Using Student-Led Classrooms to Increase Engagement, Ownership of Learning, and Academic Performance in the Mathematics Classroom

A Capstone Project
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Abstract

The purpose of this action research project was to determine if implementing a student-led classroom involving collaborative group work followed by students performing the duties of a teacher would increase student engagement, academic performance, and student ownership of learning. Students took an increased role in the learning of the classroom by teaching their peers in small groups about their findings of an inquiry-based problem set. I wanted to find if this would increase engagement in the classroom while having their sense of ownership of the learning of themselves and their peers also increase. I gathered data on engagement and ownership of learning through recorded observations, student surveys, and student interviews. Independent \( t \)-tests were used to compare common assessments of two academically similar classes, a class performing teaching duties with a class taught traditionally, to determine how student-led teaching affected academic performance. The data analysis indicated student engagement and ownership increased, while academic performance of the two classes was not significantly different.
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I’d like to thank my dog, Bailey, for she has always been a good pup. I also want to thank the good Lord, who has provided me many blessings.
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Chapter One

Introduction

For some of my secondary mathematics students, apathy and inattentiveness was a serious problem. This apathy directly hindered engagement, ownership of learning, retention of knowledge, and active participation, which I believe to be highly beneficial and educationally substantial. It was my belief that well-oiled student-led classrooms could thwart the problems of apathy and inattentiveness through student responsibility and ownership stemming from students taking charge of the classroom and the learning that takes place within it. Thus, for my project I implemented a student-led classroom in one of my two Algebra classes to determine student engagement, academic performance, and ownership of student learning increased as a result.

The student-led classroom I implemented in my Algebra class had groups of students work together on inquiry-based problem sets. Once students finished the problem sets, a group of students came to the front of the class and explained solutions, posed questions, led discussions, and helped students with concerns about the problem sets. I gradually released these teaching duties to them over time, having them effectively lead the classroom. I intended this increased responsibility to increase student engagement, academic performance, and student ownership of learning.

Motivation for the Project

My desire to find a collaborative learning teaching method that includes higher order thinking skills, while simultaneously engaging students motivated me to conduct this research project. I wanted to create a classroom setting in which students were actively engaged and involved in their daily learning. For this to happen I knew that students had to play a bigger role than traditional listening, note-taking, working on problems, and reviewing solutions. I thought
about what I could have them do to increase their engagement while still effectively learning the material. These thoughts led me to design this project in which students performed the duties of the teacher. To teach something, one must understand the material, and teaching is an active, engaging process. These benefits of teaching were what ultimately motivated me to implement my project.

**Background on the Problem**

In my classroom students were too often disinterested in the topic at hand and allowed themselves to be removed from actively learning about it. Some students chose to be inattentive and did little to nothing when possible. I believe being passive about learning has a negative effect on one’s education. This passivity can result in students not learning concepts, which leads to poor performance on assessments and a less developed mind.

Student apathy can arise from a variety of reasons including little interest in a topic, feelings of inadequacy due to poor skills, immaturity, laziness, and problems at home. I believe that finding a way to decrease apathy was worth studying and putting forth the time and effort to correct because gaining little to no knowledge in a class is unacceptable and detrimental to future learning. By becoming engaged and obtaining ownership in the learning of oneself and one’s peers, I believed students’ attitudes toward learning and concept knowledge would be heightened, making them more well-rounded and improving their chances of performing well on assessments.

**Statement of the Problem**

In my classroom, student apathy, disinterest, poor attitudes toward school and education, and lack of engagement have led to poor performance on mathematics assessments. As a result, these students gained little to no new knowledge, which further contributed to negative attitudes
that hindered learning.

**Statement of Purpose**

My purpose was to implement student-led teaching in one of my Algebra classes to increase student engagement, academic performance, and student ownership of learning. Groups of students worked together on inquiry-based problem sets. Once the problem sets were finished, a group of students explained solutions, posed questions, led discussions, and helped their peers with the problem set, essentially teaching and leading the classroom. I measured the effectiveness of student-led teaching using observations, surveys, interviews, and common assessment results comparing the traditionally taught Algebra class with the student-led Algebra class. I increased student responsibility through student-led teaching in an attempt to achieve my desired purpose.

**Research Questions and Hypothesis**

Would implementing a student-led classroom involving collaborative group work increase student engagement and student ownership of learning? Would the student-led classroom academically outperform the teacher-led classroom? I hypothesized engagement and ownership would increase, and the student-led class would have significantly higher academic performance than the teacher-led class, as a result of implementing student-led teaching.

**Definitions**

*Student-led teaching*—Students perform the duties of a teacher, such as presenting solutions, leading discussions, posing questions, answering questions, helping peers, and explaining concepts.

*Student-led classroom*—The classroom setting in which student-led teaching took place.

*Leading the classroom*—Students perform student-led teaching.
Base class—The Algebra class I taught in the traditional method in which I led this classroom, also known as the control group.

Intervention class—The Algebra class where I implemented student-led teaching, also known as the experimental group.

Summary

I implemented a student-led model of teaching in one of my Algebra classes to address the problem of apathy and disengagement by having students perform the instructional duties of a teacher. I analyzed the effectiveness of student-led teaching using observation, surveys, interviews, and common assessment results comparing the traditional Algebra class (base class) with the student-led Algebra class (intervention class). The desired results of this project were increased student engagement, academic performance, and student ownership of the learning that took place in the classroom. The methods of implementing my project were influenced and supported by the review of research literature that follows.
Chapter Two

Review of Literature

In the following chapter I summarized my analysis of several related educational topics that are critical parts of student-led teaching and described how these topics directly affect student-led teaching. Literature related to the main purposes of this project—to increase student engagement, academic performance, and ownership of student learning—is interwoven throughout various topics of student-led teaching. Each topic is supported with recent research literature. The following topics are discussed: pre-existing conditions that are conducive to student-led teaching; dynamics of a productive classroom environment; reasons for implementing student-led teaching; the teacher’s role during student-led teaching; benefits of student-led teaching; and student-led classroom factors to manage.

