

EFFECTS OF STRUCTURED COOPERATIVE LEARNING GROUPS IN A HIGH
SCHOOL PHYSICS CLASSROOM

by

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ABSTRACT

In this investigation, cooperative learning groups were implemented with the purpose of improving students' attitudes and academic competencies. Participants will include high school students enrolled in conceptual physics classes. Treatment involved requiring students to work in purposefully structured groups over the course of several weeks. Test scores between this year's students and last year's students, as well as test scores of this year's students during treatment and non-treatment were compared to determine any change in academic competencies. Additionally, students completed exit tickets, interviews, and attitude surveys. The instructor and a peer made observations, and together with students' information, data was analyzed to establish any change in amount of time students spend on-task during class, as well as in their attitudes about the course content and classroom environment.

INTRODUCTION AND BACKGROUND

Project Background

Teaching Experience and School/Classroom Environment

I am in my eighth year of teaching, and this is my third year at D.C. Everest Senior High School. Located in Weston, Wisconsin, our school is made up of students in grades 10 through 12. The district is comprised of 5,690 students, with most recent data (2011-12 school year) showing a 93.3% graduation rate. Students at all levels consistently perform above state standards in all subject areas, as measured by the state mandated WKCE test. Additionally, students participate in academic and athletic extracurricular activities at a higher rate than students who attend other schools in our conference.

D.C. Everest High School is comprised of 10th, 11th, and 12th grades and the current enrollment is about 1,436 students. According to the Wisconsin Department of Instruction's data analysis, the student body is made up of approximately 82.9% white students, 12.5% Asian students, 1.9% Hispanic students, 1.6% black students, and 0.5% American Indian students. The percentage of white and Asian students is higher than the state average, while the percentage of Hispanic and black students is lower than the state average. Ten of the past 12 school years have seen an increase in the percentage of economically disadvantaged students. This year in the district, about 26.9% of students are considered economically disadvantaged. This is below the state average of 33.3%. About 95.2% of the students in the district are considered proficient in English, while about 96.3% of high school students statewide are considered proficient in English.

I currently teach Biology and Conceptual Physics. Students can also take Traditional Physics, Honors Physics, Chemistry, Honors Chemistry, Advanced Chemistry, Human Biology, AP Biology, Conservation, STS (Science, Technology, and Society), Food Science, and EMN (Electricity, Magnetism, and Nuclear). Our school is focusing on content area literacy, PBIS within a developing RTI framework, standards-based grading, and generally maintaining the level of service currently offered to students as our state faces severe cuts to public education. All departments meet weekly for 45 minutes of collaboration time, which is built into the school day on Wednesday mornings; school starts later for students on these days. Our department works together to create common assessments, select new textbooks, refine labs, and generally improve our instruction.

Although we already have a lot on our plates, I have decided to focus on something new for the purpose of this project. I feel that work time and lab time (as opposed to lecture) is underutilized and not as productive as it potentially could be. Students in my classes often work together, but there is very little structure to with regard to purposeful grouping or roles within groups. Not all students are highly engaged in their class work, and I would like to improve their level of engagement, and hopefully a higher level of achievement will also follow. While I want my students who will soon be graduating to be independent in their decision-making, they do not always make the best choices when selecting group members or utilizing their class time. I feel that introducing structured cooperative learning will improve their ability to work productively as well as give them skills they can use after graduation.

Focus Question

Concern about students' choice of partners and use of time in class led me to my principal focus question: What effects does the implementation of cooperative learning groups have on students' attitudes and academic competencies? I hope to discover if test grades improve when students are placed purposefully in structured groups. I also wish to determine whether students spend an increased amount of time being on-task while in these groups. Finally, I want to determine how working in structured groups affects their attitudes about the course content and classroom environment.

CONCEPTUAL FRAMEWORK

This review of the literature on the topic of cooperative learning will focus on measures a teacher should take in order to properly structure groups and student work time, the benefits of cooperative learning to students, and methodologies used by researchers studying cooperative learning. The focus of this action research project is the implementation of cooperative learning groups in upper level science classes. Research will examine students' attitudes and academic competencies as a result of cooperative learning.

Structuring groups

In order to structure successful group work, teachers must have a conceptual understanding of cooperative learning and be able to adapt it to their particular classroom environments (Johnson & Johnson, 1993). Five essential elements must be present in

order for effective cooperative learning to take place. Johnson and Johnson (1993) highlight positive interdependence, face-to-face promotive interaction, individual accountability, social skills, and group processing.

When executing this action research project, it's important that students have sufficient time to accomplish work expected of them. Students being asked to complete a task individually do not need as much time as those who must deal with both task-related issues and team-related issues (Hsiung, 2010).

Students should not be left alone to direct their cooperative learning groups. Careful implementation and guidance can improve their learning experience (Johnson & Johnson, 1993). Siegel (2005) found that there is room for flexibility depending on teacher style and student need. When examining a specific teacher's practices, she found, among other things, that the teacher adapted his approach based on individual classroom circumstances. Also, his adaptations varied in three distinct ways: personal techniques, integration of cooperative learning with previous lesson plans, and implementation depending on the level taught.

Simply requiring students to work together does not constitute cooperative learning. Johnson and Johnson (1999) assert that in a true cooperative learning group, there are shared goals, and "students discuss material with each other, help one another understand it, and encourage each other to work hard," (p.68). Teachers must approach the implementation of cooperative learning thoughtfully. Specifically, Johnson and Johnson note that teachers must clarify objectives, explain the work to be done and how students must work together and also be individually accountable, monitor students' work, and ultimately, assess their learning.

Another study conducted at the college level supports carefully structured cooperative learning. In a gender and family relationships course, Walker (1996) did not purposefully group students. Students grouped themselves into teams of four, with the stipulation of not working with friends or acquaintances. Among her teaching strategies during the course were only grading the final project, providing for individual accountability by requiring each student to submit a separate paper, and giving students a role in decision making. Walker informally concluded that students' performance exceeded that of previous experiences, based on the quality of their research projects as compared to those from her previous students. In addition, evaluations of her course were the best she had ever received.

Bertucci, Conte, Johnson and Johnson (2010) recognize that one reason students report disliking group work is because of the potential of disproportionate distribution of the work load, also known as social loafing. The size of the group is important; the larger the group, the higher the degree of social loafing. Yet, there is not necessarily an ideal group size. In terms of achievement, groups of four did not have higher results than groups of two.

