

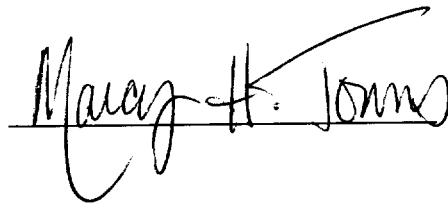
Benefits of Small-Group Learning Activities
A Qualitative Study

An Honors Thesis (HONRS 499)

by

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A handwritten signature in black ink that reads "Marcy H. Towns". The signature is written in a cursive style with a horizontal line drawn through the middle of the text.

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Purpose of Thesis

This thesis is a presentation of research results from a research project that I was involved in through the Chemistry department and the Honors College. The purpose of the research was to build an understanding of the student perspective of small-group learning activities in an undergraduate chemistry course. Students participated in these activities throughout the course. Student surveys and student interviews were conducted to collect data and a qualitative research methodology to analyze the responses. The analysis of the data yielded four findings. The first was that students developed supportive and cooperative relationships with their peers which enabled them gain a better understanding of the course material. Secondly, students were able to implement and practice important life-long skills such as communication, teamwork and problem solving skills. Thirdly, students were given tools to help them to succeed in the course. Finally, the students discussed a few weaknesses including the length of time spent on the activities and how to deal with students who did not participate positively in the group work. These results added to the knowledge base of the benefits of small-group learning activities.

Introduction

The purpose of this study was to build an understanding of the student perspective of small-group learning activities in an undergraduate chemistry course. The course was designed to incorporate group learning activities as often as possible, with a one hour class period per week being entirely devoted to them. The student perspective was investigated through open-ended surveys and student interviews. The analysis of the data generated a perspective which is typically overlooked. Students believed that the small-group activities gave them a chance to get to know their peers, which led to more open relationships and a greater understanding of the material. The students also stated that the small group learning activities gave them an opportunity to pull together their experiences from lecture and make sense of them. Finally, students felt that the small-group activities gave them a better understanding of skills which will be needed in future classes and in their work environment. These skills include communication, problem solving skills and knowledge about how groups function.

We also discovered some weaknesses of group work. The students felt that they did not have enough time to complete the problems given. They also felt that the small group activities should be longer to allow more time for group interaction. Finally, there was some concern with the effect of non-performers on the groups. Students who were consistently absent, came to class unprepared or did not participate in the activities were termed non-performers. Some students in the course believed that the non-performers were a hindrance to their group and wanted the professor to confront them. Addressing these weaknesses allowed us to refine the small group activities so that they better fit the needs of the course and the students. Each of our findings provided information from the perspective of the students in the course which will serve to enlighten researchers and educators in the future.

Background

Educators have been encouraged to integrate small group learning into their classrooms (1). It has been heralded as a replacement for the competition typically found in science classrooms. This competition can inhibit learning, especially for students without high confidence in their abilities (2). Small-group learning and cooperative learning encourages students to work together to gain a greater understanding about the material being taught. This can also help the students to be a larger participant in their own education because they are encouraged to build understanding on their own. Cooperative learning creates an active, student-centered classroom environment (3).

Cooperative learning has been used in a large variety of science classrooms. Chemistry specifically has used cooperative learning in general chemistry (4-7), organic chemistry (8,9), analytical chemistry (10) and physical chemistry (11). Both labs and lectures have been testing grounds for new types of cooperative learning activities. Group problem solving creates a learning environment that has excitement and energy (12). This type of classroom leads to greater interest in the subject and a more positive learning experience. Also, small-group activities create a warmer classroom climate which can lessen the anxiety levels of the students. (3,13) Previous research has described the differences between cooperative and competitive classrooms and the benefits of small-group activities. Our research is different from previous research in that we are using qualitative methods which will directly incorporate the student's comments and feelings on their experience with small-group learning.