Pre-Existing Conditions Conducive to Student-Led Teaching

Young people have a natural child-like energy to discover the unknown, especially if they are allowed to play a bigger role in their learning. Doda (2011) wrote, “children are inherently curious and eager to learn, and will be more so when adults can find ways to step aside and give children’s natural inclinations some room to stretch” (p. 8). Trusting students by providing the opportunity to take charge of the classroom heightens their engagement and enthusiasm in learning. When students are trusted to learn for themselves, young adolescents will seek to do so with very little push from their teachers (Doda, 2011). The increased involvement and responsibility of student-led teaching nourishes the engagement that Doda described.

Successful cooperative group work is a key element of a student-led classroom. Esmonde (2009) expressed that cultural background, common communities, age, subject matter, and similar classroom experience affect the productiveness of group work. These beneficial
shared characteristics result in better group performance, and concurrently higher academic achievement.

Students have a natural productive ability to peer-teach each other. Webb, Farivar, and Mastergeorge (2002) described peers as effective explainers because they share a similar language and can translate difficult readings to common words that their peers can better understand. The ability for students to teach their peers is the most essential aspect of student-led teaching. According to Jackson, Johnson, and Askia (2010), the ability is not foreign to students; they found students taught each other so efficiently, effortlessly, and naturally, that it seldom felt like teaching and learning. Harnessing students’ innate ability to teach each other well through student-led classrooms increases the ownership the students feel from being more engaged and also their academic performance from the increased understanding students provide each other through their common language.

**Dynamics of a Productive Classroom Environment**

In order for students to feel comfortable voicing their opinions and teaching their peers, a safe classroom environment must exist. Doda (2011) stated that teachers must take time throughout the year to foster social skills that support a learning community, and when such a community is established students know each other beyond superficial impressions, cliques, and stereotypes. This community enhances ownership of the learning of students and their peers.

The efforts undertaken to familiarize students with each other are helpful to student-led teaching. For example, Patty, a teacher who implemented a similar project, developed an environment in which her students took responsibility for leading whole-class discussions. The environment was successful. Arbaugh and Avery (2009) stated, “The environment that Patty established in her classroom encouraged engagement by all students, making it safe to contribute
This safe feeling is vital to productive student sharing. Bochicchio et al. (2009) wrote that productive cooperative environments depend on students believing their contributions are meaningful and their involvement matters. When students feel safe and their contributions matter, ownership for learning increases along with the heightened engagement needed to provide meaningful contributions to the class. This type of environment has been successful in student-centered classes like Patty’s where involvement is vital (Arbaugh & Avery, 2009).

**Reasons for Implementing Student-Led Teaching**

In a classroom environment conducive to idea-sharing and one in which peer teaching has been established, the person most responsible for learning must shift from teacher to student. Various research studies have shown that students see mathematics teachers as God-like authorities who determine whether something has mathematical value and whether something is correct or not. Webel (2010) commented on the negative results of such beliefs: “Such reliance is problematic. Students who always defer to their teachers are failing to make sense of their own solutions” (p. 315). He continued to say that teachers need to shift the students’ audience of their work from teacher alone to their fellow students. Once students are required to convince their classmates, sharing ideas becomes a way to fit-in by helping each other decide what is right.

This student-led approach results in increased ownership of learning and engagement. Doda (2011) echoed Webel’s thoughts; teachers’ lessons are too often constructed in a way that places the teacher as the “sage on the stage,” rather than the more student-centered, “guide by the side.” Arbaugh and Avery (2009) described Patty’s need to reform her classroom to allow more student ownership:

This meant providing more time for them to collaborate in small groups and allowing
them the authority and opportunity to lead whole-class discussions with less input from me. Only by turning over to them the entire experience of learning, would they learn how to learn. (p. 9)

The increased ownership inherent in student-led teaching helps students learn how to learn, which in turn increases their academic performance. The preceding comments clearly indicate the need to have students more engaged in their learning. Student-led classrooms provide this type of engagement.

Romanin (2011) said that students are most unengaged, unmotivated, and unsuccessful in classrooms where teachers are doing all the talking. Student-led teaching allows students to do the talking and the doing. Pazos, Micari, and Light (2010) emphasized the importance of increased engagement; a vast quantity of evidence exists that students who are more engaged by wrestling with problems and expanding their answers learn better than students who just find the correct answer. The student-led structure of wrestling with inquiry-based problems, followed by students presenting their solutions to their peers, raises ownership and engagement.

At a middle school in Newark, New Jersey, certain students have been responsible for teaching their peers. Jackson et al. (2010) described the engagement of these students: “In Newark, New Jersey, middle school students are taking over the classrooms—and the excitement is palpable and contagious” (p. 60). Jackson et al. indicated teachers realized that empowering students through more ownership of learning changed the classroom climate for the better.

The excitement exhibited by students leading the classroom increases student ownership in learning and its resulting benefits. Doda (2011) said that student ownership produces personal investment and accountability. Increased student ownership of learning is produced when students know they have an authentic audience to help learn.
The authentic audience of student-led teaching is students’ peers. In this setting, students depend on their peers to review work and consolidate and enhance findings. The most productive way to engage students is to create an authentic audience for them besides their teacher and parents. By doing this, students know their audience is affected by their work (Levy, 2008). An authentic audience raises academic performance when student work culminates in a genuine product for receivers of the work who value it. According to Levy (2008), this creates a world of difference in student learning, engagement, and academic achievement. “When students work on curriculum standards in the context of producing a genuine product for an authentic audience, the result is enhanced achievement in the content-area knowledge, literacy, craftsmanship, and character” (Levy, 2008, p. 79).

Teaching an authentic audience requires students to know the content beyond the superficial level, thus resulting in higher academic performance. According to Webb et al. (2002), students must be willing to give elaborate help and be able to clearly provide explanations that are meaningful to the audience. The benefits of this work are true comprehension of the topic, knowing the difference between providing answers and providing detailed help, and the knowledge to express answers clearly. When students express and defend their findings and question others’ ideas in a student-led classroom, the interaction helps students recognize and repair inconsistencies in their own thinking. This results in heightened academic knowledge and performance (Webb et al., 2002).

