

THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF CHEMISTRY

ANALYSIS OF THE EBERLY COLLEGE OF SCIENCE LEARNING ASSISTANTS
PROGRAM IN THE CONTEXT OF NATIONAL SCIENCE EDUCATION REFORM

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ABSTRACT

Although it has been established for decades that active learning teaching methods are significantly better for student understanding than traditional lecture there has been little change in the method of instruction at the university level. The Eberly College of Science Center for Excellence in Science Education is developing a Learning Assistants program with the ultimate goal of incorporating more active learning and research based teaching techniques in the classroom to improve the quality of undergraduate science education at Penn State. This thesis details my study of the perceptions of the students and Learning Assistants in regard to the developing ECoS Learning Assistant Program progress in achieving its goals through the investigation of national efforts to reform undergraduate science education and study of the courses that incorporated LA's. Utilizing multiple assessment methods, I determined that students believe having LA's helped increase their understanding of course material and students in courses that have LA's are more comfortable working with their peers. LA's report having an increased understanding of course material and science pedagogy, as well as deeper relationships with the course professor. Based on these results, I conclude that the Penn State LA program is successfully making progress in achieving its goals. However, there is still significant room for improvement, and based on my findings I present recommendations for the Penn State Learning Assistants program in order for it to become more successful in transforming undergraduate science education at Penn State.

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Chapter 1

Introduction

The Penn State chemistry department is nationally ranked and renowned for its excellence in chemical research. However, despite the department's success in research, it has failed to adopt the research-based teaching reforms that have been well established for decades. The Penn State chemistry department is not alone in its reluctance to adopt new methods of teaching into the classroom, the vast majority of chemistry courses, undergraduate and graduate, remain taught in the lecture format.

In an effort to improve the quality of education at Penn State, the Eberly College of Science Center for Excellence in Science Education (CESE) adopted the Learning Assistants Program established at the University of Colorado, a program grounded in educational research that has demonstrated superior learning gains of students versus traditional lecture.

Herein, I will present and discuss the theoretical foundations of the science education reform movement and its emphasis on active learning, review the programs that developed as a result of this movement while providing evidence for the effectiveness of these reforms in improving undergraduate chemistry education, and establish the reasons why the Learning Assistants program is the most suitable method to improve the quality of instruction in the ECoS at Penn State, and its associated Department of Chemistry. I will then outline the implementation of the Learning Assistant Program at Penn State, including its goals, the role of the LA, and courses that have used LAs. I will next discuss the goals of my thesis research, and the research questions that I intend to investigate. I will present the results of my research, and provide recommendations for the future improvement of the Penn State LA program.

Chapter 2

The Science Education Reform Movement

2.1 The Problem

The need for reform in undergraduate science education has been clear since the 1990's when organizations such as the National Science Foundation and the National Research Council issued calls for instructional innovation (1,2). While the demand for students with expertise in science, technology and engineering has continued to grow, with the Department of Labor Statistics estimating that by 2018 there will be more than 3 million job openings in STEM fields (3), the percentage of students majoring in these fields has dropped, even while total bachelor degrees has tripled in the past forty years (Figure 1-1)(4). This lack of students graduating with STEM degrees has led to the United States facing "a crisis in S&E talent and expertise."(5).

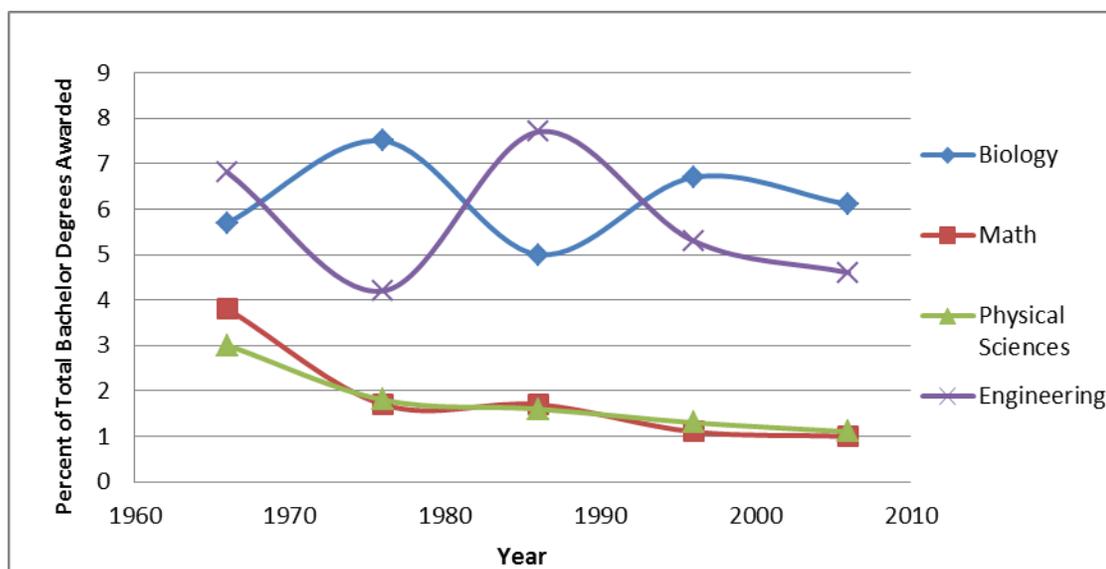


Figure 2-1. Trends in percent of total bachelor degrees by field (4).

Contributing to this shortage of STEM majors is the “weed out” process of college courses, and other negative experiences of undergraduates in introductory science courses. Introductory courses are often large-enrollment, lecture courses where students are bored and overwhelmed by the competitive atmosphere. Students frequently report that these courses are filled with isolated facts and memorization (6). Students at Penn State report frustration with these issues in their SRTE’s, saying of CHEM 112, a typical large lecture introductory course, “I felt like we were told all semester what to do, but not told a lot about why you use certain equations at different times. On the tests, it was always hard for me to remember which equation applied to which type of problem. I don’t think we covered the purpose of them enough for me to fully understand.”

These frustrations are directly linked to the lecture-style of instruction, which promotes memorization rather than understanding (7). Research in the fields of cognitive psychology and educational psychology has grown our understanding of the methods through which students learn, and it has become clear that lecture is not in agreement with human learning processes. (8) Further evidence to the ineffectiveness of lecture as a teaching format is Hake’s 1998 study, which analyzed results on the Physics’ concept survey, the Force Concept Inventory. In the study of 62 different physics courses, Hake demonstrated a strong correlation between active learning and greater conceptual gains. In fact, the conceptual gains of those in active learning classrooms were two times that of traditional lecture style courses (Figure 1-2) (9).

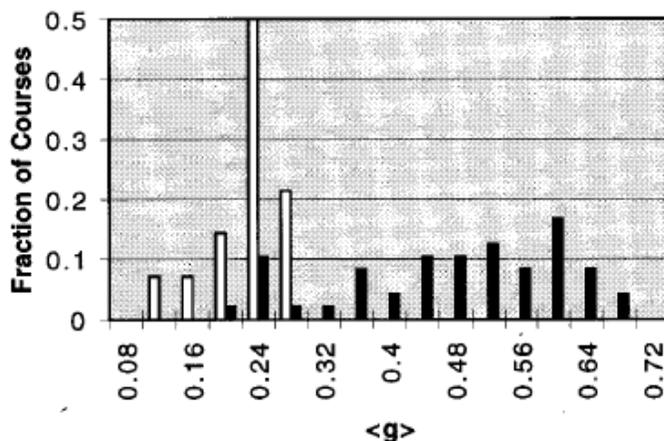


Figure 2-2. Histogram of gains ($\langle g \rangle$) on the Force Concept Inventory from traditional lecture courses (White) and courses that incorporated active learning (Black) (9).

2.2 The Solution

While there have been a large variety of methods of reform that have been investigated, all of the more recent efforts have been founded on the practice of active learning. Active learning is a process through which students actively participate in the learning process. There has been widespread agreement between education reformers, NRC panels, and cognition specialists of necessity to implement active learning in the undergraduate classroom (10,11,12). Additionally, there has been a vast amount of evidence demonstrating the superiority of active learning over the traditional lecture format (See Hake Example above).

Active learning is based on constructivism which is the theory that “knowledge cannot be transmitted but must be constructed by the mental activity of learners” (13). This psychological theory shifts the focus of a classroom away from the lecturer because it is no longer what the instructor teaches that is important. The theories being lectured are not learned as concepts but as facts. Constructivism states that in order for a student to understand an idea or concept they must think through it and actively construct the concept for themselves based on what they already

know (14). This presents the need for student focused classrooms, where students are doing real science, through problem solving and discovery, to construct new ideas for themselves, and the emphasis is on what is being learned and understood.

A crucial component of most implementations of active learning is collaboration, where students have the opportunity to discuss, debate, and understand ideas as a community, similar to how scientific research is actually conducted. In science collaboration is crucial and has led to some of the most important scientific gains of our time. James Watson, nobelist and co-discoverer of the DNA double helix stated, “Nothing new that is really interesting comes without collaboration.” Collaboration is just as crucial in the classroom as it is one way of actively involving the student with the material and working towards learning. Additionally, there is a significant social aspect of learning and collaboration inherently incorporates this type of pedagogy. The importance of social interaction was first proposed by Vygotsky, a soviet, psychologist, who developed the theory of zonal proximal development, which states that learning is social, and that learning outcomes produced by an individual are inferior to those achieved when that individual works with others (15). The discrepancy between the two is referred to as the zone of proximal development (ZPD). According to this theory the greatest amount of learning is done when the material is within a student’s ZPD, where they are unable to accomplish the task on their own, but are able to with the assistance of peers (16). Practice within a student’s ZPD leads to the student’s eventual ability to complete similar tasks on their own. The social interdependence theory is another psychological theory emphasizing the importance of collaboration. Proposed by Koffka in the early 1900’s, social interdependence theory states that positive interdependence, or cooperation, between groups promotes interactions where the group encourages and facilitates each other’s learning, while a competitive group dynamic such as in classes where individual performance is judged, tends to promote individuals to discourage or impede each other’s learning (17).

The benefits of active learning through some form of collaboration have been thoroughly studied and demonstrated in the undergraduate classroom. Some benefits cited by research into active, collaborative learning as compared to traditional lecture are a deeper understanding of the material, a greater retention of the material, lower attrition rates of students (with the largest improvements being in retaining female and minority students), an increased motivation to learn, a greater interest in the subject, and a recruitment of new students to that major (18-21). While this list is not exhaustive, it clearly demonstrates the vast benefits achieved through incorporation of an active learning pedagogy. However, it is difficult to generalize these benefits, as there are various forms of collaborative active learning that have been implemented and studied, and there are a variety of differences between each situation. Many of these benefits were determined to be applicable for any form of collaborative, active learning by a meta-analysis of 39 different peer-reviewed studies on the effects of small-group learning methods in undergraduate STEM courses (22). This study established an overall significant benefit in academic achievement, attitudes towards learning and course material, and persistence in STEM, especially for minorities. It is not possible to outline all of the varieties of programs and studies that provide evidence for these benefits, so I will outline the main forms of collaborative active learning that have been implemented and studied in undergraduate chemistry classrooms and provide evidence for their effectiveness at achieving these benefits.

Collaborative Learning/Cooperative Learning

Collaborative/Cooperative learning is the most basic form of peer interactive learning, which generally incorporates groups that work together on a common assigned project. This type of classroom reform is based directly on the theories of constructivism, ZPD, and social interdependence theory. The distinction between collaborative learning and cooperative learning

is based on assessment. In collaborative learning students are evaluated on their individual work, while for cooperative learning the group is evaluated as a whole (23), however in the literature they are often used interchangeably. There are significant variations in implementation between the numerous collaborative and cooperative programs, however overall these peer work-group reform methods have been shown to increase learning gains and lower drop rates for courses.

A pioneer implementation of cooperative learning was in a graduate level thermodynamics course (24). A weekly group discussion replaced one of the three weekly course meetings. The groups were randomly formed each week, given 10 minutes to discuss a conceptual concept related to the thermodynamics they had learned that week and then each group gave a presentation based on their conclusions. The study was concerned with how students perceived the collaborative aspect of the course. Overall they discovered that students moved away from memorization-focused study strategies towards more meaningful study strategies and felt that the cooperative learning experience increased their conceptual understanding. A quote from a student illustrates this increased conceptual understanding: "I believe I will go out of this class actually knowing something-not just walking out of here memorizing a bunch of formulas and then forgetting them." Additionally students felt that this format helped them to develop interpersonal and communications skills. This study demonstrates the increased conceptual knowledge that is acquired during active learning, however it provides no quantitative evidence that learning was increased and this model of collaborative learning would be difficult to scale for use in a larger course.

Cooperative learning has also been implemented into countless introductory chemistry courses, such as general chemistry and organic chemistry. At the California State University Los Angeles, cooperative learning was implemented to replace lecture entirely (25). Instead, these 50 person lectures were run as discussions, with questions being presented, small group discussion, followed by large class discussion, for about 3 questions per lecture. The professor continued to

cover the entire organic chemistry curriculum, with a heavy emphasis on mechanisms, as he had previously, when using the cooperative learning model. The increase in number of students passing the course was significantly improved, from 38% across the three quarter year, to 75% (Table 1-1). This dramatic increase in students passing organic chemistry due to cooperative learning provides quantitative evidence that this method increases retention rates and improves student performance.

Table 2-1. Passing Rates in Lecture vs. Active Learning Formats (25).

Course	Sections (No.)	Av Enrollment	% Pass
<i>Standard Lecture Format: 1984-1994</i>			
Chem 301A	8	48	71 ± 5
Chem 301B	8	50	63 ± 4
Chem 301C	8	40	85 ± 3
<i>Cooperative Learning and Active Learning: 1994-1998</i>			
Chem 301A	3	43	92 ± 2
Chem 301B	3	50	86 ± 4
Chem 301C	4	44	94 ± 2

A meta-analysis conducted by Bowen demonstrates the quantitative effectiveness of cooperative learning as compared to traditional chemistry courses (26). In a study of 15 peer-reviewed research publications on cooperative learning in high school and undergraduate chemistry courses, he found a mean effect size of 0.37, indicating that across the 15 studies, the average percentile change was 64%. This means that a student in the 50th percentile of a traditional lecture chemistry course performs at the 64th percentile in a cooperative learning course, an overall improvement in student performance (Figure 1-3). This study shows that over 15 institutions using cooperative learning there was a significant overall improvement in chemistry performance. However, it is significant to note that a few had negative effects on chemistry achievement.

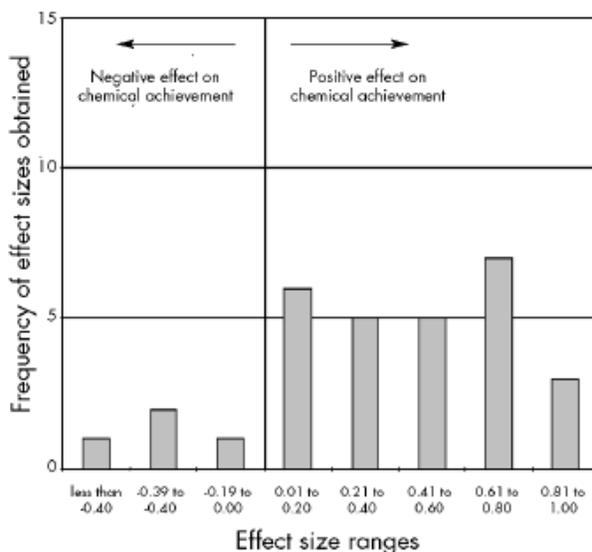


Figure 2-3. Effect sizes from studies of cooperative learning in chemistry courses.

Bowen's findings that negative effects are possible when using cooperative learning methods, demonstrate the importance of implementation. While not all cooperative learning programs improve student performance, the method has been thoroughly studied and guidelines have been established to help ensure its successful implementation. Johnson and Johnson have studied collaborative learning for over a decade, and have the key elements successful cooperative learning: a) each student perceives that he/she is linked with others such that the student cannot succeed unless the others do, b) individual accountability so that the performance of each student is assessed, c) there are meaningful face to face interactions, which requires small groups, d) effective use of interpersonal and small-group skills, and e) group-processing skills (27).

Peer Led Team Learning

The Peer Led Team Learning (PLTL) method is a more structured form of collaborative, active learning, usually involving a workshop that supplements a traditional lecture course. This is advantageous for its implementation, as it does not require significant alteration of the traditional lecture course, but instead is supplemental to the lecture. In the workshop small groups of students are paired with undergraduates who have previously taken the course and been successful who acts as a moderator and guide for the students as they work through problems that are designed to supplement the lecture and specifically build conceptual understanding. During these workshops the students are involved in collaborative, active learning that is guided by a peer.

PLTL is based on the constructivist evidence for active learning, with a significant emphasis on the Vygotsky theory of ZPD. Along with the benefits of collaborative learning, interpretations of the Vygotsky theory indicate that students will learn better from peer experts than from superior due to their more similar ZPD's (16). This method also assures that the key components to successful collaboration as defined by Johnson and Johnson are met by placing a peer facilitator who facilitates small group work and encourages individual accountability, and promotes positive interdependence. PLTL is perhaps the most commonly used method of reform in chemistry courses, which may be due to the fact that it was developed initially for a chemistry course at the City College of New York in 1991, or because PLTL became an NSF-funded initiative due to its success in improving the passing rates of students, improving student understanding, and the positive benefits for the undergraduate leaders (28, 29, 30).

Due to the national interest in spreading the PLTL method, numerous books and studies have been done on the method, and the six critical components for PLTL have been identified (16). These components are:

1. Workshops are closely integrated with the course and all of its elements
2. Faculty teaching these courses must be actively involved with the workshops and with the peer leaders
3. Peer leaders are students who have taken and excelled in the course, who have good interpersonal skills, and are well trained and supervised in facilitating workshops
4. Workshop problems must be appropriately challenging and designed for use in collaborative settings
5. Organizational arrangements must be made to account for small group sizes, required space, time, and teaching resources
6. Institutional and departmental support of innovating teaching methods

PLTL has been adopted into countless general chemistry classrooms with great success. Frey et. al. demonstrated this in their paper detailing the implementation and measure of success of a new PLTL program at the Washington University of St. Louis (31). As a research university, they were not able to adopt mandatory workshops for all students so instead implemented an optional PLTL program that required attendance of all participants. PLTL groups of eight students met weekly for two hours with peer leaders. The peer leaders have previously taken the course and PLTL supplement and received an A grade, additionally the peer leaders complete two credit-based courses; a course on the content of the PLTL workshop, and a course on scientific pedagogy covering group dynamics, learning styles, and other teaching related topics. They typically enroll around 500 students in organic chemistry per semester, and about 350 elect to

participate in the PLTL workshops. They found that students who attended the PLTL workshops had significant academic achievement gains, performing one third of a grade point higher than students who did not attend the workshop. Additionally, PLTL students had a higher retention rate and showed positive attitudes towards the PLTL program, and also had positive attitudes towards chemistry in general. The authors also report that the program's success in general chemistry led to PLTL being incorporated into physics, calculus, and organic chemistry courses at the university. This study demonstrates the effectiveness of PLTL and the ability of PLTL to be scaled for large courses.

Table 2-2. Drop Rates and Grades for PLTL vs. Non-PLTL Students (31).

Performance Indicators	All Students	PLTL Students	Non-PLTL Students
Withdrew from course after 2nd week	3.2%	1.3%	4.4%
Mid-term grade (mean, not %)	2.68	2.73	2.64
Final grade (mean, not %)	2.82	2.94	2.74
Final grade was <B- in course	39.0%	33.6%	42.8%

NOTE: Level of significance calculated for PLTL versus non-PLTL students where $p \leq 0.05$.

In Kampmeier's study of the incorporation of PLTL into organic chemistry at the University of Rochester, they demonstrate similar positive effects on academic performance, retention, and attitude, but the study also collected qualitative data to assist in elucidating the aspects of the PLTL program that contributed to the improved performance (32). At Rochester the PLTL workshop replaced the traditional recitation section for the course and was required for all students enrolled in first semester organic chemistry. Peer leaders were undergraduates who had taken the course in the past, and were trained in pedagogy and content. The workshop

problems were constructed in accordance with the requirements of the PLTL components; they fit well with course material and were adequately challenging so as to encourage collaboration.

There were significant gains in performance, retention, and attitudes over the four years that data was collected, additionally the success rates of females and minorities were significantly greater than the gains of the male group, reinforcing that switching from competitive traditional classrooms to collaborative atmospheres most significantly impacts women and minorities. In addition, students reported that the workshop was the most important aid to learning organic chemistry, more important than even the workshop problems used during workshop time, and significantly more important for their learning than the lecture. The same professor taught the course, and received the same positive evaluations from students both before and after the implementation of PLTL, indicating that quality of structure had little impact on students' appreciation of the workshop over the lecture. Through interviews with peer leaders, the authors isolated three key components that they felt made the workshops so effective: a) the community of learners, b) negotiating ideas and concepts to refine understanding, and c) acquiring expert thinking skills.

