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Are In-Class Peer Leaders Effective in the Peer-Led Team-Learning Approach?

By Keith Schray, M. Jean Russo, Roger Egolf, William Lademan, and David Gelormo

Students currently taking the course in organic chemistry were found to be as effective serving as peer leaders as standard peer leaders in the peer-led team-learning (PLTL) environment, measuring learning effectiveness and student and peer-leader attitudes.

Peer-led team learning (PLTL) *(www.sci.ccny.cuny.edu/~chemwksp)* has been widely adopted for enhanced learning in a variety of disciplines, most widely in introductory chemistry, but also in organic chemistry as in this study (for example, Tien, Roth, and Kampmeier 2002). This pedagogical approach forms student groups led by students who have previously done well in the course (herein referred to as standard peer leaders). These groups, which are termed *workshops,* work outside of class on content provided by the professor. This study shows that in-class peer leaders (students currently taking the class) can perform group leadership as effectively as standard peer leaders, enabling easier implementation of this pedagogy. This change in peer leadership was undertaken because using students who have already completed the course in question as peer leaders presents two implementation barriers. These are cost, primarily payment of peer leaders, and concerns about sufficient availability of peer leaders. For cost reduction, we reasoned that since in-class peer leaders had to go to workshop anyway, we would pay them less than standard peer leaders, so using this system would cut costs significantly. For our discipline, organic chemistry, increasing peer availability was important in both the four-year environment at Lehigh and the two-year environment at Northampton Community College and Penn State, Lehigh Valley. Historically, there are few peer tutors at Lehigh and implementing peer-led team learning in the whole class would require about 20 leaders, which wasn't thought to be achievable. At Northampton CC and the Penn State branch campus, students leave after taking organic chemistry, effectively preventing the PLTL program for this second-year course. Thus, in-class peer leaders would make PLTL possible at the two-year college level in organic chemistry.

Because we are making a comparison to the normal PLTL program, we have been careful to make this study as similar as possible, though there are many variations to be found in current practice around the country. Certainly, we have met the six critical criteria for success (PLTL Workshop Project 2003), which include (1) being integral to the course, (2) strong faculty involvement, (3) peer-leader formal training, (4) content similarity achieved by using workshop materials derived from Kampmeier, Varma-Nelson, and Wedegaertner (2001), (5) greater than 90% attendance at workshop sessions, and (6) institutional support.

Our local environments

At Lehigh, 100–200 students take Organic Chemistry each semester. Engineers make up 28% of the class, biologists are the majority with 50%, chemistry/biochemistry majors are in the minority with 12%, and 10% are other majors. The classes are 45% sophomores and 45% juniors and are supported with Blackboard course software. At Northampton Community College, there are 25–35 students, who attend day or evening classes; while at Penn State, there were 10 students and too many dropped to make it a useful evaluation. Data from the two-year environment are not presented here but are qualitatively similar.

Study protocol

Groups of eight students were allowed to self-form. Fifty percent of students formed full groups, 30% formed as smaller groups, and 20% said they had no preference for fellow group members. These last 50% were aggregated into full groups. The meeting times (one to one and a half hours) were chosen by groups, which met in seminar-type rooms. Standard peer leaders were selected because they were good students with interactive

personalities. In-class peer leaders were recommended by their introductory chemistry instructors and, as it turned out, they came entirely from honors chemistry classes. Standard peer leaders were paid $500 per semester, while in-class peer leaders were paid $250 per semester. Either a standard peer leader or an in-class peer leader was assigned to each group. Half of the groups had standard and half had in-class peer leaders, and over the semesters reported here there were 120 groups. All peer leaders received identical training (a nine-hour preliminary period followed initially by weekly meetings). Workshop time was one to one and a half hours. Workshop exercises were often those of Kampmeier, Varma-Nelson, and Wedegaertner (2001) or were written locally. Attendance was in the 90% range, inspired by attendance being 10% of the grade and workshop questions' appearance on exams. Groups selected the time of their meeting outside of regular class time, typically evenings and weekends. In the first two years, all students were in workshop groups. In the last two years, we let students opt into workshop groups or choose an alternative (see below).

