

Evaluating Peer-Led Team Learning: A Study of Long-Term Effects on Former Workshop Peer Leaders

Leo Gafney*

Independent Program Evaluator, Lakeville, CT; *leo.gafney@sbcglobal.net

Pratibha Varma-Nelson

Department of Chemistry, Earth Science, and Physics, Northeastern Illinois University, Chicago, IL 60625

Peer-led team learning (PLTL) began in the early 1990s as Workshop Chemistry (1–5). In contrast to peer tutoring and study groups, PLTL links the use of a trained peer-leader with small group work and integrates these into the structure of the course.

Peer leaders serve as role models. They are selected because they have recently completed the course, have done well, and demonstrated communication and leadership skills. They are motivated to help other students, and the workshops often create a learning group that thrives beyond the life of the course. The leaders also serve as a bridge between students and instructors. Grading, preparing exams, and teaching new content are generally not part of the leaders' responsibilities (6–8).

The most relevant theoretical basis for PLTL is found in the work of Lev Vygotsky, particularly in his zone of proximal development (ZPD). Vygotsky concludes that learning is essentially social and that there is a gap between learning outcomes produced in isolation and those produced with careful guidance (9). Studies have demonstrated the effectiveness of other academic support programs such as supplemental instruction (SI), tutoring, and small group interventions (10–15).

Methodology

Numerous site visits, comparative studies, surveys, and interviews have produced data about the dynamics of PLTL, student performance, and the impact on the workshop leaders (16–18). But we also wanted to investigate the longer-term impact on the leaders. An online survey was used because there were a large number of geographically dispersed former leaders and funding for the research was limited.

During 2001–2002, a pilot survey was conducted with former PLTL leaders from St. Xavier University in Chicago where Pratibha Varma-Nelson was a professor (19). For this pilot we received 16 completed surveys. Respondents gave high ratings to their experience as workshop leaders and as students participating in workshops. They recounted how their experiences as workshop leaders had benefited them in subsequent courses and initiation into careers. Based on the pilot study we then revised the survey.

The survey contains three sections. The first part asks the former leaders to rate the impact of different activities on their learning. This section of the survey was modeled on the widely used Student Assessment of Learning Gains (SALG) instrument, developed by Elaine Seymour (20). From this we obtained data about how the workshops compared, in the respondents' experience, with other teaching–learning activities.

Items for the second part of the survey were based on benefits previously noted by student leaders in interviews and questionnaires (21). These benefits were investigated with this larger population and over a longer time frame. This part of the survey provided a platform for the third section, which asked open-ended questions about the impact of experiences on future decisions and events. High levels of ratings for the second section would lead us to conclude that the qualitative material provided in response to the open-ended items was an articulation of generally positive experiences, not idiosyncratic or random responses. Responses to the open-ended portion of the survey were sorted and coded according to categories that emerged.

To summarize, the study used a mixed method approach combining quantitative and qualitative methods to confirm and corroborate findings within a single study in what Creswell (22) would call a concurrent triangulation strategy.

The survey was sent by mail or email to more than 570 former leaders from 11 institutions. About 12% of these were returned due to inaccurate addresses. Second and third contacts were made. The survey was completed using a Web link to the City University of New York (CUNY) Research Foundation. As with most surveys of this type, we cannot claim that we have a random sample. We have data from those who were interested enough to respond, and this interest may reflect more positive experiences. The respondents were reflective and insightful about the value of the workshops, and described a wide range of experiences.

Responses

Final results included 119 (about 24% of those actually contacted) completed surveys from respondents. These responses came from 11 institutions with 56% (67) from one institution. Of the respondents, 64 were female, 55 were male; 116 were undergraduates as leaders, 3 were graduate students. Many of the respondents had worked as leaders during more than one year. The leaders served in the span 1995–2003. Disciplines included 31 in general chemistry, 84 in organic chemistry, 4 in biology, and 2 in mathematics; 107 (90%) of the respondents had participated in a leader training program.

Employment or educational status was reported as follows: 51 working in science-related fields; 5 working in nonscience-related fields; 9 teaching; 18 in medical school (including dental, podiatry, and veterinary); 10 in graduate school; 2 were not employed; 22 were still undergraduates; 2 no response.