PLTL has been demonstrated to positively impact learning, retention rates, and student attitude, but there are also significant positive effects for the peer leaders involved. In "What Teaching Teaches: Mentoring and the Performance Gains of Mentors," Amaral and Vala analyze a PLTL program at the University of Florida and demonstrate the positive impact acting as a peer leader has even after they are no longer mentoring (33). At the University of Florida the PLTL program was implemented for an introductory chemistry course for students underprepared for general chemistry based on a placement exam. The peer leaders were selected from students who had previously taken the introductory course. The study compared three groups of students, those who were prepared for chemistry and enrolled in general chemistry; those who were considered underprepared and enrolled in the introductory course and the peer leaders who had taken the

introductory course. The performance of each of these groups in first and second semester general chemistry was tracked. The mentors did significantly better, and had lower withdrawal rates, in first semester general chemistry than both groups of non-mentors, earning a half a letter grade better than the group deemed prepared for general chemistry and a full letter grade higher than the group who took the introductory course and did not elect to be mentors. These gains for the mentors were determined to not be related to better mastery of the introductory chemistry course material, as it is only a minor component of the material covered in the general chemistry course. The mentors continued to outperform the other two groups in second semester general chemistry, earning an average grade of 2.9 as compared to a 2.5 for the students who had taken the introductory course and a 2.7 for the students who had gone straight to general chemistry. Additionally the mentors were much more likely to enroll in further chemistry classes than either of the other groups. This clearly demonstrates that mentors will perform better academically in future courses unrelated to the course in which they are peer leaders, especially because the mentors in this study were also considered underprepared to take general chemistry and required the introductory course, but in the future outperformed the students prepared for general chemistry. The study provides evidence that a PLTL program academically benefits both the students and the mentors.

While there have been many other iterations of the PLTL program in universities across the country, I have demonstrated that despite differences in programs, significant benefits can be seen. PLTL programs through their incorporation of collaborative, active learning into college courses, demonstrate significant gains in academic achievement, student retention, and attitudes towards chemistry. However, while there are small variations in the implementation of PLTL, it remains a workshop model, with no incorporation of active learning in the classroom. This program is limited by utilization of the workshop allowing the continued use of traditional lecture courses.

The Colorado Learning Assistants Model

The Colorado Learning Assistants Model is a more open-ended method of incorporating collaborative, active learning into college courses than the PLTL method, and is focuses on different goals. The Learning Assistants Program was developed at the University of Colorado Boulder in 2003 as collaboration between science and education faculty four specific goals:

1. To recruit and prepare talented STEM majors for careers in teaching,
2. To improve the quality of STEM education for all undergraduates,
3. To engage STEM faculty in the recruitment and preparation of future teachers and in the transformation of undergraduate courses
4. To transform cultures within the university STEM departments to value research-based teaching as a legitimate endeavor for ourselves and our students (34).

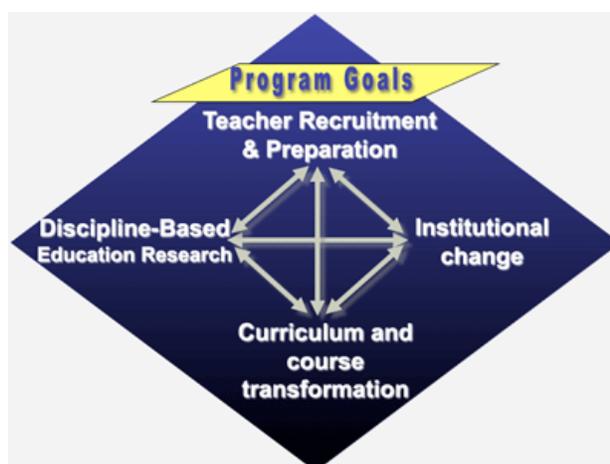


Figure 2-4. Goals of the Colorado LA Program (35).

In the LA program, LA's act as mentors very similar to PLTL mentors and their training is similar in that it includes pedagogy and instruction in course content. However, because of the different goals of the two programs the emphasis and structure of these trainings may be significantly different. Learning Assistants (LA's) are viewed as having two roles in this

program: they are actively assisting faculty in the transformation of undergraduate courses towards active, collaborative learning, and being prepared for careers in K-12 science education. All of three of the components of an LA's training are viewed as preparing the LA for a future career in teaching, as well as facilitating the successful transformation of courses. The LA's receive training in science pedagogy with a focus on facilitating collaborative learning; this prepares them to successfully facilitate collaborative learning in the course, while teaching them the basics of how science is learned. The LA's meet weekly with the faculty instructor where they learn more deeply the course content that they will be facilitating, while providing feedback to the professor on the progress of the course transformation. Finally, the LA's work with students facilitating group collaboration, where they gain experience in the role of an instructor in a student-centered classroom and provide assistance in transforming the course.

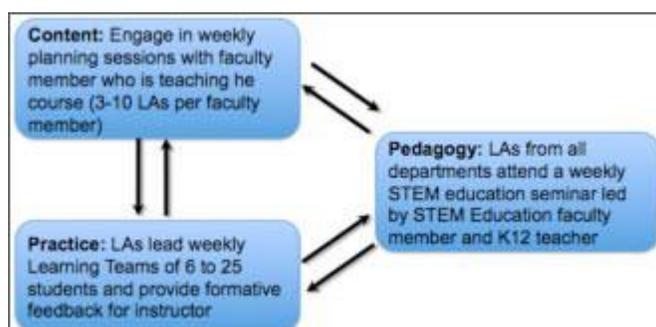


Figure 2-5. Components of the LA Training (35).

To accomplish the goals of discipline-based education research and institutional change, the LA program requires faculty to collect data on the transformation of their courses. The collected data is published on the LA program website (35). Through the collection of this data faculty are conducting education research, and ideally as they examine and publish this data that they learn more about education-based teaching practices and current education research. Additionally, by exposing other faculty to the successful results of the LA transformed courses, it

is hoped that other faculty will take an interest in research-based teaching practices and be inspired to utilize LA's and transform their course, thus leading to an institution wide change in attitude towards what constitutes teaching and learning.

Another difference between the LA program and the PLTL program is that the LA program has more flexibility in incorporation into courses. Courses transformed through the LA program incorporate active learning in a variety of ways; some LA's are used in class to facilitate group discussion on group activities or clicker questions, while some LA's are utilized outside of class in student-centered tutorials similar to PLTL workshops. This flexibility makes transforming a course through use of LA's more accessible to a wide variety of courses.

The benefits of the LA program are very similar to those of the PLTL program as far as student outcomes. Studies conducted of the learning gains of courses with LA's indicate that there is a significant increase in learning gains for all of the LA transformed courses, as well as significant increase in learning gains for the LA's. This is demonstrated by the learning gains of students in general chemistry whose scores on a chemistry concept test were significantly greater with the use of LA's (36). Additionally, the LA's for the course scored similar to graduate student TA's on general chemistry content exams.

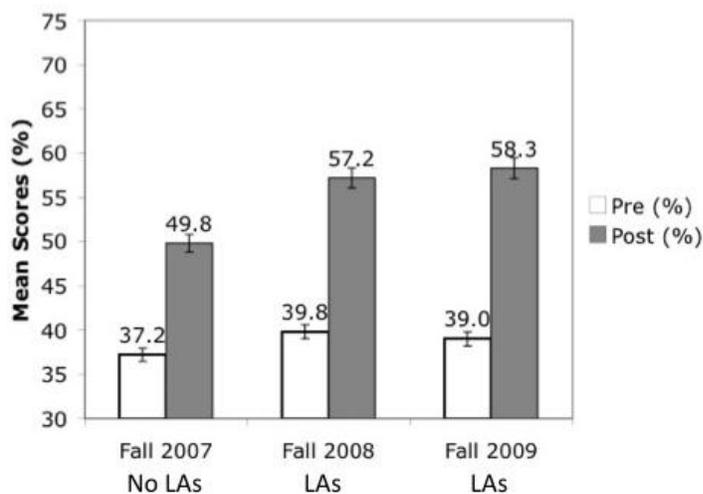


Figure 2-6. Effect of Learning Assistants on Concept Test Scores in General Chemistry (35).

However, the LA program has many other goals besides improved undergraduate education that must be assessed to determine the program's success. The LA program has significantly increased the number of STEM teachers certified by the University of Colorado Boulder (Fig A). Additionally the collection of data gets faculty involved in education reform, and faculty using LAs have reported a greater focus on educational issues, including increased attention to what and how students learn (34). By demonstrating program successes the LA program was successful at gaining the interest of more faculty members who were willing to take on LA's and transform their courses. The program began in the math and physics department, with no chemistry courses utilizing learning assistants, but since its implementation the chemistry department has transformed 6 courses with LA's, including general chemistry and physical chemistry.

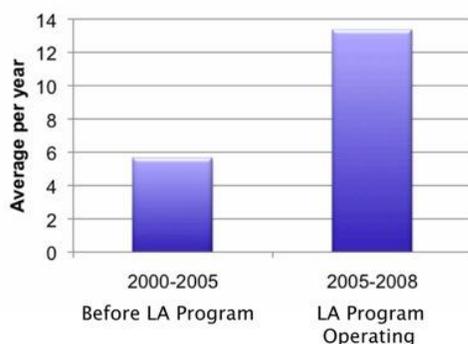


Figure 2-7. The Increase in STEM teaching certification before and after the LA Program (35).

The LA programs success at recruiting STEM teachers, improving undergraduate education, and causing institutional change, that it has since been adopted at a number of other universities across the country with varying goals, including Florida International University, West Virginia University, Seattle Pacific University, The University of Arkansas, and The University of Missouri-Rolla. All of these programs have been able to successfully implement the LA program within their universities and have seen improvement in the scientific education of

their undergraduates (36). However, many of these programs have had different goals than that of the original LA program at the University of Colorado and have had success in achieving those goals as well. For instance, the physics major at the University of Arkansas was in danger of closure due to lack of undergraduate physics majors. The LA program was implemented as a way of improving the quality of undergraduate physics courses in an attempt to recruit more students to the major, and it was successful. The success and versatility demonstrated by LA programs at this large variety of institutions demonstrate the strength of the program in successfully improving undergraduate science education.

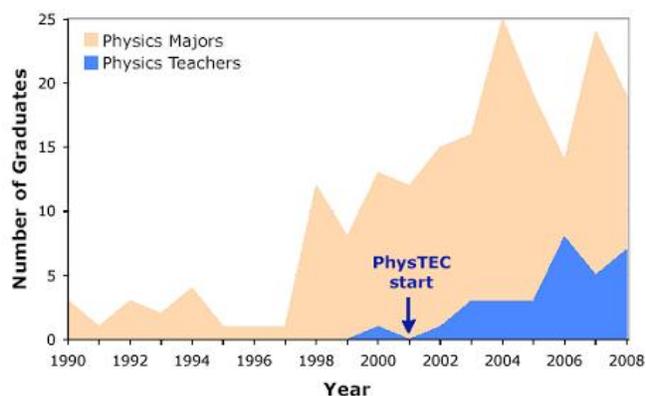


Figure 2-8. Number of Physics majors teachers at The University of Arkansas before and after the LA program (36).

Chapter 3

The Learning Assistants Program at Penn State

Since the fall of 2011, ECoS faculty at Penn State, through CESE, have been working to develop an LA Program at Penn State. The faculty recognized that the structure and components of the LA program, as well as the flexible implementation for methods of incorporating LA's into courses, made it the ideal model for sustainable transformation of ECoS courses to incorporate peer assisted, cooperative and active learning.

3.1 Goals of the LA Program

CESE has significantly different goals for the Penn State Learning Assistant program than those established in the Colorado model. These goals have been defined as:

1. To improve content mastery and learning gains of all students,
2. To increase retention in first and second year courses,
3. To encourage formation of small learning communities where students engage in collaborative problem solving,
4. For LA's to develop a mastery of the subject in which they are LA's,
5. For LA's to gain an understanding of science pedagogy and how learning works,
6. For LA's to develop deeper relationships with the course professor

These goals were designed with specific concern for the needs of the ECoS, as well as based on the demonstrated benefits of other peer-assisted learning programs. Since the majority

of these goals have been thoroughly established as a benefit by either the LA program or PLTL in peer-reviewed literature, it is reasonable to expect the same benefits from a properly implemented program here. Additionally, many of these goals were established with the intention that if they are achieved it will lead to more successful course transformation and growth of the LA program.

Goals 1, 2, and 4 are all established benefits of peer-instruction programs such as PLTL, and will serve to improve the quality of education for undergraduates in ECoS. These benefits of PLTL programs are established in Chapter 1. The other goals, 3, 5, and 6, are more specified for the needs of ECoS, and differ from those of other established PLTL or LA programs, so I will discuss them further.

The goal of formation of small learning communities is based on the evidence produced in Chapter 1 that collaborative learning increases understanding. The ECoS recognizes that it will take time before every course can be transformed, due to many professors resisting changing from lecture towards active learning. By transforming introductory courses into collaborative courses through the LA program, it is hoped that students will form study groups of students within their major that can be retained, and that students will begin to value collaborative learning. If students understand the benefits of collaboration on their learning, when they enter standard lecture courses, these students will continue to collaborate with classmates outside of class, and continue to learn and understand better than with lecture alone. Additionally, if students form these study groups and understand the benefits in active learning, they are more likely to encourage professors who prefer to lecture to incorporate more collaborative learning into class, aiding the transformation of more ECoS courses over time.

It is hoped that by achieving an increase in LA's understanding of science and pedagogy that both the LA's and the LA program will benefit. The LA's will learn to learn better, and use these practices to improve their performance in other courses. Additionally, the LA's will be better able to facilitate group collaboration, and more successful at helping students learn, if they

have a better understanding of pedagogy. They can communicate these learning skills to their students, increasing students' capability of learning. Finally, LA's will be able to communicate these skills to their course professor, in order to facilitate the transformation of the course. If the LA's have an understanding of how active learning works, they will be able to better advise the professor in transforming the course to incorporate collaborative and active learning.

Finally, it is a goal of the LA program that the LA's and professors will form deeper relationships. This will benefit the professor, the LA, and the students enrolled in the course. This is a crucial component of the LA programs successful course transformation and growth. It is hoped that the course professor will act as a mentor for the LA's, and help in shaping their future careers in science. Additionally, if the LA's are comfortable with the course professor then they will be able to provide honest feedback on the progress of course transformation. This will allow the professor to improve their implementation of collaborative, active learning, and lead to a more successful transformation. Professors are often unfamiliar with these types of teaching techniques, and will need feedback on whether the new approaches are working.

3.2 Components of LA program

The components of the LA program were strongly based on the Colorado model, and are intended to facilitate in the completion of the aforementioned goals. These components are:

1. The science pedagogy course,
2. The regular meetings with the course professor, and
3. The LA facilitating group work in class or homework sessions.

The science pedagogy course will teach the LA's about learning, leading to LA's understanding pedagogy and learning, and all of the benefits associated with that, and will prepare the LA's to help students by facilitating group interactions. The meetings with the course professor provide

the venue for the LA to develop a deeper relationship with the course professor, and will also help increase LA content knowledge, two goals of the program. By having a deeper understanding of course content, LA's will be more successful at achieving student respect and answering student's questions, and will contribute towards LA's helping students mastering course material. Finally, LA facilitation of group work will lead to better student content understanding, as well as towards more formation of learning communities and appreciation of the benefits of collaborative learning. Based on this description, it is clear how each of these components contributes towards the successful achievement of the goals of the LA program.

3.3 Role of LA's

The role of an LA is to act as a facilitator of group discussion. Each LA, by the ECoS guidelines, should be used to facilitate group work with students, either in lecture or in a problem session. The LA should be working to improve the collaboration between groups of students to create the most beneficial collaborative learning atmosphere possible. The LA should also provide support for the professor in developing an active learning environment by providing feedback on course transformation.

3.4 Courses Using LA's

The LA program at Penn State has so far been utilized in 9 science courses: Physics 211 and 212, Chemistry 112, 227 and 310, BMB 401, 430, and 464, and Bio 230W. I focused my study on Physics 211, Chemistry 227, and BMB 430 and 464, because the LA's for these courses were part of the fall 2012 cohort who took the pedagogy course together, to eliminate variables in training and student experience with LA's. Additionally I studied Chemistry 112, because only

one section of 112 was being taught with LA's in spring 2013, so comparative data could be collected. Because the structure of the LA program varies so much from course to course, it is necessary here to describe how each course utilized LA's:

Physics 211

In Physics 211 LA's are utilized during course time to help students answer short clicker questions, less than five minutes per question. In addition to helping during class time, the physics 211 LA's meet with the course professor once a week to go over the material that will be in the next week's clicker questions.

Chemistry 227

The Chemistry 227 LA's were responsible for attending class and holding 2 hour problem sessions twice per week, where students could come in and work together on completing their problem sets, that were later submitted for a grade. Chemistry 227 LA's did not meet with the course professor.

BMB 430

LA's in BMB 430 were responsible for helping facilitate group discussion during extended in class problems that took around 15 minutes. Additionally BMB 430 LA's help 1 hour review session once a week where they went over optional problem sets related to course material that were not graded. Finally, BMB 430 LA's met with their professor once a week to review course material. There were also group leaders in BMB 430, students who were currently enrolled in the course but performed similar duties as the LA's.

BMB 464

The BMB 464 LA's were used during class time to help answer questions and facilitate group work during activities where the students were closely analyzing scientific papers related to the course material. These activities lasted the entire course period, and occurred about once every two weeks. BMB 464 LA's did not attend the course unless activities were being run that day.

BMB 464 LA's also met with the course professor to go over the articles and activities that the students would complete that related to the article.

Chemistry 112

In Chemistry 112 the LA's are used during the scheduled course meetings to help students answer short clicker questions, less than five minutes per question. Additionally, the LA's meet with the course professor once a week to go over the clicker questions for the next week's courses.

Chapter 4

Evaluating Penn State's Learning Assistants Program

4.1 Survey to Analyze Student Perception of Learning Assistants (SASPLA)

Purpose

Goals of Survey:

1. To compare students comfort level working with peers, LA's, and professors.
2. To determine the extent to which having LA's associated with the course created learning communities and increased student understanding of the course material.

Methods

Participants

The population of interest in this survey was students enrolled in courses that were utilizing LA's at that time, specifically Physics 211, BMB 430, BMB 464, and Chemistry 227.

Sample

Of the 1,210 student in courses using LA's, 348 responded, a response rate of 29%.

Table 4-1. Response Rate to SASPLA

Course	Number Of Students	Number of Responses	Response Rate
Chemistry 227	82	63	76.8
BMB 430	134	107	79.9
BMB 464	44	44	100
Physics 211	950	134	14.1
Total	1210	348	28.8

Survey Development

A 12 item survey was written to elicit from students in courses utilizing LA's, how comfortable they were working with the LA's, how much they perceived the presence of the LA's impacted their understanding of the material and their attitudes towards working collaboratively with other students. The majority of the questions were adapted from published, peer-reviewed literature that used surveys for assessing peer led team learning programs, learning communities, and LA programs (30,37,38). The questions were selected and modified to assess the intended goals of the study; the effect of LA's on their understanding of the course material and creation of learning communities.

The survey was designed to be general so that it could be used to analyze the effectiveness of the LA's in the variety of courses and methods in which they are being used.

An additional consideration for the design of this survey was length. In order to elicit student responses and to facilitate distribution and use by faculty it was considered critical that the survey be short in length.

Survey Items

Items 1-3 draw data on students comparative comfort level in working with professors, LA's and peers. A 5-point, likert-scale based response was used (1= Not Comfortable, 5= Very Comfortable).

Items 4-11 collect data related to students' perception of LA effect on their understanding of the material as well as their collaboration. A 5-point Likert scale was

used (1= Strongly Disagree, 5= Agree). All questions were worded positively so no reverse-coding was necessary.

Procedure

The surveys were administered via Angel by professors in Physics 211, BMB 430, and BMB 464. The surveys were administered on paper during class time for Chemistry 227. The survey was administered during the last week of classes of Fall Semester 2012.

Limitations

The courses incorporating LA's and being studied in this experiment vary significantly. Variables such as instructor, class size, and content level are not controlled between these courses and so comparisons between courses are subject to significant uncertainty. The survey response rates were not 100% for most courses, meaning that the survey results represent a non-random sample that could skew the results. An additional source of error could be the variety of formats that the survey was administered through. For other surveys used to measure success of programs similar to this, instruments have been developed and subjected to rigorous validity and reliability studies that were not possible here. Because the surveys were designed by a student and based off of the language and structure of other similar instruments, it is believed that the results should be reliable.