Students' peer orientation, or the degree to which they prefer to work with others or to work alone, is related to how much they desire to work cooperatively (Hancock, 2004). Hancock (2004), working with graduate students enrolled in an educational research methods course, found that students who actually want to work together are more motivated to learn in a group setting, but they did not score differently than those who were less inclined to learn in a group setting. Hancock (2004) concluded that "if students' motivation to learn is a goal, professors may want to determine the peer

orientations of their students before designing instructional strategies,” (p.164). He also concluded that researchers should not only foster students’ motivation to learn, but that they should also try to recognize personality and situational variables that affect achievement.

Benefits to Students

Beyond increased academic learning, cooperative learning can benefit students’ interpersonal relationships and psychological health (Johnson & Johnson, 1999). Students who are required to work cooperatively establish friendships and have higher self-esteem than do those who work individually and compete with each other. Moreover, students report enjoying courses in which they have the opportunity to collaborate with their peers. Walker (1996) reported that at the end of the course in which she instituted cooperative learning, students’ evaluations of their experience revealed their appreciation of group work.

Many bodies of research provide support for using cooperative learning in classroom settings. When teachers use cooperative learning, they hope to provide a richer experience for their students. Closely monitoring cooperative learning groups reveals exactly how students work together as well as the kind of support that they need to maximize achievement. Mueller and Fleming (2001) determined that when sixth and seventh graders were working together, they used language more frequently to propose ideas than they did to secure social and organizational agreements. When the students were asked what they learned, it can be summarized as “acquisition of scientific knowledge, acquisition of practical skills, acquisition of group cooperation skills, and

learning to enjoy the challenge of science,” (p.264). Mueller and Fleming (2001) also identified three components of effective group work: “(a) sufficient time should be allowed to participants in cooperative learning projects to talk and work ideas out, (b) to listen and to exchange ideas with others, and (c) to present what they have learned to each other and to an outside audience,” (p.264).

Methodologies used when studying cooperative learning

Several researchers employ similar methodologies. For example, Hornby (2009) contrasted two similar workshops. Students in each workshop learned identical material, and the control group learned in a whole group format. However, individual accountability and positive interdependence were built into the experimental group’s workshop. All students completed pre and post multiple choice tests and a post intervention questionnaire, and results indicated that academic learning was greater in the experimental group.

To determine whether homogenously or heterogeneously grouped students perform better, Baer (2003) compared the two types of groups. Like Hornby (2009), Baer measured students’ academic performance on a test, finding that high and average achieving students that were homogenously grouped outperformed high and average achieving students that were heterogeneously grouped. Baer also found that grouping had no effect on the low achieving students in his study.

Conclusion

This action research will determine the impact of implementing cooperative learning groups in upper-level high school science courses. Topics explored will be the effect of cooperative learning groups on student achievement and on student attitude. I will investigate whether using cooperative learning groups has a positive effect on students, and I will explore my role as their teacher in structuring their groups and monitoring their work time. Finally, I will collect data about the relationship between cooperative learning groups and test scores as well as students' feelings and opinions.

METHODOLOGY

During the course of research, I implemented cooperative learning groups during one unit of a high school physics class, and compare students' attitudes toward course content and the classroom environment as well as their academic competencies. Data was collected before, during, and after the treatment period to help determine any changes in the aforementioned areas. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

Participants

Participants in the study were seniors enrolled in year-long elective conceptual physics classes. The classes are comprised of a total of 60 students. Thirty-nine students

are female, and 21 are male. There are 48 white students, 11 Asian students, and 1 black student.

Instruments

In order to determine the effects of the implementation of cooperative learning groups on students' attitudes and academic competencies, I considered the needs of my high school physics students that were involved in the study, as well as what was feasible for me to complete during the treatment period. I included tools that allowed for the efficient collection of data, provide reliable information, and that can include meaningful reflection on the part of the students. During the course of the implementation of my research, I used several instruments prior to, during, and at the end of the treatment period.

An important component of my research was the unit summative test score. I compared unit test scores from the treatment period to test scores from the identical unit taught during the previous school year. I also made a comparison between test scores from the previous school year and this school year during a non-treatment period to show that the above groups are comparable. Additionally, I compared students' test scores between two similar units, using the same students in each instance. One unit was during the treatment period, and another was not. These comparisons yielded insight into how purposefully structured groups affect test scores, and thus their academic competencies. Students also completed a self-assessment in which they reflect upon their perceived academic competencies at the end of the treatment. The self-assessment revealed whether students felt that they had improved comprehension, motivation, study skills, and more. The self-assessment is available in Appendix E.

Additionally, in order to determine if there was a change in student attitude, I conducted interviews during the treatment period with students who are interested in participating (I had four males and two females who represented a spectrum of different abilities). To the same end, I required all students to complete exit tickets before and during the treatment period. I also asked students to complete an attitude survey both pre and post-treatment. It can be found in Appendix F. Interview questions and exit tickets are included at the end of this paper, in Appendixes A through D.

Finally, I tried to determine whether the implementation of cooperative learning groups results in students spending an increased amount of time on-task. A combination of my own observations, peer observations, student interviews and exit tickets helped me evaluate any difference that might exist between time spent on task pre-treatment and time spent on task during treatment. Again, interview questions and a ticket are included in Appendixes A through D. The data collection techniques for this study are summarized in Table 1.

Table 1
Data Triangulation Matrix

Focus Questions	Data Source 1	Data Source 2	Data Source 3
<i>Primary Question:</i> 1. What effects does the implementation of cooperative learning groups have on students' attitudes and academic competencies?	Compare test scores between two similar units using the same students; compare test scores from the same unit from the previous school year; compare test scores from two non-treatment units from this school year and previous school year.	Student interviews	Student attitude surveys, exit tickets
<i>Secondary Questions:</i> 2. Do test grades improve when students are placed purposefully in structured groups?	Compare test scores between two similar units using the same students.	Self-assessments	Compare test scores from the same unit from the previous school year.
3. Do students spend an increased amount of time being on-task while in these groups?	Instructor observations, peer observations	Interviews	Exit tickets
4. How does working in structured groups affect students' attitudes about the course content and classroom environment?	Interviews	Student attitude survey	Exit tickets

Data Collection and Analysis Strategies

The above instruments provided a great deal of both qualitative and quantitative data. Test scores supplied quantitative data that allowed for determination of any contrast in academic competency. Exit tickets provided quantitative data revealing the percentage of students who felt they performed better or worse during the treatment period, as well as qualitative data about their feelings towards course content and the classroom environment. An attitude survey and student interviews provided both quantitative and qualitative data about any changes that occurred in feelings towards science and towards the course in general. My own observations and those of my colleagues allowed for an evaluation of any changes in time spent on-task.