Table 1. Comparative Effects on Learning by Respondent Groups

Learning Experiences	Ratings		Rankings	
	Rochester Respondents ^a	Non-Rochester Respondents ^b	Rochester Respondents ^a	Non-Rochester Respondents ^b
Acting as a peer-leader for workshops	4.3	4.4	1	1
Studying assigned work alone	4.2	4.1	2	4
Participating as a student in a peer-led workshop	3.9	3.5	3	10
Attending lectures	3.8	4.4	4	2
Acting as a recitation leader	3.7	2.9	5	12
Acting as a tutor	3.6	4.2	6	3
Working with a friend, study partner, or small group	3.5	3.6	7	9
Independent projects	3.2	3.7	8	7
Participating in a research project	3.2	4.0	9	5
Participating in a recitation led by a graduate student	2.9	2.9	10	11
Laboratory work	2.9	3.6	11	8
Individual consultation with professors	2.8	3.8	12	6
Receiving assistance from a tutor	2.0	2.4	13	13
Overall average of means	3.38	3.65		

^aN = 67; ^bN = 52

Survey Outcomes: Learning Gains

Students were asked to rate 13 learning experiences on a 1–5 Likert scale. Mean scores greater than 4 are high for this type of survey. Since 56% of the respondents were from the University of Rochester, a comparison between Rochester and non-Rochester responses is interesting.

Items in Table 1 are ranked in order from greatest to least for Rochester respondents. A look at the rankings reveals that both groups gave the highest scores to “Acting as a peer leader for workshops”. This experience was viewed as having the greatest impact on learning. Next, both groups gave high ratings to “Attending lectures” and “Studying assigned work alone”, indicating that these were generally conscientious college students, making good use of conventional teaching–learning methods. Table 1 compares mean ratings and rankings for all groups of respondents. (Not all students participated in all of the activities listed; low rankings in some cases may be due to lack of experience with this activity.)

The most important difference between the Rochester and non-Rochester students was in response to the item, “Participating as a student in peer-led workshops”. The Rochester ranking was third, after “Studying assigned work alone”, with a rating of 3.9, considerably higher than the average, 3.38, for all ratings. (This item also ranked third in the pilot study of students at St. Xavier University.) But the ranking of this item for non-Rochester respondents was 10, with a 3.5 rating, below the average for all ratings, 3.65. The differ-

ence between the average ratings for this item for the two groups is statistically significant at the $\alpha = .05$ level.

We have to conclude that a number of workshop students—even those who went on to become peer leaders and who found that experience to be highly beneficial—did not find their student workshop experience to be substantially more important than many other academic activities.

Clearly, not all PLTL workshops are implemented in the same way or have the same impact on students. One respondent reported having had workshops in several courses, with differing levels of effectiveness.

I think the reason was because the department did not actually know how to utilize the workshops to their full potential. The problems were tough and the leaders were more used to being TAs and fulfilling that role. Also, they were often graduate students who did not understand the workshop model.

Another commented that the workshops introduced new and difficult material. The workshop model recommends that new material be introduced in lecture, not workshops.

We were supposed to be using the whole discovery process. And if it had been introduced to me in more of a lecture format, it would have been a lot less confusing.

These comments may help explain the modest ratings given to workshop participation by some respondents. Like any educational initiative, the workshops can be implemented

in ways that will have a positive impact, or they may be adapted in ways that diminish the impact. This is why it is important for each institution to evaluate student experiences in their workshops.

Survey Outcomes: Personal Benefits

The next set of items (Table 2) asked the former leaders to indicate agreement or disagreement with items about appreciations and skills derived from their leadership roles. For these items there were no significant differences between the mean ratings of Rochester (94.8) and non-Rochester (94.9) respondents, so the groups were combined for the analysis.

These are benefits that any institution of higher learning would be pleased to find in its graduates. This is particularly true of improved presentation skills, teamwork, and an appreciation of “what it takes to be a teacher”. These percentages also provide a solid foundation for the open-ended items that follow. These highly positive responses about workshops cannot be attributed to respondents reporting what they thought the survey wanted. If that were the case they would have given much higher ratings to the value of attending workshops, as discussed above.

Open-Ended Items

The survey contained six open-ended items asking the former leaders to report the effects of the workshop experience on different aspects of their learning, personal growth, academic and career decisions, and overall benefits. In these open-ended items respondents selected areas to emphasize. They were not led or given topics from which to choose. Responses were analyzed and coded.

Learning

How did being a workshop leader affect your content learning and your ability to become a better learner?

- Knowledge and Problem Solving: 43% (51) reported that being a leader had provided a more thorough knowledge of the discipline and made them better problem solvers.
- Groups: 26% (31) commented that the group activities provided an understanding of different approaches, learning styles, and methods of problem solving.
- Self-understanding: 23% (27) discussed an increased awareness of their own approach to study and learning.

People Skills

How did your experience as a workshop leader influence the way you interact with people?

- Skills in teamwork, leadership, and presentation: 44% (52) commented on enhanced skills in working with others, particularly in presenting material or leading a group.