Results

Data Entry

The web-based Angel surveys were returned to the professors as Excel files containing responses for each item. The paper-based surveys were entered into Excel manually. The responses with missing data were deleted (N=15, or <4%). The data was then transferred into SPSS Statistics 20 for Windows.

Analyses

Subscales

The survey items were grouped into subscales based on what they were assessing.

Subscale 1 contained questions related to student perception of LA impact on their learning, and subscale 2 contained questions related to student perception of LA impact on collaboration and group work. A sample question from subscale 1 is, “Working with Learning Assistants has increased my understanding of course material.” A sample question from subscale 2 is, “The Learning Assistants increased the amount I collaborated with other students.”

Internal Consistency

Questions 1-3 measured student comfort with different people; therefore these were not included in the internal reliability measurement. Internal reliability for each subscale was calculated using Cronbach’s α . For subscale 1 $\alpha=0.795$, for subscale 2 $\alpha=0.850$.

Cronbach’s alpha values greater than 0.70 indicates that there is a high level of internal consistency, therefore it can be concluded that there is strong internal consistency in the SASPLA. Further statistical analysis shows that the Cronbach’s alpha for each subscale

would decrease if any survey question was removed, indicating that each question reliably contributes to the subscale it is associated with.

Discussion

Based on the calculated means, students on average felt most comfortable working with their peers and least comfortable working with the course professor. Overall students were somewhat comfortable working with each different type of person that they may interact with in the classroom. These results also indicate that students are more comfortable coming to LA's with questions than going to the professor, which was an anticipated benefit of the LA's.

Table 4-2. Descriptive Statistics on Student Comfort.

	N	Mean	Std. Deviation
Professor	346	4.006	1.0741
LA	346	4.101	.9096
Peers	346	4.257	.9327

Interestingly, there was no distinct correlation between student's comfort working with LA's, professors or their peers, indicating that comfort working with one type of individual in the classroom will not impact comfort working with another type. This could be an advantage of using LA's, as it seems if a person is not comfortable with a professor or student they may be comfortable with the LA's. However, this also means that comfort working with LA's does not help students comfort level of working with their peers, or their comfort level with the professor.

The student comfort level ranged significantly depending on the course the student had LA's in. Students in BMB 464 had a higher comfort level with the course professor than the other courses. The difference between comfort level with the course professor was significantly different between BMB 464 and BMB 430, where the students were least comfortable with the professor ($p=0.027$). It is difficult to compare anything about the professors in these courses based on student comfort level because of the significant variability in course size, content difficulty, and faculty personality.

The comfort level of students with LA's also ranged significantly between the courses. Student's reported the greatest level of comfort with LA's in Chem 227, with the lowest level of comfort in Physics 211. Both BMB 464 students and Chem 227 students were statistically significantly more comfortable with their LA's than students in Phys 211 ($p=0.025$ and 0.002 respectively). One variable that probably contributed to this was the small LA/ student ratio in physics. In physics the LA/ Student ratio is 1:41, whereas in Chem 227 it is 1:21, and in BMB 464 it is 1:22. In BMB 430 the ratio is 1:67, but there are also "group leaders" who have overlapping duties with the LA's, but have less expertise and content knowledge, which brings the ratio to 1:13. BMB 430 also had relatively poor student comfort interacting with LA's. Overall, it seems that having a higher LA to student ratio will lead to a greater level of student comfort in interacting with LA's.

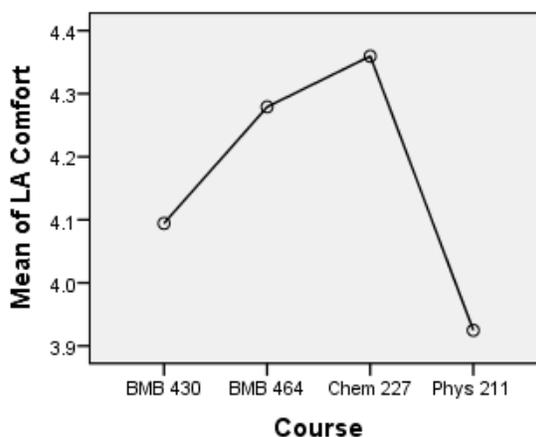


Figure 4-1. Comparison of Means of Student Comfort with LA by Course.

The comfort level of physics students with LA's is also significant because it is the only course analyzed where students were more comfortable working with the professor. This may be due to Dr. Hudson's years of experience working in active learning classrooms, and also due to poor student comfort working with LA's.

Students in BMB 430 were the least comfortable working with their peers. They were significantly less comfortable working with their peers than students in any of the other courses ($p=0.007$ for BMB 464, $p=0.000$ for Chem 227, and $p=0.019$ for Phys 211).

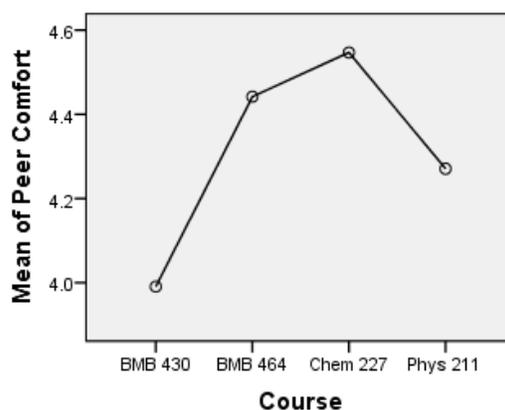


Figure 4-2. Comparison of Means of Student Comfort with Peers by Course

While overall students reported being most comfortable with their peers, it is important to note that BMB 430 students reported being most comfortable working with LA's. In BMB 430 LA's reported acting more like TA's, and the LA from BMB 430 who participated in the LA focus group emphasized teaching as their role, with no mention of group facilitation. The lack of group facilitation by LA's in BMB 430 could have significantly contributed towards students discomfort in working together.

Table 4-3. Mean Comparison of Student Comfort by Course.

Course		Professor	LA	Peers
BMB 430	Mean	3.849	4.094	3.991
	Std. Deviation	1.0492	0.8786	0.9206
BMB 464	Mean	4.279	4.279	4.442
	Std. Deviation	1.0741	0.9096	0.9327
Chem 227	Mean	4.063	4.359	4.547
	Std. Deviation	0.8706	0.7636	0.7954
Phys 211	Mean	4.015	3.925	4.271
	Std. Deviation	1.1997	0.9818	0.9857

Student comfort when interacting with professors, LA's and their peers is an important factor in determining their academic success, and also serves as a means for evaluating how well active learning is being incorporated into the classroom. It has been shown that in courses where the professor more actively interacts with students, such as answering student questions and discussing with students, the students have a significantly higher comfort level with the professor (1a). Additionally it has been shown that there is a strong correlation between the amount a professor encourages student-to-student discussion, and students comfort level discussing material with their peers (37).

While it is difficult to make comparisons between these courses due to the significant variability between them, it should in the future of the LA program be

possible to ask these questions of students at the beginning and end of a course, and determine by the change how well the active learning was implemented.

Overall, students felt that LA's led to an increase in collaboration between students and the formation of learning communities. Additionally students felt that working with LA's led to them understanding the course material better. Students perceived that the LA's were more helpful towards improving their learning and understanding, subscale 1, than in the formation of learning communities, subscale 2. This trend was true for each individual course.

Table 4-4. Descriptive Statistics on Student Perception of Benefits of LA's.

	N	Mean	Std. Deviation
subscale1	337	3.6484	.76051
subscale2	337	3.3361	.88830
Valid N (listwise)	337		

There was a somewhat strong positive correlation (Pearson correlation was used because the data was normal. Pearson correlation =0.762) between students perception of the LA's benefitting their learning and encouraging groups to work together. This correlation could potentially indicate that the collaboration encouraged by the LA's leads to greater learning, or it may mean that the same students are interacting more with the LA's and thus benefitting in both ways.

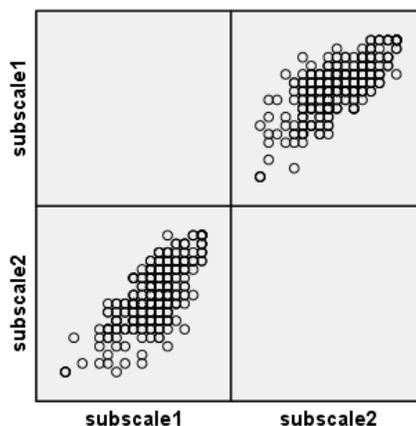


Figure 4-3. Matrix Scatterplot Demonstrating Positive Correlation between Subscales

An ANOVA analysis of the means for each subscale in the different courses using LA's showed that the means were statistically identical, except for Chem 227, which had significantly higher means for both subscales ($p=0.000$ for both). This significant distinction of results from Chem 227 could be due to a number of factors. As previously stated comparison across the classes is subject to a large degree of uncertainty. One possible reason for this difference is the difference in survey administration, because research has shown that online responses tend to have lower averages than forms filled out by hand (39). Other potential causes of this are the use of Chem 227 LA's primarily outside of class time, whereas in BMB 464 and Phys 211 LA's were used only in class. However in BMB 430 there were also optional outside of class workshops. These workshops may not have increased the impact of LA's on BMB 430 students due to the majority of the workshops being run by group leaders, or due to the structure of the workshops, where LA's reported acting more as TA's and teaching at the board, rather than facilitating group work as the LA's in Chem 227 did.

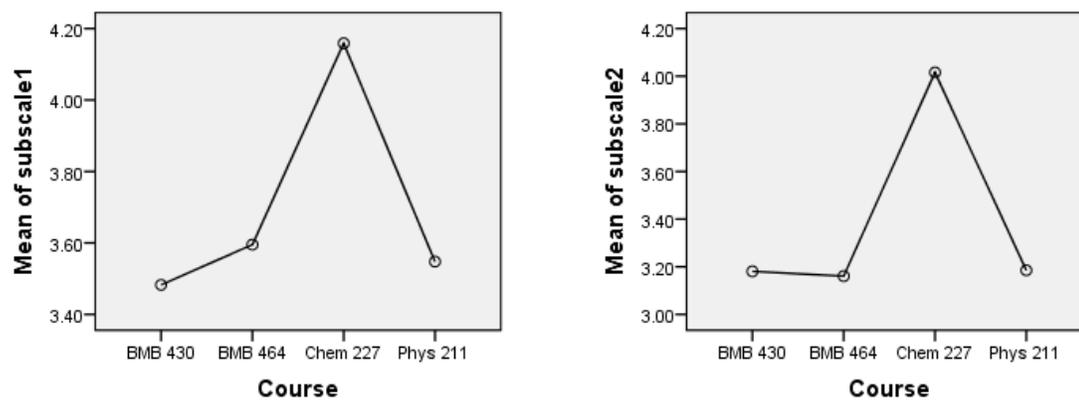


Figure 4-4. Comparisons of Means of Subscales Compared by Course.

4.2 Learning Assistants Survey

Purpose

The goals of this survey were to determine:

1. LA's perception of their increased knowledge of the subject
2. LA's perception of increased knowledge of pedagogy
3. LA's opinion on the importance of the components of the LA program.

Methods

Participants

The participants for this survey were LA's that were enrolled in SC 297, the pedagogy course designed for LA's. The LA's were currently LA's for Physics 211, BMB 430, BMB 464, and Chemistry 227. Of the 28 students enrolled in the course 21 responded, a 75% response rate.

Table 4-5. Response Rates to LA Survey

	Responses	Number of LA's in Course	Response Rate
BMB 430	3	4	75%
BMB 464	2	2	100%
Chem 227	3	4	75%
Phys 211	13	22	59.1%
Total	21	32	65.6%

Survey Development

A 9 item survey was written to collect data related to the goals of the survey, to what extent the LA's perceived they were mastering the content of the course and pedagogy, and how they felt the components of the program were helping them perform as an LA. The first two questions were demographic questions, asking which course they

were an LA for, and how often they were able to attend meetings with the course professor. The next four questions were likert-scale questions intended to determine how important and useful students felt each component of the LA program was for their success as an LA (1=extremely unimportant, 5=extremely important). The next two questions asked about the impact of the LA program on student's mastery of course content and pedagogy, on a 1-3 scale. The last question simply asked whether the LA would recommend being an LA to a friend, as a general gauge of whether being an LA had been a positive experience.

Procedure

The survey was administered on paper during the SC 297 course during the last course meeting, 3 weeks before the end of Fall Semester 2012.

Limitations

While the response rate was large, the pool of possible participants was limited to only students who were currently LA's, which means that the sample was small. This issue is especially important when comparing LA survey results by course, because the number of LA's for certain courses was as low as two, meaning the survey results reflect the opinion of a very small number of individuals and so could differ significantly from actual circumstances.

Results

Data Entry

The paper-based surveys were entered into Excel manually. The data was then transferred into SPSS Statistics 20 for Windows. A one-way ANOVA comparison of means was done, with an LSD analysis to compare means.

Analysis

All 21 survey responses indicated that the LA would recommend being an LA to a friend, indicating an overall positive experience with the program, which is good for the growth of the LA program because if being an LA is an enjoyable experience it will be easier to recruit students to these positions.

Overall students also believed that each aspect of the LA program (the pedagogy course, the meetings with the course professor) was important for their success as LA's. The mean responses (with a maximum of 5) show that they thought the meetings with the course professors were more important than the pedagogy course, however they felt both led to greater understanding and better performance as an LA.

Table 4-6. Mean of Student Responses to Q1-4.

	Mean	Std. Deviation
Q1: How important were meetings with the course professor for your understanding of the subject?	4.00	.894
Q2: How important were meetings with the course professor for helping students in your role as an LA?	3.95	.865
Q3: How important was the pedagogy course for helping students in your role as an LA?	3.76	.995
Q4: How important was the pedagogy course for your understanding of learning and pedagogy?	3.81	1.030

Students reported that being an LA increased their knowledge of pedagogy and course content. The mean response was 2.19 for each question, with the maximum response being 3. This mean corresponds with somewhat increased knowledge on the survey.

Table 4-7. Mean of Student Responses to Q5-6.

	Mean	Std. Deviation
Q5: To what extent did working as an LA increase your knowledge of the subject	2.19	.402
Q6: To what extent did working as an LA increase your knowledge of learning and pedagogy	2.19	.680

Next, the surveys were analyzed to determine the impact of frequent meetings with the course professor. There was a linear trend between the frequency of meetings with the course professor and students reporting an increased mastery of the subject, demonstrating that the weekly meetings with the course professor are important for improving the LA's understanding of the subject. However, this trend is not statistically significant. The variance is low because the range for the question of increased content knowledge was given on a 3 point scale. In the future this question should be asked on a 5 point scale. Additionally, the sample size is low; a greater number of samples could lead this trend to be statistically significant. While not statistically significant, this trend indicates that frequent meetings with the course professor are associated with increased content knowledge for the LA's. This is important because if the LA's have a greater understanding of the course content knowledge then they are also able to perform better as LA's.

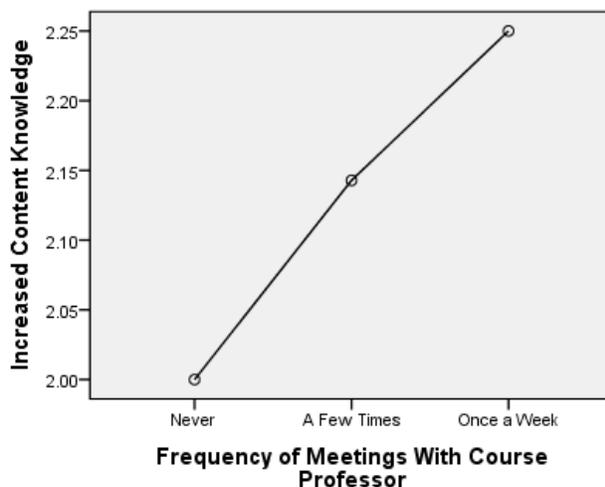


Figure 4-5. Comparison of Frequency of Meetings with Course Professor with Increased Content Knowledge

The students who had infrequent meetings with the course professor also believed them to be less important for their mastery of the course material. There is a strong correlation ($p=0.576$, using Pearson's correlation, which is valid because the data showed a normal distribution) between students mastery of the course content knowledge, and their perception of the importance of the meetings with professors, which indicates that students who are meeting with their professor appreciate these meetings and recognize their importance in being successful as an LA.

Next, they results were analyzed based on the course, to determine how each group of LA's felt about the pedagogy course and their weekly meetings with the course professor. Students from Chem 227 felt that meeting with the course professor was the least important, while students from BMB 464 felt that they were the most important. The difference between Chem 227 and BMB 464 is statistically significant with a p value of 0.001. This correlates well with the trend of frequency of meeting with the professor, because Chem 227 students met with their professors the least, while students in BMB

464 met with their professor the most. Additionally, students in BMB 464 did not attend the class lecture as all of the other LA's did, leading the meetings with the professor to having more importance in mastering course content.

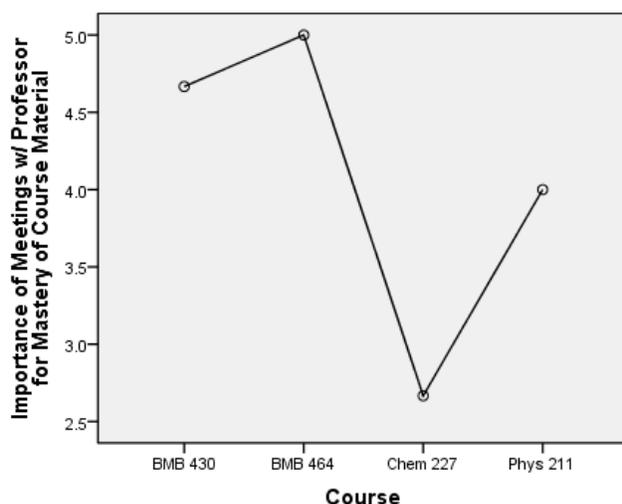


Figure 4-6. Mean of Importance of Meeting with Prof. for Mastery of Course Material, by Course

The importance of the pedagogy course also varied significantly between LA's from different courses. The LA's from Chem 227 found the course to be significantly less helpful than LA's from other courses ($p=0.000, 0.010, 0.000$). A reason for this is that the usage of LA's in Chem 227 was different than the other courses. BMB 430, BMB 464, and Phys 211 all incorporated LA's into facilitating group interactions during class time, while Chem 227 LA's were mainly focused on facilitating out of class review sessions. Since the pedagogy course discussed ways to handle situations with students, the discussion of handling situations in class led the Chem 227 LA's to believe that the material was not relevant for them. During the LA focus group (section 3.4) a Chem 227

LA mentioned, “[the pedagogy course] wasn’t really applied to the class that we were Laing for.”

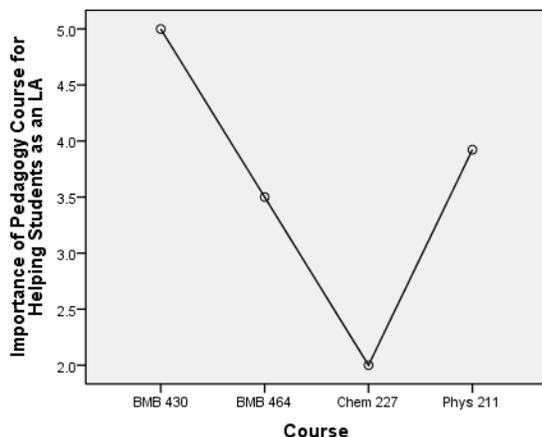


Figure 4-7. Mean of Importance of Pedagogy Course for Helping Students, by Course

The LA’s from Chem 227 also reported the lowest gains in pedagogy knowledge from the pedagogy course. They reported learning gains significantly different from the LA’s in all other courses ($p=0.000$, 0.001 . and 0.000). It is likely that the Chem 227 LA’s learned the least, since the Chem 227 LA’s did not perceive the pedagogy course as relevant, and motivation is a necessary condition for learning to occur (40).

