



THE PEER-LED TEAM LEARNING INTERNATIONAL SOCIETY
PROCEEDINGS OF THE 2013 CONFERENCE
MAY 30-JUNE 1, 2013
UNIVERSITY OF HOUSTON-DOWNTOWN
HOUSTON, TEXAS

**STUDENTS' ATTITUDES ABOUT PEER-LED TEAM LEARNING WORKSHOPS
IN GENERAL CHEMISTRY: A CRITICAL INCIDENT STUDY**

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Peer-Led Team Learning (PLTL) is a "curricular structure" (Gosser and Roth, 1998) developed in the early 1990s to improve students' performance and understanding of course material. In addition to the lecture sessions by faculty, a *workshop* session is scheduled weekly and led by a Peer Leader, a student who has previously taken the course and performed well. The PLTL model is characterized by six "critical components" which were developed through extensive evaluation (Gafney, 2001):

1. Workshop is integral to the course;
2. Faculty are involved with workshop;
3. Peer Leaders are trained and supervised;
4. Materials are challenging;
5. Time and space are designated for workshop sessions; and
6. There is institutional support.

Several studies at various types of campuses have shown that students involved in peer-led study groups receive A, B, or C grades at higher rates than those students who have not had a peer-led workshop (e.g., Liou-Mark, Dreyfuss, and Younge, 2010; Hockings, DeAngelis, and Frey, 2008; Lyon and Lagowsky, 2008; Gafney, 2001). Students are also less likely to withdraw from introductory courses (Gafney, 2001) and more likely to persist to higher-level courses (Wamser, 2006). However, beyond the importance of tracking students' performance and persistence to determine the effect of the incorporation of workshops in courses, students' attitudes toward workshop have rarely been studied. A study (Dreyfuss, Liou-Mark & Gafney, 2014) using Gafney's (2001b) survey examined General Chemistry students' responses to 36 questions about workshop. The results over three semesters showed that students found workshops helped them do better on exams, the interaction with Peer Leaders and their peers increased their understanding of the material, and they would strongly recommend workshops to other students.

How would students respond to open-ended questions regarding their experiences with PLTL workshops? This paper will present the results of a two-semester qualitative study on how students view workshop in their introductory chemistry courses, using Brookfield's (1995) Critical Incident Questionnaire (CIQ). As noted by Keefer (2009), the CIQ "seeks to capture the

critical moments, experiences, or ‘vivid happenings’ that occur in a learning episode for the purpose of informing the class instructor or facilitator about how the learning experience is proceeding” (p. 177). The five questions probe what stands out in the affirmative and negative, using key words: engaged, distanced, affirmed, puzzled or confused, and surprising. Collecting key moments from students in workshop, after several weeks of meeting, would allow a grounded sense of how students view the workshop experience.

Since the mid-1990’s a PLTL program has been incorporated in a two-semester General Chemistry course at the City College of New York of the City University of New York, which has had an enrollment of 500-800 students each in the fall and spring semesters. For many students the course is a requirement for their majors in science or engineering, and it is a pre-requisite for higher-level courses. When students enroll in the General Chemistry course, they are assigned a time for lecture, laboratory, and workshop. For each semester, there are six faculty members who teach the course – four for General Chemistry I sections, and two for General Chemistry II sections (not all students are required to take both semesters). Workshop sessions, which meet once a week, are separate from the lecture and laboratory sessions. They are led by a Peer Leader, a student who has completed the course with an “A” or “B” grade and is selected and trained for this role. Workshop groups are composed of eight to twenty students. For each semester, there are approximately 60 workshops held both during the day and evening.

Population

The participants for this study were students who were enrolled in General Chemistry I or II during the Spring 2006 and Fall 2007 semesters. For Spring 2006, a total of 232 students completed a Critical Incident Questionnaire, and a total of 426 students in Fall 2007. Table 1 summarizes the number of respondents by courses.

