



PEER-LED TEAM LEARNING IN CALCULUS I

Introduction

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In 2002, the three of us learned about the Peer-Led Team Learning (PLTL) model and began discussing how we could incorporate it into math classes at the University of Maine. As we discussed the advantages of such a model, Paula recounted her memories of calculus in high school:

The only memory I have from high school calculus, after my teacher's name and the fact that there were six girls and six boys in the class, is how I used to telephone my friends to ask if they understood the ideas, like the epsilon-delta proofs, Miss Burbeck had showed us. The on-going joke was that it was all Greek to us! But, we picked each other's brains and learned as we laughed. Looking back, I realize that the lessons of those phone calls were three-fold. First, we talked about math together (and laughed) and I think that in itself was good. Second, our conversation let us know we were not alone in our struggles. And third, we had the opportunity to pool our ideas during our conversations, take the time to think about those ideas between conversations, and then talk again to say, "I got it!" or to continue to struggle together.

Background

After hearing about the experiences of the Physics and Chemistry Departments at UMaine, in early 2002 the three of us started discussing how we could implement PLTL in our classrooms. In July 2003 we traveled to the City College of New York for a PLTL conference that focused on mathematics. We also applied for a Workshop Project Associate (WPA) grant through the national PLTL office, and in the fall of 2003 we received funding to implement PLTL in two sections of Calculus I for two semesters. With two departments on our campus already using the PLTL approach, we had the benefit of sharing ideas with colleagues already further along in their own PLTL experiences. Also, some of our students were aware of, and some had actual experience with, PLTL.

PLTL in Calculus I

Our goals in implementing PLTL in Calculus I were threefold:

- To improve student comprehension of mathematics so students can successfully solve both routine and non-routine problems.
- To improve student attitudes about math.
- To provide an alternative way of learning. As well as helping students learn calculus, we hoped that PLTL might encourage students to consider a career in teaching.

After deciding that PLTL could be an excellent approach to achieve the goals enumerated, the natural next question was in which course should the experiment start. We applied for the grant to help us implement PLTL in Calculus I (MAT126) for several reasons. First, there are a small number of core concepts in Calculus I. Second, there is a large pool of potentially strong leaders in Calculus I – majors in mathematics,

engineering, the sciences and secondary education. This leader pool contains students with a sincere interest in the course material. Lastly, some of the efforts in calculus reform dovetail well with the PLTL goals.

The choice of Calculus I also seemed appropriate given its history and its current state of flux in our mathematics department. Twenty or so years ago, calculus courses were large lectures. In the last 10 years sections have been smaller, about 40 students per section. Yet, the cycle is beginning again. Financial considerations are prompting the department to offer some 80-student sections with weekly TA recitations.

The NSF funds received by the Mathematics Department supported two sections of Calculus I in the spring of 2003 and two sections in the fall of 2004. In spring 2005 and fall 2005 we continued PLTL with alternate funding. The sections are structured as four-credit courses with three 50-minute classes with an instructor and one 75-minute PLTL session each week. The weekly PLTL sessions are used for nine PLTL workshops with a PLTL leader and four in-class exams.

Workshops

As we began creating workshops, we realized that the types of workshops we wanted to create fell into one of three categories. First, some of the workshops are discovery workshops. These occur before discussion of a concept occurs in class, with the goal that student learning be enhanced through discovering an idea with peers. Second, some of the workshops are exploratory occurring after a concept is discussed in class. In these, students explore concepts in more depth with the goal being to deepen student understanding of the idea. Lastly, review workshops were created. These occur so that students can just practice skills. Sample topics include velocities studied in a pre-lecture workshop using data from an actual car trip made by Sue, surge functions used to model nicotine and blood alcohol concentrations in a post-lecture workshop, and a Jeopardy-like game in which students practiced taking derivatives in a review workshop.