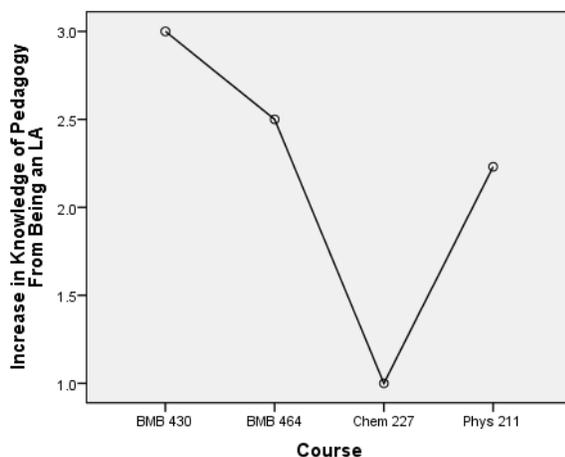


Figure 4-8. Increase in Knowledge of Pedagogy, by Course

Based on the response of students that the pedagogy course was important for their performance as an LA, it is important to involve LA's from all courses in the pedagogy course. By making the pedagogy course more applicable for out of class focus groups, the overall LA gains knowledge of pedagogy can be increased, and the LA's will be better at using this knowledge to facilitate learning in their courses.

Finally, students perception of how being an LA increased their content knowledge was studied. Interestingly, students from BMB 430 reported mastering the course content significantly higher than each of the other courses ($p=0.000$ for all courses). From the survey and use of the LA's it is not immediately clear what potential causes of this significant difference could be. However, in the LA focus group the LA from BMB 430 reported spending 10 hours/ week preparing for the recitations held by LA's for that course. This extra responsibility and preparation may have led to greater increases in content mastery.

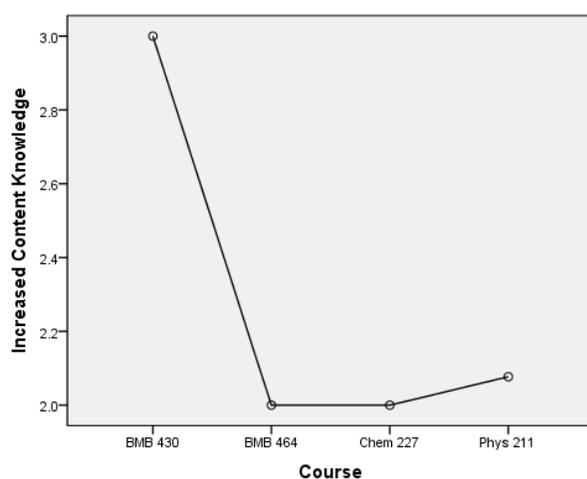


Figure 4-9. Mean Response for Increased Content Knowledge, by Course

For future study using this survey, it is recommended that the three point questions be altered to fit a five-point likert-scale. Additionally, by adding multiples of questions based on the same category, a measure of internal reliability can be done, to assure that each question is eliciting the intended responses.

4.3 Learning Assistants Focus Group

Aims and Methodology

This experiment was done to:

1. Contextualize results found from the survey given to Learning Assistant,
2. Elicit information on the differences in the way LA's are utilized in different courses,
3. Determine how successful the LA program was in achieving its goals for the LA's, and
4. Collect suggestions for improving the LA program in the future.

The goals of the LA program that are specifically for the benefit of the LA's are:

1. For LA's to develop a mastery of the subject in which they are LA's,
2. For LA's to gain an understanding of science pedagogy and how learning works, and
3. For LA's to develop deeper relationships with the course professor

A focus group was conducted to generate a variety of responses that would give more understanding of the experiences of different LA's. One LA from each course was invited to participate in order to get a large range of responses for comparison. Seven LA's participated in the focus group, each was an LA for a different course. Three of the LA's were currently acting as LA's for the second time. Only one of the LA's was not in the fall 2012 cohort. The focus group was taped and transcribed using Express Scribe. Data was then coded and analyzed using NVivo 10 for Windows. The coding was done based on themes that emerged during repeated readings and studies of the data, and analyzed based on frequency.

Results and Findings

Role of the LA

The majority of the discussion was focused on the role that each of the LA's played in their course. The LA's discussed their role and their typical interactions with students. This discussion was then coded into emerging themes in what the LA's mentioned most frequently. The number of codes for each subject was then sorted by LA, and the percentage of discussion was determined. This was done by taking the number of codes in the category mentioned by the LA and dividing it by total number of coded responses mentioned by the LA. This gives a percentage that represents how much the LA mentioned a category, as related to how much that LA spoke. By far the most frequently discussed duty was to answer student questions, which all of the LA's mentioned as a significant part of their interactions with students. This is a positive result, as it shows that students are comfortable to ask the LA's questions, and LA's can then serve as an extra resource for students. Most LA's also mentioned group facilitation as something that they did frequently. The LA from physics 211 frequently mentioned group facilitation as their main duty. Only the LA from BMB 430 did not mention the goal of group facilitation and also most frequently mentioning teaching as part of their duties. During the discussion only the LA from BMB 430 and the LA from Chem 227 mentioned teaching as part of their role or interaction with students, and they had the lowest frequency of group facilitation. This distinction in the role of an LA is significant because it has ramifications on the class that the LA's work in. The students in BMB 430 were the least comfortable working together on the SASPLA (see section 4.1), and this can be directly linked to lack of collaboration in class, because there are not group facilitators. Additionally, the students from Chem 227 reported during their focus group, (section 4.4) that they were frustrated by the LA's acting as teachers because of their lack of

content knowledge. As discussed in chapter 3, the role of the LA is meant to be more of a peer and group facilitator, to emphasize the benefits of collaborative learning demonstrated by studies of collaborative learning, PLTL, and other LA programs, rather than teaching, especially as these students are not meant to be experts.

Table 4-8 . LA Discussion of Roles and Duties of LA, by Percentage of Discussion

	Answering Questions	Friends With Students	Group Facilitation	Giving Hints	Teaching
BMB 401	31.25%	12.50%	37.50%	18.75%	0.00%
BMB 430	38.46%	15.38%	0.00%	0.00%	46.15%
BMB 464	41.67%	0.00%	25.00%	33.33%	0.00%
Chem 112	33.33%	33.33%	33.33%	0.00%	0.00%
Chem 227	57.14%	14.29%	14.29%	0.00%	14.29%
Chem 310	60.00%	0.00%	20.00%	20.00%	0.00%
Phys 211	40.00%	0.00%	60.00%	0.00%	0.00%

The role of the LA's and their interaction with students was also analyzed based on experience of the LA, and the structure of the LA program, whether LA's were used during class, outside of class, or both. Interestingly, students who were LA's for the second time were more likely to utilize group facilitation. This may indicate that as LA's get practice they focus more on facilitating group discussion. Additionally, LA's who were used during class time were much more likely to use group facilitation than LA's who only held problem sessions. This could be due to the nature of in class activities lending themselves to group facilitation, or to the presence of the professor who may reinforce the role of the LA as a facilitator rather than as a teacher. Chemistry LA's are largely used in outside of class problem sessions, and the LA from Chem 227 reported using group facilitation and teaching equally. Therefore for chemistry it is important that the LA's are reminded that their duties are based around group facilitation. However it is important to note that there are a large number of factors that play into LA's focusing of

facilitating group work, including the professor's emphasis on this role, the individual LA, and countless other factors.

Table 4-9. LA Discussion of Roles and Duties of LA, by Number of Times an LA and Course Incorporation

	Answering Questions	Friends with Students	Group Facilitation	Giving Hints	Teaching
LA one time	45.95%	8.11%	13.51%	13.51%	18.92%
LA two times	33.33%	12.50%	41.67%	12.50%	0.00%
LA'd during Classtime	40.00%	5.00%	35.00%	20.00%	0.00%
LA'd in Problem Sessions	53.33%	13.33%	20.00%	6.67%	6.67%
LA'd in both	34.48%	13.79%	20.69%	10.34%	20.69%

Goal's for the LA's

Developing a Mastery of the Subject

The LA's agreed that being an LA helped them to learn the content better. This corroborates the results of the LA survey (section 4.2). The reasons given for why being an LA led to mastery of content were hearing the subject matter again in lecture and that "teaching the material, explaining it, reasoning with the students helped reinforce [the material] so it's more long term memory now, vs. short term." Based on this, attending lecture and interacting with students are crucial duties of an LA that lead to content mastery. Only one of the courses utilizing LA's, BMB 464, did require students to attend class, and one of the LA's had previously LA'd BMB 464, and was currently the LA for BMB 401, and this LA stated, "I definitely learned the material better, I think more for 401 than 464." The course professor was the same for both courses, which indicates that attending lecture was an important factor for gaining a deeper understanding of the material. Due to this, it would be recommended that LA's attend the lecture of the course that they are LAing regardless of whether or not they are utilized during class time.

However, this does not discount the importance of meetings with the professor determined from the LA Survey.

Gain an Understanding of Science Pedagogy and How Learning Works

Two LA's mentioned that acting as an LA improved their learning skills, stating: "It makes you a better learner," and "It teaches you study skills that you can use on your own." These skills are gained from learning how to learn, which can be attributed to the pedagogy course, indicating that the course is being successful. The LA's are learning how learning works and applying these skills to themselves. However, this was not as recognized a benefit as mastering the content, being mentioned in only 0.33% of the discussion, vs. 2.22% of the discussion focusing on mastering course content. This may be due to the fact that it is a less recognized and emphasized benefit, and the LA's may not be aware of it. This could also be due to the fact that the pedagogy course was not as successful as it could have been, as seen on the LA survey the pedagogy course was not seen as being as important as meetings with the course professor.

Deeper Relationship with Course Professor

Most of the LA's reported feeling extremely comfortable with their course professor. Additionally, most of the LA's reported being able to give honest feedback to the course professor on how things were going. The exception was that the Chem 112 LA felt uncomfortable with the professor, and didn't feel that they were able to give honest feedback. Based on the Chem 112 LA's responses, it seems that this is due to the course professor being, "awkward," and also to the discomfort between the Chem 112 LA's. The Chem 112 LA stated that:

"I think it's because we aren't comfortable with each other that we don't talk... so people are kind of afraid, kind of like in class you are afraid to ask a question cause you

don't want to sound stupid, you don't want to sound like you don't know how to run your section.”

This was different from the other course that used LA's only in class, with a large number of LA's, Phys 211. The Phys 211 LA reported being very comfortable with the other LA's and the course professor, which was due to the structure of their weekly meetings. In the Phys 211 weekly meetings:

“We meet with Dr. Hudson every week and we go over the clicker questions that we are going to have that week, and ... they are so confusing and misleading and if you don't get it wrong it's amazing, so were very, we get to the point where it's totally fine to get the answer wrong because at some point everyone's got it wrong, and then we will argue and yell, and then eventually he'll step in and tell us why were wrong and what the right answer is and then be like those are all the same misconceptions the students are going to have. We end up being pretty comfortable with each other and with [the course professor].”

This is very different from the weekly meetings held in Chem 112, where there is no discussion between the LA's and professor:

“We've all already done all of the problems when we get there and then he just goes and he goes ok what number 1 and someone will go D, and he goes ok everybody get that and we'll go yeah, and then we go on to number 2, number 3, number 4, were just done. Only if someone gets it wrong is there a discussion, and even if we get, if the person who says the answer first is wrong, he'll go did anyone else get an answer, and that's how you know you're wrong, what about someone else. Ok so those weren't right, I'll just do it on the board, and then you copy it down and then you move on.”

This lack of discussion between LA's and the course professor in their only interactions with each other leads to them being uncomfortable with each other and the course professor. This leads to a lack of a formation of a deep relationship with the course professor, which limits the feedback given to the professor, as well as limits the benefits of a mentorship for the LA. Therefore, it is recommended that the weekly meetings with the course professor include discussion, which will help to build these relationships.

Pedagogy Course

All of the LA's felt that the pedagogy course could have been improved. There were three types of suggestions that prevailed. Most of the LA's felt that the pedagogy course was inefficient, and this was the most frequently mentioned area for improvement. The LA's agreed that it should have gone faster. The comments were mostly that too much time was spent on each question, and that there was a lot of digression. Additionally most of the LA's think it would have been helpful to mix up the seating arrangement, to get more discussion and hear LA's from other courses perspectives. Finally, a few of the LA's mentioned that the material in the course wasn't relevant to them, whether it was because they felt the course focused on material meant for teachers, or that the material was better suited for LA's of other courses. An LA also mentioned that they would have liked more hands-on practice.

4.4 Chemistry 227 Focus Group

Aims and Methodology

The aim of this experiment was to determine the students' views on:

1. The effect of the LA's on their learning,
2. The effect of the LA's on the formation of Learning Communities,
3. The benefits of courses with LA's,
4. The negatives of courses with LA's, and
5. Suggestions for improving the use of LA's in the future.

A focus group was chosen as the method of data collection because it was expected that student discussion would elicit deeper and more thorough responses than individual interviews. Students enrolled in Chemistry 227 were chosen as the participants for this study because students from the same course will be able to comment and elaborate on each other's experiences, and because Chemistry 227 was the only Chemistry course utilizing LA's in fall 2012. Eight students were chosen of the ten volunteers to participate. Due to potential bias, as I acted as an LA for that course, another undergraduate conducting research on science education was asked to moderate the focus group. I provided him with a list of questions designed to provoke student discussion related to the aims of the experiment. The focus group was taped and transcribed. Data were then coded based on the main identified categories and the themes within these categories. The coded data was sorted by frequency.

All 8 students participated in the weekly workshops at least once per week, with four reporting participating twice per week. The grade distribution within the group was 3 A's, 1 A-, 1 B+, 1B, and 2 B-'s. It is also important to note that students self-selected into the focus group, and this may lead to error between the reported attitude of the group and the actual attitude of the course.

Results and Findings

The findings of the focus group were summarized under 6 general categories:

1. The positive impact of LA's on students learning,
2. The negative impact of LA's on students learning,
3. The positive impact of LA's on group collaboration,
4. The negative impact of LA's on group collaboration,
5. The positive relationship of the students with the LA's, and
6. The negative relationship of the students with the LA's.

Within this chapter I will report the main insights of students related to each of these categories. I will analyze the frequency of the responses, and include quotes that best illustrate the overarching attitudes of the students.

The data was first sorted into the general categories that represented the main thoughts shared by the students. This data shows that overall the Chemistry 227 students had largely positive experience with the LA's. There were significantly more comments made related to the positive impact of LA's on group collaboration, and the positive relationships with LA's than negative comments made (Figure 1). Interestingly, there

were more negative comments made regarding LA's impact on learning than positive comments, but this is attributed mainly to one participant who frequently commented on the negative aspects of LA's on his learning. If this student's responses were removed as an outlier, the data would show an overall positive effect of LA's on student learning.

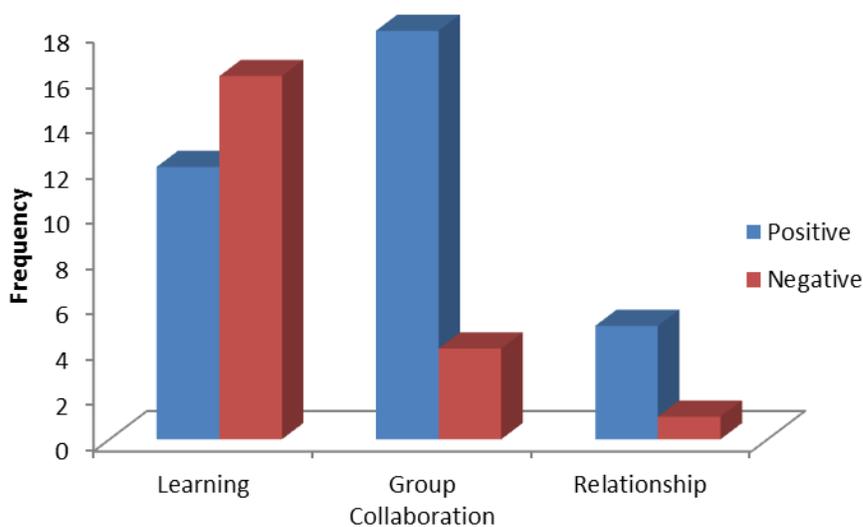


Figure 4-10. The frequency of the overall findings from the focus group.

All participants overwhelmingly agreed that LA's helped collaboration, and seven of the eight participants felt that they had positive relationships with the LA's. One of the participants provided the large majority of the negative comments, while it seemed that the other seven students were largely satisfied with the LA program and reported positive effects on their learning and group collaboration (Figure 2). This student thought that the LA's negatively impacted his learning, and felt that their relationship with the LA's was not positive. It is important to note that this student had a bad experience with the LA's, specifically that an LA provided this student with the wrong answer which ended up

negatively impacting their grade. This tainted his view of working with the LA's, and led to an overall negative experience. The experiences of this student emphasize the importance in selecting qualified LA's and training them well, so that students do not lose respect for the LA's.

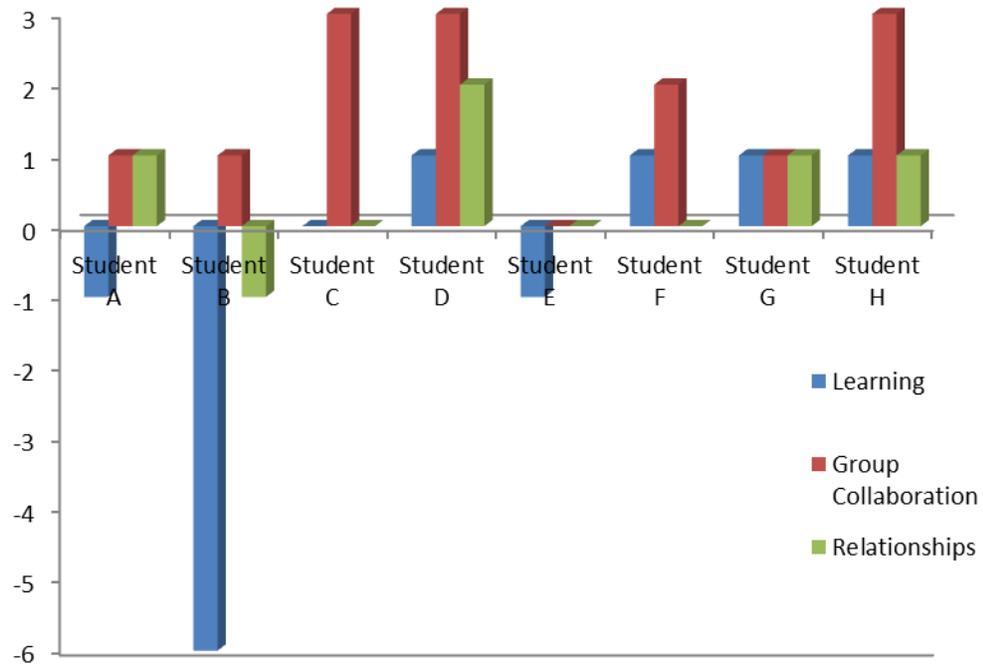


Figure 4-11. Frequency of Category, by Student.

After coding the responses into the general categories, these categories were divided into themes and the frequency of each theme was recorded. A summary of the themes and their frequencies is provided in Table 1. The frequency of coded themes are cumulatively greater than the frequency of coded categories, due to some coded categories referencing more than one of the themes isolated from the discussion.

Table 4-10. Summary of Focus Group Findings

LA's Impact on Students' Learning	
Positive	Negative
Facilitated asking questions (4) Give hints (3) Individual attention (2) Explaining concepts helps you learn (2) Asked leading questions (1)	Lack of trust in LA content knowledge (14): Being unprepared (7) Giving the wrong answer (6) Huddling (3) Giving answers (3) Not being able to say I don't know (3) LA's should ask more leading questions (2)
LA Impact on Group Collaboration	
Positive	Negative
Helped form study groups for outside of class (6) Paired groups or individuals to help each other (6) Helped class comradery (5) Acted as mediators (1)	Groups were giving answers to other groups (3) Other students not as good at explaining concepts (1)
LA Relationship	
Positive	Negative
Easier to ask LA's questions (2) Easier to relate to LA's (2) Individual Relationship (2)	LA's are in other classes with you, may judge you (1)

The Positive Impact of LA's on Students Learning

Students explained the benefits of the LA program for their learning were the LA's availability and relatability making it easier to ask questions, the LA's ability to give hints or ask leading questions when the students got stuck, the individual attention LA's were able to provide for such a large class because of their greater numbers, and the LA's pairing up groups forced students to explain their work, which lead to a better understanding of the material.

One student elaborated on the importance of individual attention and being able to easily ask questions for their learning:

“Having the personal talk with someone and saying I don’t understand this specific thing ... they can show you how to think about the problem, even if you got a problem that was different from that on the exam or on another problem set, you understood the process of thinking about it, so you were able to reason your way through it.”