I used I used an Apperson test scanner (similar to a ScanTron machine) to initially compile results from the exit tickets, self-assessment and the attitude survey. Then I used Excel to tabulate and analyze the results from the Apperson machine in addition to test scores. In the case of the attitude survey, Qualitative evidence will be used from student interviews and peer observations. I looked for trends and themes in both student and peer comments and attempt to quantify the amount of student and peer statements that are negative, neutral, or positive.

Reporting Strategies

In order to provide a clear snapshot of data to readers, I provided graphs and charts that display changes in test scores, student attitudes, and amount of time spent on-task that exist after the treatment period. I also provided direct quotes from student interviews and peer observations which demonstrate examples of overall opinions presented, as well as quotes which provide evidence to the contrary.

DATA AND ANALYSIS

In the spring of the 2011-2012 school year, students in high school conceptual physics classes were put in purposefully structured groups for the duration of one unit. Previous to this treatment, students had been allowed to work with classmates of their choice. Data was collected from exit tickets, student interviews, surveys, and instructor and peer observations.

Working in purposefully structured groups did not significantly affect test scores.

Test scores from identical non-treatment units taught to students during this school year and last school year were compared. It was found that there is no significant difference between this year's students' and last year's students' non-treatment unit test scores. To be more specific, the 2010-2011 students, or the control group, had a Mean score of 82.27% on the non-treatment unit, with a Standard Deviation of 11.90. The 2011-2012 students, or the intervention students, had a Mean score of 81.12% on the identical unit, with a Standard Deviation of 16.30. The difference between these two groups was not statistically significant, $t(139) = 0.4843$, $p = 0.6289$. This establishes that last year's students and this year's students are comparable. Figure 1 below depicts this comparison.

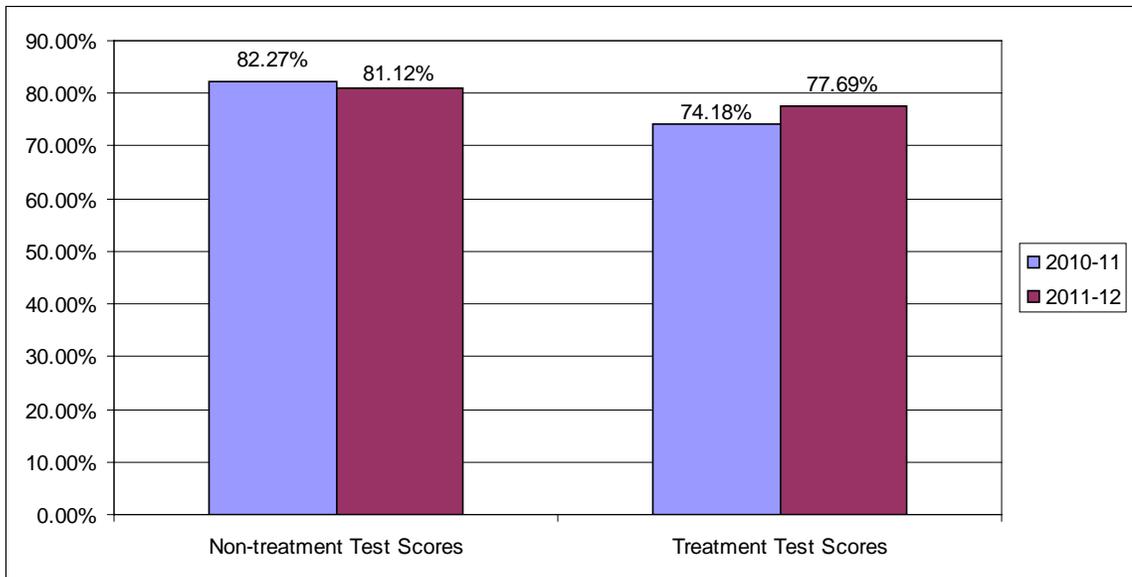


Figure 1. Non-treatment and Treatment Mean test scores, (2010-11 $N=81$) (2011-12 $N=60$).

When examining the scores of last year's students, they had lower combined unit test averages on the treatment unit than on the non-treatment unit (bearing in mind that last year's students received no treatment at all). On average, the 2010-2011 students scored 8.09% lower on the treatment unit test; they had a Mean score of 74.18% (as seen in Figure 1 above) with a Standard Deviation of 15.54. This year's students also had lower combined unit test averages on the treatment unit than on the non-treatment unit. But by contrast, this year's students, who did receive the treatment, saw a smaller drop in average test scores: they scored 3.43% lower on the treatment unit than on the non-treatment unit. They had a Mean score of 77.69% with a Standard Deviation of 14.74. While a comparison of both groups' test scores of the treatment unit shows that there is no statistically significant difference, $t(139)=1.3536$, $p=0.1781$, it is worth noting that the drop in scores of this year's students is not as steep. Test scores do not improve, but the structured groups might have a somewhat positive effect on student achievement, although it is limited.

Students appear to spend more time on-task while working in purposefully structured groups.

This project sought to determine whether students would spend more time being on-task while in structured groups. Several data sources were used in conjunction with instructor and peer observations to determine if there was a change in the amount of time spent on-task. These are discussed below.

Students were asked to assess themselves in this area, when responding to the questions in Appendix E. Specifically, they were asked to respond to question 4, "Are you more engaged during class time than you were when work time was not structured?"

This statement had 22 “yes” responses, 33 “no” responses, and 5 “unsure” responses.

The results are summarized in Figure 2 below. While more students replied with no, this statement had more positive responses than any other on the Academic Competency Survey (Appendix E). A complete figure summarizing the results of Appendix E can be found in Appendix E.

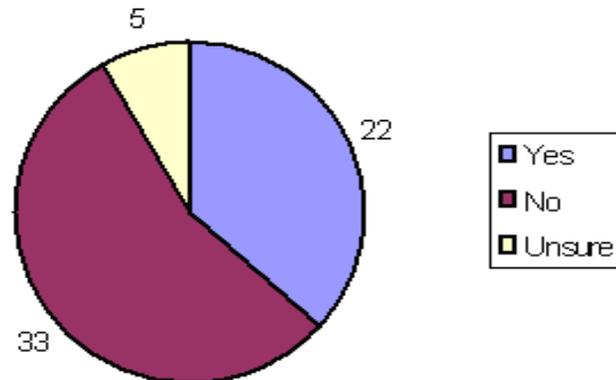


Figure 2. Responses to Appendix E, Question 4, “Are you more engaged during class time than you were when work time was not structured?” ($N=60$).