Results

Two evaluation approaches were used in this peer-leader comparison—academic performance and student/peer-leader attitudes.

Academic performance

Figures 1A–D show the mean scores in all learning evaluations in the four semesters of the study taught at Lehigh University for students in the two peer-leader-type groups. Visually, these are clearly very similar. Table 1 shows the statistical analyses for these semesters. In comparing the two groups, only 3 of the 29 grading exercises showed a significant difference (Table 1, row 1). The exam scores were averaged for comparison (row 2), and the difference is given in row 3 (Δ-actual). There is very little difference between groups and the difference does not favor either group. Because the two types of groups were self-selected and therefore wouldn't necessarily be equivalent, we were concerned that might be masking an actual difference. For example, if better students preferred groups with in-class peer leaders, they would be expected to exhibit superior performance. This might nullify a

FIGURE 1A

Quiz, exam, and final mean scores for in-class peer-led students versus standard peer-led students—fall 2003.

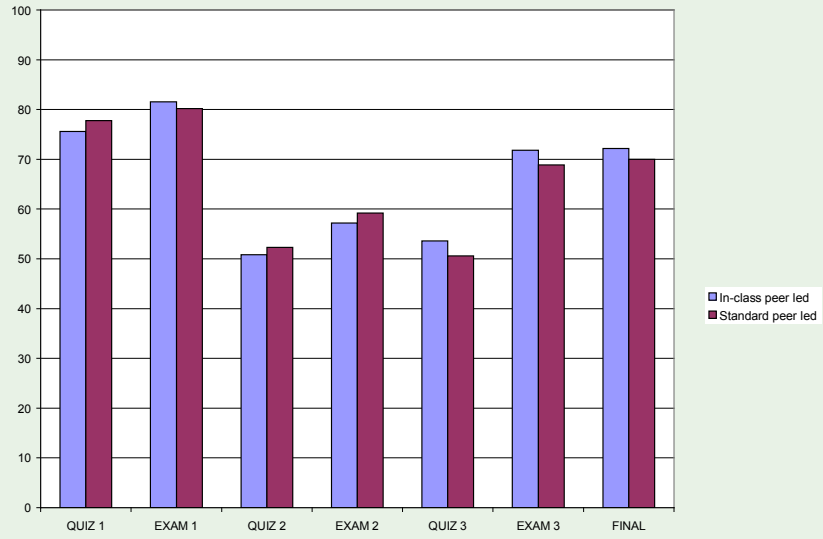


FIGURE 1B

Quiz, exam, and final mean scores for in-class peer-led students versus standard peer-led students—spring 2004.