Table 2. Level of Agreement with Statements of Personal Benefits from Participation

Statements	Agreement ^a (%) ^b
Acting as a workshop leader gave me an appreciation for the value of small-group learning.	95.8
As a workshop leader I gained an appreciation for different learning styles among students.	91.6
As a workshop leader I gained confidence in presenting that was useful later on.	95.8
As a workshop leader I gained confidence in working with a team that was useful later on.	93.3
As a workshop leader I came to a deeper appreciation of what it takes to be a teacher.	97.5

^aRespondents who chose “agree” or “strongly agree”; ^bN = 119

- Confidence and patience: 28% (33) reported increased confidence, comfort, or patience in working with people, particularly in teaching–learning situations.
- Insights into differences and commonalities: 32% (38) described a new appreciation for differences among people, particularly in how they learn or understand new material.

Academic and Career Decisions

How did the experience of being a workshop leader influence your choice of future courses and your career direction?

A majority of students said that their decisions did not change as a result of workshops. But a significant number reported an impact in the following areas.

- Interest in and appreciation for teaching: 29% (34) said that they wanted to include some form of teaching in their careers. They found that they enjoyed explaining ideas and helping others learn.
- Confidence in studying science: 10% (12) reported that the leadership experience had increased their own enjoyment and confidence in studying science.

Workshop Pros and Cons

How did the workshops promote undergraduate learning? What were the best things about workshops? What were the worst things about workshops?

Among the best things about workshops, respondents cited the following.

- Environment and process: 50% (59) said that workshops promote group process, questioning, and learning in a relaxed, supportive setting.

- Experiencing success: 24% (29) reported that students learned to succeed and solve problems by doing demanding work.

Among the worst things about workshops, the respondents cited the following.

- Uninterested students: 13% (16) said that some students did not want to participate, and that clashes among students can interfere with learning.
- Model: 7% (9) reported that for some the model is difficult to implement and some leaders were not proficient.

Recommendations

What recommendations would you make to professors who are teaching workshop courses?

Respondents were enthusiastic about the value of workshops. Their suggestions covered a number of important areas. One comment nicely summarizes the benefits along several dimensions.

I would tell them that even though the investment in workshop courses is extensive at the beginning, the results that come from that investment are much more fruitful in terms of depth of student knowledge, and in the students' abilities to connect with one another and build relationships, which ultimately lead to a better quality of life in college as well. It's definitely worth it!

While most PLTL implementers already use the following suggestions, their importance makes them worth noting.

- Materials and workshop problems: Write workshop problems with varying levels of difficulty and problems that encourage different methods of approach.
- Leader support: Give the workshop leaders some type of support network or class while they are teaching. Most student leaders have little or no experience or training and it is helpful to have a group with which to discuss concerns and challenges and to give suggestions for teaching strategies.
- Persistence: Stick with it. I was in the entire introductory process and there were some bugs at the beginning, but it was never a negative experience for anyone. It's tough, but it will work well once the wrinkles are ironed out. Keep at it.

Connections with Previous Studies

In 1984, Alexander W. Astin (23) proposed a theory of academic student development based on involvement. He distinguished his approach from earlier theories that were based on the quality of courses available and taken; presence of quality resources; and the institution's focus on individual needs. Astin defines involvement as the amount of physical and psychological energy that a student devotes to the academic experience. He identified weaknesses in previous theories, and found that involvement theory was simple yet comprehensive and was positively related to virtually all of the factors associated with success and retention in college. Since Astin proposed his theory, others have conducted studies and added

to the literature in this area. The most impressive study is that of Cress (24) in which data on 875 students from 10 institutions led to conclusions that students involved in leadership activities, "showed growth in civic responsibility, leadership skills, multicultural awareness...and personal and societal values". Finally, Astin (25) has further expanded and elaborated his thinking about involvement, examining peer-groups at some length and concluding that the peer group is "the most potent source of influence on growth and development" during the college years.

Peer-led team learning workshops are implemented to improve learning by engaging students. This is the essence of the program—when workshops are implemented according to the model, students and leaders become more involved and their learning improves.

Results of the survey, tabulated and analyzed in this report, confirm previous anecdotal evidence that the workshop leaders reap significant, ongoing benefits from their roles. Respondents report in overwhelming numbers that leading workshops reinforced the breadth and depth of their own learning, helped them develop personal qualities such as confidence and perseverance, and fostered a variety of presentation and team-related skills. These benefits were not associated with the nature of the institution—private or state, large or small, community college or four-year institution—but with the quality of workshop implementation.

This study contributes to the growing body of literature on involvement theory, indicating that greater involvement and engagement, particularly in leadership activities during college, leads to personal and professional benefits in the years immediately following college.

Acknowledgments

We thank the students, peer leaders, faculty, and learning specialists across our coalition for their participation in the development and support of the PLTL model. We are particularly grateful to Victor Stozak of the Graduate Center at the City University of New York for coordinating the online survey, and other co-principal investigators of the project who contributed to the shared vision of the PLTL model.

We are pleased to acknowledge support from the NSF Division of Undergraduate Education, Course and Curriculum Development Program (grants DUE 9972457, DUE 0004159, and DUE 0231349).