Our research also questions some of the struggles of small-group learning activities. One of our most important questions was how to deal with non-performers. We defined non-performers as those students who were consistently absent, not prepared or did not listen or contribute to the group

discussion. Several different methods of evaluating students in small-group learning activities have been implemented. Some researchers suggest setting group expectations (12), while others give group members the opportunity to evaluate each other (2). Some educators do not feel that any of the final student evaluation should come from the group work (14). Others feel that the final grade should have a component, such as a group exam or group homework set, which arises from the cooperative learning activities. (12).

During the small-group activities used in this research, the students were able to assess their groupmates. That assessment was used to determine a portion of the individuals' overall grade in the course. We wanted to explore this type of evaluation to see if the students felt that this was an effective way to deal with their less-involved peers. We also wanted a better understanding of how the non-performers affect other members of their groups.

Using previous research for a base, we were able to build upon our knowledge of the benefits of small-group learning activities and effectively evaluate their use in this course.

Methods and Procedure

In order to gather the information we desired for our research, we found it necessary to implement a methodology known as action research. Action research, as applied to our situation, provided us with a process to link the practice of small-group learning and the analysis of that practice. We were able to use a continuum of planning, implementing, observing and reflecting to continually assess the impact of the small-group learning environment and revise the activities accordingly. Our data was collected and analyzed qualitatively which enabled us to better incorporate the actual student comments and feelings into our results. Surveys and interviews served as our method of data collection. The goal during our research was to better understand what was happening in the classroom in regard to the small-group learning activities and to use that knowledge to refine the teaching procedure. The results of our research were then shared with other education professionals through publication and presentations.

Our study focused on the first semester Physical Chemistry course at Ball State University. This course, which is designed for chemistry majors, covers topics such as thermodynamics and chemical equilibrium. The time students were in class was divided into three 50 minute lectures, one 50 minute problem solving session (PSS), and one 3 hour laboratory period per week. The PSS was entirely devoted to small-group learning activities and, later in the semester, 2-3 short small-group activities were incorporated into each lecture session. The class was divided into groups of 4-6 students. These groups were changed once during the semester at the request of the students.

The class was composed of 24 undergraduate students, 8 women and 16 men. Four of the students were chemical education majors and the rest were science majors.

PSS work ranged from textbook problems to real life scenarios. Some problems required

little group discussion while others revolved almost entirely around group collaboration. Samples of these problems are included in Appendix III.

The course was graded on a straight percentage scale. A portion of the grade was derived from student ratings of each person in their group during PSS.

Collection of data for this study was from student responses to a questionnaire and an interview. Samples of these questions are in Appendices I and II respectively. The questionnaire included several open-ended questions and was given to each student at the end of the semester. The one-on-one interviews were with 4 randomly chosen members of the course after participation in the small-group learning activities. By using these methods of data collection we were able to directly hear the students' reflections on their experience with the activities. These statements were then analyzed.

We analyzed the data by reading the surveys one question at a time and looking for common thoughts. These thoughts were marked by letter codes which represented the common themes. The codes were then grouped into broader categories and from those categories we were able to develop our findings from this research. The findings were refined by the information gained from the interviews and from our experiences with previous research. During the entire data analyzation process we, as researchers, maintained strong communication with each other. This enabled the findings to have more credibility since every result was checked and discussed together. By doing this we were able to better ensure that our results were true to what the students said in their remarks and not simply our feelings on past experiences.

Results

The discovery of common themes, both positive and negative, was vital to our research. This helped the cycle of planning, implementing, observing and reflecting to continue throughout the following semesters of the course. Upon the analysis of the surveys and interviews, four overall findings became apparent. These findings are summarized first and a more in depth discussion of them follows.

The first apparent theme was that supportive and cooperative relationships were developed between the students due to their interaction and communication. This more open relationship led to a better understanding of the material. As the students spent time working closely with each other, they were able to become better acquainted. This led to a more comfortable and trusting classroom environment which in turn gave the students more opportunity to learn the material from each other. The students were able to see different perspectives of the material from each other and to receive or give help on the problem areas. Some groups also became engaged in more in depth discussions of the material which provided them with learning beyond that of the lecture.