Table 1: Summary of Respondents of the Critical Incident Questionnaire in Spring 2006 and Fall 2007 semesters

	General Chemistry I		General Chemistry II		Total	
	Number of respondents	Number of workshops	Number of respondents	Number of workshops	Total # Respondents	Total # Workshops
Spring 2006	---	25	---	10	232	35
Fall 2007	304	28	122	14	426	42

Method

The instrument used for the study was Brookfield’s (1995) “Critical Incident Questionnaire” which evaluates the important attributes of a learning event from the participant’s standpoint. The following five open-ended questions, on one page, allow respondents to express their opinions anonymously:

Question 1. *At what moment in workshop have you felt most engaged?*

Question 2. *At what moment in workshop have you felt most distanced from what was happening?*

Question 3. *What action that anyone (leader or other student or professor) took in workshop have you found most affirming or helpful?*

Question 4. *What action that anyone (leader or other student, or professor) took in workshop have you found most puzzling or confusing?*

Question 5. *What about the workshop has surprised you the most?*

The CIQ surveys were administered during the Spring 2006 and Fall 2007 semesters to students participating in workshops in either General Chemistry I or II. In Spring 2006, students were surveyed mid-semester, and in Fall 2007, the surveys were distributed three weeks prior to the end of the semester. Peer Leader coordinators visited the workshops to give out and collect the surveys from the students. The surveys were anonymous, and students were informed that non-participation would not affect their grades. In Spring 2006, some workshops that met in the evening were not surveyed, leading to lower numbers of respondents.

Results

The written responses to each question were entered in Excel spreadsheets, and they were aggregated based on commonality of wording. Responses varied from one word to a few sentences. Therefore, the number of responses may exceed the total number of respondents. The following results are summarized by question.

Question 1. *At what moment in workshop have you felt most engaged?*

For both Spring 2006 and Fall 2007 semesters, over 90% of the respondents stated that they felt engaged in workshop and less than 10% said they were not, or offered no answer (Table 2).

Table 2. Responses to Question 1 – Spring 2006 and Fall 2007

Question 1. At what moment in workshop have you felt most engaged?		
	Spring 2006	Fall 2007
'Yes/Always'	79 (34%)	118 (25%)
'Yes,' with detailed answers	135 (58%)	321 (67%)
Total 'YES'	214 (92%)	439 (92%)
Total 'No' or no answer	18 (8%)	37 (8%)
Total # of Responses	232	476

The top three specific responses to the question of engagement centered on (1) working in groups and solving problems; (2) when a student understood, asked questions, and made connections to the material covered during lecture; and (3) by going to the board and discussing problems. These activities describe active engagement with the course material (Table 3).

Sample responses included the following regarding engagement in workshop:

- During working on the problems in a group. And when we were constructing arguments, to support our ideas

- All the time. You have to participate to learn
- When we are doing the questions and interaction, discussing our errors, and finding shorter ways to do the questions
- When we all talk together through problems using the board
- When [the Peer Leader] takes his time and gives us tips about how best to approach the material

Table 3. Specific responses to Question 1 – Spring 2006 and Fall 2007

Question 1. At what moment in workshop have you felt most engaged?			
Spring 2006	Number of responses	Fall 2007	Number of responses
Work in groups/ Solve problems	62 (46%)	Group problem-solving; when we did problems, especially homework	86 (27%)
When understood; Asking Questions	25 (18%)	When I understood and made connections to lecture	15 (5%)
Going to the board	19 (14%)	Problems on board	17 (5%)
Exam prep	8 (6%)	Before/after test	45 (14%)
Miscellaneous responses	21 (16%)	Covering specific topics	58 (18%)
		"Today" or "at the beginning" (when the course was easy)	86 (27%)
		Miscellaneous responses	14 (4%)
Number of responses:	135	Number of responses:	321

Question 2. At what moment in workshop have you felt most distanced from what was happening?

In both semesters, a third of the respondents rarely felt distanced in workshop, and over half felt distanced during specific instances (Table 4).

Table 4. Responses to Question 2 – Spring 2006 and Fall 2007

Question 2. At what moment in workshop have you felt most distanced?		
	Spring 2006	Fall 2007
Never/rarely felt Distanced	73 (32%)	185 (38%)
Felt Distanced (often/always) or Not Applicable	23 (10%)	20 (4%)
Felt Distanced (specific instances)	135 (58%)	282 (58%)
Total Number of Responses	231	487

In the Spring 2006 semester, approximately a third responded feeling distanced when they did not understand something or at the beginning of the semester, approximately a tenth said during the 1st or 2nd session (when presumably they didn't know others in the group) and when the discussion went on too long on a particular question, a quarter said when they were hungry, tired, or they were unprepared. In the Fall 2007 semester, also approximately a third responded feeling distanced when they didn't understand something and during a specific time, especially

at the start of the semester, and a fifth said when they were not prepared, or were hungry, tired, or they were otherwise distracted (Table 5).