Students do not need to be correct 100 percent of the time for student-led teaching to be successful. Mistakes or incorrect conclusions by students are a part of student-led teaching and can result in increased academic performance. Mistakes can serve as starting points for valuable learning. Arbaugh and Avery (2009) said that wrong ideas and answers are not failing and
actually create opportunities for deeper learning as classmates will usually notice and suggest corrections. Bochicchio et al. (2009) expressed the benefits of wrong answers:

Exploring incorrect solutions can serve as a springboard for discussion. It gives a focus to the discussion and engages students in figuring out why an idea does or does not make sense. This move can help address common misconceptions, refine student thinking, prompt metacognition, and engage students in developing hypotheses. (p. 609)

Increased engagement and academic knowledge result from using mistakes in a positive way.

Students will also ask questions when leading the classroom. According to Arbaugh and Avery (2009), effective questioning begins when students learn to lead large-class discussions by asking questions, instead of using the less beneficial “show and tell” act. Questions engage both the students who ask them and the students who answer them.

The Teacher’s Role During Student-Led Teaching

Once students begin leading their peers, the teacher’s role plays an integral part in successful student-led classrooms. According to Doda (2011) by giving students the right amount of leeway, or the gradual release of responsibility, teachers allow students’ leadership abilities to blossom in due time. Arbaugh and Avery (2009) described Patty doing this in her classroom. When beginning a project similar to student-led teaching, throughout the course of a few weeks Patty began to move away from the front of the room while students began to lead discussions. This allowed her to relinquish being the focal point of the room and direct instruction less and less each class period. Instead, she contributed more by questioning and encouragement from the side and less by stating directions from the front.

Balancing the level of teacher involvement is important. Arbaugh and Avery (2009) described the right level of teacher involvement when describing Patty’s classroom: “Patty did
not fade into the background completely during this discussion. Her role as teacher was especially important in helping her students connect important mathematical concepts” (p. 12). Choosing the correct amount of teacher involvement, especially when students take a glaring wrong turn in concept understanding, is key to the success of student-led classrooms. Teachers can check and redirect student behavior to ensure productive levels of student engagement, ownership, and academic performance.

Students must also be instructed to provide thorough explanations for their solutions. Bochicchio et al. (2009) described the importance of this:

For discussions to be mathematically productive, the teacher must encourage students to articulate why their idea or solution is mathematically sound. Promoting justification maintains a level of rigor during discussions and helps students become more aware of their own thinking, more explicit about articulating ideas they are connecting, and more adept at judging the validity of mathematical arguments. (p. 609)

Providing justification to answers is a natural part of student-led teaching. The justification students provide while explaining solutions is at a higher level of justification than simply writing an answer on paper, and as a result, raises academic performance. In student-led teaching, mathematical justification not only is about understanding why a solution is correct, it also encompasses convincing others why the solution is correct.

In a student-led classroom, student justification increases ownership of learning as it allows students to be owners of mathematical authority. According to Webel (2010), when students provide mathematical justifications for their solutions, their legitimacy is not solely determined by the teacher, it is established by a peer-driven process of presentation, negotiation, revision, and agreement. Such increased responsibility increases student ownership and
engagement through increased involvement and purpose of their work. More detailed mathematical justifications provide evidence that mathematical concepts are understood and academic knowledge is gained.

**Benefits of Student-Led Teaching**

Once students become comfortable in their role as leaders, and the teacher exhibits an appropriate level of intervention with the student leaders, a student-led classroom can provide many rich educational and character benefits. According to Doda (2011), when students are allowed to take more responsibility for their learning, their intellectual and social capacities increase. Doda also stated that increased decision-making develops more advanced critical thinking skills, empathy, social skills, and instills dignity and self-respect. An additional benefit is increased student involvement. Allowing students to take charge of classroom learning is a powerful form of motivation that develops skills in young people that better equip them to be vital members of classrooms, teams, schools, and communities. Student-led teaching benefits students by not only increased engagement and ownership, but it also instills valuable life skills (Doda, 2011).

According to Jackson et al. (2010), having students teach is a powerful activity; it builds self-direction and competence as teachers and learners. In their role as teachers, students increase ownership of classroom activities and develop confidence and poise. Jackson et al. (2010) concluded that, as teachers, middle school students assumed a sense of responsibility and purpose that transformed them to more well-rounded individuals.

According to Arbaugh and Avery (2009), Patty also expressed these benefits in her descriptions of student-led teaching. Students learned leadership skills, thought on their feet, developed public speaking skills as well as people skills, displayed courage, increased their
confidence, learned how to prepare, and developed empathy for the struggles of others. Students learned to be self-reliant and collaborate well in groups; they learned to articulate and justify thoughts; listen to others; communicate well; reflect on their thinking; become better readers of technical material; develop better questions; and became advocates of their learning. Patty added, “When students lead class discussions, they justify their own thinking, examine the ideas of others very carefully, and become critical friends to one another” (Arbaugh & Avery, 2009, p. 14). Finally, she echoed the increased ownership students achieved; students relied on themselves as the authority of mathematics. The many benefits of student-led teaching suggest student engagement, ownership, and academic performance can increase when students lead the classroom.

**Student-Led Classroom Factors to Manage**

While a student-led classroom is extremely beneficial, developing students to become the leaders of their education and the mathematical authority in the room has its growing pains.

Patty described these growing pains as a continual work in progress, evolving as it goes, and at times messy, noisy, and time-consuming (Arbaugh & Avery, 2009). Some days students will do better than others, and teachers need to be patient. It takes time for both students and the teacher to adapt to this form of teaching. Doda (2011) agreed, “this is not something that will develop overnight” (p. 10).