Notably, one student commented on the overall positive impact that the LA’s had on the students learning. This student remarked that having the LA’s and problem sessions gave the student:

“an opportunity to learn how to do it, rather than just find the answer online and copy it down... having the opportunity to actually learn the material helped me to do well in the class... I think it helped me look at the homework and exams in a better light than a regular class without LA’s”

The Negative Impact of LA’s on Students Learning

The most frequently occurring theme within the category of the negative impact of the LA’s on learning was the lack of trust in the content knowledge of the LA’s. Students reported a variety of reasons for the loss of this trust, such as the LA’s being unprepared, giving the wrong answer, huddling together to discuss the answer, or simply showing the students they answer key because they weren’t able to explain it. The students expressed frustration with the LA’s inability to say that they didn’t know the answers, but rather gave the wrong answers. Lack of trust in the LA content knowledge

accounted for 66% of all of the negative codes regarding the LA program, which demonstrates that it is by far the most significant issue that the students had with the LA's.

This negative attitude of the students could in part be due to a misinterpretation by the students of the role of an LA, because based on the duties of an LA outlined by the ECoS LA program the LA's are not meant or expected to be experts in the course that they are assisting in. This problem is exacerbated by LA's performing duties outside their role as an LA, and attempting to teach rather than facilitate group interaction. However, LA's are expected to be mastering the course content, as stated by one of the goals of the LA program. In order to improve the LA's mastery of course content it is crucial that they are engaging in weekly meetings with their course professor that are focused on mastering course material and anticipating issues that student's will have, in order to prepare leading questions.

A quote from a student illustrated how the lack of concept knowledge of the LA's affected them:

“It wasn't that I lost faith in the LA program, I lost faith in that specific LA, and I didn't come to them with any more questions, but there were other LA's that I could go to, so I don't feel like I lost respect for the program.”

Every participant in this study acknowledged that they continued to go the problem sessions run by the LA's throughout the entire semester. This indicates that despite their frustrations with the LA's, the problem sessions remained beneficial for them. The above quote adds to this, that the students had overall positive experiences with the LA program, but there is a need for better LA's, whether that means better

preparation, or students who performed better in the course, if the LA program is to be truly successful at improving the learning gains of students enrolled in the course.

The Positive Impact of LA's on Group Collaboration

Students felt overwhelmingly that LA's were helpful towards group collaboration and the formation of outside study groups. 82% of coded responses on LA impact on group collaboration were positive. The students felt that LA's facilitated the formation of study groups that would meet outside of class; they observed that the LA's often paired groups or individuals so that they could help each other. Overall many of the students agreed that LA's led to making friends in the class, the class being a friendly, comfortable environment, and a feeling of class comradery. Additionally the LA's could act as mediators for the group, keeping them focused and helping them along when they are stuck. Some observations students made about the positive impact of LA's on the group dynamics in Chem 227 are:

“Referring you to other students who had just solved the problem, and also that the person explaining it helps the other students, you are all better cause that person has to explain it. That also adds to the whole cohesive feeling.”

“You knew the people around you and you didn't feel like you were pressured to ask certain questions or not ask certain questions, it was definitely much more of a friendly feel.”

“They encouraged group work and comradery between groups, so overall I feel like they did add positive things to the course”

These representative quotes demonstrate the success of the LA's in Chemistry 227 at achieving a primary goal of the Penn State LA program, which is the development of study groups, or learning communities of students who can collaborate, even in classes that do not incorporate collaborative learning into class, and experience the learning gains associated with collaboration.

The Negative Impact of LA's on Group Collaboration

There were relatively few complaints about the LA's role in facilitating collaboration in Chem 227. One issue that was mentioned is that groups would give answers to other groups rather than thoroughly explain their answers, or that other people were not as good at explaining themselves. This is an issue because a crucial piece of collaborative learning that leads to many of the observed benefits is the act of explaining your critical thinking. In order to counter this problem, the LA's should be instructed to be on the lookout for students who are copying or not collaborating efficiently. Additionally, to improve this problem the professor can emphasize the importance of this aspect of collaboration, and explain to the students the reasoning behind it, so that they can see the potential benefits for themselves in explaining the solutions to others. Finally, punishments can be enacted for students caught copying rather than collaborating, as it is against Penn State's honor code.

The Positive Aspects of the Student- LA Relationship

Students reported feeling comfortable with the LA's, and said that they were easier to relate to, and that over the semester they developed individual relationships with

the LA's. This positive relationship allows LA's to be mentors and gain the trust of their students, and allows the students another resource in their chemistry course, one who they can relate to more than TA's and professors, and who can give the student's another perspective on the class.

“It's a lot less pressure because they have just taken the same course, so they understand what you have been through, whereas TA's had it in the past, they are just so far along it seems second nature to them, they don't necessarily understand, what you are not comprehending, so it's easier to relate to the LA's.

The Negative Aspects of the Student- LA Relationship

A negative aspect of the Student-LA relationship was brought up by one student who mentioned that the LA's are peers, who are in other classes with their students, and that this may lead to judgment by the LA of the students. In order to deal with this potential drawback it is necessary to train the LA's in how to not be judgmental and how to express this to the students.

An additional issue with the student-LA relationship not mentioned by the students in the focus group, but mentioned to the author in separate conversations with students is the fact that LA's are peers, and sometimes certain LA's can be more concerned with their friendships than with acting as an LA. This problem was demonstrated by the students' complaints that LA's often showed the answers to students. This may be the LA's attempt at making friends with peers, as it is difficult to be disliked by students your own age. Therefore it is important that the LA's have practice in responding to these difficult situations, and talk to their course professor about the

issues that they are encountering. They should have support in acting as an LA and not a friend or peer, and they should practice acting in this role.

Students Perception of the Role of an LA

The students were asked at the conclusion of the focus group what they believed the role of an LA should be. The responses to this question were closely analyzed because to improve the program it is necessary to understand what roles the LA should have to best facilitate their learning and group collaboration. Four themes appeared across the answers given by the participants, and these were coded and the frequency was analyzed (Figure 3). The four themes that appeared in the students responses were that the LA's should facilitate group work, they should teach students how to approach problems or learning strategies that were successful for that course, and that they should act as an additional resource for students to improve their understanding, so they should be able to help students understand the material. Additionally many students mentioned the importance of distinguishing LA's from TA's and the Professor, and that the LA's should not be placing themselves, or being placed in, those teaching roles. The students felt that if the LA's are not supposed to know everything they should not be acting as a teacher.

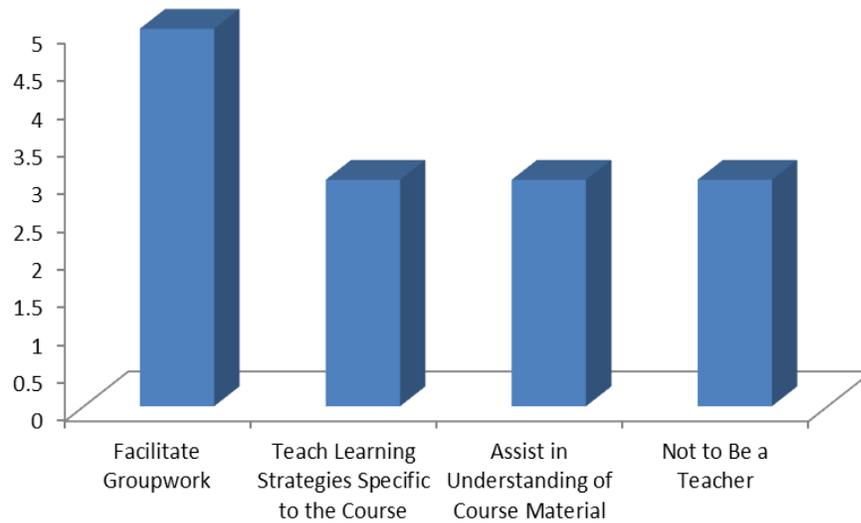


Figure 4-12. Students Responses for “What Role the LA Should Have” by Frequency

The students expectations for the roles of the LA’s are aligned with the roles of LA’s set out by the Penn State LA program, which shows that the students have a clear understanding of what the roles of an LA should be, and that the roles for LA’s set out by Penn State are interpreted positively by the students. It also indicates the importance that the LA’s are careful to fulfill the roles of an LA, rather than attempt to act as a TA.

4.5 Comparative Survey on Student Attitudes in General Chemistry

Purpose

The goal of this survey was to compare changes in attitude towards collaboration of students enrolled in the section of chemistry 112 using LA's with a control section of chemistry 112 not using LA's.

Methods

Participants

The population of interest in this survey was students enrolled in the chemistry 112 section that utilized LA's.

Sample

Of the 247 student in the LA section of Chem 112, 120 responded to the initial survey, and 72 responded to the final survey, a response rate of 29%. There were 334 students in the control section, with 144 responding to the initial survey, and 62 responding to the final survey, a response rate of 19%.

Survey Development

A 14 item survey was written to elicit from students how comfortable they were working in groups, how much they collaborated with others, and whether they believed working with others increased their understanding. There were 3 items designed to question aspects of each category. Additionally, in the final survey, the students were asked about their comfort level on completing chemistry problems with their professor

and peers, and for the course that had LA's, the LA's. Finally, a question was put in asking if students would like to take another course that used LA's.

The survey was distributed online via a Google forms survey. Another consideration for the design of this survey was length. In order to elicit student responses it was considered important that the survey be short in length.

Survey Items

Item 1 was meant to identify if the student was in the LA course or the control. Items 2-13 collect data related to students attitudes towards group collaboration on a likert-scale (1= Strongly Disagree, 5= Agree). Items 8 and 11 were negatively phrased and so the coding was reversed. Items 14-16 draw data on students comparative comfort level in working with professors, LA's and peers. A 5-point, likert-scale based response was used (1= Not Comfortable, 5= Very Comfortable).

Procedure

Limitations

While this study was done to compare to similar class samples, because it was conducted using two sections of the same course, there is still significant variability. The course professors were not the same, and it is not possible to determine the differences in composition of the two courses. The survey response rates were not 100% for most courses, meaning that the survey results represent a non-random sample which could skew the results.

Results

Data Entry

The online survey results were compiled into a spreadsheet automatically by Google. The responses with missing data were deleted (N=32, or <8%). The data was then transferred into SPSS Statistics 20 for Windows.

Analyses

Subscales

The survey items were grouped into subscales based on what they were assessing. Subscale 1 contained questions related to whether the students are forming study groups or working collaboratively. Subscale 2 contained questions related to student enjoyment and comfort in collaboration and group work. Subscale 3 was composed of questions regarding students' perception of benefits of group work.

Internal Consistency

Internal reliability for each subscale was calculated using Cronbach's α .⁴ For subscale 1 $\alpha=0.795$, for subscale 2 $\alpha=0.850$. Cronbach's alpha values greater than 0.70 indicates that there is a high level of internal consistency, therefore it can be concluded that there is strong internal consistency.

Discussion

In the final survey students responded to how comfortable they were with their professor and with their peers. The students rated similar levels of comfort with each professor, but the students in the course that used LA's was significantly more comfortable working on problems with their peers than students in the control class. This

correlates well with research that shows students in courses that utilize more active learning are more comfortable collaborating. (37).

Professor		N	Mean	Std. Deviation	Std. Error Mean
Comfort W/ Prof	Class with LA's	72	3.764	1.0680	.1259
	Class without LA's	62	3.710	1.0144	.1288
Comfort W/ LA	Class with LA's	72	4.014	.9115	.1074
	Class without LA's	0 ^a			
Comfort W/ Peers	Class with LA's	72	4.014	.9713	.1145
	Class without LA's	62	3.371	1.0594	.1345

a. t cannot be computed because at least one of the groups is empty.

The students were also asked whether they would take a course that utilized LA's again, to determine if having LA's was overall perceived positively by the students. The question was given on a likert-scale, with 1= Definitely Not, and 5= Absolutely. The students responded with an average of 3.931, with a standard deviation of 0.9243, showing that overall the students would prefer to have LA's in future courses.

The main goal of this study was to compare the changes in attitude towards collaboration between students in the course that used LA's and the control. While the means for two of the three subscales used to measure student attitudes towards group work increased, these gains were not statistically significant. The control group means in every subscale decreased, for some of the subscales significantly. The averages for the control on the pre-survey were significantly higher than those of the LA group, indicating that there were too many differences between the courses to make an accurate comparison.

	Change in Subscale 1	Change in Subscale 2	Change in Subscale 3
Course with LA's	0.1185	0.0264	-0.0259
Control	-0.3510	-0.1469	-0.1468

Chapter 5

Conclusions and Future Recommendations

Based on the findings of these studies of the Learning Assistants Program, it is clear that the LA program is making progress in meeting a number of its goals. Students benefitted from increases in content knowledge and collaboration as a result of interacting with LA's. LA's also increased their content knowledge and their knowledge of pedagogy, and developed relationships with course professors. The LA program is making progress in meeting five of its six goals (in this study I did not collect data related to retention). However, there are still areas for improvement, and each of these goals could be reached on a larger scale.

Using the results of my surveys and focus groups, as well as research of other successful peer assisted learning programs, I have developed a set of recommendations for improving the ECoS Learning Assistants Program. These recommendations should be reviewed for implementation and included in the Program's annual report to ensure continued progress in ultimately meeting overall goals of the ECoS Learning Assistant Program.

1. Meetings with the course professor should be mandatory for all faculty participating in the LA program. These meetings should be designed to incorporate discussion of the materials and activities that the students of the course will engage in, and that the LA's will assist in. This time should be used to increase the LA's knowledge of the course content in order to prepare them for interacting with students. Additionally, faculty should use this time to elicit feedback from the LA's on the progress of course transformation.

2. The pedagogy course should be modified in order to be more efficient, applicable to all LA's, and to incorporate active learning activities that allow the LA's to practice skills related to the goals of the LA's. This includes a greater focus on facilitating group collaboration rather than teaching.

3. The students and LA's should both understand the role of the LA as the course facilitator. The students should understand that the LA's are peers not meant to teach or have a complete understanding of the course content. This should be made clear by the instructor, presented in the syllabus, and repeated often. The LA's should be aware of their duties, and should be reminded by course professors and pedagogy instructors. LA's should not act in the role of a TA, but rather facilitate group learning.

4. Faculty should be required to be more involved in the course transformation process. This could be incorporated through requiring professors who use LA's to submit reports on modifications to their course that incorporate active learning or research based teaching methods, or as weekly meetings of course professors using LA's to discuss course transformation progress.

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SUPPLEMENTAL INFORMATION

SASPLA

What course are you taking this survey in _____

	<i>Not comfortable</i>	<i>Somewhat Uncomfortable</i>	<i>Not Sure</i>	<i>Somewhat Comfortable</i>	<i>Very comfortable</i>
1. If a professor were to approach you while you were working on a problem, how comfortable would you feel discussing the content with him/her while you are trying to solve it?	1	2	3	4	5
2. If an LA were to approach you while you were working on a problem, how comfortable would you feel discussing the content with him/her while you are trying to solve it?	1	2	3	4	5
3. How comfortable do you feel discussing problems given in class or in problem sets with your peers during collaborative work time?	1	2	3	4	5
	<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
4. Working collaboratively with other students has helped me do better on exams	1	2	3	4	5
5. Working with Learning Assistants led me to work with other students outside of class	1	2	3	4	5
6. Working with Learning Assistants has improved my grade	1	2	3	4	5
7. In the future I will actively seek study groups in other classes	1	2	3	4	5
8. Interacting with Learning Assistants increased my understanding of course material	1	2	3	4	5
9. Taking this class increased the degree to which I studied with other students	1	2	3	4	5
10. Working collaboratively with other students has improved my understanding of the material	1	2	3	4	5
11. The Learning Assistants increased the amount I collaborated with other students	1	2	3	4	5

LA Survey

What class are you an LA for? _____

How often did you meet with the course professor?

- Never
- A few times
- Once per week
- More than once per week

	<i>Extremely Unimportant</i>	<i>Not Important</i>	<i>Not Sure</i>	<i>Important</i>	<i>Extremely Important</i>
How important were meetings with the course professor for your understanding of the subject?	1	2	3	4	5
How important were meetings with the course professor for helping students in your role as an LA?	1	2	3	4	5
How important was the pedagogy course for helping students in your role as an LA?	1	2	3	4	5
How important was the pedagogy course for your understanding of learning and pedagogy?	1	2	3	4	5

To what extent did working as an LA increase your knowledge of the subject?

- No change in knowledge of subject
- Somewhat increased knowledge of subject
- Significantly increased knowledge of subject

To what extent did working as an LA increase your knowledge of learning and pedagogy?

- No change in knowledge of learning and pedagogy
- Somewhat increased knowledge of learning and pedagogy
- Significantly increased knowledge of learning and pedagogy

Would you recommend being an LA to a friend? ___Yes ___No

Survey for Chem 112

Initial Survey

Please respond to this survey to assist me in completing my honors thesis.

* Required

Who is your professor? *

- Dr. Boehr
 Dr. Van der Sluys

Have you taken a course with LA's (Learning Assistants) before *

- Yes
 No

Survey Questions:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I work with other students outside of class on homework	<input type="radio"/>				
I enjoy working with other students on in-class problems	<input type="radio"/>				
I study with people in my classes	<input type="radio"/>				
When I work in groups I mostly listen to other people's ideas	<input type="radio"/>				
When I work with other people I learn more	<input type="radio"/>				
I like to do homework with classmates	<input type="radio"/>				
I have friends in my classes	<input type="radio"/>				
I do not participate much when working in groups	<input type="radio"/>				
I contribute to the groups I work in	<input type="radio"/>				
Working collaboratively helps me to better understand concepts	<input type="radio"/>				
I would rather work alone than in a group	<input type="radio"/>				
I do better on tests when I study with other people	<input type="radio"/>				
I prefer to study with other people	<input type="radio"/>				

Transcript of LA Focus Group

Marley: First thing, just talk about what course you LA'd for, and say what your duties as an LA were. What did you do on a regular week, who did you meet with, what were your jobs/ what were you responsible for?

BMB 430: Weekly as an LA... I was a learning assistant for Bio 430, developmental biology, and I would typically go to class, Tuesday and Thursday mornings, and I would go around the classroom and help the students, answer their questions, facilitate them thinking, kind of get them going a little bit more, motivate them, when they are kind of just sitting like a bump on a log. I would also just help my professor out, Dr. Wendy, with whatever little errands she needed too. Outside of class, though, I probably spent like 10 hours a week reviewing the material and preparing to run an hourly session every Sunday evening from like 7-8 and I would typically stay until 9, so it was always like 2 hours for me, helping people out, and what we'd do is we walked through the problem sets that were posted on angel by Dr. Wendy and I'd walk through with them ask them, how they would approach the problem, and I would explain how I would approach it, if I feel like they might be going off onto a broken path, that would lead them into a poor exam score. So I would work with them to correct whatever they had bad feelings about or clarify things for them, so and if I couldn't answer something, I would always follow up with Dr. Wendy, so some of my hours were spent in office hours, Dr. Wendy would also meet with the Learning Assistants and the group leaders once a week, when we all could meet, or the majority of us. We would just go over class activities and stuff, what we were going to do in class, she would clarify stuff that was unclear, that's pretty much it, and I answered emails of course, I had a ton of emails from everyone.

BMB 401: So for BMB 401 we meet with Dr. Defelice weekly, and just like go over the, we have practice sets that we all have review sessions for, we just go over them, and the questions she's going to ask in class. And then when we are in class we just help with clicker questions that she asks, we walk around and answer questions, make people talk to each other. There's six of us and we break into pairs of two and we each hold a review session once a week for an hour. She gives us questions to ask.

Phys 211: So we have during Phys lectures for 211 and 212 which is the one I am LAing now, these clicker questions that are designed to be misleading, they are really hard and they are designed to trip you up and so we have a meeting um, once a week to go over what the questions for that week will be so that we don't get tripped up, and then sometimes he changes them and we get tripped up anyway, but usually its ok and so then during the lectures we go, we go down into the aisles and we try to facilitate conversation between small groups of students and basically try to lead them into giving an answer and then justifying their answer, and unless there's some terrible misconception, then not telling them whether or not they are right.

BMB 464: We didn't really need to know, we needed to know the course material if it related to the research papers that we discussed, but I would say that like, once every two weeks, we'd have at least one sometimes up to three research papers that we had to like, be able to answer like any questions that somebody would have and there were always a lot of... they were complicated... so we had to go through them like 5 times each, and we would meet with Dr. Defelice once a week to kind of like go through any parts of the paper that were like confusing, and then we'd also get the study guide that they would get in class, so that we would have the questions, we would go over them with her ahead of time, and then uh, usually, sometimes we would go over the lectures because usually she tried to tie them in with the research papers.

Marley: Did you go to class except when they were working in class on the papers

BMB 464: No

Chem 310: I LA for inorganic chemistry, and my duties are going to class, 3x a week, and holding a 2hr review session every week where we go over the homework problems before they are due, and students can ask any questions they need.