Peer Leaders

To identify potential peer leaders, faculty members in the Mathematics Department were asked to submit names of undergraduate students who had recently completed Calculus I successfully. We were looking for students who faculty believed had the calculus skills and the leadership abilities to be good peer leaders. These students were contacted and if they were interested were invited to attend an informational meeting and to apply to become leaders. Based on the applications, eight peer leaders were chosen, four for each section of 40 students.

Training and support for the peer leaders were of prime importance. Throughout the semester, we conducted weekly leader training sessions. Each two-hour session followed the same basic format. First, the previous week's workshop was discussed so that leaders could share successful strategies, get suggestions for dealing with difficult situations, and report on any changes they thought needed to be made to improve the workshop for the following semester. Next, during the first half of the semester, leaders were asked to read chapters in *Peer-Led Team Learning: A Handbook for Team Leaders* (Roth, Goldstein and Marcus, 2001) and the readings were discussed. This was particularly important for the peer leaders who had little experience leading groups and those who had never thought of teaching as a career. Lastly, time was dedicated to work through the next week's workshops with one of the instructors acting as a peer leader, while the peer leaders acted as first-time calculus students. This proved to be an excellent way for the peer leaders to determine what they knew and what they had forgotten, and to identify potential problems for their own students. At these weekly training sessions, we also discussed different approaches to facilitating the workshop such as round robin or small groups and decided which would work best for the given workshop. In addition, it was an excellent opportunity for the leaders to discover and discuss how different students might solve the same problem. Another benefit of this role modeling was that the workshops, after this dress rehearsal, could be revised based on suggestions from the student leaders and difficulties that they encountered. Not only were the workshops polished before they were given to the students, but the peer leaders realized that their input was valuable in creating better workshops.

As well as attending the weekly training sessions, leading the PLTL workshops once a week and completing some outside reading in the Handbook, leaders were asked to write journal entries after each PLTL session describing the session. Entries were sent to us electronically. Comments varied considerably with statements about the general reception of the workshop, its length and level of difficulty, comments about the approach used in doing the workshop and its success, and questions about how to deal with a particular aspect of the group dynamic.

Our Reflections

Although the assessment is incomplete, we feel the experiment has been worth the effort. First, students in the groups experienced a different way of learning with their peers leading them to actively learn the material. Some student attitudes toward math changed significantly. With most Calculus I students in their first year at University, it also provided an environment where the creation of bonds among a group of peers was possible.

Second, the peer leaders definitely had an excellent experience. They solidified their knowledge of calculus and learned about how differently students can think about problems. They experienced some of the satisfactions of teaching, strengthened their leadership skills, and had a place to have fun with math, as well as earn some money! New bonds formed among the group of peer leaders and the faculty and peer leaders worked as a team and all enjoyed it! (A couple of peer leaders commented that the leader training sessions were the highlight of their week!)

Third, the three of us enjoyed the weekly leader trainings, welcoming the opportunity to meet with a small group of talented and motivated leaders each week (a change from our 40-80 student classes). And, we worked together in writing some excellent workshops, which are published here – collaborative work all around!

While these results are encouraging and satisfying, we do want to mention the loss of time with our students. Instead of the standard four lecture meetings per week, our sections only meet together three days per week, the fourth meeting used for the workshop sessions. We have found it challenging to cover the same amount of material in a reduced amount of time, and we miss the lost time with our students. While we see the benefits of PLTL, we envision meeting four days per week in lecture, and then a fifth day set aside for PLTL workshops. Wishful thinking?

Conclusion

Although there were few phone calls exchanged, the PLTL experience replicated what was most memorable about Paula's high school calculus experience and, in the process, expanded and formalized it. We – the students within the workshops, the peer leaders with the instructors, and the instructors alone – talked about math together (and laughed) and that was in itself good. We realized we weren't alone in our struggles. And, we pooled our ideas during our conversations, took the time to reflect between conversations, and then talked again to say, "I got it!" or to continue to struggle together!

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Reference

Roth, V., Goldstein, E., Marcus, G. (2001). *Peer-Led Team Learning: A Handbook for Team Leaders*. Upper Saddle River, NJ: Prentice Hall.

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