PEER-LED TEAM LEARNING
EVALUATION

MEASURING THE EFFECTS OF PEER-LED TEAM LEARNING

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Measurement of human characteristics is a difficult task, yet as instructors and educational researchers, we are required to repeatedly measure the academic performance of students. The most common characteristic we measure is content knowledge that results from students' participation in a course that we teach. Typically, this is measured by assignment of points for a combination of exams, quizzes, laboratory reports, and attendance in PLTL workshops. The total number of points is assumed to be proportional to students' knowledge of the principles that were to be learned in the course, and those points are usually translated into a letter grade, which is the method by which the measurement is recorded on students' transcripts.

Grades, in turn, have been the primary measurement outcome used to assess the success of the PLTL project throughout its history. Certainly, this is an important criterion because it is directly related to the ultimate goal of any curriculum change: to increase the quality of student knowledge, and as a necessary correlate, increase success rate of students, as measured by percentage of students who earn quality grades in a course. However, a problem with this type of measurement is that the course grade reflects the effects of *all* parts of the course, including the lecture and the laboratory. If we simply consider time distribution for a typical PLTL course that consists of three hours of lecture, three hours of laboratory, and two hours of PLTL workshop per week, we see that only 25% of the students' time is spent in a PLTL environment. This simplistic model shows that fully three-quarters of the course grade is dependent on curriculum characteristics other than the effect of PLTL. Thus, we can better measure the specific effect of PLTL on students if we direct future efforts toward measurement of student learning outcomes other than the overall course grade.

One extremely important characteristic that a PLTL curriculum has the potential to have a profound effect upon is the development of students' thinking skills. The definition of *thinking skill* is a mental processing ability that is sufficiently flexible to operate on different content, including novel situations. Such skills are the ability to "know how" to do something, in contrast with knowledge where an individual "knows that" something is true. For example, most scientists know how to recognize natural relationships between two variables that are directly proportional to one another. The ability to do proportional reasoning in various different contexts is an example of a thinking skill. A number of these skills that are frequently employed in scientific reasoning can be measured experimentally.

Research has shown that PLTL-like curricula are effective at promotion of the development of students' formal thinking skills. Key elements of these courses include giving students opportunities

to explain answers to content-related questions and providing opportunities for interactive engagement, which are precisely what a PLTL environment makes available. Better yet, we believe that the peer leader adds a significant additional benefit. The leader challenges students to address workshop questions from different perspectives, relate answers to previous knowledge, and combine the team's knowledge in different ways. Throughout this process, the leader models the appropriate thinking skills. This type of coaching is essential to insure that the skill is developing properly and that the student learns that the skill can be generalized and used in many contexts. The peer leader acts as the thinking skills coach and therefore plays a vital role in maximizing students' developmental potential. We believe that measurement of this type of effect and dissemination of the results would add to the argument in favor of the need for curriculum reform such as that provided by PLTL.

Many other measurable effects on students that are primarily due to PLTL should be able to be measured. For example, the PLTL workshop is a great place for students to learn problem-solving skills. These skills are difficult to obtain by listening to lectures or working homework problems from a textbook. The interaction with other students is invaluable in providing the insight needed to develop general strategies that assist in problem solving. Thus, we might design a study to measure the effect of a PLTL curriculum on students' problem-solving skills. Another PLTL effect that may be measurable is the ability to discuss scientific concepts. The traditional classroom largely excludes the opportunity to verbalize their thinking, but the PLTL environment encourages such discussion. It is logical to assume that students who spend time talking about science should be more skilled at verbal expression of those concepts. Interviews of PLTL versus non-PLTL students (with a control for time on task) from the same course would be one way to measure these effects of a PLTL workshop. Many other PLTL-specific benefits are also potentially measurable, such as relative improvement in study habits, choice of career goals, and attitude toward science.

In summary, we believe that the data about the effect of PLTL on student grades has been critical to demonstrating the successes of PLTL courses. We believe that the project can gain even more "proof of concept" if we can show how additional gains come from implementation of a PLTL curriculum. Certainly, demonstration of gains in thinking skills from a PLTL course would be extremely significant. Other types of gains would also be important to measure and disseminate. Intuitively, it seems readily apparent to many PLTL practitioners that these types of benefits result from what happens in the workshops. What lies before us is the challenge to measure these important additional effects of Peer-Led Team Learning.

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