Chem 112: It's the regular section in the forum, so um, Dr. Boehr does clicker questions, so he sends those out to us by email probably 2 weeks ahead and we go through them, and then we meet with him on Saturdays before the week and we go through all the questions with the TA there also, to get her input, and then in class were each split into different sections of the room, so we can't really walk down the aisles, so we sit in the middle of a section, and try and help people with the clicker questions as they come

Chem 227: You go to lecture 3x a week, and you hold a 2hr review session 1/wk and then you supervise, help supervise, a 4 hr lab 1/wk. there's a lot of prep that goes into the 2 hr review session, but besides that, the lecture, he didn't really utilize us the way he should've once in a while we had questions

Marley: Ok, thanks so much, next question, for the people who had group sessions outside of class, describe what the structure of the outside of class workshop, what was your role supposed to be, what was gone over

BMB 430: For my section, initially the goal was to get everyone in to groups, up to the board, and they were very reluctant to do that, so people with different levels of preparation were coming in, and they would cluster around each other, the students who were prepared kind of knew who was and who wasn't so the unprepared people would be in their own little area, and the prepared people in their own area, so instead of really hounding them and getting on their backs about it, I would just call on random people, like go up to the board, while were walking through a question, I would like, come up with another question very similar to it, asking it, for like the same general thinking, the concept that I was trying to get across, and if no one would answer then I would just call on someone and not really give them a choice. And that ended up turning out to work, since like towards the end of the semester, more people were participating and everything, you just have to force them into it first. But like in that position, I felt like I was more of a teaching assistant than a Learning Assistant. And the classroom that we were in, it's just a pain in the butt to turn the desks around and everything, if we had a table like this where we could all see each other, that would facilitate it better, but just the standard school desks and everything, no one is really anxious to turn it around and make a mess. The sessions were optional so that they could go to any session, and cause there were other sessions held during the week by other Learning Assistants too and I think there was maybe 4 days out of the week that they could go. Sunday Tuesday Thursday, and I think there might have been one on Wednesday. They were optional, the problem sets that they would do were optional, there are optional bonus questions to encourage participation in the sessions, and uhh, most of the students came like with varying questions, and then I'd also like lead review sessions for the exams and everything, per their request, or make a concept guide for them. That's pretty much how the structure was in my sections; it might have been a little bit different in some of the other LA sessions, but our bonuses for instance, they kind of asked us to split them into groups, so it just kind of like, make 3 groups, and have them discuss and go back and forth between the two larger groups and see what they are coming up with. That's pretty much it.

Marley: You said you felt more like a TA, why was that?

BMB 430: I was at the board more, the LA aspect came in when they asked me a question and I was stumped, and I was like, well I'm going to have to follow up with Dr. Hanna Rose, then I didn't feel responsible for completely knowing it, so my reviewing was just out of my trying to give them the most that I can. And, when I like come up with my own questions, that's when I felt more like a learning assistant, rather than I'm just re repeating and regurgitating what they already had in class. So I would make up different names of proteins for instance for them, something that would just stick for them, and occasional crude joke now and then to get people to remember stuff. I actually got an email from someone thanking me for telling him about helicase- why do you want to be helicase, so you can unzip your jeans... so... it's the little tidbits like that that help the students remember

BMB 401: For our class there's 3 separate sessions each week help by each pair of LAs, it's an hour long, and its optional. I usually get the same kids coming because the time works for them, between 10-20 kids, and they just immediately get into little groups and then like as people come in I'm just like, just join a group, it's usually no problem, and then they all just work through it, and when they have questions they ask us. We never go over anything at the board, we just talk about it in small groups, and it's really casual. They'll ask other questions about how her exams were and stuff and I just talk to them as like, I took one of her classes, she tests fairly her questions are long, I can talk to them as a student would from their class.

Marley: What are they working on in those review sessions?

BMB 401: She sends out a work sheet for the chapters that she goes over in class. Its optional, and she doesn't post the answers online for other students.

Chem 310: The chem 310 review sessions are once a week, and its myself and another LA and its optional, and basically we chose Tuesday night because the homework is usually due on Friday, and we thought that most of the students wouldn't come with it started or looked at or anything, so we thought that

would give them enough time to go over everything. We do it in the conference room 301 A in chemistry building, which is really nice because the tables are round with 4-5 seats per table so that really facilitates and helps with us getting into groups. Other than that we just circulate throughout the room it's pretty casual and if they have questions. We never really do anything up at the board, there was some confusion with the first exam that kids thought we were going to like go up to the board, and basically go through a practice exam that the solutions were posted online, and we were like you have the solutions there's no point in us standing up there, so.

Chem 227: For 227 I guess we had 4 LA's so we split up, 2 did one night, 2 another night, for 2 hour homework review sessions, we generally got a ton of kids probably like, I was Thursday, the homework was due Friday so it was the last minute kids, who probably came to Wednesday but then didn't get it, we probably had 30-40 maybe 45 kids for two of us which was a lot, and they would just ask us random questions, we actually had some trouble with kids trying to like take the answer key because we were given answer keys by our professor, so we had some kids try and do that, cause a lot of the kids in the class were in our other classes, so that whole peer to peer thing got a little blurry sometimes, they would take our answer keys or just try to worm it out of you, it caused problems that way

Other Chem 227: Yeah Wednesday night was a little calmer, we generally had about 20-30, they weren't always there the whole time, but most of them would be starting it that night, there were a couple that would have it done already or like partially started it and just ask questions, but most of the time it was them working in groups or pairs, just working on the problem set and then asking questions. And we didn't, I didn't have too much trouble with them trying to take it... I'm a year ahead of most of them being peers so... that wasn't an issue for me. We also had review sessions for the exams which we went over a practice exam, the last year's exam, on the board; we went over it because he didn't post the answers online.

Marley: How many people get the answers from the professor, like get a copy of the answers, do you know what the answers are beforehand?

Everyone does

Phys 211: We're supposed to know what the answers are but sometimes he changes them in between when he gives them to us and before class, and so I'm like oh the answer is this, no its not, he changed it, the answer isn't on there anymore, he changed it, but usually it's the same.

Chem 310: We weren't given answer keys and first but I requested them so now we get them every week.

Marley: Do you think there are ways that you could be used better in your classes? Any suggestions for how your role could be improved to help your students learn?

BMB 430: I personally think that I would have done a little bit better helping the students, and this is just like a structural thing, is most of the classrooms were just these big rows of chairs, so it's hard for me to access the students who are in the middle, so all the students on the periphery on the outside chairs or 3-4 seats in, I can still help and communicate with them, but anyone who is like in the middle, there's just no way that I could crawl over them, and I have no desire to crawl over a bunch of people to get to them and answer their question, so I feel like if there were a couple of empty rows, designated for people not to sit in, then I could like go up and down the rows. I actually for, Bio 129, I see Dr. W, he does that with his LA's in Osmond. He actually has designated rows where students can't sit and the LA's can access more people that way. I feel like if I had something like that it would improve me motivating people and answering questions.

Phys 211: that only kind of works, we tried that, but there are so many students in that class that they got really angry and sat there anyway, and were not happy about it.

BMB 410: We block off rows in our class, were in 117 Osmond, and I never use it, I never walk across it, for fear of tripping or something. Maybe the rows are not that big, I never have a problem getting in the middle

Phys 211: they aren't quite as wide as they are in 119 Osmond. I kind of figure if you want to ask me questions don't sit in the middle.

Chem 310: I would say for my class, meeting with the professor will really help, and I think that he needs an LA specifically with the goal to alter his problem sets for clarity, because the questions that are coming up are the exact same questions that we had when we took the class, and he has things that are common sense to him but to students they don't know that silver when it's in its particle form complexes to

agcl2 rather than agcl, you need to put a hint there or something. Someone needs to be in there and commenting on this stuff so he can fix it and its clear

Chem 112: it would really help to let the students know what LA's are. These are like freshman coming in, they've never heard about it before it's from HS, and they don't really understand what you are there for or how they can use you so they don't ask you questions, and you kind of have to force it out of them, so what you get, how'd you get it, what'd you do?

Marley: Do other people feel like the people in your class knew what an LA was?

Phys 211: They do now (General agreements) this is the second semester and I actually have a lot of the same students in my class now that I had last semester, so they all know what we were there for, but last semester was a lot more awkward to start

Marley: Do you think that because they've had LAs before they work together better?

Phys 211: Absolutely, it's so much better, I've got an entire section of like 20 kids still who do not want to talk to me at all. Completely ignore me, but then there's a bunch of other kids who are always asking questions

BMB 464: I would say for 464 to have utilized us more, cause like I said we didn't have to be there for class, we only had to know the lecture material that was directly relevant to the research papers, and I think when we took it she didn't have LA's and she was just constantly running around the classroom and she couldn't get to everyone, so I understand why she wanted LAs to help her answer questions but she also doesn't have review sessions before the exams or um, and I remember people asking for like review sessions but, I don't know why she doesn't but um, I guess in the future she could use the LA's to actually like learn lecture material, which is not that much, cause we've already learned it, and then like maybe hold an exam review or something.

Marley: Do you know the course content better because you were an LA, what helped you learn the course content better? Were there problems?

BMB 401: I definitely learned the material better, I think more for 401 than 464, cause in 464 we only had to go over these research papers that were really complex, but it was helpful, but for 401 being there and hearing it again, and I know I took it with Dr. Tu who is really confusing, and I really like defelice as a teacher, so it was helpful hearing it the way she explained it, and then when you have to explain something, you are going to learn it better.

Phys: 211: I definitely think it's been helpful, especially since I'm trying to remember all this stuff for the praxis, it's been really useful as a review for me, but then I also get to learn how to explain it multiple ways, so then different students will understand it better, and then I remember it better.

General Consensus

Marley: Can you guys describe your relationship with your professor, how honest do you feel you can be with them about how things are going?

BMB 430: My relationship with my professor was great, Dr. Wendy was very very friendly, there was a lot of communication between us, and she would try to make herself available if I was unavailable for whatever reason, and she trusted us enough to let us go over exams preview exams and make our suggestions and comments on the exams, which is very nice and its encouraging from a professor cause it shows they have a certain level of trust with you, and with that, it's that trust that you don't ever want to break. She was very very nice, she gives us a lot of advice, I still stay in touch with her. I could give her feedback and be honest about everything, I was pretty up front with her with what I disagreed on or thought she didn't explain well enough, and it kind of relates back to class, when I was a student in her class I was kind of confrontational with her cause I felt like a few exam questions were unfair

BMB 401: we meet weekly I feel really comfortable like if something's confusing I feel like I'm one of 6 LAs and we all feel pretty comfortable if something is confusing just letting her know, and she asks us too, she makes it very, a comfortable situation, cause she wants what's best for the students, so we'll tell her if something is confusing, we'll give her feedback of what the students say to us during the LA sessions that they are not necessarily going to go say to her, about how the exam was and all that stuff, and I think she really appreciates hearing that, and doesn't take offense to it, it's just growing, making the class better. She really opens the floor

Phys 211: we meet with Dr. Hudson every week and we go over the clicker questions that we are going to have that week, and like I said they are so confusing and misleading and if you don't get it wrong it's amazing, so were very, we get to the point where its totally fine to get the answer wrong because at

some point everyone's got it wrong, and then we will argue and yell, and then eventually he'll step in and tell us why we were wrong and what the right answer is and then be like those are all the same misconceptions the students are going to have. We end up being pretty comfortable with each other and with Dr. Hudson.

BMB 464: Dr. Defelice, I first had her for 464, and the first day was talking about how she's interested in how students learn and trying to make her classes interactive, so she's always come across as somebody who is primarily interested in making sure her students actually understand it not just memorize it, and then personally I had her for 464 401 and 402 and then I laed with her, so I was pretty comfortable with her by the time I LAed with her, and our weekly meetings, if something was confusing we didn't have a problem saying so, she was, it was good for her to see where people might get caught up if her questions weren't clear enough or anything

Chem 310: like I said, we haven't met with our professor, I think we met once at the beginning of the semester, I'd probably say I'm more afraid of approaching him in person just cause he's so busy and he has to be different places all of the time, but as far as being honest it's not really a big deal, I'll send him email updates every once in a while and just say hey this is working this isn't working or um, one student mentioned to me about the in class discussions he does this year, and he calls students up to the board, and I just said you know this a really stressful thing for them, they really don't enjoy it, there are people that have been called on and avoid going up, and just don't say that you said their name, so were kind of trying to smooth those wrinkles out but I don't know.

Chem 112: Dr. Boehr, he's kind of awkward in himself, so he's Canadian too so he's got a good accent but I don't know I don't think any of the LA's are super comfortable telling him things, if he prompts us specifically we'll tell him but I don't think any of us would just go up and tell him on our own. There's not a lot of things that he does that vary that he needs to be told about either, but were definitely not that comfortable with him, were not comfortable with each other, we don't actually know each other, because were spread out in class. On chem 227: It was really different with Dr. Sykes, has actually my research professor so I know him really well, I'm probably too honest with him, too comfortable.

Marley: what are the weekly meetings like for Chem 112?

Chem 112: We just go in a room, it has long tables, and everyone just sits down, and we've all already done all of the problems when we get there and then he just goes and he goes ok what number 1 and someone will go D, and he goes ok everybody get that and we'll go yeah, and ten we go on to number 2, number 3, number 4, were just done. Only if someone gets it wrong is there a discussion, and even if we get, if the person who says the answer first is wrong, he'll go did anyone else get an answer, and that's how you know you're wrong, what about someone else. Ok so those weren't right, I'll just do it on the board, and then you copy it down and then you move on. Every class, every time we meet he'll ask for feedback but it's generally like are they talking to you, are they asking you questions, yes or no. I think it's because the students aren't comfortable with each other that we don't talk, I know at least for 227 that we were all really comfortable with each other we would talk all the time it wasn't really a problem, but in this class were not comfortable with each other, so people are kind of afraid, kind of like in class you are afraid to ask a question cause you don't want to sound stupid, you don't want to sound like you don't know how to run your section, when all the other kids know how to run their sections. I tried to start a group me to get that doing, it didn't really work. It's just me talking to myself

Marley: Does anyone else feel like they had good comradery with fellow LA's
Universal Yes's.

Phys 211: Better now, now that we have nametags, that is a good thing

Chem 112: I don't know anyone's name

Marley: Does knowing your fellow LA's helps you

Yeses

Phys 211: It does especially cause if we have noticed he's changed something, I'll be like what is the answer to this cause I can't figure it out.

Chem 112: I don't even know the la who sits in the section next to me and I saw a kid that needed help in his section and I was just like you in the yellow, help him.

Chem 227: We didn't have weekly meetings, which I think would have helped a lot especially cause sometimes the problem sets, since I was Wednesday, we didn't even really get the homeworks answers sometimes until we got there, you could work through the problems which I usually did, but that takes sometimes greater than 8 hours to do prior, but I feel like I was really comfortable with my LAs

definitely and Dr. Sykes, really comfortable, I could talk to him about anything really, I've gone in a couple of occasions, and said so I think you need to think about this again or like we should think about changing something, really comfortable.

(34) Marley: Let's talk about the pedagogy course. How did you feel about it? What was helpful, what was not helpful?

BMB 464: I think we took so long to go over every single questions, upwards of 20 minutes and we discussed them in like 4 minutes, it was just like you were sitting there, did we discuss this yet, and then we wouldn't get through all of the questions

BMB 430: there was a lot of digression, especially among the physics guys
Universal Agreement

Chem 310: I think it's better, there have been times where we've had way too much time, but I think it's been pretty good

BMB 430: It was nice to hear other people's ideas, how other peoples sessions get run, other small little tips for getting a concept across, or something, so that's what I took from it and tried to use in my sessions

BMB 401: I wish they had made us switch up the seating arrangement more, because I was with the same people every time

Chem 310: I also work with all the same people

Phys 211: I feel like that would have been really helpful

General agreement—everyone wants to mix up

Chem 227: I felt like the course was helpful in the fact that it gave you some really useful tips, but at the same time it wasn't really applied to the class that we were Laing for and it was really I don't know it was hard to sit through some of them, because it was like this doesn't apply

BMB 464: I think it definitely could have been sped up, and if it had been sped up it could have been an hour instead of two hours which would have been nice

BMB 430: just some efficiency things...

BMB 464: It just went way too slow

BMB 430: And I think some more hands on work, like actually doing the scenarios, because it's just a lab, like you are going to take more from the lab by doing the hands on stuff, then you are going to take from hearing a lecture of the lab. And another thing that was like the activities, the paragraphs, they were so long, they were way too long for trying to get a point across, and I feel like it would be better at the beginning, because not everyone does the readings, just to have a little bulleted outline, saying what the main points were in the reading, this is what you should have looked up about pedagogy.

General consensus that many people did not do the reading.== a few people read the summaries== a few people never once tried to do readings== I read the summaries that was about it.

Phys 211: It's a pedagogical book and it's supposed to be for teachers, and examples of how they applied it, this is how you could maybe use it, this is why it's important, but in applying that as an LA, it's not all relevant, and I wish that there had been more on facilitating discussions, which I am learning now in one of my educational courses, that is REALLY useful as an LA, it would have been really nice to have (Math ed, 411).

Marley: Describe how your typical interactions with students went, what was your role, what strategies were you thinking about when you were interacting with them?

BMB 430: Students and myself, it varied by individual, the individuals who were in my session all the time, we were like buddy buddy, and I try to like crack jokes about material or class to try and open people up so that they would like complain about class or whatever and because I knew that they would have complaints because I don't know if they would want to say them in front of me I would say I remember last year when I took this course and xyz really ticked me off and I could be lying about it and they won't know and they'll be like ohyeah I felt that way too, so I'd go back and relay that stuff to Dr. Wendy and she'd be thankful for that, but as far as coming up with other strategies for them, if they had trouble in the class like with an exam or something then I would just kind of evaluate like how do you study, lets change how you are doing this, hang out with this person a little bit more, so I would try to do stuff like that where I get like a little bit more formal with them, but still keeping like semi-formal or just casual relationship with most of them. The kids that were just quiet I would try to interact with them but

most of the time they were just like, so yeah I mean it was overall a pretty friendly experience, nice cause I made new friends so

BMB 401: I was definitely more relaxed during the review sessions cause dr defelice wasn't there, but in class I would just go up to them, ask them what they are thinking. They are more reluctant to ask questions in class, in the review sessions they'll ask questions more, and they are just more comfortable talking to me.

BMB 430: A lot of students like if I overhear them asking questions among each other and they couldn't answer, I'd wait for them to ask Dr. Wendy, and if they didn't ask I'd ask the question for them, so a lot of people were like oh can you ask this ask that, kind of like the voice for the students too.

BMB 464: it's definitely me trying to get them to work more together, because that's what Dr. Defelice wants us to do, is like to get them to talk and figure it out themselves, which is way easy for us, even if they ask something that I have no idea, I can be like well what does your neighbor think? And they'll end up answering it themselves half the time, and now they talk to each other it's beautiful to watch. In class she does clicker questions so its timed, so if they ask a question I'll kind of give them a hint and be like why don't you talk about it with your neighbor, I'm going to go help other people, cause I don't really have enough time, and sometimes you'll get one kid that's just asking too many questions, and you'll just be talking to them for the entire clicker period, because it's like a minute and half, so you're like I didn't get to anyone else, so you have to keep that in mind, that you can't spend that much time with each student. In the review sessions there's usually like 2 or 3 big groups, and the whole group will ask a question, and they'll all just be talking and saying well I thought this, but I disagree cause I thought this, and then I'll give them a hint, and someone else will be like OH and they'll get it. Little like, what to focus on hints, gets them on the right track of what she was looking for in the answer. They are really, they talk amongst each other a lot more than I thought, but if I need to I'll come

BMB 430: In class I would like well we'd have our class activities and I go around and help answer peoples questions and like guide their thinking, sometimes the activities would just be a little ambiguous or unclear in what they are asking for, someone just needs a little bit of a head start to help move them along, if the problem is where do I start. Most of the time I give them what they need to start and let it go from there, and if they had a question, like where it's just like oh can you tell me the answer, it sometimes it depended on the question, in terms of if it's just a simple fact that they should recall or it's a broader concept they need to understand, then I quickly ask if anyone else has the same question in the area, and if the majority did then I would explain it to everyone, and if they didn't then I'd quickly say, why don't you think in this direction, or look to your notes right here and think about how that changes, and if you are still struggling, put your hand up and I'll come back over. Our activity session were like 15 minutes, they were multi step activities, and you could usually tell when most people were finished cause it gets a little bit noisier, versus in the sessions where it was more majority than individual, if someone had an individual question that they still needed clarified, I would just be like oh I'm going to move on so everyone else, for the majority here. You can see me like after the normal review hours and so I'd stay and answer questions more 1on1 like that but I was kind of reluctant to give just the answers, like just memorize this, if it was just like a straight memorization thing then I would recommend it, but most of the concept stuff then I'd spend a lot more time making up my own questions and trying to drive the point home. Whereas in class, Dr. Wendy already had the questions and I was just trying to steer them to the thinking that she wanted to grasp.