**Summary**

The benefits of a student-led classroom far outweigh the drawbacks. Eighth-grade students are young enough to be eager to learn and have a desire to seek out the unknown and share their findings with others if inspired to do so. Students perceive the world similarly, which naturally allows them to easily explain concepts to one another. Students are more engaged and
have more ownership in the classroom when they know they are responsible for teaching others, their audience is authentic, and their classmates rely on them for learning. Ownership for student learning increases with increased responsibility. In addition, academic performance increases when students are aware that they are the mathematical authority in the room and demonstrate that authority by leading others through well-thought-out academic work. Simply put, students have the natural ability to effectively teach their peers with a little guidance, and by leading their peers increase engagement, ownership of learning, and academic performance. Leading the classroom in this way is highly beneficial. The development of my student-led classroom and the methods involved are described in the following chapter.
Chapter Three

Research Design and Method

I implemented student-led teaching to try to increase student engagement, academic performance, and ownership of their learning and the learning of their peers. The setting of my classroom, the design of my plan, the specific details of how my project was carried out, assessment methods, analysis methods, expected results, and timeline are described below.

Setting

I was 25 during this study and in my third year of teaching eighth-grade mathematics. I have taught for three years, all at a middle school in North Dakota. Although I taught three sections of Pre-Algebra and two sections of Algebra, I only implemented my project in one of my Algebra classes (experimental group), and I used my other Algebra class as a base class for comparison (control group). The chosen Algebra course was designed to challenge eighth-graders who were advanced in math. The textbook used for this class was *Impact Mathematics Course 3* (Ruopp, 2009). The course was more challenging than a typical algebra class as it was more exploratory and inquiry-based, and the level of questioning was higher than a normal algebra course.

I chose to implement student-led teaching with my Algebra students instead of my Pre-Algebra students because in my past two years of teaching I have observed that my Algebra students are more inclined to ask questions, participate in discussions, and seek and search out solutions on average than my Pre-Algebra students.

Intervention/Innovation

I taught my second period Algebra class using the standard format of myself leading the classroom (base or control class). I used this class to provide comparative data with my first
period Algebra class where the intervention took place (intervention or experimental class). The comparison between the two Algebra classes provided information on whether or not the intervention class outperformed the base class. Before the intervention started, I compared all quiz and test results of the two classes using a $t$-test of independent samples. The results of the $t$-test yielded no significant difference between the base and intervention classes. This showed the base class and intervention class were academically comparable; thus, comparing all quiz and test results during the intervention provided evidence to determine whether student-led teaching increased academic performance. The bulk of the statistical analysis is found in Chapter Four.

In the intervention class students led the classroom. This means that, after the class completed an inquiry-based problem set, a group of three or four students led discussions, answered questions, and helped their classmates with the problem set instead of me.

By the time I began my project, students had worked in groups on inquiry-based problem sets (see Appendix A for an example) for several weeks prior to having students lead the classroom. In preparation for students fully leading the classroom, I had groups of students come to the front of the class for a short period of time so they became comfortable being in front of their peers while discussing math topics. I also gave my students a guide that explained to them what I expected during student-led teaching and spent 30 minutes thoroughly explaining it and answering questions about it. This form is located in Appendix B. I also modeled how to effectively lead the classroom and demonstrated some effective and ineffective leading strategies to help them be more comfortable and prepared to lead when it was their time to do so.

Once I prepared students for leading the classroom, I had one group of students at a time lead the classroom on days when the lesson or activity lent itself well for it. A group did not lead the classroom every day, but rather a group led the classroom every time a lesson lent itself to
students answering inquiry-based questions, helping their peers, and leading discussions. Each group led the classroom four times. On the days that students led the classroom I informed the group at the beginning of the class period that they would be leading the classroom for the day. During these days I provided a short mini-lecture on the topic at hand to the class, giving all students a foundation to build upon. The groups then worked on their problem sets that were completed in-class with time to spare. Once the groups finished I moved to the back of the classroom while the group chosen to lead the classroom that day came to the front of the class and reviewed answers, asked questions, helped their peers, and led discussions over the problem set that they just completed in class. The groups were not responsible for leading any material that was not contained in the in-class problem set they completed that day in class.

During days in which student-led teaching was used I made observational notes regarding engagement, academic performance, and ownership in my research journal, and any other notes that I thought to be educationally relevant. When a group of students was leading the classroom, I intervened only when answers and discussions were significantly off track, or when students were not staying on task or causing behavioral issues; however, I stayed away from becoming involved in any way as much as I possibly could, as it is the students’ job to have ownership for the learning of themselves and their peers. At times I even ignored direct questions to me and remained silent and let the students realize that they were responsible for the learning of the class. Once the problem sets were fully reviewed and the discussion of the topic was exhausted, I regained control of the classroom. This was the normal procedure on days where students led the classroom. On two occasions, I informed a group in advance that they would be responsible for leading the classroom over the day’s homework the next day at the beginning of the class instead of leading a same day in-class problem set. On these occasions, all expectations and
procedures of leading the classroom remained consistent.

**Design**

I used a mix of qualitative and quantitative methods of data collection. I used qualitative methods of observation notes, interviews, and survey results including open-ended questions. These methods helped me answer the question of whether using student-led teaching helped increase engagement and ownership, as quantitative analysis falls short to provide answers to these questions. When analyzing the qualitative data I used inductive analysis to determine common themes and results.

I used quantitative data to determine if student-led teaching increased academic performance. I assessed both Algebra classes with the same assessments and compared the results of the two classes, the one with student-led teaching (intervention class) and the one with myself leading the classroom (base class). I compared all quiz and test results prior to project implementation to determine if one class was mathematically stronger than the other. Once the intervention concluded, I compared all quizzes and tests during intervention to see if the student-led class performed significantly better than the teacher-led class. I then compared the pre-intervention and post-intervention assessment comparisons of the two classes to determine if student-led teaching caused increased academic performance. Qualitative methods fall short of measuring performance as a student may say that they learned more or less, but these comments may be inaccurate. The numerical assessment data provided me with concrete evidence of performance, which is the greatest quality of the quantitative analysis used in this study.

I recorded the non-open-ended survey results, assigned numerical values to the answers, and used these data to help answer the question of whether involvement and ownership improved. Together, the qualitative and quantitative results were used to help me answer the
research questions, and triangulation of these results increased validity and trustworthiness of the results.