Table 5. Specific Responses to Question 2 – Spring 2006 and Fall 2007

Question 2. At what moment in workshop have you felt most distanced?			
Spring 2006	Number of responses	Fall 2007	Number of responses
When I didn't understand/chemistry questions/concepts	42 (31%)	When I'm confused, don't know how to solve problem, during specific material	84 (30%)
Late or not present; day-dreaming; hungry; tired; noise; Not prepared/ my turn to participate; Working alone/ not participating	38 (28%)	At a specific time during the semester (usually semester's start)	85 (30%)
During the 1 st or 2 nd session	15 (11%)	When I wasn't prepared or missed a workshop, was tired, distracted, when we did problems, especially homework; today; when we cover too much material; when other students chat; when done with my work	53 (19%)
When the discussion went on too long on a particular question	11 (8%)	Before, during, or after exams	16 (5%)
Miscellaneous – other times	29 (21%)	Miscellaneous – other times	44 (15%)
Number of responses:	135	Number of responses:	282

Sample responses included the following regarding feeling distanced in workshop:

- When I didn't understand something, which was rare because [the Peer Leader] always explained everything in detail
- In the beginning when I didn't know conversion and didn't know what to ask
- That problem can take 40 minutes?
- When we get distracted with the growing sound of other class. So disturbing!
- When I am confused based on the process used to find result. When the process is long and complicated
- When I solve the problem individually
- When I was in [Peer Leader's] class. Did not feel engaged
- Never felt distanced, just confused at times, but then I get help
- I have not experienced a situation like the above question
- At the start of the class. Basically when am getting myself prepared for the class-work in class
- You can't because small group and instructor always make one participate
- When people are hostile (sarcastic, attitude, know-it-all) to the workshop leader
- Distance only felt in lecture

Question 3. What action that anyone (leader or other student, or professor) took in workshop have you found most affirming or helpful?

In the Spring 2006 semester, approximately a fifth of the participants said they found solving problems or working step-by-step most affirming, followed by also a fifth who stated they liked working in groups or the group discussions, and they appreciated the leader's explanations. For the Fall 2007 semester, a quarter said they found the leader's explanation or review of materials most affirming and they enjoyed reviewing problems, and a fifth liked working in groups or the group discussions (Table 6).

Table 6. Specific Responses to Question 3 – Spring 2006 and Fall 2007

Question 3. What action that anyone (leader or other student, or professor) took in workshop have you found most affirming or helpful?			
Spring 2006	Number of responses	Fall 2007	Number of responses
Solving problems or working step-by-step	33 (17%)	Leader's review/explanation of material	134 (26%)
Liked working in groups or group discussion	43 (22%)	Reviewing problems (especially before exam, quizzes)	129 (25%)
The leader's explanations	38 (19%)	Working together, other students' input	99 (19%)
When I understood/ or was asking questions	22 (11%)	Participating / writing on blackboard	36 (7%)
Going to the board	14 (7%)	Leader's reassurance / patience /going the extra mile:	26 (5%)
Alone or one-on-one	12 (6%)	Reviewing concepts / formulas	24 (5%)
Exam prep	12 (6%)	All of it!	6 (1%)
Students disruptive/ Leader problem /Prof problem	5 (3%)	Quizzes	10 (2%)
Miscellaneous	4 (2%)	Miscellaneous	6 (1%)
Not Applicable	12 (6%)	Confusing or irrelevant answer / Not Applicable/ Nothing	46 (9%)
Number of responses:	195	Number of responses:	516

Sample responses included the following regarding feeling affirmed in workshop:

- The leader explains questions and concerns. If she doesn't feel you understand she goes back to break it down more
- Asking for volunteers (rather than putting people on the spot) to do problems is good
- Going over the questions. Explaining everything very well until everyone understands. Quiz after every class about what we just finished learning to help ourselves and know better if we understood the topic or need more help
- The leader uses other scenarios that don't deal with chemistry to explain what is going on. In chemistry she uses examples that deal with people or normal things.
- When I ask a question and others explain the solution in different ways
- When other students ask me questions about how I answered a problem- that way I can check if I truly understand

- When a partner was helping me with something I didn't understand.
- Solving similar problem that was discussed in lecture

Question 4. *What action that anyone (leader or other student, or professor) took in workshop have you found most puzzling or confusing?*

For both semesters, approximately 40% of the respondents said they found nothing puzzling or confusing in workshop. Forty percent provided specific examples of confusing incidents in Spring 2006 and approximately half of the respondents in Fall 2007 (Table 7).

