A new teaching model focuses on student achievement through active learning

Peer-Led Team

THROUGHOUT ALL LEVELS OF education, there has been a shift in teaching strategies away from lecture, rote memorization, and telling students what to think, and toward student interaction, active learning, and allowing students to develop their own conceptions. The nature of this shift was eloquently summarized by the well-respected science educator J.D. Herron who wrote, "The major influence that research in psychology and education has had on my teaching is the portion of time I spend telling students what *I* think versus the portion I spend asking them what *they* think" (Herron, 1984, 851). In secondary science education, a common approach to making learning active has been to implement cooperative learning. Although this is a step in the right direction, we believe that there is an even better choice: Peer-Led Team Learning (PLTL).

PLTL IN PRACTICE

When taking education courses, virtually every teacher is instructed to use cooperative learning. However, these courses often fall short of giving teachers a method of implementation that will work in a variety of classroom settings. Once these teachers are on their own, they may not understand how to apply cooperative learning strategies effectively. Although traditional cooperative learning is a solution to switch to less telling and more asking, when used alone it is lacking because students do not function as a team. In effect, teams need leaders. In the PLTL model, the teams have leaders. We have found that this method challenges students to take responsibility for their own learning, while at the same time it gives them the necessary guidance so often lacking in traditional cooperative learning.

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The PLTL model organizes students from various grade levels into workshop groups or teams that meet regularly to solve problems and reinforce science content without teacher intervention. Each team has a student leader who recently completed the course, showed evidence of learning the material (usually earning a grade of A or B), and demonstrated leadership potential and strong interpersonal skills. PLTL has been defined by a model containing six critical components (Gafney, 2001) listed in Figure 1; all conditions must be met for implementation.

Each PLTL team holds workshops during lab or class time. The workshops require 45 to 60 minutes each and are held once for every unit of study,

Learning

typically once every two weeks, as shown in Figure 2. A workshop group is comprised of four to six students plus a peer leader, and the groups remain intact throughout the year. The teacher provides materials designed for group work, and the peer leader facilitates a discussion among the students, encouraging them to voice their ideas, interact with one another, and think beyond simply getting the "right answer." The teacher does not interact with the students during the PLTL workshop session.

FIGURE 1.

The six critical components of Peer-Led Team Learning.

1. The organization promotes learning, taking into consideration the limits on group size, space, time, noise level, and teaching resources.
2. The materials encourage active learning, work well in groups, and are appropriately challenging and integrated with the course.
3. The peer leaders are well trained and closely supervised.
4. The instructor is involved with the workshops and peer leaders.
5. The workshops are an integral part of the course, coordinated with the lecture, laboratory, and exams.
6. The school supports the program.

A typical session begins with students taking out their materials and breaking up into their workshop groups. The groups are spread far apart in the room to minimize cross-talking distractions. Whenever practical, desks are arranged in semi-circles next to a board so that the group members can face one another and write answers that all can see. We also write on large sheets of paper taped to the walls or use small hand-held dry-erase boards.

The peer leader starts the session by asking a student to read aloud the first question from the written materials. The students then work toward a solution to the problem, with the leader typically acting as secretary, recording steps in the solution of mathematical problems, writing phrases summarizing student ideas, or constructing diagrams suggested by students. The leader also prompts students toward problem solutions by giving advice about the resources available (typically textbooks), suggesting the application of thinking patterns used in previous problems, and helping students examine their thinking processes.

FIGURE 2.

A sample schedule for a PLTL classroom.

	Monday	Tuesday	Wednesday	Thursday	Friday
Traditional scheduling (45 min periods)	Lab	Lab and discussion	PLTL workshop	Discussion/ lecture	Discussion/ lecture
	Lab	Lab and discussion	Review for exam	Exam	Discussion/ lecture
Block scheduling (90 min periods)	Lab	No class	Lab and discussion/ lecture	No class	PLTL workshop and discussion
	No class	Discussion and review for exam	No class	Exam/ discussion/ lecture	No class

This approach benefits students in many ways at both the intellectual and emotional levels. When students in the PLTL group learn about alternate approaches and beliefs, it causes them to consider the merits and flaws of their own thinking patterns. They can then advance counter-arguments to attempt to resolve any contradictions, which eventually leads to better content and procedural knowledge for each individual in the group. We find that students are more likely to honestly express their ideas—both scientifically valid conceptions and misconceptions—in a peer group where they have no fear of looking stupid in front of a teacher who will be issuing grades. This free-flowing exchange of ideas, assisted by a more experienced peer, is an ideal format for encouraging intellectual development.