**Description of Methods and Analysis Strategy**

Approval from Minot State University’s Institutional Review Board (IRB) was granted prior to the start of the study (see IBR approval letter in Appendix C). Three weeks before students began leading the classroom, I sent home parent/guardian letters of permission to both Algebra classes (see Appendices D and E) that were signed and returned to me. These letters detailed what took place during my study and gave me permission to use student data gathered during my study in the results of this study. I explained to parents/guardians that none of their students’ names would appear in my report, all information would remain strictly confidential, and results would be reported anonymously. They were informed that everything was kept in a locked file cabinet or kept in files on my password-protected computer, and all documents would be destroyed once my master’s degree is earned. I obtained permission from my principal using the form in (see Appendix F) and student assent (see Appendices G and H) to participate in my study.

Once student-led teaching began, I recorded observational data in my researcher’s journal to document how group work was affected by students knowing they would lead the classroom, answer student questions and concerns, and other interesting occurrences related to the project. I also recorded common themes, questions, comments, and discussion topics that took place while students led the classroom. I noted any differences in behavior that students exhibited while having their peers lead the classroom compared to when I led it. These observations were recorded every day of student-led teaching. Once the nine-week intervention was over, I qualitatively analyzed my research journal and found common themes. These observation notes
and the common themes that arose through my qualitative analysis helped me determine if student engagement and ownership increased, and they also helped shed light on new dynamics that this project brought about that I had not considered yet.

Throughout the nine weeks I recorded the score from every common assessment (see Appendix I for an example) that I gave to both the base class and the intervention class. I took the assessment results for both classes and used them for comparison to determine if the student-led intervention class outperformed the traditionally taught base class. I recorded each student’s results on each assessment, and used the data to compare the two classes using $t$-tests to determine if student-led teaching caused the intervention class to perform significantly better than the base class.

Once the intervention was finished I gave my intervention class a survey that measured their engagement, ownership, and other educational aspects concerning student-led teaching (see Appendix J). I gathered these results, assigned numerical values to the rating scale on the survey, and computed statistical results to determine any common results and themes that arose, including measures of central tendencies. The survey also contained two open-ended questions that allowed students to freely write their thoughts about student-led teaching. These data were key in helping me answer my research questions.

I calculated the mean, median, frequencies, and percentages for appropriate quantitative data. When comparing assessment results I used a 95% confidence level (or 0.05 level of significance) and a $t$-test of independent samples to determine if the intervention class had significantly higher academic performance than the base class. Academic performance was measured using identical quizzes and tests administered to both classes. My null hypothesis was no difference in academic performance of the base and intervention classes, and my alternative
hypothesis was the intervention class would have higher academic performance.

I also conducted student interviews with six of my twenty-one students of my interventions class (see Appendix K). I selected students whose engagement varied from being very engaged to having very little engagement; three males and three females were selected. The interview questions were open-ended and designed to allow students to freely express their thoughts, concerns, likes, and dislikes related to student-led teaching. Once I collected all interviews and surveys, I analyzed the interviews and answers to the open-ended items on the survey for common themes through an inductive analysis. This analysis helped me answer the questions concerning increased student engagement and ownership, and also shed light on dynamics of student-led teaching that I had not considered before.

Once all data were collected I finalized my results. I used triangulation on the qualitative and quantitative aspects of my project to ensure that my findings were as unbiased and accurate as they could be. I used member checking for both my interview and survey results. When I felt comfortable with my results, I shared them with the intervention class to see if their perceptions matched my results. This process of triangulation provided another check of quality for my study.

**Expected Results**

I hypothesized engagement, academic performance, and ownership would increase as results of the intervention. I also expected lack of time to implement student-led teaching in the best possible way would be a problem throughout the intervention. I predicted students would use more time than I use when leading their peers, as they do not have training in mathematics and pedagogy, increasing the time it takes to teach the concepts. Also, because of this lack of training I expected students to stumble through teaching their peers from time to time. Arbaugh
and Avery (2009) supported this type of process by stating, “This type of student-centered learning is messy and slow” (p. 14).

**Timeline for the Study**

The intervention took nine weeks, while the data collection of administering the surveys and interviews took an additional two. Completing the qualitative and quantitative analysis, compiling and writing the results, and methods of triangulation for checks of quality took six weeks beyond the completion of the project implementation.

**Summary**

Throughout the nine-week intervention, one of my Algebra classes was provided the intervention of a student-led classroom. The results of this process in which a group of students answered questions, led discussions, and helped peers with an inquiry-based problem set were compared to my other Algebra class where I led the classroom. Through observations, surveys, interviews, and common assessments with the base class, I gathered multiple forms of data and used these to determine if student-led classrooms increased engagement, academic performance, and ownership in my Algebra classes. The results of this study are provided in the next chapter.
Chapter Four

Results and Interpretations

My study investigated whether using a student-led model of teaching in which students took a more active role in their learning and the learning of their peers increased student engagement, academic performance, and ownership of the learning that took place in the classroom. During the intervention, groups of students performed the duties of a teacher when teaching, reviewing, answering questions, and leading discussion about an inquiry-based problem set. After the intervention, all students took a survey, and some students were interviewed on questions concerning engagement, academic performance, and ownership of learning. Identical assessments were given to the student-led class and the base class prior to and during the intervention. The analysis of these results determined if academic performance increased. This chapter includes the results from the surveys, interviews, assessments, and research journal, including the conclusions they yielded.

Results of Data Analysis

Survey. The first instrument, the survey (see Appendix J), was administered after the intervention and was used to collect data on students’ thoughts about how student-led teaching affected their ownership and engagement. I analyzed the survey data quantitatively for the thirteen single-response items in which students indicated their level of agreement (strongly disagreed, disagreed, no opinion/neutral, agreed, or strongly agreed). All thirteen items, except item 1, involved students’ perceptions of how student-led teaching affected their engagement, academic performance, and ownership in the learning experience. Item 1 measured how normally interested they were in learning mathematics. Although I took into account the students’ thoughts on how student-led teaching changed their academic performance, I did not
use these item results to make my final conclusion on how academic performance was affected since the assessment analysis better determined this.