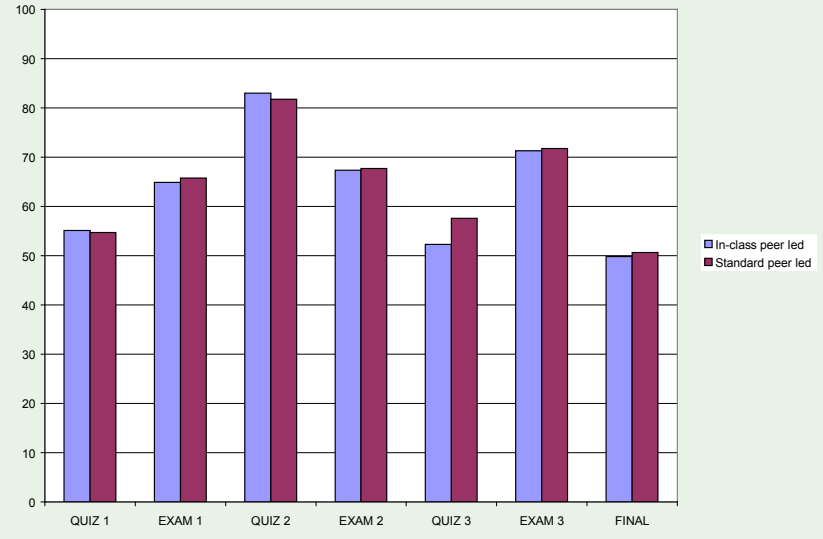
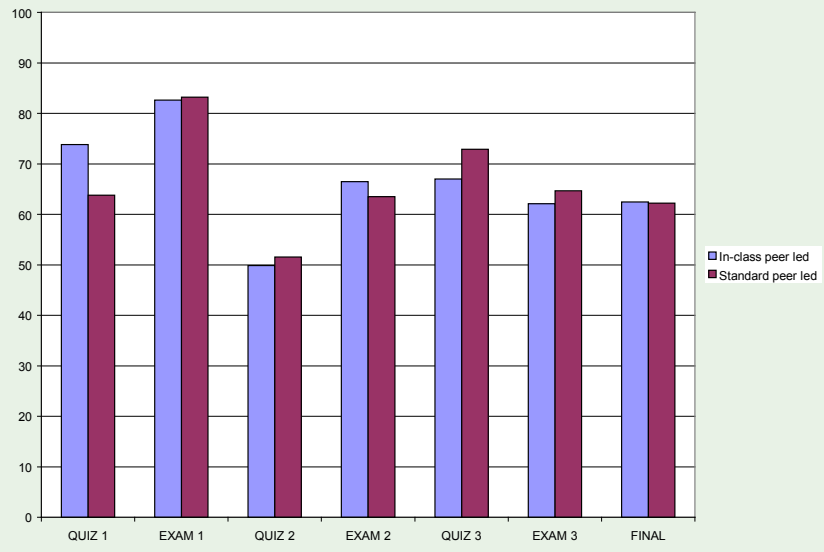


FIGURE 1C

Quiz, exam, and final mean scores for in-class peer-led students versus standard peer-led students—fall 2004.



better performance that the standard groups might show due to the more experienced peer leader. Thus we determined students' average GPA score when they entered the class to determine group equivalence. These are shown Table 1, row 4, with the difference between GPA of the two groups noted in row 5. The spring 2004 and fall 2004 semester groups are equal. But in the fall 2003 and spring 2005 semesters, a difference in the ability of the groups would be expected to yield differences in the academic performance. The in-class group would be stronger in the fall of 2003 and the standard group stronger in the spring of 2005. So the expected differences among the averages of all the exams were then calculated (Table 1, row 6) for the performance difference predicted from the small GPA differences between the groups. This was determined by a regression line (not shown) of the dependence of performance on GPA in the student pool. Then the observed exam difference was adjusted by that expected difference to yield row 7, which yields the performance difference in the two groups. For example, for fall 2003, the in-class group was stronger by 0.12 in GPA (row 5), which should lead to an exam average improvement of 2.73 (row 6). But the actual difference in exam scores (row 3) was 1.1. So the standard group was actually 1.63 better than expected (row 7 = row 6 – row 3). The average difference in performance favors the standard group by 0.89 %, not a significant figure, thus the initial conclusion of equivalence between the two groups stands.

Attitudinal effects

Surveys were used to assess both students and peer leaders. The Student Assessment of Learning Gains (SALG) was used to survey student perspectives of the workshops. This survey was the basic instrument *(www.wcer.wisc.edu/salgains/student),* modified to exclude the optional questions and include a number of questions focused on the workshop aspects of the course.

These data of the average values of responses to the SALG questions are shown in Table 2, comparing questions from the fall of 2003, which showed significant differences between the two leader types, and from spring 2005 for those same questions. A total of 85 questions were asked and the 5 shown were the only ones show-

TABLE 1

Summary comparative analysis.