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PLTL has been used effectively in colleges and universities for more than five years, and more recently at Big Sky High School in Missoula, Montana, as a way of actively engaging students in their own learning. It was one of the five systemic initiatives sponsored by the National Science Foundation for systemic reform in chemistry. To date, about 30 post-secondary institutions use the strategy in chemistry classes, and now teachers of other science disciplines, such as physics and biology, are beginning to implement the model. Student achievement results have been impressive, as shown in Figure 3.

Brett Taylor, a teacher at Big Sky High School, was enthusiastic about his initial experience with PLTL. "I was apprehensive at first, and as I walked around students kept coming to me for the answers," he said. "I finally had to leave the room to get them to interact with their groups. When I returned, every student was on task and engaged in the subject. In fact, every student stayed engaged for 50 to 60 minutes." He could not believe how effective this method was at encouraging active learning and keeping students interested.

High school peer leaders also believe that PLTL is an effective learning tool. When asked whether participating in PLTL affected how students solve problems, one leader answered, "PLTL forces them to learn on their own and not have the teacher hold their hand every step of the way. The students must come up with their own answers and work together to figure problems out. The groups helped build student confidence because I didn't have all the answers and so they had to rely on each other for help."

FINDING PEER LEADERS

There are three major challenges to starting a PLTL-based curriculum: finding peer leaders, training the leaders, and selecting appropriate materials. Using peer leaders is a key element of PLTL, but recruiting them, especially at the high school level, can be challenging. High school students usually have rigid schedules that make it difficult for them to be available to lead the workshops. One option is to work cooperatively with other instructors within the science department so that students in advanced courses can be released weekly or biweekly to serve as peer leaders. For example, the sophomore-level biology instructor can work with the junior-level chemistry instructor so that the chemistry students can serve as biology leaders on workshop days. In turn, the senior-level physics instructor can release a

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few physics students to lead chemistry workshops as needed. This option works nicely if serving as a workshop leader is included in the requirements of the advanced course. This scheme leads to a problem with senior-level courses, but college students can be used as peer leaders if there is a nearby post-secondary institution. Students in college science courses and those in science teacher preparation programs make good leaders.

Another approach used to recruit peer leaders is to give students credit as science teaching assistants. In class periods when they are not leading groups, the leaders can prepare laboratory materials, set up demonstrations, and do advanced studies. Study hall can also be scheduled to coincide with a science course so that the leaders can be available. No matter what the details, as long as they have the support and cooperation of the administration, teachers who want to implement PLTL can work with the local situation to ensure the availability of peer leaders.

TRAINING TECHNIQUES

Once arrangements have been made for peer leaders, the next challenge is training them. At a minimum, general training should occur once before the start of the first workshop, and content-specific training should occur before each workshop during the year. We use the President of the Carnegie Foundation for the Advancement of Teaching L.S. Shulman's categories of teacher knowledge—content knowledge, pedagogical content knowledge, and curricular knowledge—as guideposts for training leaders (1986). All three are touched upon in each training session, although the degree of each varies from week to week.

Content knowledge is understanding the subject matter of the course. The majority of training time is spent on content. We find that when peer leaders feel comfortable with their own understanding of the material, they are more likely to effectively engage their groups. We review each major concept immediately before the corresponding workshop.

Pedagogical content knowledge is the arsenal of content-specific teaching strategies that all good teachers learn throughout their careers. It includes knowing the best examples, analogies, illustrations, demonstrations, and so forth for teaching a particular concept. During peer leader training, we discuss what is important about each question from the written materials provided for the workshop. We then give the leaders focus questions to ask that will help probe more deeply into the heart of the target concept. We also tell the leaders what types of questions to expect and how to respond to them. We sometimes do this by role-playing the workshop itself, with the instructor acting as leader and the leaders acting as students.