Table 7. Responses to Question 4 – Spring 2006 and Fall 2007

Question 4. What action that anyone (leader or other student, or professor) took in workshop have you found most puzzling or confusing?		
	Spring 2006	Fall 2007
Nothing puzzling or confusing	89 (38%)	153 (41%)
Something Puzzling or confusing (specific answers)	94 (40%)	195 (52%)
Not Applicable	49 (21%)	23 (6%)
Total Number of Responses	232	371

When asked what was confusing for the Spring 2006 cohort, 57% of the respondents said they found the questions confusing and how their peers confused them. As for the Fall 2007 cohort, a third found the professor's lecture and general issues with the professors confusing (Table 8).

Table 8. Specific responses to Question 4 – Spring 2006 and Fall 2007

Question 4. What action that anyone (leader or other student, or professor) took in workshop have you found most puzzling or confusing?			
Spring 2006	Number of responses	Fall 2007	Number of responses
Did not understand the way problems were solved; chemistry question confusing; others confused them	54 (57%)	Professor's lecture is confusing; general issues with professor	64 (32%)
Professor's lecture	6 (6%)	Unclear (or incorrect) explanations by professor, leader, or peers	32 (16%)
Concept/technique not introduced in lecture	6 (6%)	Issues with Peer Leader, workshop questions	99 (51%)
Quiz	5 (5%)		
Miscellaneous	23 (24%)		
Number of responses:	94	Number of responses:	195

Sample responses included the following regarding feeling puzzled or confused in workshop:

- Nothing really, because everything was explained
- I haven't really found a problem. Everyone listens and participates
- We have a book for this class - really? And we need to open it?

- I thus far spared from confusion
- Workshop goes at a slow pace, so everyone gets to understand before moving on
- Different methodologies used in problem-solving sometimes can be confusing, that's why outlining steps on how to resolve a problem had been beneficial
- When it's new things but he finds a way to make us understand and know what's happening
- When we would go too fast
- Teacher says one thing and then teacher at workshop says something else (or word differently)
- Just progressing with the work example without explaining
- I'm not confused in workshop...only in lecture

Question 5. What about the workshop has surprised you the most?

In the Spring 2006 semester, approximately a third of the participants said nothing had surprised them about workshop or did not answer. Fifteen percent said that workshop was helpful (they were surprised by this!), and half of the group had been surprised by something specific (Table 9). In the Fall 2007 semester, a quarter of the respondents said nothing had surprised them about workshop or did not answer. Eighteen percent were surprised that workshop was helpful for them, and less than half had been surprised by something specific.

Table 9. Responses to Question 5 – Spring 2006 and Fall 2007

Question 5. What about the workshop has surprised you the most?		
	Spring 2006	Fall 2007
Not Applicable	25 (11%)	27 (6%)
Nothing	43 (18%)	69 (17%)
SUBTOTAL	68 (29%)	96 (23%)
Workshop was helpful	35 (15%)	76 (18%)
Something surprising (Specific answers)	129 (56%)	175 (42%)
Negative issues	--	70 (17%)
Total Number of Responses	232	417

Approximately a third of the Spring 2006 participants were surprised by the interaction in groups and the discussion of problems. Sixteen percent said they learned more in workshop than in lecture, and 18% were surprised at the helpfulness of the Peer Leader. There was also feedback on the abbreviated workshop time allotted for the second semester of General Chemistry, with the suggestion of a longer workshop. Almost 40% of the Fall 2007 group were surprised by working in groups, that they understood better by asking questions and by solving problems together. A tenth said they learned more in workshop than in lecture, and also a tenth was surprised at the helpfulness of the Peer Leader (Table 10).

There were also negative comments, such as the Peer Leaders were confusing or disorganized, workshop is long or not useful, lecture was not synchronized with workshop, and the participants stated that Peer Leaders are students and do not know everything.

Table 10. Specific responses to Question 5 – Spring 2006 and Fall 2007

Question 5. What about the workshop has surprised you the most?			
Spring 2006	Number of responses	Fall 2007	Number of responses
Working in groups; Understood better by asking questions; solve problems	51 (39%)	Participation / interaction / discussion of problems	50 (29%)
Leader was helpful	12 (9%)	Leader was very helpful	32 (18%)
Learn more in workshop than in lecture	15 (11%)	Need a longer workshop (Gen Chem 2)	29 (16%)
Feel more confident	5 (4%)	Workshop more helpful than lecture; helps understanding of lecture; workshop was fun	28 (16%)
Test questions were same as workshop questions	6(5%)	Issues with workshop; miscellaneous	22 (13%)
Workshop is too late/ too long	6(5%)	Quizzes (how many there were)	14 (8%)
Miscellaneous	34 (26%)		
Number of responses:	129	Number of responses:	175