The exit ticket found in Appendix C also contains questions that relate to time spent on-task in responses between the non-treatment and treatment unit. Questions 1 asked “I spent most of my time actively working on physics.” The non-treatment had a Mean score of 3.417 (1= Strongly Disagree, 5= Strongly Agree) and a Standard Deviation of 0.850. The treatment had a Mean score of 3.383 and a Standard Deviation of 1.010. There was no statistical significant, $t(118)=0.1960$, $p=0.8449$, between the non-treatment and treatment units. Question 3 asked “I used my time well today” which also showed no significant difference, $t(118)=0.1926$, $p=0.08476$, in responses. The non-treatment had a Mean score of 3.550 (1= Strongly Disagree, 5= Strongly Agree) and a Standard Deviation of 0.790. The treatment had a Mean score of 3.517 and a Standard

Deviation of 1.081. A complete table summarizing the results of Appendix C can be found in Appendix C.

Other instruments used to assess how well students used their time while working in structured groups were instructor observations as well as the observations of a peer of the instructor. My own (as the instructor) observations are that initially, students seemed a lot more on-task than they had been when they were allowed to choose their own partners and group sizes. As time went on, socializing increased somewhat, but it still appeared to be considerably less than during the non-treatment units. Some students seemed too shy to ask group members questions, and I had to really coax some students to participate. Also, some students would ask me a question without asking their group members first. I had to remind them that they were to consult with their partners first, and then if there was still a question, they could ask me. Overall, there were a lot more physics-related conversations than side conversations, and even those who weren't talking much with their group members were doing physics.

My colleague visited during two non-treatment work days and two treatment work days. His observations were that during the non-treatment work days, most students were working, there were some side conversations taking place that were off-topic, the students directed their questions mostly towards me, students seemed to be working with friends, and that they were easily side-tracked. Similar to my own observations, during the treatment work days, he noted that most students were discussing physics in their groups, some groups were not talking at all, and most students asked their group for help first, and then the teacher. He also commented that in general, students were more on task than they were non-treatment; there were some side

conversations taking place, but fewer than on the non-treatment work days; and like I noticed, even those who were not participating with their groups were still doing physics. Therefore, while circumstances were not ideal for every group, both he and I observed some positive changes during the treatment period.

Students have widely varied, but mostly negative, opinions regarding being required to work in purposefully structured groups.

After spending the first part of the school year with relative freedom with regard to in-class work time and partners, students did not react very positively to having group members chosen for them. Students worked in assigned groups of three to five members, and they were placed with classmates with whom they did not normally work. As a result, there was a decline in the number of students who responded positively to post-treatment exit ticket questions, which can be reviewed in appendices A through C. For example, after the treatment period, more students responded negatively to the statement, “I like coming to this class.” That statement appears in Appendix A, question 3. Prior to treatment, student responses showed a Mean of 3.60 (1= Strongly Disagree, 5= Strongly Agree) with a Standard Deviation of 0.87. After the intervention, student responses showed a Mean of 3.13 with a Standard Deviation of 0.75. This shows that there is a statistical difference, $t(118)=3.1576$, $p=0.0020$, between the pre- and post- responses.

Perhaps of note is a decrease in student agreement with the statement “This unit has been very interesting to me,” (Appendix A, question 1) which appears on the same exit ticket. Prior to treatment, student responses showed a Mean of 2.70 (1= Strongly Disagree, 5= Strongly Agree) with a Standard Deviation of 0.85. After the intervention, student responses showed a Mean of 2.38 with a Standard Deviation of 0.87. Non-

treatment and post-treatment averages shows that there was a statistically significant decrease, $t(118)=2.023$, $p=0.045$. There may be a correlation between a less interesting unit and more negative responses to enjoying course content and activities.

There was also a decline in the number of students who agreed with the statement, “I think the teacher is fair and reasonable with regard to expectations of our work and behavior,” which appears in Appendix B, Question 1. Prior to treatment, student responses showed a Mean of 4.47 (1= Strongly Disagree, 5= Strongly Agree) with a Standard Deviation of 0.65. After the intervention, student responses showed a Mean of 4.07 with a Standard Deviation of 0.99. Analysis reveals a statistically significant decline, $t(118)=2.6175$, $p=0.0100$, in agreement with that statement after the treatment period. A complete table summarizing the results of Appendix B can be found in Appendix B.

Analysis of Appendix C, which is a third exit ticket administered to students both pre- and post-treatment, reveals another decrease. In Appendix C, Question 4 students responded more negatively after the treatment session to the statement: “I was able to get the help I needed in order to complete my work today.” Prior to treatment, student responses showed a Mean of 3.97 (1= Strongly Disagree, 5= Strongly Agree) with a Standard Deviation of 0.99. After the intervention, student responses showed a Mean of 3.52 with a Standard Deviation of 1.13. This showed a statistically significant decrease $t(118)=2.3224$, $p=0.0219$.

While it is unfortunate that students did not all appreciate the treatment experience, it is not altogether surprising that a group of seniors responds with some dismay about restrictions on their ability to work with their friends. If the groups had

been assigned from the start, perhaps students would accept them more readily. An encouraging response among the negative ones was in the amount of students who agreed with the statement in Appendix B, question 7, “I feel that everyone in class contributes toward the goal of learning.” Prior to treatment, student responses showed a Mean of 1.00 (1= Strongly Disagree, 5= Strongly Agree) with a Standard Deviation of 0.00. After the intervention, student responses showed a Mean of 2.98 with a Standard Deviation of 0.89. This was a statistically significant increase, $t(118)=17.2149$, $p=0.0001$, that indicates that though the students disliked some aspects of working in assigned cooperative groups, they at least appear to feel that their classmates were more productive during the treatment, as noted previously in the discussion of time spent on-task.

Appendix F contains one section of the ROSE survey: part F, “My Science Classes.” The only significant change when comparing pre- and post-treatment responses was to question 2, “School science is interesting.” Prior to treatment, student responses showed a Mean of 2.82 (1= Disagree, 4= Agree) with a Standard Deviation of 0.97. After the intervention, student responses showed a Mean of 2.42 with a Standard Deviation of 0.79. There was a significant decrease, $t(118)=2.4871$, $p=0.0143$, in the amount of students who agreed with the statement. This mirrors the students’ attitudes to Appendix A Question 1, which is a similar type of question. “This unit has been very interesting to me.”