The third category of teacher knowledge covered in leader training is general curricular knowledge. Because this is the first time that most students have been placed in formal instructional roles, we help them learn generally how to be effective leaders, keeping in mind that they are leaders and technically not instructors. This includes instructions on group dynamics

FIGURE 3.

A comparison of PLTL vs. non-PLTL student grades.
%ABC is the percentage of students earning a letter grade of A, B, or C in the course, and n is the number of students in each group.*

Institution	non-Workshop	Workshop
U. of Rochester-Organic Chemistry, %ABC	66 (n = 1450)	79 (n = 1554)
St. Xavier U-General, Org, & Biochem, %ABC	72 (n = 95)	84 (n = 116)
NYC Tech-General Chemistry, %ABC	61 (n = 433)	81 (n= 131)
U of Kentucky-General Chemistry, %ABC	60 (n = 4554)	80 (n = 188)
City College-General Chemistry, %ABC	38 (historical)	58 (n = 484)
Queens College-General Chemistry, final exam scores	42 (n = 56)	51 (n = 55)

*The data from City College's comparison contain the first semester historical percentage of students earning a letter grade of A, B, or C from previous years versus a first-semester implementation of PLTL. The University of Rochester data compared four non-PLTL semesters with four subsequent PLTL semesters. St. Xavier University data compared two non-PLTL semesters with two subsequent PLTL semesters. NYC Tech data compared three semesters of simultaneous PLTL/non-PLTL instruction. University of Kentucky data compared eight semesters of simultaneous PLTL/non-PLTL instruction. PLTL was offered to approximately 10 percent of the students enrolled in the course (ACT scores for the PLTL students were slightly higher than those for non-PLTL students at the University of Kentucky).

and questioning techniques. We also survey the tools used in group work, such as the round robin (a group activity in which each student contributes one step to the solution of a multi-step mathematical problem and all students verify the correctness of each step as it is presented), paired problem solving, and concept mapping.

SELECTING THE RIGHT MATERIALS

The final major challenge to implementing the PLTL model is the selection of the appropriate materials. The simplest approach is to use college textbooks for general chemistry (Gosser et al, 2001) or organic and biochemistry (Varma-Nelson and Cracolice, 2001) and choose questions included in these materials with modifications as necessary. Other sources of questions for cooperative learning groups, such as the teacher's guide to the textbook and the accompanying worksheets that are often provided by commercial publishers, can also work well. However, in all instances the materials must be structured for group work at an appropriately challenging level.

Our preference at the secondary level is to write PLTL materials in a learning cycle format (Lawson et al, 1989). Workshops based on this format generally begin by the team leader introducing real data obtained by students in a laboratory experiment or by introducing hypothetical data that can be impractical to collect in a high school laboratory setting. The students are then asked to find a pattern in the data. The leader provides the scientific terminology commonly used to describe the pattern when appropriate. Once the initial pattern has been understood by the group, we like to provide further examples and counterexamples to increase the richness of students' understanding. Finally, we supplement the activity by providing questions of a more standard type for practice, as time permits.

A MODEL THAT WORKS

The PLTL model emphasizes student achievement through active learning. Peer leaders play an indispensable role in keeping students on task, providing guidance, and using language that can easily be understood by other students. They have a unique feel for gauging the appropriate level at which to provide help to their fellow students. The model also provides an opportunity for students to discuss their understanding, or time for leaders to ask them what they think.

A team learning approach in the classroom can greatly enhance any science curriculum. Working in teams not only improves students' understanding of the coursework but also prepares them for the modern workplace where corporations embrace the teamwork strategy for optimizing the management of their employees. According to Kelvin Cooper, senior executive director for candidate synthesis enhancement and evaluation at Pfizer Central Research, in Groton, Connecticut, "In short, we do believe that teams are the only way to succeed in today's environment" (Ainsworth, 1999, 54).

It is time to unlock the untapped potential in secondary school students who have the ability to become peer leaders. The gains in content knowledge, leadership abilities, and attitudes among the peer leaders are easily seen, and the growth that occurs as students work in their teams can be surprising. Peer-led team learning is cooperative learning that *really works.* ✧

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