home part may be kept, but not partners. ”

“The collaborative exam was a good source of a review for me. Unfortunately it was somewhat difficult to do since I do not see my learning partner outside of this class... In the future it might be better to allow the whole class to work together in what ever way they see fit, or allow us to pick test partners. ”

The students’ opinions were mixed. It appeared that of 12 responses, seven favored having collaborative exams, three raised objections to having collaborative exams, one supported the in-class discussions with learning partners without commenting on collaborative exams, and one equivocated.

The following week a direct vote was taken on whether the learning partner pairs should be assigned by the instructor or arrived at by voluntary pairing. Students chose voluntary pairing, and voluntary pairing was implemented. A direct vote was also taken on whether, with voluntary pairing, the practice of having collaborative take-home exams should be continued. The majority voted yes.

Student Feedback at End of Semester

At the end of the semester, students were asked again about learning partners. Here they were to state whether they strongly agreed, agreed, were not sure, disagreed, or strongly disagreed with statements about the use of learning partners. There were 13 students responding. The results are tabulated below.

SA: Strongly Agree A: Agree NS: Not Sure D: Disagree SD: Strongly Disagree

	SA	A	NS	D	SD
“Collaborative take-home exams, done with learning partners, should be used in more classes”	6	6	1	-	-
“In-class consultations with learning partners, such as in comparing homework, should be used in more classes”	4	9	-	-	-
“My learning improved significantly by having a collaborative take-home exam”	4	4	4	1	-
“My learning improved slightly by having a collaborative take-home exam”	2	6	2	-	3
“My learning probably did not gain at all by having a collaborative take-home exam”	-			8	5
“My learning improved significantly by having in-class consultations with my learning partner (such as in comparing homework)”	2	8	3	-	-
“My learning improved slightly by having in-class consultations with my learning partner (such as in comparing homework)”	2	6	2	2	1

"My learning probably did not gain at all by having in-class consultations with my learning partner"	-		1	9	3
"Having collaborative exams probably unfairly skews the course grades"	-		3	5	5
"Having collaborative exams will probably help my grade in the course"	2	8	3	-	-

At the end of the semester, the advice of the class was in favor of wider use of learning partners. The students perceived some learning benefit from collaborative take-home exams, and from having in-class consultations with one's learning partner, but the amount of perceived benefit varied widely.

Student Performance

In comparing the performances on individual exams, including the final exam, for students in this class vs. students in previous years, there is a difference in the lowest grades of the classes. In previous years there were some students who scored extremely low on some exams. Such extremely low scores did not occur in this class.

Having a collaborative take-home exam before the individual in-class exam provided additional preparation for that individual exam. This probably had a significant impact on a few students, and may have prevented the occurrence of extremely low test scores.

It seems likely that just giving a pre-exam individually would also have helped some students, especially those who are highly motivated to do well and who are most capable of studying alone. The collaborative exam may have especially helped those who are less capable of studying alone.

On the final exam in this course in fall 1995, 11 students scored at least 65 (out of 100 possible points), and three scored below 65. In the corresponding courses in fall 1992, 1993 and 1994, a total of 19 students scored at least 65 on the final exam, and 15 scored below 65. The use of learning partners, including the use of collaborative exams, may have been helpful in raising the lowest test scores.

Conclusion

The students clearly preferred voluntary pairing of learning partners over assigned pairing. By the end of the semester, the collective opinion of the class was that the use of learning partners should be expanded to other courses.

This class avoided the extremely low test scores that occasionally occurred with a few students in previous years. The explanation for this is not known. However, from the students' feedback at the end of the semester, it is believed that the activities with learning partners, including the collaborative take-home exams, had a significant, positive impact on some of the students. This may have been a factor in helping to avoid extremely low scores in exams.

The noticeable difference in grades in this class, compared to prior years, occurred at the lower end of the scale. If this difference were partly due to the use of learning partners, it would suggest that the use of learning partners benefits the weaker students.

The use of learning partners seems to be advantageous in trying to get the entire class to master the basics of a course. If it is true that the use of learning partners supports the students who tend to be at risk, then the use of learning partners might be helpful in the retention of students, a possibility not clearly foreseen at the outset of this exercise in using learning partners. In engineering programs it could be especially useful in those difficult courses historically causing much student attrition.

Bibliography

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