Student interviews revealed some more specific insights. Three high-achieving and three lower-achieving students were asked the questions in Appendix D. Regardless of their current grade in class, all six students indicated that school had been going well, and that they generally liked physics class. When asked specifically what they liked,

students cited work days and demos most often. A strong student mentioned the structured groups, saying he liked them because “you had to explain why you did what you did to others.” There were no themes for things the interviewed students disliked. All of the students felt they were doing as well or better than expected in class.

When asked to compare the unstructured work days (non-treatment) to structured cooperative learning (treatment), only one of the interviewed students did not feel that he benefited academically from the treatment unit. He said that his group did not talk much, and that he was nervous and embarrassed to ask his partners for help. The other five interviewed students cited that during the treatment period there were fewer distractions because they were not working with friends, more work was accomplished, and they spent more time on-task. For example, one student stated, “Before we had to work in these groups, I worked hard enough to get stuff done. In the structured groups, we spent the entire time talking about problems.” Another student said that in the structured groups, “More work was accomplished and there were fewer distractions because we weren’t by friends.”

When the interviewed students were asked how they felt when a teacher tells them that they will need to work together in groups, no student thought it was a particularly bad thing. Some students mentioned that the group composition mattered to them. One of the weaker students cited that he preferred to work with friends and dislikes teacher-chosen groups. Two of the stronger students stated that they end up doing more work when they must work in a group and that they do not like feeling as though they are not in complete control of their grades. No additional insights about the treatment period were revealed in student responses to the final two interview questions

regarding continuing taking science courses or sharing anything else about how physics was going. Students simply mentioned things like, “Yes, I’ll be taking more science classes because I am planning on a Natural Resources degree.” Another student doesn’t plan on taking more science classes because he “prefers English over math and science.”

Appendix E asked students to report their perceived academic competency after the treatment period. Similar to the exit tickets, the majority of students did not respond positively to any of the questions. They especially felt that working in structured groups had not had a positive influence on them as students, and that they did not improve their study skills as a result of knowing how their classmates approach coursework. Still with more negative than affirmative responses, though somewhat more evenly divided, were their responses to whether they were more engaged during the treatment period or whether they were more motivated to complete their work in a structured group.

The final question on the survey in Appendix E was open-ended, asking students for comments about how working in structured groups affected them as students. Of the students who answered the question, 18 responded negatively, 12 responded positively, and 9 were indifferent about the experience. Students echoed similar sentiments revealed during the student interviews.

When examining the negative responses, one student wrote that s/he “felt if you worked with your friends, you would be more comfortable with asking questions.” Another student shared that, “It has made me work less because I don’t want to feel stupid always asking people I don’t know as well questions.” Three of the students who responded negatively did not like to work in groups regardless of their partners; they in fact stated that they preferred to work alone. It’s also worth noting that three more

students didn't state anything that actually indicated a negative effect on them as a student. They all made comments similar to "I'm more of a fan of hanging with who I want to." Therefore, there are really only 12 responses that specifically mention how students felt they were negatively affected during the treatment period.

On the positive spectrum of responses to question 10 of Appendix E, one student shared the comment, "I like working in groups; everyone is more focused and I get more work done and more help from those in my group." Another positive comment from a potentially weak student was "My physics work actually gets done, plus I get help!!" A person who may be a stronger student mentioned, "I enjoy helping my peers if they need it. It benefits the person asking for help and the person giving it."

Students who were indifferent wrote things such as, "I work the same not being in a structured group," and "It's no different than when we worked in other groups." A few cited that they worked hard to maintain high grades regardless of classroom environment.

INTERPRETATION AND CONCLUSION

This investigation sought to determine the impact of purposefully structured groups on students' attitudes, academic competencies, and their time spent on-task in class. For most of the school year, prior to the intervention, students had been allowed to work with partners of their choice, and typically gravitated towards their friends. This intervention required students to work with group members of the instructor's choice; groups were meant to be heterogeneous with regard to academic ability. The instructor gathered data from exit tickets, surveys, interviews, his own observations, and his peer's observations. Analysis of the data shows that most students had negative attitudes about

being required to work in purposefully structured groups, and that the groups did not appear to have an impact on test scores. However, students appeared to spend more time on-task while working in these groups, when compared to working in groups of their choice. Some of the implications of the intervention are discussed below.

One concern is student discomfort when being required to work with classmates they didn't know. Since some of the interviewed students cited that they were worried about asking group members questions because they felt uncomfortable or self-conscious, perhaps a teacher who knows his students well can predict who these students might be and place at least one friend in their group. It is also possible that given more time, students would become more comfortable with their group members. The concern of comfort is perhaps echoed in the previous discussion of the decrease in students who responded positively to the statement, "I like coming to this class" (Appendix A Question 3) and "I was able to get the help I needed in order to complete my work today" (Appendix C Question 4). The possibility that these statements are linked to the same general discomfort in working with students who aren't identified by friends cannot be ignored with considering group make up.

Since students had fairly negative opinions about the treatment period because they missed working with friends, perhaps the positive aspects of working with other classmates (getting more accomplished, fewer distractions) should be stressed to them ahead of and during subsequent times when structured groups are implemented. Also, if structured cooperative groups were to be used for an entire year, students would not be used to choosing their own partners and would not feel a loss of control or freedom. In addition, the teacher could change the group compositions periodically to make sure that

if there are problems between group members, they don't impede academics and student comfort for an extended period.

The above information can be summarized and generalized to answer the primary question that this action research project sought to answer: "What effects does the implementation of cooperative learning groups have on students' attitudes and academic competencies?" In general, the structured groups do not seem to have had a positive effect on students' attitudes. While some students saw value in the structured groups, more disliked it, as mentioned above. In terms of academic competencies, test scores did not have a statistically significant increase as a result of the treatment.

Every physics unit is different and care was taken to select two that were of similar difficulty. However, test scores, as mentioned previously, appear to show that the treatment unit is more difficult than the non-treatment unit. This may also be a contributing factor to students' preference for non-structured groups; the apparently more difficult material may contribute to their more negative attitudes.