Sample responses included the following regarding feeling surprised by something in workshop:

- The ability to participate and solve problems
- That it [workshop] actually helps you learn the topic better
- The workshop helps to reinforce the learning of the material by providing time to apply knowledge
- The creative mind flow that emanates from all of the students which eventually strengthened our general concept of chemistry.
- The fact that it does help in clarifying somethings that lecture doesn't
- That not enough students take advantage of it
- The thing that surprises me the most is that I leave the workshop knowing something, instead of lecture, which I leave knowing the same thing I went inside there with
- My workshop leader. She is very attentive and helpful. She really knows how to handle the material and she is good at explaining concepts. Chemistry is hard to understand, but she really surprised me because I found out that things become clearer after I had her as my workshop leader.
- Nothing really, it's fun and informative and I get to practice the stuff I learn
- The whole workshop surprised me. [Peer Leader] turned out to be a really good workshop teacher.
- The leader lets student do problem on blackboard and explain them by themselves. That is good for us.
- I learn the most in workshop. I feel like [Peer Leader] is teaching me chemistry
- That we go around in a circle and everyone takes one step on the question. Makes sure everyone understands. Great idea.
- When we went over a problem in the workbook, that I thought I knew how to solve but I completely solved it wrong.
- Most of the time it is very engaging. Learn more in workshop than in lectures

- Collaboration with fellow students has helped ground me in techniques and concepts which are reaffirmed by the workshop leader
- I explained something to a fellow student
- That it wasn't as boring as I thought it would be.
- By this workshop I learned more than I would learn at home solving problems on my own
- I thought workshop was extra work. But it was more helpful than I thought.
- The attention that I receive. The sessions make me more involved and so more interested.

Discussion

Students taking General Chemistry I and II at the City College of New York expressed exceptionally positive attitudes toward their participation in peer-led workshops. The active engagement in working in groups helped the participants understand the concepts better and strengthened their connection with the material. Disengagement usually occurred at the beginning of the semester when the groups were in their formation stages or when the questions posed were unclear. Confusion was mostly felt when the explanations by their professor, by their Peer Leader, or by their peers were not lucid. However, participants found the step-by-step process in solving problems during Workshop helpful and the guidance and explanations offered by the Peer Leaders beneficial to their learning. What surprised most of the participants was the effectiveness of the Workshops, namely the open discussions surrounding the course material. This collaborative setting allowed questions to be answered, and understanding and concept mastery to be developed among the individuals.

Ideally, the immediate results of these qualitative surveys would be useful for the faculty, administrators, and program staff, to note where workshops could be improved since the contextual information implied by the insider knowledge of how a program operates plays an underpinning role in understanding what issues are presented by respondents that may need to be addressed.

Conclusions

The crux of the PLTL instructional model is the Peer Leaders. Their roles and responsibilities are indispensable and vital in developing a nurturing and effective team setting. Peer-led workshops are an ideal setting for students to learn the value of collaboration and the skills necessary to contribute positively to a working environment. Eventually, this experience will be useful in the workplace.

As noted by Keefer (2009), the questions asked on the CIQ can be "tweaked" to "be adaptable based on learner and instructor needs" (p. 181), including asking a question on what was learned in a specific session (classroom, training, or workshop). The CIQ is intended, as suggested by Brookfield (1995), as a classroom assessment technique for an individual session. However, its versatility can be demonstrated in obtaining respondents' views regarding the workshops over the course of a semester.

Future studies on workshops may include using the aggregated responses presented here to further investigate the essential benefits of peer-led workshops and the interplay between working collaboratively and academic success in the Science, Technology, Engineering, and Mathematics disciplines.

Acknowledgments

This study was partially supported by a grant from Howard Hughes Medical Institute, David Gosser, Principal Investigator, the City College of New York, CUNY.

The authors also wish to thank the students in workshops who completed the surveys, the Workshop Coordinators and Peer Leaders who helped distribute and collect the survey forms, the Department of Chemistry, and the contribution by Chris Schramm for data entry and initial analysis.

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Cite this paper as: Dreyfuss, A.E., & Liou-Mark, J. (2014). Students' Attitudes about Peer-Led Team Learning Workshops in General Chemistry: A Critical Incident Study. *2013 Conference Proceedings of the Peer-Led Team Learning International Society*, May 30-June 1, 2013, University of Houston-Downtown, www.pltlis.org; ISSN 2329-2113.