The second theme was that students received important tools for success in the course. The PSS sessions provided sample problems and practice for what might be seen on the exams and served to link concepts from lecture to real-life scenarios. The sessions also made time for study in the busy schedules of the students.

The third theme was that important life-long skills were developed and put in to practice. Students learned problem solving skills and how to better communicate with others. They also learned about working with a group towards a common goal. The students will be able to transfer these skills as they move into employment or graduate school.

The fourth theme of our research was a combination of two weaknesses. The first being that students wanted the PSS time to be spent more efficiently and the second being that students struggled to effectively work around the members of the group who were not participating positively in the group work.

Better Understanding Due to More Open Relationships

The small group learning activities provided students with the opportunity to interact with each other on a more informal level. As students became acquainted with each other, they were able to trust and support their classmates. As a result of this developing trust and support, the classroom environment became more open and it was easier for students to communicate with each other. Josh commented that he was “able to get to know classmates...[and] felt more relaxed with the class.” It was important that the students became comfortable in the classroom because then they were able to share their ideas and thought processes with each other without being intimidated. Kevin said that “...[PSS] made talking to people easier” and Chris said that the students “got to know [their] friends better.” As the semester moved on, the students became more open with their discussion and help during the PSS. Shawn commented that “[PSS] helps open channels of communication that would normally not be there for students.” After the open communication was made possible, the students began to benefit from their interactions with each other. Erik summarized this by stating “Our group had a good rapport. We all provided input, were friendly, [and] helped each other learn.” Resulting from these developing relationships was a better understanding of the material which was presented. Many students felt that there was a direct relationship between the open communication channels and the greater understanding of the course. As Chris said the students were able to “learn by sharing.”

Students felt that several aspects of their communication contributed to their better understanding of the information in the course. The first was that they were able to learn the material from several different perspectives. Todd said that “[PSS] let me see how other people worked and reasoned through the problems.” Being able to see how someone else learned gave some students the tools to better understand the material. Josh thought that because of the PSS he was “able to get...different...outlooks on solving problems.” This was especially helpful if the students did not understand the problems the first time they were explained in lecture. The second aspect of the students’ communication was being able to receive and provide help on the problems. Andy felt that PSS was an opportunity for “...group interaction which allowed fellow students to explain subjects or topics which may have been problematic...” Teaching the material to their fellow group members also helped students reinforce their own knowledge. Matt felt that “helping others to understand and gaining their insight was particularly beneficial.”

The third aspect of the students’ communication was that the PSS provided a forum for discussion of the lecture material. The groups were able to compare and contrast their thoughts on the problems and from that added discussion were able to reinforce their understanding. Theo told us that “[PSS] was helpful because my group would talk about the theory behind the problems.” This type of in-depth discussion was made possible through the small group activities. Due to the more open relationships which were formed through the small group activities, the students were able to better interact with each other. This interaction, whether it was helping teach the material or just offering a different perspective, gave the students the opportunity to improve upon their understanding of the concepts taught in the course. Steven wrote, “I understood a lot better, I believe, because if I got stuck on a problem I had 5 others to help me out.” This type of rapport

between classmates greatly benefitted them throughout the course.

Tools for Succeeding in the Course

The PSS sessions gave students some very important tools for success in the course. Sam comments, “[PSS] gave me an idea of what to focus on [and] what to expect on quizzes and tests.” The small group sessions were beneficial to the students since they provided a different channel through which information was given out. Robyn said that “[PSS]...also helped me put together some concepts that I didn’t understand.” Matt thought that “PSS supplemented the homework and really drove home the key concepts.” These extra sessions of problem solving and discussion also helped provide built-in study time for the students. Marissa felt that “The problems given in PSS were helpful because we were allotted time in our busy schedules to complete them.” Finally, students felt that PSS brought up scenarios that related their learning to real-life. They felt that this type of relating made the course work more relevant. Erik said, “The use of real life examples to understand applications of Pchem concepts is helpful.” Whether it was through the extra practice problems handed out during the sessions, a planned study hour once a week or real-life applications of the material, the PSS sessions helped the students on their way to a successful completion of the course.