It is very difficult to arrive at a cut and dry conclusion about the success, or lack thereof, of this action research project due to all of the potential variants. One of the biggest pitfalls I ran across during this action research project was the fact that some students were uncomfortable in their groups and did not want to ask peers questions. Johnson and Johnson (1999) state that "Working cooperatively with peers, and valuing cooperation results in greater psychological health, higher self-esteem, and greater social competencies than does competing with peers or working independently," (p.73). However, they also emphasize relationships that need to form between students in order

to realize these benefits. It's possible that the short duration of this study did not allow time for these personal and professional relationships to form.

Some positive findings from this action research have me considering trying to implement purposefully structured groups again. Several students reported positive experiences such as being less distracted when working with students of the teacher's choice and that explaining concepts to classmates reinforced the material. I would like to emphasize benefits like those to a new group of students, and hopefully increase the percentage of students who subsequently benefit in the same way. Also, I was encouraged by student comments and my own observations of on-task behavior. I feel that the amount of time students spent discussing and working on physics increased, and that is something I'd like to continue next year.

Some changes I would make in the future, based on all of the above data and analysis, would be to possibly have a group component of an assessment, to encourage and even necessitate that all groups interact with each other. Additionally, I would include "getting to know you" activities and team-building activities to help students become more comfortable with their groups before diving into their physics assignments.

The main question that I have after completing my action research is whether students' attitudes would have been different about working in these teacher-selected cooperative learning groups if the groups began at the beginning of the school year compared to March. As mentioned previously, I feel that the change in attitude that was observed in this investigation was a result of almost an entire school year where students selected their groups. Establishing these groups at the beginning of the school year is something I definitely need to think about for next school year.

Other questions I have, based on student feedback, have to do with group make up, since several students mentioned they were uncomfortable with their partners. Choosing groups for students can be a difficult balancing act. I aimed to create academically heterogeneous groups, but perhaps this is not best for weaker students who do not have the confidence to ask stronger students questions, and perhaps the stronger students could be accomplishing more if they did not stop to help weaker students. Finally, I wonder what can be considered an optimal level of group versus individual accountability when it comes to students' grades. This was a valuable learning experience for me, and I believe for the students as well, and it raises more questions to be investigated next year.

VALUE

This study has been a learning experience for me as a teacher. Prior to planning and implementing the investigation, I had not experimented with my students' group composition during their work days. While not all students appreciated the experience, conducting the research has given me valuable feedback to use when considering how to try purposefully structured groups again next year. Additionally, while I typically have brief conversations with students about how things are going, this research project gave me more specific feedback about how I can structure work days in the future. I also was able to get opinions from all students instead of just a few. Because this feedback revealed so much information, I plan to continue to use quick tools like exit tickets next year.

Completing this project also altered my views about how I should probably structure work days. Prior to this, I knew that students were not utilizing their time as well as they could be, and that they were not developing social skills that they might need in order to work cooperatively in post-secondary or work experiences. While not all aspects of this intervention had positive results, I feel that I have furthered my understanding of how and when to create groups. I also feel that I may need to add even more to my students' cooperative learning experiences, perhaps by requiring some type of assessment to be completed by the entire group, for which the students share a grade. I suppose one could say that by completing this project, I "opened a can of worms" and have new issues to tackle when I try this again next year.

This capstone project was rewarding for me personally, both as a student and as a professional. As a student, I researched ways to improve my students' learning, learned new technical writing skills, and learned how to analyze data. As a professional, I tackled a project that I otherwise would not have, and was rewarded with new insights about how I approach organizing classroom work time, after reflecting on the process as a whole. I look forward to continuing to try to improve my students' classroom experiences and to developing my craft as a teacher.

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APPENDICES

APPENDIX A

EXIT TICKET: ATTITUDES TOWARD THE COURSE AND CLASSROOM
ENVIRONMENT (A)

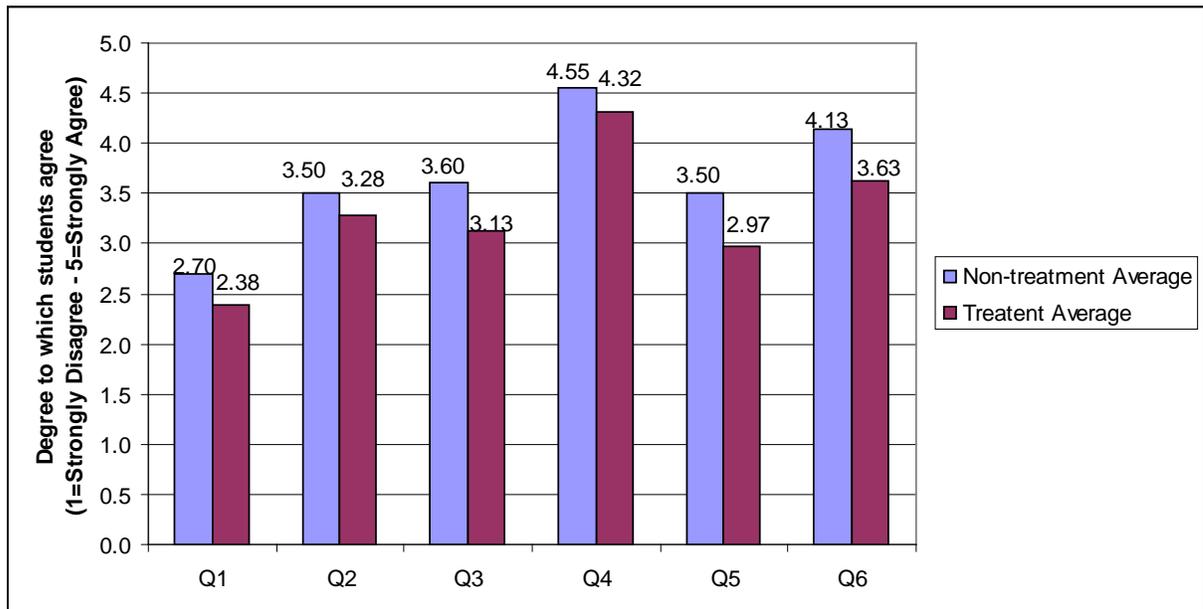
Exit ticket: Attitudes towards the course and classroom environment (A)

Please circle one choice for each statement.

1= Strongly Disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree

- | | | | | | |
|---|---|---|---|---|---|
| 1. This unit has been very interesting to me. | 1 | 2 | 3 | 4 | 5 |
| 2. I learn a lot in this class. | 1 | 2 | 3 | 4 | 5 |
| 3. I like coming to this class. | 1 | 2 | 3 | 4 | 5 |
| 4. I like my school friends. | 1 | 2 | 3 | 4 | 5 |
| 5. I feel like I will be prepared to take the unit test. | 1 | 2 | 3 | 4 | 5 |
| 6. I think I have made a positive contribution to this class; I participated, I did my homework, and my behavior was appropriate. | 1 | 2 | 3 | 4 | 5 |

Responses to Appendix A, (n=60).