		Fall '03		Spring '04		Fall '04		Spring '05		
Row		In-class	Standard	In-class	Standard	In-class	Standard	In-class	Standard	Total
1	Sig. diff.	0/7		0/7		1/7		2/8		3/29
2	Ex. ave.	70.7	69.6	63.3	63.9	68.4	68.4	58.2	60.9	
3	Δ-actual	+1.1			+0.6	0.0			+2.7	
4	GPA	3.27	3.15	3.25	3.24	3.26	3.25	3.25	3.34	
5	GPA Δ	+0.12		+0.01		+0.01			+0.11	
6	Δ-expect	+2.73		+0.14		+0.19			+1.67	Ave.
7	Δ-adjust		1.63		0.74		0.18		1.03	0.89

ing significant differences between the two types of peer leaders. Clearly the two leader types are very comparable, and in looking at the spring 2005 data, several of these questions no longer had significant differences, further strengthening the observation of equivalence. Two questions remain significantly different: (1) whether interacting with the leader increases student understanding (higher for the standard peer leaders). This suggests that the leader is doing more tutoring and answering of questions (that is borne out in Table 3). By design, that is one of the things they should not be doing. (2) Students prefer standard peer leaders, strongly so for those who had one. Again, this is understandable because students prefer someone who will tell them the answers, although this is not what they should be doing. Thus, the use of in-class peer leaders appears to be equivalent not only in learning results but also in student attitudes compared to the standard peer leaders.

We also conducted a separate survey of the two groups of peer-leader types. There are few significant differences between the two groups. Table 3 shows those differences for both fall semesters. It can be seen that of the questions that produced significant differences between the groups in the two fall semesters, only one is significant in both semesters. That pertains to how the in-class peer leaders explain problems less than the standard peer leaders, as mentioned in the student survey. Interestingly, the question about acting more as a guide than a teacher is identical for both groups in the fall of 2004. This may reflect that 44% of the standard peer leaders the second fall semester were former in-class peer leaders.

FIGURE 1D

Quiz, exam, and final mean scores for in-class peer-led students versus standard peer-led students—fall 2004.

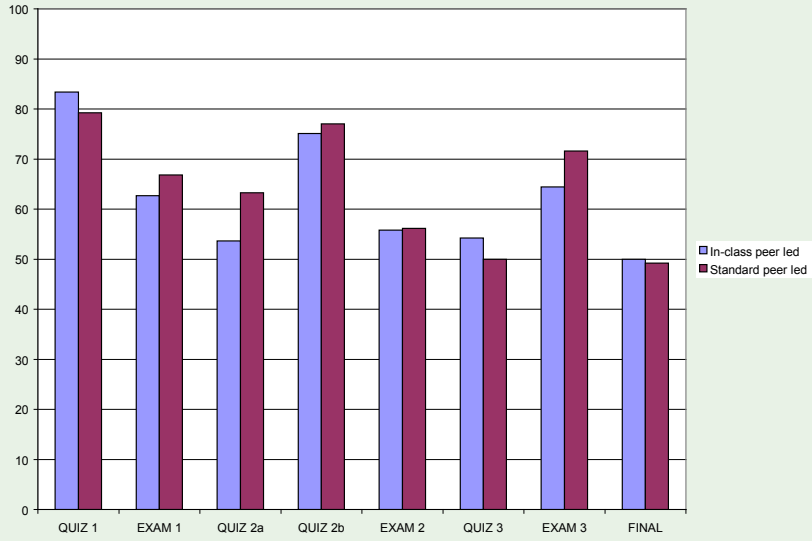


TABLE 2

Significant differences on the SALG survey between students with in-class peer leaders and standard peer leaders—fall 2003 and spring 2005 comparison.

