PEER-LED TEAM LEARNING IMPLEMENTATION

ASSESSMENT OF PEER-LED TEAM LEARNING IN AN ENGINEERING COURSE FOR FRESHMEN

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Peer-Led Team Learning (PLTL) has been implemented in large undergraduate courses in biology, chemistry, and physics. Studies of these implementations (e.g., Tien et al., 2002) have shown that students who attend PLTL workshops earn higher scores on examinations and develop significantly better attitudes toward science. From these studies however, we cannot infer that an implementation of PLTL in engineering would produce the same learning outcomes as in the sciences, because the population of engineering students differs from the population of students who take an introductory chemistry course. In general, compared with other college students, engineering students take more mathematics and physics courses, and they have earned higher scores on the mathematics portions of college entrance tests, such as the American College Testing program (ACT) and the Scholastic Aptitude Test (SAT).

Since the fall semester of 2007, we have implemented PLTL in ECE 110, *Introduction to Electrical and Computer Engineering*, at the University of Illinois at Urbana-Champaign. Carrying four semester hours of credit, ECE 110 is a large gateway course that is required for freshmen (first-year) students majoring in electrical and computer engineering. ECE 110 is also required for students majoring in general engineering. ECE 110 introduces selected topics in circuits, electronics, and digital systems, all directed toward the design of an autonomous line-following vehicle in the laboratory (Uribe et al., 1994). The enrollment runs from 250 to 300 students per semester. Each week students attend three hours of lecture and three hours of laboratory; there are no discussion sections. Students use an online system for homework. ECE 110 is unusual because in engineering curricula at most other institutions, students must complete a year of college-level mathematics and science courses before they take substantial engineering courses.

In our implementation of PLTL, the workshops are optional. We offer 90-minute workshop sessions at three different time periods on Sundays. Students indicate their available time periods on Sundays, and they are randomly assigned to learning teams according to their availability. We ensure that none of the learning teams has an isolated woman student (at least initially).

The undergraduate and graduate teaching assistants assigned to ECE 110 hold office hours (both face-to-face and online), grade exams, and serve as leaders of the student learning teams. In addition, about half of the team leaders are volunteers. The willingness of older students to volunteer comports with the strong sense of community in the student culture in the College of Engineering at Illinois—and especially in the Department of Electrical and Computer Engineering. Students study in groups, and they work together in student chapters of professional engineering organizations, where they provide services such as peering mentoring, peer tutoring, and exam reviews.

On the Saturday before the first workshops, all new team leaders attend a two-hour training session. In subsequent weeks, they attend short optional weekly meetings, which cover topics such as Bloom's taxonomy of instructional objectives, Perry's model of intellectual development, and diversity issues. We do not yet have a separate academic course for the team leaders. Instead, team leaders keep reflective journals; they write journal entries after each workshop session and at the end of the semester.

In each workshop session, every learning team solves four to eight difficult problems selected from ECE 110 examinations given in previous semesters. These problems are more complicated than most homework problems: their solutions require understanding of the concepts, analysis of unusual situations, and integration of several ideas. The team leaders serve as facilitators.

In Fall 2007, to assess the effectiveness of the PLTL workshops, we administered two paper surveys to the students in ECE 110. Among the 286 students who finished the course, 208 completed the first survey, and 198 completed the second survey. The first survey gathered ACT-Math scores. In the second survey, which was anonymous, students reported their majors, whether they regularly attended the workshops, and whether they intended to continue taking courses in electrical and computer engineering. Regular attendees identified the benefits of the sessions. Other students explained why they discontinued attendance, did not attend, or studied in groups outside these workshops. All completed surveys were sequestered until after course grades had been filed. We highlight two findings here. For more details, see Loui and Robbins (2008).

Did Workshop Attendance Improve Exam Performance?

We decided *a priori* to define a **regular attendee** to be a student who attended a strict majority, six or more, of the eleven workshops. Among the 208 students with complete data, 43 attended workshops regularly, and 165 did not. For these two populations of students, Table I presents their average Final Exam and ACT-Math scores, and the standard deviations (SD); the maximum possible Final Exam score was 100, and the maximum possible ACT-Math score is 36. The regular attendees earned significantly higher Final Exam scores ($p < 0.02$ on the one-tailed t-test), despite slightly lower ACT-Math scores ($p < 0.1$ on the Mann-Whitney U-test).

TABLE I
FINAL EXAM AND ACT-MATH SCORES

Population	**Final Exam** Mean (SD)	**ACT-Math** Mean (SD)
Regular attendees (n = 43)	76.5 (14.1)	33.0 (2.35)
Other students (n = 165)	71.0 (15.2)	33.6 (2.27)

We also conducted a multivariate analysis of variance for the Final Exam score, using the ACT-Math score and the Attendance (number of workshops attended, from 0 to 11) as the independent variables. The analysis showed that including the Attendance variable in a linear regression effectively gives the model 34% more predictability than the ACT-Math score alone.

Did Workshop Attendance Improve Retention?

Among the 198 students who completed the second survey, the 160 students who were majoring in electrical and computer engineering (ECE) were asked whether they planned to continue. Out of the 50 students who claimed to attend the study sessions regularly, 46 students planned to continue in ECE, 4 decided to switch, and 1 was omitted. Of the remaining 110 students, 99 students planned to continue, 9 decided to switch majors, and 2 were omitted. The odds ratio of regular attendees remaining in ECE versus other ECE majors was 1.023. We infer that regular attendance did not affect retention in ECE.

Conclusions

We determined that students who regularly attended the PLTL workshops in Fall 2007 earned higher scores on the final examination than did other students. The difference was statistically significant, even after controlling for ACT-Math scores. Regular attendance did not seem to affect decisions to continue majoring in ECE, however.

The workshops may benefit not only the students in the course but also the team leaders. We plan to analyze the journal entries written by the team leaders. Using the journals as evidence, we expect to document how team leaders learned about group dynamics and developed leadership skills.

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