APPENDIX B

EXIT TICKET: ATTITUDES TOWARD THE COURSE AND CLASSROOM
ENVIRONMENT (B)

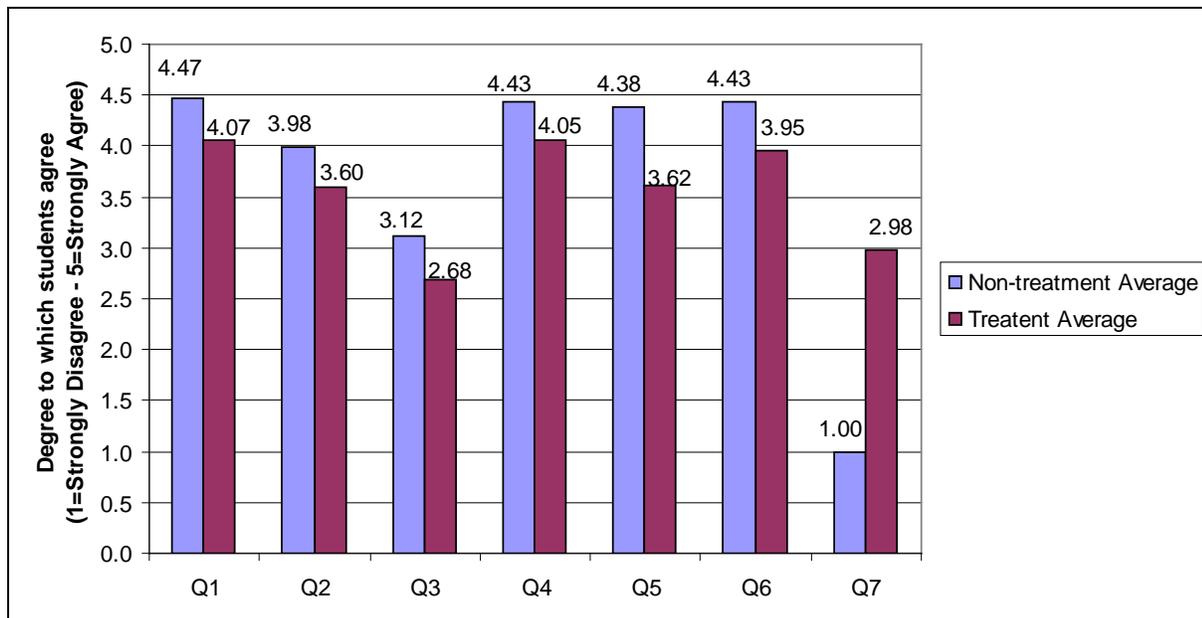
Exit ticket: Attitudes towards the course and classroom environment (B)

Please circle one choice for each statement.

1= Strongly Disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree

- | | | | | | |
|---|---|---|---|---|---|
| 1. I think the teacher is fair and reasonable with regard to expectations of our work and behavior. | 1 | 2 | 3 | 4 | 5 |
| 2. I am happy with the work I do in school. | 1 | 2 | 3 | 4 | 5 |
| 3. What we learn in this class makes we want to learn more. | 1 | 2 | 3 | 4 | 5 |
| 4. I think the teacher is fair and reasonable with regard to expectations of our work and behavior. | 1 | 2 | 3 | 4 | 5 |
| 5. In-class work time reinforces classroom instruction; I can practice what I learn meaningfully. | 1 | 2 | 3 | 4 | 5 |
| 6. The classroom environment is disciplined, but pleasant and non-threatening | 1 | 2 | 3 | 4 | 5 |
| 7. I feel that everyone in class contributes toward the goal of learning. | 1 | 2 | 3 | 4 | 5 |

Responses to Appendix B, ($n=60$).



APPENDIX C

EXIT TICKET: TIME SPENT ON-TASK

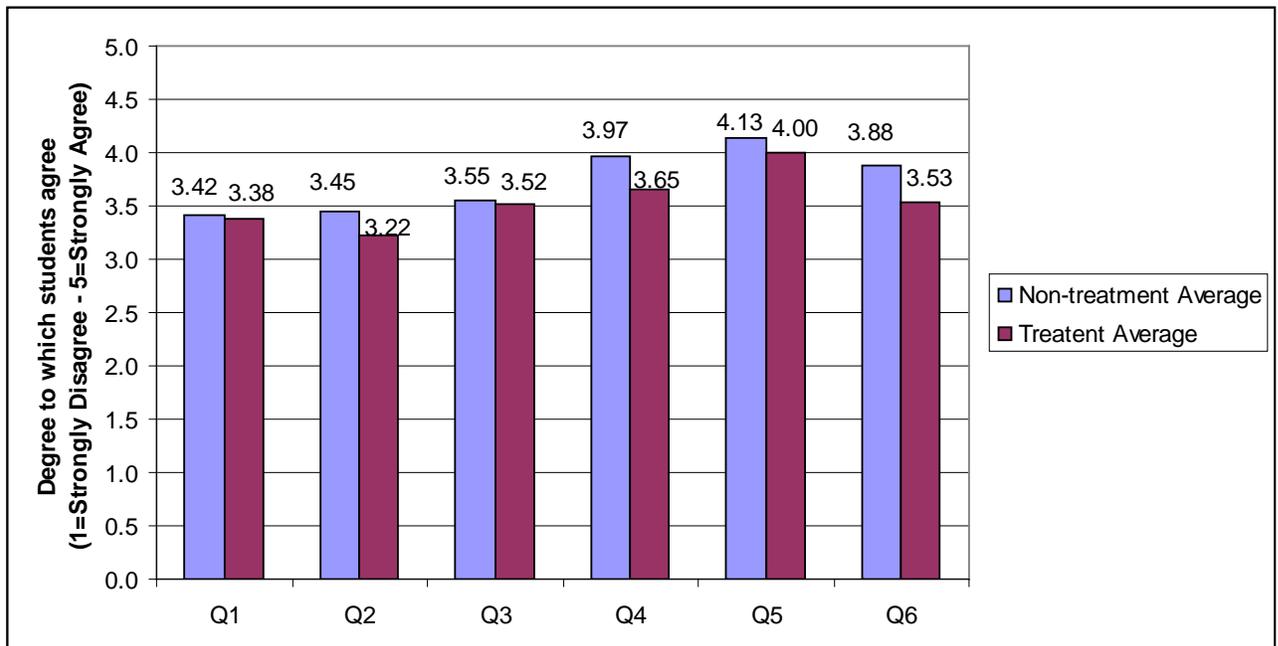
Exit Ticket: Time Spent On-task

Please circle one choice for each statement.