Life-Long Skills

The small group activities provided an opportunity for students to learn skills that they will be able to use for the rest of their lives. These skills include problem solving, communication and group interaction. As the semester progressed, these skills developed in the students because they were able

to practice them several times each class period. Kevin liked "...being able to refine problem working with criticism of group members..." As the students worked together to find solutions to the problem sets, they were refining their problems solving skills in general. Since the groups had to work together towards a common goal, they learned about how groups function positively and negatively. Robyn said that "PSS helped me learn more about how groups work together." This information was not only useful to the students while they were in Physical Chemistry but for any other situation in which they need to be involved in group work. Chris liked that he "got to see how others react to a group setting." The students were also able to refine their communication skills because they needed to express their ideas clearly in order to be understood by their group. Similarly the students were constantly presenting their ideas and thoughts to their groups. This type of presentation and justification of their solutions provided the students with practice of communication skills used every day. It was stated by participants in the American Chemical Society Committee on Professional Training Industrial Round Table that when looking at new hires, industry desires strong communication skills as well as the ability to work as a team in addition to technical strength (15). The students were given the opportunity to develop these desired skills through the small group activities.

Weaknesses; Time and Non-performers

The final theme that came forth was a combination of weaknesses in the small group learning activities. The first part was that students did not feel that there was enough time spent in the problem solving sessions. Some felt that the assignments were too extensive for the 50 minute time period. Others wanted to spend more time working with the group since it was so beneficial. Missy said,

“Sometimes it was very difficult to get enough accomplished. It seemed that just as we got going we had to stop.” Having to stay within the time constraints of the course makes it difficult to increase the time in PSS but other modifications can be made to help alleviate the problem of not enough time.

The second part of the weaknesses was that students did not appreciate having to deal with non-performers in the course. Non-performers include students who are absent, not prepared or simply do not participate in the group activities. Robyn wrote, “Some people were not as into PSS as others. It made it hard to work with a group if some members didn’t want to be here.” Joe also wrote that “The sessions can get slowed down if someone doesn’t come prepared.” Trying to cope with non-performers was a common issue in group sessions. When asked about how to deal with students who do not participate positively, some responded that it was the responsibility of the group to address the problem. Other students felt that it was the responsibility of the professor to recognize the situation and confront the non-performer. While talking about how she dealt with a student who was not contributing to the group, Tami commented, “I felt like it was more his loss that it was ours.” Other students also felt if a student was consistently absent from the PSS’s it was only hurting that student and not the group. Carrie, however, brought up the point in reference to non-performers, “...it is a loss for everyone else if they can’t give their point of view.”

Since the PSS’s revolved entirely around group work, it was very important that the students be able to receive the proper assessment from their work. Only a portion of their final grade came from the group sessions and these points consisted of peer evaluations. Each student gave their group members a numerical score based on their participation and also had the opportunity to make comments about the other members. These evaluations were confidential and only seen by the professor of the course. The numerical scores for each person were averaged and the comments were

taken into account in the final score. This type of scoring helped to alleviate some of the difficulties with non-performers because it gave the students a chance to provide feedback on their group. Tami liked this type of grading because "...it's private so you can write the things down that you couldn't say in front of everybody else..." Since the final score for the student was originated through an average of scores, it helped to avoid the problem of a low score due to personal issues between students. As Chris stated, "...one person may not score you well but taking the average of everybody's scores is probably going to be a fairly good representation of how well you are performing."

The issues of assessment and dealing with non-performers is something that will continued to be observed and investigated in the coming semesters of the course.

Implications

An integral feature of this research is the direct impact it has on planning activities in future courses. The results presented above are from the fourth group of students to participate in these small-group activities. As time passes, we are able to use results from previous semesters to refine our use of the small-group learning activities in the following semesters. This moves our research cycle forward and also benefits future chemistry students.

This set of results was used to support the belief of the benefits of small-group learning. The results also provided suggestions for changes or refinement of the current small-group activities.