The results from the quantitative analysis of the thirteen items are found in Table 1. This table lists the percent of students who chose each selection rounded to the nearest tenth of a percent. For all items, except item 1, the “agree” and “strongly agree” results indicate a perceived increase in engagement, academic performance, and ownership depending on the item. The “neutral” results indicate no perceived change, and the “disagree” and “strongly disagree” show a perceived decrease in engagement, academic performance, and ownership. Item 1 was not used in the following analysis.

The items showing the greatest perceived increases, those in which 75% or more of students marked “agree” or “strongly agree,” were items 2, and 4. These two items involved engagement in the classroom: item 2 was about increased effort to learn the material; and item 4 involved working better on in-class group work prior to leading the classroom.

The items displaying substantial but less dramatic perceived increases, those in which 50-75% of students marked “agree” or “strongly agree,” were items 3, 5, 6, 8, and 10. Item 3 concerned paying closer attention to teacher explanations and item 5 concerned students’ thoughts on academic performance and whether they learned the material better by leading the classroom. Items 6 and 10 were about increased ownership in the learning process: item 6 was about feeling a greater sense of responsibility; and item 10 was about being more willing to participate in class. Item 8 involved engagement; it asked if students were more interested during class when their peers led compared to the teacher leading it.
Table 1

*Student Survey Choice Percentages*

<table>
<thead>
<tr>
<th>Item</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am normally interested in learning mathematics.</td>
<td>14.3%</td>
<td>9.5%</td>
<td>19.0%</td>
<td>52.4%</td>
<td>4.8%</td>
</tr>
<tr>
<td>2. When it was my turn to lead the classroom, I made a greater effort</td>
<td>0.0%</td>
<td>9.5%</td>
<td>4.8%</td>
<td>61.9%</td>
<td>23.8%</td>
</tr>
<tr>
<td>3. When it was my turn to lead the classroom, I paid more attention</td>
<td>0.0%</td>
<td>4.8%</td>
<td>23.8%</td>
<td>61.9%</td>
<td>9.5%</td>
</tr>
<tr>
<td>4. When it was my turn to lead the classroom, I worked better with</td>
<td>0.0%</td>
<td>4.8%</td>
<td>14.3%</td>
<td>76.2%</td>
<td>4.8%</td>
</tr>
<tr>
<td>5. Leading the classroom helped me to learn the material better.</td>
<td>4.8%</td>
<td>9.5%</td>
<td>28.6%</td>
<td>42.9%</td>
<td>14.3%</td>
</tr>
<tr>
<td>6. I felt a greater sense of responsibility for my peers learning</td>
<td>0.0%</td>
<td>4.8%</td>
<td>38.1%</td>
<td>42.9%</td>
<td>14.3%</td>
</tr>
<tr>
<td>7. I was more interested in class when it was my turn to lead the</td>
<td>0.0%</td>
<td>14.3%</td>
<td>47.6%</td>
<td>28.6%</td>
<td>9.5%</td>
</tr>
<tr>
<td>8. I was more interested when my peers led the classroom compared</td>
<td>0.0%</td>
<td>9.5%</td>
<td>33.3%</td>
<td>33.3%</td>
<td>23.8%</td>
</tr>
<tr>
<td>9. I was more willing to question my peers when they led the class-</td>
<td>0.0%</td>
<td>14.3%</td>
<td>38.1%</td>
<td>33.3%</td>
<td>14.3%</td>
</tr>
<tr>
<td>10. I was more willing to participate in discussions when my peers</td>
<td>0.0%</td>
<td>4.8%</td>
<td>33.3%</td>
<td>38.1%</td>
<td>23.8%</td>
</tr>
<tr>
<td>11. I learned better from my peers leading the classroom than when</td>
<td>9.5%</td>
<td>4.8%</td>
<td>42.9%</td>
<td>19.0%</td>
<td>23.8%</td>
</tr>
<tr>
<td>12. I feel more comfortable in front of a group of people than I</td>
<td>0.0%</td>
<td>9.5%</td>
<td>47.6%</td>
<td>38.1%</td>
<td>4.8%</td>
</tr>
<tr>
<td>13. I feel more confident teaching and helping others as a result</td>
<td>4.8%</td>
<td>14.3%</td>
<td>42.9%</td>
<td>28.6%</td>
<td>9.5%</td>
</tr>
</tbody>
</table>
The remaining items, 7, 9, 11, 12, and 13 showed moderately positive results, as between 30 and 50 percent of students marked “agree” or “strongly agree.” Item 7 concerned engagement and increased interest when it was the student’s turn to lead the classroom. Items 9, 12, and 13 concerned ownership of learning: item 9 was about being more willing to question other’s findings; item 12 was about being more comfortable in front of a group of people; and item 13 involved feeling more confident teaching and helping others as a result of student-led teaching. Item 11 had the largest percentage of students mark “strongly disagree” with 9.5%, and item 13 had the largest percentage of students mark “strongly disagree” or “disagree” with 19.1%.

Table 2 displays the values for the mean and median measures of central tendency. It also includes the number of responses, and minimum and maximum values for each survey item. In order to quantify the data, numeric values were given to each of the response categories. A value of one was assigned to “strongly disagree;” two was assigned to “disagree;” three was assigned to “neutral;” four was assigned to “agree;” and five was assigned to “strongly agree.” Means were rounded to the nearest tenth of a percent.

Of the twelve items measuring the perceived effects of student-led teaching, item 2 had the greatest mean, followed by items 3, 4, and 10. Items 7, 11, 12, and 13 were the only items with a mean under 3.5, with item 13 having the lowest mean of 3.2. All items had a median of 4 except for items 7, 9, 11, 12, and 13, which had a median of 3. The mean and median results are consistent with one another.