1= Strongly Disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree

1. I spent most of my time actively working on physics. 1 2 3 4 5
2. I was motivated to complete my work today. 1 2 3 4 5
3. I used my time well today. 1 2 3 4 5
4. I was able to get the help I needed in order to
complete my work today. 1 2 3 4 5
5. I spent no time, or only what was absolutely
necessary (ex: quick bathroom break) outside of the
classroom today. 1 2 3 4 5
6. I helped my group today. 1 2 3 4 5

Responses to Appendix C, ($n=60$).



APPENDIX D

STUDENT INTERVIEW QUESTIONS

Student Interview Questions

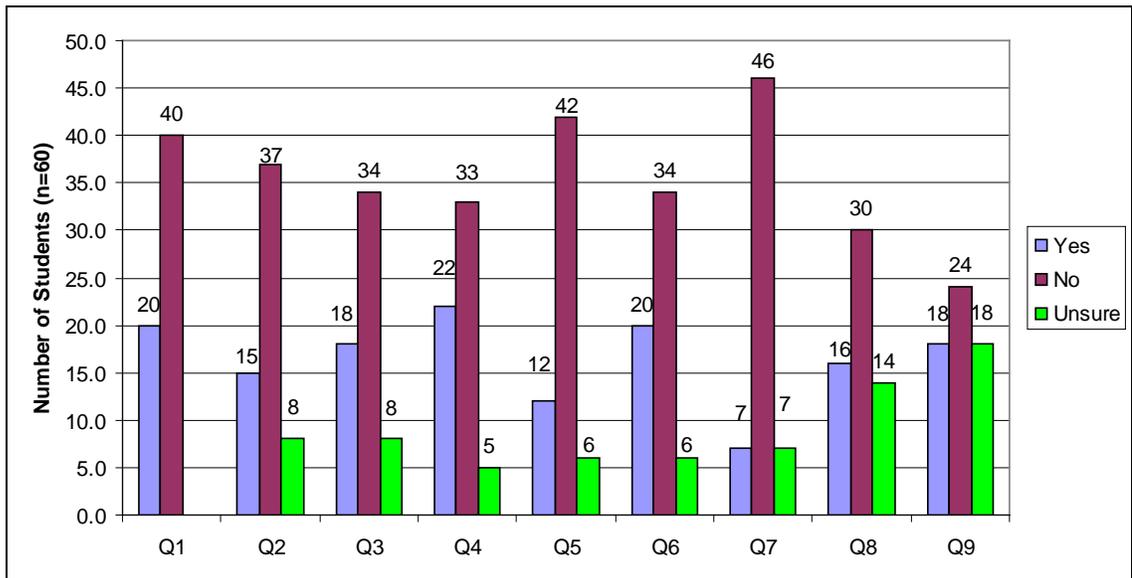
1. How has school been going for you?
2. How do you feel about learning physics? What about other science classes?
3. What is there about this class that you especially like or dislike?
4. Are you doing as well, better than, or worse than you expected? Why?
5. How do you feel about the way work time is structured?
6. Do you feel you use your time well in class, or do you feel that you are often distracted?
7. Do you think you spend more or less time on-task in this class as compared to other classes?
8. How do you feel when a teacher tells you that you will need to work together in groups?
9. Do you think you will continue taking science courses? Why or why not?
10. Is there anything else you'd like to share with me about how physics is going?

APPENDIX E

SELF ASSESSMENT WITH REGARD TO ACADEMIC COMPETENCIES

Academic Competency Survey
Participation is voluntary

- | | | | |
|--|-----|----|--------|
| 1. Are you getting a better grade now than you did in the pre-treatment unit? | Yes | No | |
| 2. Do you feel that working in structured groups has improved your comprehension of physics concepts and problems? | Yes | No | Unsure |
| 3. Do you feel that you have a greater role in your own learning when you work in a structured group? | Yes | No | Unsure |
| 4. Are you more engaged during class time than you were when work time was not structured? | Yes | No | Unsure |
| 5. Have your study skills improved as a result of knowing how classmates approach coursework? | Yes | No | Unsure |
| 6. Are you more motivated to complete your work when you work in a structured group? | Yes | No | Unsure |
| 7. Has working in a structured group had a positive influence on other subjects you take? | Yes | No | Unsure |
| If yes, how? | | | |
| 8. Has working in structured groups had a positive influence on you as a student? | Yes | No | Unsure |
| If yes, how? | | | |
| 9. Are you more successful when working in a structured group? | Yes | No | Unsure |
| 10. Please share your comments about how working in structured groups affected you as a student. | | | |

Responses to Appendix E, ($n=60$).

APPENDIX F

ATTITUDE SURVEY



ROSE

The Relevance of Science Education

F. My science classes

To what extent do you agree with the following statements about the science that you may have had at school?

(Give your answer with a tick on each line. If you do not understand, leave the line blank.)

	<i>Disagree</i>		<i>Agree</i>
1. School science is a difficult subject	1	2	3 4
2. School science is interesting	1	2	3 4
3. School science is rather easy for me to learn	1	2	3 4
4. School science has opened my eyes to new and exciting jobs	1	2	3 4
5. I like school science better than most other subjects	1	2	3 4
6. I think everybody should learn science at school	1	2	3 4
7. The things that I learn in science at school will be helpful in my everyday life	1	2	3 4
8. I think that the science I learn at school will improve my career chances	1	2	3 4
9. School science has made me more critical and sceptical ..	1	2	3 4
10. School science has increased my curiosity about things we cannot yet explain	1	2	3 4
11. School science has increased my appreciation of nature ..	1	2	3 4

- 12. School science has shown me the importance of science
for our way of living.....1 2 3 4
- 13. School science has taught me how to take better care of
my health.....1 2 3 4
- 14. I would like to become a scientist1 2 3 4
- 15. I would like to have as much science as possible
at school1 2 3 4
- 16. I would like to get a job in technology.....1 2 3 4

Responses to Appendix F (ROSE Survey), (n=60).