Many students felt that the PSS's should be longer or that too much information was pushed into too short a time period. Since the class length can not be changed, it is important that the assignments be adjusted to fit the time provided. It is believed that shortening the assignments might take away some of the benefits of the sessions so we must begin to look at other options for using the time more efficiently. Student suggestions such as providing an answer key for the problems after the class will be explored and possibly implemented in the course. It is also important to understand that there can not be unlimited time spent on the small-group learning activities. Formal lecture and lab must remain a part of the course for the activities to be effective. This balance between too much time spent on small-group activities and too little time spent on them is very delicate and can be adjusted throughout the semester accordingly.

Effectively dealing with non-performers in the course is a subject that we explored in the one-on-one interviews. Through student comments, it became apparent that they felt that each individual should be ultimately responsible for their performance in the course. They felt that as group members, they could try to encourage non-performers and support the work they did but did not want

to be responsible for pulling a person along throughout the course. Krista suggested trying to encourage the non-performer by "...asking them direct questions so that they can't just sit on the side and hide out." Chris also suggested to "...help them and try to build them up and then they [can] become an active part of the group..." As the students became better acquainted with each other it made it easier for them to confront their peers who were not participating positively in the group. Many students still felt that the professor should recognize the non-performer and help to deal with him. According to the student comments the assessment used in the course was appropriate for dealing with students who were not participating positively. Since the assessment was private the students could inform the professor of the problem without having to voice their opinion in front of the entire group. Ultimately, the students believed that the non-performer was the only one in the group being affected. That student was missing out on important material for the course and not the rest of the group. Because of this many students feel that the assessment and confrontation of non-performers should be the responsibility of the professor.

The results, as presented, will serve to broaden our understanding of the use of small-group learning activities in Physical Chemistry.

Appendix I

First Semester PSS/Course Survey/Fall 1997

1. As you look back over the semester, what are your perceptions of the course?
2. What were the strengths of the PSS's? How were they helpful to you?
3. Describe the weaknesses of PSS.
4. What suggestions do you have for improving the PSS's?
5. Describe your perception of group work prior to your involvement in PSS. Describe how your perception of group work has changed after being involved in PSS.
6. Describe the most significant and the least significant learning experiences for you in the course.
7. What advice would you give to students taking 344 or 340 next fall?
8. Please write any other comments that you have about the course.

Appendix II

Interview Protocol

1. Get permission to interview student.
2. Dr. Towns and I have been doing research on cooperative learning, or small-group activities for about 2 years. One of the things that we have noticed that students write about when asked about the strengths of PSS or small-group activities are different perspectives they get on solving problems.
 - A. Do you think that different perspectives on solving problems are helpful? Can you give me an example?
 - B. Is/was interacting with others helpful to you? Can you give me an example?
 - C. How did/does it help you learn? Can you give me an example?
3. We have noticed that when students write about the weaknesses of small-group activities they mention people who are absent, don't contribute, don't listen, are not prepared, get off task, or who don't ask for help. We have termed these people non-performers.
 - A. How should non-performers be addressed?
 - B. Have you ever had to address a person who was not meeting the expectations of the group, or your expectations? What did you do? How would you change what you did?
 - C. How should small-group activities be set-up or graded so that non-performers get the appropriate amount of credit for their efforts (or lack there of)?
4. What is the most significant aspect of PSS or small-group activities to you? Why?
5. What is the least significant aspect of PSS or small-group activities to you and why?
6. Do you have anything else that you want to add?

Appendix III

Sample PSS questions

1. Yesterday we discussed how in carbon, the 2s and 2p orbitals can be hybridized. Imagine that you have the wavefunctions which represent two of four sp^3 orbitals (like h_1 and h_2 on page 468 in your book) (16). How would you go about showing that these two orbitals are orthogonal?
2. From lecture: Can water with an electron in an a_1 orbital make a transition to a b_1 orbital via an electric dipole transition?
3. Compare and contrast the Arrhenius equation and Transition state theory (17).
4. Using BF_3 , find the number of normal modes. Are the following modes IR active?
(a) Simultaneous stretching of each bond? (b) Each atom moves perpendicular to the molecular plane, with B moving in the opposite direction as all three F's.

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