Literature Cited

1. Gosser, D.; Cracolice, M.; Kampmeier, J.; Roth, V.; Stozak, V.; Varma-Nelson, P. *Peer-Led Team Learning: A Guidebook*; Prentice Hall: Upper Saddle River, NJ, 2001.
2. Sarquis, J. L.; Dixon, L. J.; Gosser, D. K.; Kampmeier, J. A.; Roth, V.; Stozak, V. S.; Varma-Nelson, P. The Workshop Project: Peer-Led Team Learning in Chemistry. In *Student-Assisted Teaching: A Guide to Faculty Student Teamwork*, Miller, J. E., Groccia, J. E., Miller, M. S., Eds.; Anker Publishing Company: Bolton, MA, 2001; pp 150–155.
3. Varma-Nelson, P.; Cracolice, M.; Gosser, D. K. Peer-Led Team Learning: A Student-Faculty Partnership for Transforming the Learning Environment. In *Invention and Impact: Building Excellence in Undergraduate Science*,

- Technology, Engineering, and Mathematics (STEM) Education*, Proceedings of Conference Sponsored by the NSF Division of Undergraduate Education and in Collaboration with the AAAS Education and Human Resources Programs, April 16–18, 2004, Crystal City, VA; American Association for the Advancement of Science: Washington, DC, 2004; Successful Pedagogies, pp 43–48.
4. Varma-Nelson, P. Project Kaleidoscope Volume IV: What Works, What Matters, What Lasts. <http://www.pkal.org/documents/Vol4PeerLedTeamWorkshop.cfm> (accessed Nov 2006).
 5. Gosser, D. K.; Roth, V. J. *Chem. Educ.* **1998**, *75*, 185–188.
 6. Tien, L.; Roth, V.; Kampmeier, J. A. *J. Res. Sci. Teach.* **2002**, *39* (7), 606–632.
 7. Peer-Led Team Learning: Comparing the Performance of Students with and without Workshops Home Page. <http://www.sci.ccny.cuny.edu/~chemwksp/ResearchAndEvaluationComparisons.html> (accessed Nov 2006).
 8. Tenny, A.; Houck, B. J. *College Sci. Teach.* **2004**, *33*, 25–29.
 9. Newman, F.; Holzman, L. *Lev Vygotsky: Revolutionary Scientist*; Routledge: New York, 1993; pp 82–83.
 10. *Student-Assisted Teaching: A Guide to Faculty Student Teamwork*, Miller, J. E., Groccia, J. E., Miller, M. S., Eds.; Anker Publishing Company: Bolton, MA, 2001.
 11. Light, R. J. *Making the Most of College: Students Speak Their Minds*; Harvard University Press: Cambridge, MA, 2001; pp 76–77.
 12. *Readings in Cooperative Learning for Undergraduate Mathematics*, Dubinsky, E., Mathews, D., Reynolds V. E., Eds.; MAA Notes Series; The Mathematical Association of America: Washington, DC, 1997.
 13. Treisman, P. M. (Uri). *College Math. J.* **1992**, *23* (5), 362–372.
 14. Mazur, E. *Peer Instruction: A User's Manual*; Prentice Hall: Upper Saddle River, NJ, 1997.
 15. Moog, R. Process-Oriented Guided Inquiry Learning (POGIL) Home Page. <http://www.pogil.org> (accessed Nov 2006).
 16. Varma-Nelson, P.; Coppola, B. P. Team Learning. In *The Chemists' Guide to Effective Teaching*; Cooper, M. M., Greenbowe, T., Pienta, N., Eds.; Prentice Hall Publishing: Upper Saddle River, NJ, 2005.
 17. Lyle, K. S.; Robinson, W. R. *J. Chem. Educ.* **2003**, *80*, 132–134.
 18. Gafney, L. *Progressions: The PLTL Newsletter* **2001**, *2* (2), 3–4.
 19. Gafney, L.; Varma-Nelson, P. *Progressions: The PLTL Newsletter* **2002**, *3* (2), 1, 8–9.
 20. Seymour, E. Student Assessment of Learning Gains. <http://www.wcer.wisc.edu/salgains/instructor/> (accessed Nov 2006).
 21. Blake, R. *Progressions: The PLTL Newsletter* **2001**, *2* (4), 5–6.
 22. Creswell, J. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*; SAGE Publications: Thousand Oaks, CA, 2003; p 217.
 23. Astin, A. W. *J. College Student Personnel* **1984**, *25*, 297–308.
 24. Cress, C. M.; Astin, H. S.; Zimmerman-Oster, K.; Burkhardt, J. C. *J. College Student Dev.* **2001**, *42*, 15–28.
 25. Astin, A. W. *What Matters in College: Four Critical Years Revisited*; Jossey Bass: San Francisco, CA, 1993; p 398.