Most items had a range of 3. Since the maximum for each item was 5 and the minimum was either 1 or 2, students answered between “disagree” to “strongly agree” on all the items with a range of 3. Items 5, 11, and 13, which all had a range of 4, had every choice selected at least once by a student.
Table 2

*Measures of Central Tendency*

<table>
<thead>
<tr>
<th>Item</th>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am normally interested in learning mathematics.</td>
<td>21</td>
<td>3.2</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2. When it was my turn to lead the classroom, I made a greater effort to learn the material because I knew I would be leading the classroom.</td>
<td>21</td>
<td>4.0</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3. When it was my turn to lead the classroom, I paid more attention to the teacher explaining things.</td>
<td>21</td>
<td>3.8</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>4. When it was my turn to lead the classroom, I worked better with my group members.</td>
<td>21</td>
<td>3.8</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>5. Leading the classroom helped me to learn the material better.</td>
<td>21</td>
<td>3.5</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>6. I felt a greater sense of responsibility for my peers learning and myself learning when I led the classroom.</td>
<td>21</td>
<td>3.7</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>7. I was more interested in class when it was my turn to lead the classroom.</td>
<td>21</td>
<td>3.3</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>8. I was more interested when my peers led the classroom compared to the teacher leading it.</td>
<td>21</td>
<td>3.7</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>9. I was more willing to question my peers when they led the classroom compared to when the teacher led it.</td>
<td>21</td>
<td>3.5</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>10. I was more willing to participate in discussions when my peers led the classroom compared to when the teacher lead it.</td>
<td>21</td>
<td>3.8</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>11. I learned better from my peers leading the classroom than when the teacher led it.</td>
<td>21</td>
<td>3.4</td>
<td>3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>12. I feel more comfortable in front of a group of people than I did before leading the classroom.</td>
<td>21</td>
<td>3.4</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>13. I feel more confident teaching and helping others as a result of leading the classroom.</td>
<td>21</td>
<td>3.2</td>
<td>3</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

The survey also contained two open-ended items, items 14 and 15, for which students wrote about their likes, dislikes, and activities that helped and hurt their learning during the student-led experience. I looked for common themes in their responses to help me answer my
research questions and other themes that were relevant to the effectiveness of student-led
classrooms.

Item 14 read, “Write about the things you liked about the student-led classroom
experience. What did you enjoy? How did it help you learn better compared to the teacher
leading the classroom?” Student responses were themed and tallied using qualitative analysis.
Results are found in Table 3.

Table 3

<table>
<thead>
<tr>
<th>Student Responses to Item 14</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liked learning from their peers</td>
<td>7</td>
</tr>
<tr>
<td>Liked working in groups</td>
<td>6</td>
</tr>
<tr>
<td>Had to know the material in order to present well</td>
<td>4</td>
</tr>
<tr>
<td>Felt it was easier to participate</td>
<td>4</td>
</tr>
<tr>
<td>Felt less intimidated to get involved in the class</td>
<td>2</td>
</tr>
<tr>
<td>Thought it was fun to teach others</td>
<td>2</td>
</tr>
<tr>
<td>Worked harder</td>
<td>2</td>
</tr>
<tr>
<td>Developed leadership skills</td>
<td>2</td>
</tr>
</tbody>
</table>

Note that the most frequent benefit the students listed was that they enjoyed learning
from their peers with a frequency of 7. The second most beneficial aspect of student-led
teaching was students working in groups with a frequency of 6. Four times students mentioned
they felt they had to know the material better in order to present it, and four times they
mentioned they felt it was easier to participate.

Item 15 read, “Write about the things you disliked about the student-led classroom
experience. What you did not enjoy? How did your learning suffer compared to the teacher
leading the classroom?” Student responses were themed and tallied using qualitative analysis.
Results are found in Table 4.
Table 4

**Student Responses to Item 15**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Had difficulties learning from peers leading the classroom because of poor explanations or lack of explanation</td>
<td>8</td>
</tr>
<tr>
<td>Had general difficulties learning from peers leading the classroom</td>
<td>5</td>
</tr>
<tr>
<td>Had difficulties learning from peers leading the classroom because of uncertainty that their answers were correct</td>
<td>5</td>
</tr>
<tr>
<td>Disliked presenting</td>
<td>4</td>
</tr>
<tr>
<td>Disliked presenting because peers would know that their answer was incorrect if it was so</td>
<td>2</td>
</tr>
</tbody>
</table>

From the results of Table 4, it is clear to see the biggest dislike of student-led teaching was students struggling to learn from their peers. Eight times students mentioned it was difficult to learn from peers due to a poor or lack of explanation. Five times students mentioned they had general difficulties learning from their peers, and five times they mentioned they had difficulties learning because they were uncertain their peers’ answers were correct. Four students said they simply disliked presenting in general.

It is interesting that both the greatest like and dislike of student-led teaching was students learning from their peers. This is not too surprising however since the heart of student-led classrooms is students teaching other students; ergo, when students teach each other well it is of great benefit, and when students teach each other poorly it is a great hindrance of learning.

**Interviews.** Interviews were conducted after the intervention and used mainly to provide data on engagement and ownership of student learning during the study, and which characteristics of student-led teaching were conducive or unfavorable to engagement and ownership. Questions about academic performance were asked and used to identify and provide
insight into academically helpful or hurtful characteristics of student-led teaching, and were not used to determine if academic performance increased.

I conducted interviews of six students after the intervention. The students had diverse characteristics; three were male, and three were female. Some were outspoken, and some were reserved. Some had been doing very well academically while others struggled. I picked these students to represent the diversity in my classroom. I recorded each of the six interviews and qualitatively analyzed them and found common themes for each question. The results are listed in Table 5 according to theme, questions students related to the theme, and frequency of question related to a specific theme. The interview questions asked can be seen in Appendix K.

A frequency of 6 means all six students commented on that common theme for a particular question. A frequency of 5 means 5 students commented on that common theme for a particular question and so forth.

A common theme arose twice for a particular question during all six interviews. On question one, “How did knowing that it was your turn to lead the classroom affect your group’s work?” all six students stated that it caused their group to work better. When the follow up question was asked, “What accounted for this change?” all students thought they had to know the material better in order to lead the classroom well.