	Year	In-class mean	Standard mean	*t*	df	Sig. (2-tailed)
The leader responds to student questions. Spends 1 = Almost no time, 5 = Most of the time	2003	3.3	4.1	-3.03	67.3	0.003
	2005	3.3	3.5	-0.55	61	0.585
Interacting with the workshop leader increases my understanding. 1 = Strongly disagree, 5 = Strongly agree	2003	2.8	3.7	-3.11	80	0.003
	2005	3.0	3.5	-1.66	61	0.103
Noise or other distractions make it difficult to benefit from the workshops. 1 = Strongly disagree, 5 = Strongly agree	2003	2.5	1.8	2.97	66.1	0.004
	2005	2.5	2.7	-0.74	61	0.464
Students who are uninterested or unmotivated make it difficult for others to benefit. 1 = Strongly disagree, 5 = Strongly agree	2003	3.1	2.3	2.91	80	0.005
	2005	3.4	3.1	0.93	61	0.355
Would you prefer a peer leader who has already completed Organic Chemistry or one who is currently enrolled? 1 = Strongly prefer completed, 5 = Strongly prefer current	2003	2.5	1.6	3.77	64.1	0.000
	2005	2.3	1.5	2.79	51.8	0.007

TABLE 3

Significant differences on peer-leader survey between in-class peer leaders and standard peer leaders—fall 2003 and fall 2004.

Code: 1 = Disagree; 5 = Agree strongly	Year	In-class mean	Standard mean	*t*	df	Sig. (2-tailed)
My workshop group sometimes has extra meetings to prepare for tests or review difficult material.	2003	2.7	1.3	2.49	11.0	0.030 *
	2004	2.7	2.8	-0.07	13	0.946
I regularly explain problems to students in workshops.	2003	3.0	4.6	-2.93	15	0.010 *
	2004	3.6	4.4	-1.81	13	0.094
As a workshop leader I act more as a guide than a teacher.	2003	4.1	2.6	2.42	15	0.029 *
	2004	4.0	4.0	0.00	13	1.000
Code: 1 = Not at all satisfied; 2=Somewhat; 3=Moderately; 4=Very satisfied						
Overall, how satisfied would you say you were with your experience as a workshop leader?	2003	3.5	3.4	0.23	15	0.825
	2004	3.4	4.0	-2.83	6.0	0.030 *

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

TABLE 4

Student responses to survey on the use of answer sheets.

	Strongly disagree		Disagree		No opinion		Agree		Strongly agree	
	Fall '03	Fall '04	Fall '03	Fall '04	Fall '03	Fall '04	Fall '03	Fall '04	Fall '03	Fall '04
I would have worked harder on the problems if I did not get the answer key at the end of the workshop.	49%	41%	21%	24%	13%	25%	12%	6%	4%	4%
Having the answers to the problems at the end of the workshop increased my understanding of the topic.	0%	4%	1%	2%	5%	5%	33%	30%	61%	59%

We have looked at two particular issues of interest concerning a difference in the workshop content of this study in comparison to normal PLTL protocol, which are independent of peer-leader type. One was that the groups were formed largely by students, who then set a time with their peer leader. About 50% of the class self-created groups of eight; 30% created groups of two to three, which were then coalesced into eights; and 20% were assigned arbitrarily. This issue was not assessed, but anecdotally, there seemed to be much less time needed to get the groups up and working by this self-formation compared to descriptions of other programs that used instructor-assigned groups. The other difference is that answer sheets were supplied to students after the workshop session, which is not ordinarily done. We surveyed students on this latter point and found that, clearly, by students' views, the availability of answers after workshop has strong learning advantages and little disadvantage (see Table 4).

In subsequent years, we have

moved to an all-volunteer in-class peer-leader format. We find that as word has spread about the workshops, voluntary participation by students in workshop has been about 85% (the principal alternative is online quizzes), and the class is generating the necessary peer leaders with no compensation needed.

Conclusions

In-class peer leaders are as effective as standard peer leaders, though they have slightly different modes of operation. Differences seen are that standard peer leaders "teach" more and have better control of the group, the former because they know more and the latter because they are not friends with their group. Academic performance and student satisfaction are virtually identical.

Acknowledgment

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