Phys 211: So we also have really timed short periods in which to help students so I'd try to get to at least 2-3 groups in that time, and I try to interact with as many students as possible at a time, so I would split up, we each have a portion of the lecture hall that is our section, and so among that I have like 6 or so groups that I try to get to, but I'm usually like hey guys how are you, what'd you get, what do you think? Why is that your answer, what questions do you have, and just kind of go from there. And usually I'll try to get them to talk with each other say oh what do you have, well what do you think, do you agree, oh you disagree, talk to each other and then I leave, cause you can't just stand there forever, it seems to work pretty well cause most of them are actually talking to each other now which is good.

BMB 464: Our groups were in the same groups all semester, because they would have to present I would say like there were definitely days where they would just not ask questions, and we would go around and be like, do you need any help, do you have any questions, and they would be like, no, they just did not want anything to do with us, but then there were other days where they were really asking a lot, but as far

as how to strategize answering, we had already done the study guides, so we had already reasoned through the problems ourselves, so if they were having similar problems I would try to like think back to how I like worked through it and which little parts of the paper you have to notice in order to get the answer. I would give them hints and stuff.

Chem 310: My role is mainly just answering questions, I found it helpful to take the problem sets that I did and my work, to see how I did the problems, and I'll spend a couple hours before going to the review sessions, looking over the answer keys and my work. But we have students that, there's one student that just really wants your attention to go over like every question, and there's some that will just be like is this how you do this, and I'll say no think about this, and they'll say I just want the answer, and there's other ones that get frustrated easily. There's all different kinds of groups. I try to give hints, sometimes it's hard because I myself struggled with the material so much that I, um, and Dylan and I are both realizing how much we didn't understand the material when we took the class, I think you have to be able to say I don't know the answer, cause its better than giving them the wrong answer. I say ask the other LA and see what he says, or I can try and look it up in the textbook, do you want me to ask Dr. Mallouk.

Marley: how much did you find yourself telling people that you didn't know the answer?

Phys 211: less now than I did before, but even now sometimes I completely dodge the question or they'll be like is this right, and I'll be like I have no idea, I did not memorize the answers, but you can justify it to me, and I can tell you if it sounds good.

BMB 401: If they ask me something that I don't know I'll, I can easily just be like, what does your neighbor think, and the more they start talking, the more it's like oh yeah ok, the class meets at 9:45 in the morning so some days I come in and I'm so asleep and have no idea what going on. If I'm like, before I say outright I don't know, I kind of get them to come to the answer themselves. But when we had these papers (IN 464) they would ask questions sometimes that I was like, cause it's like a research paper about biochemistry, there's so much you could ask that I have no idea, and that I'd just be like, just focus on this part, cause there's so much you could get sidetracked with

BMB 464: They would get really sidetracked, and get hung up on one number and specific labeling and all these crazy questions.

Chem 112: We have the short clicker questions that are like 1 minute 2 minutes, and we have to actually give them a minute to do it themselves so you are just sitting there and as soon as someone stops writing then I ask them, and its more formal what'd you get, how'd you get it, whereas in 227 I was a lot more buddy buddy with them a lot more joking around and stuff. I would actually black out the answer on the answer key so they ask me is this right I can tell them I don't know, I can show you my answer key but its blacked out, cause they are like number problems, that actually helped me a lot, I would just joke around with them, if they didn't know it, and they didn't look it up, I would just give them a textbook and tell them to look it up. Generally when they asked me questions it wasn't a group asking me questions, it was more one person. So I would ask them to explain what they were doing, how did they get to the point that got them stuck and then if it sounded right I would be like ok you are on the right track, normally I would have just helped someone with the exact same question so I would pull that other person who did it right and be like why don't you help them, so that I can go help other people

Chem 227: With Chem 227 it was more relaxed, in the review sessions its really easy just to talk to the students. Most of them ask about the same questions, I always had this one say what's the answer and I would just be like cutup imp not telling you we've been over this. Eventually they realized that we can't answer that question. So it was really easy to talk to them, and if I didn't know an answer even if during labs and stuff I usually had a lot of questions that were way off topic, and I wouldn't be afraid to say, I'm not sure, or you have to talk to Paul the actual ta for the lab section, or even dr sykes, I'm like I can't make that judgment call, that's something that you need to ask them

Chem 112: yeah I actually ended up calling Dr. Sykes once or twice cause they asked me something and I had no idea, we're really comfortable with him

Marley: The last one is would you be an LA again, why?

BMB 430: I would definitely be an LA again, and while I'm in med school I'm going to try and do something similar to that just because teaching the material, explaining it, reasoning with the students has helped reinforce it so it's more long term memory now, vs. short term leaves my pencil as I'm writing it on the exam, which I feel like is almost 80% of my college career now. That's why I'm doing a TA thing for

histology this semester, because being an LA last semester it was like oh hey I really like teaching this is really cool. Definitely going to try to keep doing that in the future

BMB 464: I've done it twice, I really like it, you learn the material better, it forces you to have some people skills, and it makes you a better learner, and work through the problems or whatever. Especially at such a big university where your classes are like 400 people to like go back and like I really like it, smaller, focused, it's cool

Phys 211: I had last semester and I'm taking again this semester, and it's kind of nice cause I got some carryover, I like it a lot cause it gives me a lot of decent teaching experience, and it happens to be right after one of my math ed courses so sometimes I can directly take what I used in one class and use it in the other, or I'll take examples from Laing and use it in my math ed class, and be like oh I should've done this or I could've done that. It's very helpful as an educator to figure out what you are doing right and what you are clearly not, and it helps you to retain more information.

BMB 464: Same thing, helps you learn it better, you don't fully understand something until you have to explain it to somebody else, and it teaches you some study skills that you can use on your own too.

Chem 310: I would do it again too, I would add to that that it gave me more confidence in myself for doing TAing or Laing cause I never thought I would ever do something like this

Chem 112: I would do it again, I just think it's fun

Chem 227: I would do it again, I really enjoy it and its good experience, cause I have to TA for the next 2 years in grad school.

Transcript of Student Focus Group

Positive Impact on Learning

Negative Impact on Learning

Positive impact on collaboration

Negative Impact on Groupwork

Relatable/ Comfort Talking to LA's

More Comfort with Prof.

Moderator: Do you think that having LA's helps you work effectively in groups? Did having someone in the problem sessions with you, did that mediate and control the environment in a different way than if you had done it on your own?

Student A: I definitely think it was helpful because we worked in a group and if you work in a group sometimes outside with nobody else who's more intelligent than you so to speak, you get to a problem you don't know how to answer it, you kinda just skip it, whereas if you had an LA if you got to a problem as a group and none of you knew how to do it, you are like well, can you give us a hint of what direction to go, and then somebody that hint would have worked for in the group, so you could then teach each other for it, so I think it helped a lot.

Student B: I think it helped having like a more formalized setting, umm, like, just the fact that an LA was there to mediate, whether or not they actually did anything or not, the fact that they were there made it feel like it was a actually a formal study session versus hey let's get together and study, where I guess it is more easier to get side tracked or distracted and not focus on the work

Student C: One of the things I liked about it was the fact that it was a lot more individual attention, I mean even if you have like a professor or like anybody like mediating that kind of a review session, it was better with 2,3, or 4 TA's or LA's going around and giving individual attention, you were able to get your questions answered much more quickly, and you were able to have that kind of back and forth like an individual relationship with the LAs rather than just one TA for a big course, so I feel like it was more individual attention that was helpful

Student D: So, generally what happened was is that you would have a group, and if another group got something, you would try and consolidate the groups so that one group might be able to help another group with what they've done, and uhh, it was good, It was good for like uhh, class comradery, I guess you could say, like people learned to work together.

Moderator: So I when you say comradery, are you saying friends, acquaintances?

Student D: ummmm... A little bit of both

Student B: Yeah, I definitely think it helped everybody get to know each other better so the study session got easier as they went because you, a lot of the people, you knew you could work with them, it actually made it more effective

Moderator: Did you ever feel like in the very beginning before you became acquainted with these people, were you afraid to ask certain questions that you thought might be considered a “dumb question”

Student C: I felt a little uncomfortable in the first place but I definitely know that the environment at the end of the class was one that was much more, you knew the people around you and you didn't feel like you were pressured to ask certain questions or not ask certain questions, it was definitely much more of a friendly feel towards the end.

Student A: I think earlier my science based career, I would have thought asking questions like a I had in analytical chemistry Would have made people think I was you know stupid or less inferior, but I think once you start going through this major you realize that you know, sometimes you just forget the simple stuff. Umm, so I think in this class it definitely helped me even more realize that, yeah, you are not stupid if you forget something from gen chem. It helped to be able to ask the questions and not be judged, because I think that was how it was.

Moderator: Who would you, if you did feel that way, who would you feel was judging you, or would you fear was judging you. Students around you, your friends, the LA's?

Student C: Kind of expanding on what he said I think that in a lot of classes when you are asking a TA or something you feel nervous about appearing stupid to the TA. Whereas with the LA I mean, going back to the individual attention, you kind of can just be like hey I forget this, it's not a big deal, just explain it to me, whereas if you go to a like a professor or TA, where they kind of expect you to already know something that you might have forgotten that was easy, and you kind of felt like, uh, I feel kind of bad that I don't remember this, so it was much less pressure talking to an LA

Student GStudent C: I feel it's a lot less pressure because they have just taken the same course, so they understand what you have been through, whereas TA's and maybe grad students had it in the past, they are just so far along it seems second nature to them, they don't necessarily understand, what you are not comprehending, so slow but easier to relate to the LA's

Moderator: Is relatable the word you would choose

Student F: That's kind of exactly what I was going to say

Student D: I was going to say that I kind of find it easier to go to the professor and like TA's, only because like some of the LA's you have other classes with so I don't know, I guess it could be like you feel more pressured because they are your peers, and you might be more embarrassed if you get something wrong in front of them cause they are in other classes and they might think down upon you in that class and maybe other classes, so it might relate in other subjects as well

Moderator: Anything to add to what we have said so far

Student E: Well, every time I want to raise my hand someone says what I was going to say. But uh, yeah, the LAs while uh, while someone just mentioned that sometimes they can be in your classes, I think overall they are a positive thing. They encourage group work and comradery between groups, um, so overall I feel like they did add positive things to the course.

Student H: I don't really have anything else to add

Moderator: So going off of that, what explicitly did the LAs do that you found was either, let's start with helpful, what are things that they actively went about and did, or that you observed, that helped you learn during the problem sessions.

Student A: Well I think that the biggest thing was actually just having the problem sessions, because going off, I don't remember who said it, but talking about how it's a formal setting. So if you go sit in a dorm room or an apt living room you are not going to get as much work done, than if you sit in a classroom with

an hour and a half two hours with people who have taken the class and did well in the class and they are your help only, the intelligent people, I think having that constricted time helped a lot. And on top of that if the entire class was stuck on a problem they kind of brought us all together and gave us hints on how to do the problem, and I thought that was more than helpful.

Student B: The other thing too, I think just because they are around, they are working with other students, so if like Oh, you have a problem with this question, here this person just solved this, so why don't you get up and meet up with him or her, and they'll help you.

Student C: There were a lot of instances where rather than just giving you the answer they would try to lead you to it so either by referring you to other students who had just solved the problem, and also that the person explaining it helps the other students, you are all better cause that person has to explain it. That also adds to the whole cohesive feeling of the review sessions, and uh even if you were just talking with the LA they would just try and ask... one of the things I thought more of the LAs could have done is ask more leading questions rather than just uhh taking it step by step, what do you think this is, what do you think that is, so um things like that were helping you thinking in the right direction, and I think that is one of the things they did well

Moderator: So they did do well providing leading questions

Student C: Some LA's did well; some LA's could have done better

Moderator: Did you see similar results?

Student A: I definitely though there were LA's that were better but I wouldn't say that any of them were bad by any means, I just think that some of them instead of they kind of held our hand and walked us to the answer, whereas in a class like this its building your knowledge, I would have rather not been , had my hand held, more like pointed in the right direction, but I feel like a few of the LA's walked us right to the answer, instead of almost forcing us to think about the answer ourselves.

Moderator: Did that feel condescending, like hand holding with a small child??

Student A: I think they were doing it to be nice, to like I feel bad for this person that doesn't know how to do it, but I feel like to some extent on some of the problems, it may have suffered, our understanding of the question may have suffered cause we didn't get to the answer ourselves

Student D: Absolutely I agree with that, and uh I feel like you know some of the LAS yeah they might have felt that and they might have felt bad for us but I am not saying all of them, but some of them definitely would give the answers, or when they combined groups together, they were aware that groups were giving away answers to different groups, and it eventually happened where it was just this group would get this question right, this group would get that questions, and then they would just split the answers and copy off of each other. I think that the LAs could have better facilitated that, and instead of just saying go ask this group they got it, to help each group one at a time. They tried to expedite people and help them as quickly as possible, so they would just say go ask these people they got it, and then they would get to the next person, and after a while of going up to these people and saying oh how did you do this one, and those people are like just copy it

Student C: I don't think that's a reflection on the LA's because there were some groups that were willing to work through the answer with you, and there were also some groups who just didn't want to be bothered, here's the answer copy it.

Student G: I feel like it was also tough for the LAs cause there were only four total, and obviously they can't make it every single time, so they rotate, and there's two people there, it may be tougher for them to get around and answer everyone's questions, so they will send them to groups, it just all depends on which

group they send them to, how the answer would be treated, whether it's more of an explanation or strict copying.

Moderator: were there any less effective, were there other aspects to the group sessions and having the LA's that weren't very effective, issues that came up or problems that you think could be improved for next semester

Student A: I thought that the homework help sessions were great, but I went to the one of the exam review sessions and it was not the same kind of thing

General consensus

Student A: I did not find them helpful, I went to one and I stopped going because I didn't find it as helpful as the homework help sessions, and I would've I'm not sure how it would've changed it, but I don't think it was done as effectively as the homework help sessions

Student B: I agree I think that, I think the difference was with the exam review sessions is that, with the homework review sessions they are not really structured at all its kind of like everyone comes in and works together, but for an exam review we are given the practice exam and I guess the expectation is to work through it stepwise which is kind of what we did, ok start on problem one, here's some time to work on it, and then someone will come up and do it or work through it. I think the problem was is that because some people struggled with it and other people didn't, that we took so long on each problem, that we only got like a third or half way through the practice exam, so I think having a little bit more structure, you have five minutes, and whoever is not done well go over it, you aren't trying to help people out, I guess more structure would have helped.

Student G: I have the same opinion on exam review, it was too slow for some people

Student C: Agree

Student H: I just found it frustrating to like sit there for a while, and you already got the problem done, and they were on the same problem for a half hour, 40 minutes, so by the end you didn't have half of it done, and you couldn't get help with it because they exam was like the next day.

Student E: You couldn't even move on to the next problem because they didn't give out the practice exam, it was just on the projector.

Moderator: You said more structure, I was confused by this, do you want more structure or less structure, would it be better if you got the entire practice exam given out, work in your own groups set your own pace

Student G: I feel like it would be better if they just handed it out and treated it the same as the problem sets, where you just come in, and if you have specific problems that you want to ask questions about they can just do that, cause everyone's getting what they need out of the exam, and you aren't just waiting for those few people in the back who don't understand what is happening in the first place

Student A: I would have rather seen maybe like the homework you had a week, or you had a couple of days before the homework help sessions to look over the problems and start them and you had two nights, I understand you know expecting four nights for an exam is crazy, but even one night and give us a little more time, you know if the review session was on a Wednesday, put the practice exam up on Friday night or Thursday night, so we had the weekend to work on it, and that way we can come in, we can just come in for the few problems that we didn't know how to do, rather than showing up, the first time we saw the exam questions was in the review sessions. I think that if we had structured it like the homework help sessions, knowing what the problems were beforehand would have been a little more effective

Student C: I think that either by doing it that way and giving us more time to work on the exam kind of as a problem set and come in with specific questions, either doing it that way or when the exam review sessions

happen working faster, cause it seems like the common theme here is the exam review sessions just were not efficient, so you can either do that by specifically targeting only the problems that we have problems with, or by targeting everyone as a group, and just spending five minutes on a problem okay and have the LA explain how to do it in a good way. Another one of the problems was they had people come up and explain how to do it and that always wasn't the best means of understanding how the problem was done. If we had LA's explaining it it might be better, and if we only spent five minutes on a problem in small groups working with each other and then the LA's went over and moved on, it would be much quicker.

Student A: One other thing that's kind of I noticed overwhelmingly, like sorry not overwhelmingly, but over all of the areas, the homework and the exam review sessions, *is sometimes the LAs didn't have the answers*, and that's not their fault because I understand that they have other classes, I don't expect them to do our homework, on top of all their other homework for their other classes, but every once in a while we would get to a problem and *you would hear the LAs say I don't know how he came up with this answer, I don't know where this answer came from, he didn't put up the work, he didn't put the answer down like that kind of stuff*. I feel like part of it falls on the professor to help the LAs be as effective as they can, because if the LAs don't have the answer, they're not, sometimes the LAs have to sit and do the problem and it took them another twenty minutes to get the problem done and then to teach everybody else, hints and all that stuff. So I think if the LA's had the answers more strictly then they did it would have helped a lot more.

Moderator: did you ever find they got an answer wrong?

Student D: Frequently

Student H: One time I think it was like the first exam, they had this big debate on something with alpha cleavages, and it took forever to figure it out, and they had to end up calling I think Dr. Sykes, and *that just took up so much time that whole process*.

Student D: *I got a question wrong on the problem set, because I checked it with an LA and they said it looked fine, and I ended up losing a good amount of points for it.*

Moderator: Did that make you feel like going to the problem sessions, would they have been as helpful then?

Student D: Oh no they are definitely helpful, but *I just kinda felt like cheated, cause like I wish they would have just told me that they didn't know what they were doing, and then I could've gave it, I could've redid how I thought it could've been done, but they told me it was good*, and then I got it back and it was wrong. I mean that only happened once, but...

Moderator: Was anyone ever frustrated with anything, especially at the leading questions. Some students find those extremely frustrating that they won't give you the answer? No one was upset at getting a leading question?

Student D: I don't think there were many leading questions

Student A: Some of the LA's had leading questions, and I think one or two occasions that I can remember, I got the leading questions, and wasn't getting the.. wasn't catching the bait, and I continuously did not catch the bait, and then they kept asking me leading questions, and that got me into a circle of frustration, but it only happened rarely at best. Umm. So I don't think that I was really frustrated by leading questions on a whole

Moderator: Was working with the LA's different from working in groups in your other courses. Had you formed study groups previously? Was this the first time you had actually engaged in a study group?

Student A: *I think it's not necessarily the first time I've formed a study group, but It was definitely the easiest I was able to form a study group because of the LA's. Because I mean we are all in hard chem*

classes, you don't go up to somebody in a random chem class unless you know them, you don't go to a random group of people and say you know hey let's get together and do work, whereas with the LA system, you came, you started seeing familiar faces, every once and awhile you'd talk to them and be like hey, did you get this problem, can you help me out, or you'd hear them talking, you'd move over, and you'd form those groups. So I think it was easier to form a study group, because it was almost a necessity that you did.

Student F: Especially with a class like 227, whoever you are working with you are most likely going to see in your future classes, so you can always go back and work with them. I know like for me even now, I work with the same group I worked with in 227, so I thought it was extremely helpful.

Moderator: Are you legitimately friends with a lot of the people you met within the study group? Did it increase the number of people you know in your other classes?

Unanimous agreement

Student A: Its nice, even if you don't, I mean , I'm in a class with a couple of kids from 227 in pchem, and it's nice even if you don't do work with them, to see familiar face walking down the aisle and say hey, this kid is suffering with me too. So it's nice to have familiar faces, and to have the opportunity if need be, to be like hey did you get problem two on last week's homework, it's nice cause it helps, like you said, not necessarily intro, this is a gateway chem class for almost every chem class you will take for the rest of your career, so getting familiar faces then is extremely useful.

Moderator: Did the LA's help encourage you to help you work together? I am assuming when you walked in some of you may have come by yourselves in the first couple of days, did that change as time went on

Nodding

Student E: Yeah, they did facilitate group work, like what was said earlier, if someone they had just helped got the problem they would send them off, and like I guess, the very first problem session people were working by themselves, and that's when you really started to see the LAs facilitating group work, they would send you over to someone else who got the thing, and you would be willing to go ask them for help, even before the LA's sometimes, before you asked them directly.

Student D: So I found that even before umm the study sessions, we would meet up, and then after the study sessions we would go to the hub to finish up the homework, so you know, we met our group in the LA sessions and then we would kind of move as a group somewhere if we didn't finish during the actual review session.

Student B: I think overall like the biggest help, they did help facilitate group work a lot, but I think that the biggest thing was having this place and this time, that all the students are getting together and then groups just kind of formed like people would be working by themselves and they would get stuck overhear what the next person was saying, and say hey can you help me with this and then.. So I think that the group study sessions a lot of the groups happened naturally

23:02

Moderator: did you ever feel like students they would solve the answer and they would maybe even force you to be like, when you would ask them how they solved it, and give you the answer. Did the LA's help with that in any way? Did they help prevent that?

Student A: I ran into a couple times when someone would not necessarily explain to help me or wouldn't explain enough to help me get the answer and then I would end up getting the answer but I would still be confused about it, so as a side note I would go up to the LA and ask them like, if I happened to be done early, go up to the LA and just be like hey just out of curiosity how do you really do this problem, like I got the answer but I am not really totally understanding it. And Most of the time I would be they would explain it in a better way than the student who either didn't explain it or didn't explain it to my

understanding. So I think they didn't necessarily help to prevent it from happening but they cleaned up the mess afterwards if there was one.

Moderator: did your professor go through these problems, some of them, examples in class?

Student B: For the first one he did but from then on not as much

Student A: It was rare

Student D: It wasn't really similar, you had to do a lot of work outside of class read the text, things like that

Student H: every now and then I felt like he did a problem in class that was almost very similar to a something on the homework, then you would kind of have a good structure for how to go about the problem with different numbers and stuff, but a good idea of how to do it.

Student A: and he had in class problem sets every once in a while, and either it worked after the homework you had already handed in the week before was a question on the in class problem set or the in class problem set was part of the next weeks homework, something like that, so you would end up seeing similar problems throughout the year, umm so he didn't necessarily going over the exact homework problem like 27 from chapter 6 but he would end up going through a problem very similar to that so that you had a structure and an idea of how to do it so that you had an idea if you saw it again maybe on an exam you would understand the process of how to do it.

Student G: when he did problems in class they were typically like easier ones from the problem set, and then you would have these really long paragraphs just you'd have to figure out what information is important, what you are trying to do, I felt like that's where the LA's came in in the problem sessions, is they were able to help you along if you were not seeing something they could facilitate that and kind of push you in the right direction.

Moderator: I Love the joke, in class professor does $2+2=4$. Now calculate the volume of the sun... I know I've felt that experience definitely. Was this type of group work, the structured problem sessions, do you think that was much more effective, or do you think now that you have gone through this you could go create these dynamics and be just as effective? Or do you think that the LA is pivotal in this learning environment

Student C: I feel like there's a barrier, one of the nice things that people have mentioned is that you know faces and you know people so it's easier to form small study groups with people you have already have classes with but at the same time if you are in a different kind of class, like I'm taking bio 110 this semester, no chem or forensics major is going to be taking that right now, so it's very hard to set up a group study session in that kind of class, so something like the problem sets in 227 would be helpful in at least jumpstarting that formation of study groups. So I feel yes it is useful, especially for early level classes when you don't know a lot of people and you are not gonna walk up to random people and say let's study together. I feel like having a set time and a set place where people all get together and do the work, even if they are not all working together, just sort of encourages you to work together more.

Student G: also having that set time and place, it kind of, you can see whose wanting to do well in that class, who is actually striving, and not just you walk up to somebody you don't know how they are gonna be, whether they are gonna be actually helpful or their just gonna sit there and try and mooch answers off you the entire time. If they are going to that homework sessions you see they have the want to do better in the class, so you can see who is going to be helpful in future classes.

Moderator: did anyone ever stop going to the problem sessions?

Student D: I went two times a week for the entire semester

Agreement

Student A: That's not true, towards the end of the semester I stopped going twice a week, I went down to once a week, because the problem sets got shorter so we were able to finish it in one sessions, but yeah no I think we all kinda went twice a week every week.

Moderator: Do you think that having the LA's helped you learn the material better, how did having the LAs help you learn the material better, was there anything else that was going on that changed how you would normally study.

28:35

Student B: I think having LA's instead of a TA or professor helped just because you know they are undergraduates they took the course maybe a year ago, they don't have all the answers they don't know how to do everything, so when they don't know but can give you hints, it forces you to look at the problem more, break it down piece by piece, understand conceptually what's going on or like mathematically what you need to do, so I think that helped a lot because like they couldn't always get you directly to the answer so you would have to you know use a lot of different strategies in order to get there.

Student D: Sometimes I had a hard time trusting them, because if there was a question that they didn't know how to do, they would all huddle up, and they would have a problem trying to figure it out, so if Dr. Sykes was there I would've just went to him, and I even felt more comfortable going to him, just because I felt like I was getting more out of it, whereas the answers from the LAs might have been wrong, like I said that experience before.

Moderator: how early on did that happen?

Student D: maybe about halfway through

Student A: I have to say that the way I treat granted its 200 level vs. 400 level the way I treat analytical homework vs. the way I currently treat pchem homework, I google pchem homework, try to, because its kinda hard to find pchem stuff online, or I use the solution guide and I just copy right out of it cause I don't understand it, whereas analytical chem, it either wasn't online or I wouldn't even try googling because I had an opportunity to learn how to do it, rather than just find the answer online and copy it down. Whereas with the higher level chem classes that I've noticed, you don't have the opportunity to learn it, because if you go to your office hours for your professor, chances are they don't speak English, or they are not willing to help you, or don't even have office hours, can meet with you for 10 minutes on a Friday afternoon at 5 o'clock. So I think having the opportunity to actually learn the material helped me to do well in the class because they exams you aren't gonna be able to have the internet next to you, you are going to have to do it yourself. So I think it helped me look at the homework and the exams in a better light than a regular class without LAs

Student C: in addition going to the review sessions with the LA's say rather than using a solution guide, you could actually say well I don't understand this step, how did that step work and they could explain it to you, or if they weren't sure they could, I remember more than one occasion where they would call Dr. Sykes because they weren't sure how to do a problem. And that just kinda goes back to, they should've had more materials to prepare for the problem set before it happened. But I definitely think that by having the personal talk with someone and just saying hey I don't understand this specific thing, rather than googling or looking for a problem set and actually they can show you how to think about the problem, even if you got a problem that was different from that on the exam or on another problem set, you understood the process of thinking about it, so you were able to reason your way through it more.

Student D: I think at the beginning the LA's, I don't want to say took it more seriously, but kind of like something like that, and they would do the actual problem sets for the first couple of weeks, and I don't think it was their responsibility to actually physically do the problem sets but I think that beforehand they should have looked it over and said I know how to do this, this and this problem. And towards the end of the semester that really didn't happen and I think Dr. Sykes was supplying them with answer keys towards

the end and then they would just come with the answer keys and try to figure it out when they got there, and if they couldn't figure it out, there was an LA that would just say here it is, this is how you do it, and then she would pretty much just you know show you the key.

Student A: I have to agree with that because I don't expect them to do our homework, but at the very least I would've thought it would've been a little bit more helpful if they had gone through, you know the answer key that Dr. Sykes happened to give them when he gave it to them and say hey what did you write here what does this say so that they at least, if they don't remember how to do the problem, or even if they do remember how to do the problem from when they took it, at least they know what he's looking for and what he said, because there was often times when they said well I can't understand what he's writing, or he didn't write the answer, or I don't get what this process is. So if they had asked him when they saw it and went through it, it would've helped a little bit more.

Student C: I would agree with that too, I mean even if they met for fifteen minutes before we got to the problem set and just said alright everyone this is how we do number one so if they have questions this is how to do it, they could even work together as a group of LAs and go over how to do the problems, just so that they assured themselves that they knew how to do every single problem on the problem set, because there were times when they didn't know the answer or they gave you the wrong answer or they had to go in a huddle for fifteen minutes. So even just preparing beforehand I think would be an issue, and if it were more structured I feel like it would be easier than just saying that as an LA you have to do the problem sets sometime this week by yourself, cause that kinda puts a lot of pressure on them, rather than like them and Dr. Sykes getting together and going over for half an hour how to do the problems.

Moderator: So one thing I'm taking away from this, it sounds like the relationship between the LA's and professor needs to be stronger, they need to spend more time interacting together?

Student C: Or just more organized

Student A: yeah cause I think they had a good relationship with the professor, I think all I mean the entire class I think for the most part had a good relationship with the professor, ummm, TAs not so much. I think the LAs needed a little bit better preparation whether that be their responsibility or the professors responsibility, I'm not gonna touch that, but I think that a little bit more preparation would have been helpful.

Student F: I mean, I feel like a weekly meeting before the problem sets, or even like you said just a quick meeting beforehand would be very beneficial, cause even if the LAs don't understand anything that's like their opportunity to ask the professor questions, cause after all they aren't experts yet, they are almost the same age as we are so.. I think that would be beneficial

Moderator: Did you feel like the problem sessions gave you opportunities to ask questions that you wouldn't be able to understand from email?

No's

Student D: No, I feel like they would have been pretty generic questions, you wouldn't have been able to ask a complex question by email

Student A: it was more math and you can't really email math. I definitely think because every once in a while because it wasn't every day that Dr. Sykes said something that I was beyond confused about in class, there were times, and those times when the homework help sessions came, it was not a question it had nothing to do with an exam or anything like that it was just something he mentioned in class and every once in a while I would ask the LAs so it did open up the opportunity to ask questions not specifically related to the homework that you were just a little bit confused on and you didn't want to go talk to him and waste his time on a simple questions, so I definitely think it facilitated question asking in that aspect.

Student G: I think it also helped cause the professor has a certain amount of office hours and when he's not around you have those LAs who are in your other classes and you can run into them if you have a question, it's a more immediate response, you don't have to wait for office hours, whenever they would be and just having that immediate response, you can move on and you don't have to remember that, a few days down the road what you were gonna ask

Moderator: Would not getting an answer to that question stall your learning

Student G: Definitely

Student E: It would have at the very least slowed you down significantly when you are trying to understand something, especially if it's a conceptual question and you just aren't seeing it, and you have to sit there and read the book and look online it's going to take you much longer to uh grasp whatever you aren't grasping

Moderator: Is there anything the LAs did that impeded your learning?

Student H: I don't think so

Student D: I think sending people to other groups ended up, it had its pros and cons, sometimes I felt like I learned less because some of us went to other groups, and sometimes we learned more because they would walk us through stuff. I think it was really uh catch 22 situation

Moderator: Did working with other students help to expose misconceptions you had, did you think that helped solidify your understanding in a different manner

Student A: the way I like to study and the way I have found really effective, is almost teaching other people, I like that part of it, because I would have specific questions because by the time the homework help sessions were I had pretty much gone through most of the questions and figured out what I could do and what I couldn't do, so I would go with specific questions but if I was pretty confident about how I did a problem and another group or another person was saying I have no idea how to do this, I would kind of talk myself as well as them through it, so I think because of that or having the LAs send someone to me or my group, I think it helped me learn, to teach the problems.

Moderator: you don't really know something until you can teach it, does everyone agree with that, does that seem true... Another thing that came up a couple of times, did knowledge of the subject matter, does that lead to credibility, cause you mentioned what they told you was wrong, or they would take 15 minutes to deliberate. Did seeing that happen reduce their credibility?

Student C: It reduced their influence on me, yes

Student D: Absolutely, yeah that's why I said if they were doing that I was like alright I'm done with the LAs right now I'm going to talk to the LAs or a TA or something like that, personally I would say that if one of the TAs or Dr. Sykes, were to run those problem sessions, then I would say ask the LAs, that's just how I feel, because I would feel much more comfortable going up to him, because I know that Dr. Sykes isn't going to just give me the answer, simply say oh here copy this off my answer sheet, he'll actually walk me through it, the same with the TA's, maybe that would help me learn more. But obviously a professor isn't going to stay until 10 o'clock at night... so...

Student B: In their defense I think it's important to remember that it's not their job to know the answers, I think that sometimes, I think that needed to be said more, and I think the only detrimental thing was when they thought they knew how to do something, and they would teach it and their like oh, not really. So I think the thing that made them lose their credibility to me anyway, was when they thought they knew how to do something, or they pretended to know how to do something that they didn't, not so much that they didn't know how to do it.

Student D: And that's the only reason why I said axe the program, at least for last semester, but if I had thought that all of them were credible, just like you know, you know that dr. Sykes and the tas are credible then I say you know fine, but it was the huddling, and the I don't know how to do this, and the calling dr Sykes in the hallway, and it was just a combination of all that, where they you know as the semester progressed they continued to lose credibility.

Student A: I think the most important thing for any person in a position of power or knowledge like they were for us or to us is the ability to say I don't know and I feel like to some extent some of the Las not saying this is a general rule of all of them or all the time but I think sometimes they were not able to say that. And I think they lost credibility because of that but if they had said no I really don't know then I would have not lost credibility for them.

Student D: it's like a pride thing

Student A: Yeah, because they didn't have the ability to say I have no idea how to do this problem they just kinda tried to struggle their way through it and every once in a while they might have led us to the wrong answer, but if they had been able to say you know I don't know, we could have worked us and the LAs or the entire group whatever it was could have worked our way through it, tried to, but I think they lost credibility because they didn't admit they couldn't do it.

Student C: I remember a specific instance during an in class problem set when I was asking an la and I was saying something was a cation and something was an anion, and she was explaining it to me, and she mixed up the two names I had to correct her and she was like oh yeah ok you're right, and then things like that, it's just little mistakes like that I feel with preparation they could have avoided, kind of made them lose credibility for me, just making small mistakes like that or things where I had to correct them, and you know that moment where you are correcting the la, it wasn't that I lost faith in the LA program, I lost faith in that specific LA, and I didn't come to them with any more questions but there were other LA's that I could go to, so I don't feel like I lost respect for the program, I just lost respect for specific LA's based on how they interacted with students or how they answered problems. And another thing was that I feel like out of all the exam review sessions it was very unstructured and they had difficulty controlling the class and mediating the review session and the way that they didn't have command of the classroom or didn't control the classroom made me lose credibility for them too, that's just a small thing that I think they could have done better.

Student A: So going to all of the homework help sessions, and then cause I went to the review session for I think the second or third exam only was the first and only one, and so going to all of the homework help session previous to that and then going to the exam review session it was like it was two totally different groups of people leading it and it was just it was like mind blowing because the homework help sessions were so helpful and then the exam review sessions were so unhelpful it was like they were led by two totally different groups, and that really threw me through a loop.

Student D: Right and I think that's because the homework sessions weren't really supposed to be organized you know it's a bunch of people at a bunch of different tables and they'd come around and say how you guys doing over here and I think that's how the actual exam review sessions should be but during the exam review sessions they tried to lecture and put stuff on the projector and write on the board and I think you know that's where the, where people aren't thinking it was as organized because it was supposed to be organized. I guess they weren't very efficient at doing that

44:15

Moderator: So the lecture, that's not what you are going there for...

Student A: Not that it was their fault because I'm don't know who decides how the exam review goes, but seeing how what worked in the homework review sessions, and seeing cause I mean we had plenty of homework review sessions before the first exam review. Seeing that that worked, the people that were there

it helped people learn, seeing that, I feel like it should have helped them structure so to speak how to work the exam review sessions. So if they see that the way they did the homework help session worked, do it for the exam review, don't switch it for the exam review.

Student C: I feel like they were trying to something very different and whether that would be good or bad I mean I guess they could have kind of figured it out after the first exam review session that wasn't as organized as we'd have wanted and they could have tried to change things, I think they were trying to compromise between leading us going through an exam and having the small group stuff like the problem sets. I feel like they should have done one or the other either give out the exam beforehand and have people work through them and work in small groups like in the problem set homework review sessions or have one or two LAs not four of them arguing with each other in front of the classroom, one or two LA's going through this is how we do the exam anybody have questions, spend five minutes answering small questions and then move on. It was either they need a lot more organization or a lot less. What they were doing it was just not working.

Student E: they should stick to what they know works, is the main thing. I mean if they were good at lecturing and they had a system that worked it would be find, again they are not, they don't have that kind of experience, so they should've seen how what worked and what didn't and went with what worked

Student D: I just thought it was really shocking that it got to the point where you know it stayed like that for three review session, you think you'd learn after the first and then definitely after the second, but it just kept happening over and over and you know they are not stupid, they knew what was happening, they knew you know, well we only got halfway through the exam. I guess so they wouldn't post it on angel afterwards because they didn't want the people who didn't show up to have access to it I guess is what happened, so I don't know I felt like that was kind of cheap too you know, maybe I had class, but I still want to practice the exam, so I don't know

Student B: I think having it beforehand would have helped a lot

Moderator: I know some or most of you are headed to a review session after this, what are some things that they are doing in there that makes it successful compared to what you are describing.

Student E: Well I don't think that, well at least I didn't see anyone from 227 go to a homework review session and never show up again, it wasn't that bad, but for uhhh the review session in 310, its mostly the same, I mean you sit down you work on problems and they walk around, they ask if you need help, they you know, it's pretty much the same. I would say there's a little bit more leading questions leading questions but I don't find that negative so...

Student D: I definitely feel like the LAs in this review session for chem 310 I feel like the LAs in that class might be a little more skilled or experienced than the LAs in 227 and it's a hard subject so it's interesting

Moderator: Last question, what do you think the role of the la should be? What is their purpose?

Student B: I would say to facilitate group work and teach you how to approach problems, basically teach you how to teach yourself

Student F: I would definitely say facilitating group work for sure and also I think it's important for them to stress that they are not experts I know we said this a few times, but that was like a big thing for me

Student A: I think, some exceptions obviously, I think exactly what they did, I think a little more effectively and more efficiently, I think leading group discussions, facilitating group discussions, leading questions maybe they could have done a little bit more of the leading questions, but I definitely think on the whole what they tried to do was teach us how to teach ourselves. And I don't expect an La or a ta or a professor to just tell me the answer because I am not paying for that, I'm paying to learn and in the end that's what I want to do because if I were just looking for the answer I could just Google it so I think what

they did was try to help us learn how to teach ourselves, and I think that's exactly what an la or a ta or a professor should do.

Student G: I feel like they're there to facilitate the material to the best of their abilities, like Student F said they aren't experts on the topics, so its whatever they can help us with they can, and it's their responsibility to say I can't help you with this you need to go see either this in the textbook or you need to go see the professor because it will make them lose their credibility. But they are there just as another resource, another opportunity to help you understand.

Student D: I mean I think there was a boundary issue, so for instance, so I think the difference between a TA and an LA is the fact that the TA is actually supposed to teach you, to teach you and show you methodology and show you things on how to do this, whereas the LA should really help you, help you progress through, help you to learn I guess instead of teaching you, they are not really experts, like someone else said earlier, so they really shouldn't be implementing new ideas or trying to mold you with new concepts, and sometimes that was happening and I think that boundary needs to be more defined.

Student C: Yeah I agree kind of with the boundary point, I think that what distinguishes the LAs from something like the TA was that there was a lot more 1 on 1 discussion because there are more of them and because you kind of had a rapport with them after week after week of talking to them and having them being kind of closer to your age rather than like a grad student. So I feel like the 1 on 1 contact and the 1 on 1 help was really helpful and also the fact the review sessions were structured such that they were facilitating the group work was also really helpful, so I feel their purpose was just to give you that 1 on 1 help or direct you to that 1 on 1 help, whereas something that like a ta or professor couldn't do with a class that's as big as 227

Student H: yeah I think, LAs should just be there to like help facilitate group work and then I guess be able to like explain to you like not just give you the answer but like try to explain more or less what you should be doing, and if they don't know then to point you to something that can help explain how you do something.

Student E: I think the key word here is help so they should be trying to help you with assist you with any of your questions on the homework um, they shouldn't be trying to teach because they don't have the experience and that can sometimes backfire, and cause problems, and they shouldn't just give you the answers either, because that's not what they are there for either, you need to learn, you are taking the class because you need to learn the material.

Moderator: Is there any final comments or anything you didn't get to say that you want to say now

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- Research Advisor: Prof. Scott Phillips
- Synthesized small organic molecules for use in microfluidic devices
- Utilized advanced laboratory techniques: Schlenk technique, column chromatography
- Trained in using NMR, HPLC/MS, Preparative HPLC, Glove Box, Chromatotron

Research Mentor, Penn State University

Summer Experience at the Eberly College of Science

- Designed and implemented a research project and lesson plan
- Instructed high- school students on the scientific background of their research project
- Mentored students from low- income backgrounds through the experimental process
- Monitored progress and understanding through laboratory notebook assignments

Learning Assistant, Penn State University

Chemistry 227 (Analytical Chemistry)

- Facilitated group- based learning in study sessions
- Supervised laboratory experiments to ensure proper technique and safety

Chemistry Tutor, Penn State University

- Tutor students in general and organic chemistry lecture and lab courses