A common theme arose twice for five of the six students when asked a particular question. On question 7, “Were you more willing to get involved in answering questions and class discussions when your peers led the classroom?” five students indicated they were more willing to get involved to answer questions and participate in discussions compared to when the teacher led the class. Question 2 also had five students comment the same way when asked how
their comfort level leading the classroom changed over time. They noticed a notable increase in their comfort level the more times they led the classroom.

Table 5

<table>
<thead>
<tr>
<th>Theme</th>
<th>Question Students Related to the Theme</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caused student to work in groups better</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Caused student to know the material better in order to lead well</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Student stated there was no difference between the effect of student-led teaching verses traditional teaching.</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Student stated and increase or better effect of student-led teaching compared to normal teaching</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Student stated a lesser or worse effect of student-led teaching compared to traditional teaching</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Student liked leading</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Student liked learning from peers</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student disliked leading</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student felt more ownership for the learning that took place in the classroom</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Caused student to focus better</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Student was influenced by fear of embarrassment</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Learning was benefited because peers would provide assistance</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Students comfort level increased over time</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

Four times did four of the six students respond with a common theme when asked the following questions. For question 3, “How did being in front of the classroom leading your
peers affect your learning?” four students thought it caused them to learn the material better. The same theme arose for question 4, “How did leading the classroom affect your sense of ownership for learning?” Four of the six also thought they had more ownership for the learning that took place in the classroom, as a response to this question. On question 8, four students stated there was no difference in their learning when students led the class and when the teacher led the class. One stated his or her learning improved, and the other stated his or her learning suffered because of students leading the classroom.

Some other interesting results from the interviews were three students felt their learning was positively affected from leading the classroom because their peers provided assistance when they ran into uncertainties while leading. Four total comments were made throughout the interviews about being motivated to work well in groups and to present adequately due to fear of being embarrassed in front of their peers while leading.

Question 6, which asked students how their engagement was while their peers led the classroom, caused a variety of responses from the interviewees. Two students said their engagement level did not change when their peers led the classroom. Another said engagement increased. One student said her engagement decreased when her peers led the classroom because she was unsure that her peers were presenting correct answers or not. Her explanation for this follows: “When my other friends are teaching up there I feel like I’m not learning what I need to learn. With you up there, you’re the teacher and you’re teaching me everything I need to know.” The other two students said their engagement increased or decreased depending on the effectiveness of the group leading the classroom. One student stated the following: “I was more interested and more engaged but when they didn’t do it right and they didn’t know how to correct it, it turned into a whole shouting war of who could get their point across first so it was
negative in that sense.” One student said he was more engaged when I was teaching most of the
time: “You don’t know if they are teaching it all right or all wrong so when you have a teacher
up there you know that you know what you’re talking about.” However this student said he
became more engaged when a discussion took place because, “You don’t really know if it’s (the
answers from the group that is leading) right or not, so you have to discuss if it’s wrong or right.”

The quality of students’ explanations was the main comment to question 10, “What
suggestions do you have to make student-led classrooms more effective?” Two students
suggested having all questions be more involved so there are less one-word answers/explanations
by students. Another student suggested I give the correct answers to students to they can provide
good explanations. Two students commented that it would be a good idea not to tell which
group would be presenting until the end of group work because they admitted that they did not
work as hard when they knew it was not their turn to present.

Common assessments. The next method I used was a quantitative statistical analysis of
common assessments given to both the intervention class and base class before and during the
study. The result of this analysis was used to determine if the academic performance of the
intervention class with student-led teaching was significantly greater than the base class with
traditional teacher-led teaching.

The descriptive statistics of the common assessments given to the base and intervention
classes before the intervention are presented in Table 6. To determine if the base and
intervention classes initially had comparable mathematical performance, I ran t-tests of
independent samples to compare the common assessments given to the base and intervention
classes before the intervention. For each assessment, my null hypothesis was no difference
between the means of the two classes, and my alternative hypothesis was a significant difference
using a 0.05 significance level. Table 7 shows the results of the analysis of the common assessment given to both Algebra classes prior to the intervention. The means of the intervention class are represented by $\mu_I$, and the means of the base class is represented by $\mu_B$.

Table 6

*Descriptive Statistics of Assessments Given Before the Intervention*

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Intervention Class</th>
<th>Base Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td>1.1 Quiz</td>
<td>20</td>
<td>14.500</td>
</tr>
<tr>
<td>1.3 Quiz</td>
<td>20</td>
<td>17.200</td>
</tr>
<tr>
<td>Linear Test</td>
<td>21</td>
<td>38.238</td>
</tr>
<tr>
<td>Quadratics Quiz</td>
<td>21</td>
<td>16.143</td>
</tr>
</tbody>
</table>

Table 7

*T-Test Results of Assessments Given Before the Intervention*

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Difference</th>
<th>Difference in Sample Means</th>
<th>Standard Error</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Quiz</td>
<td>$\mu_I - \mu_B$</td>
<td>0.147</td>
<td>0.483</td>
<td>34.975</td>
<td>0.304</td>
<td>0.763</td>
</tr>
<tr>
<td>1.3 Quiz</td>
<td>$\mu_I - \mu_B$</td>
<td>-0.356</td>
<td>0.842</td>
<td>35.561</td>
<td>-0.422</td>
<td>0.675</td>
</tr>
<tr>
<td>Linear Test</td>
<td>$\mu_I - \mu_B$</td>
<td>-0.484</td>
<td>1.036</td>
<td>36.263</td>
<td>-0.467</td>
<td>0.643</td>
</tr>
<tr>
<td>Quadratics Quiz</td>
<td>$\mu_I - \mu_B$</td>
<td>0.087</td>
<td>0.581</td>
<td>33.161</td>
<td>0.150</td>
<td>0.881</td>
</tr>
<tr>
<td>Quadratics Test</td>
<td>$\mu_I - \mu_B$</td>
<td>-1.214</td>
<td>1.070</td>
<td>34.459</td>
<td>-1.135</td>
<td>0.264</td>
</tr>
</tbody>
</table>

*Note. df = degrees of freedom*

Since the $p$-values of each test are greater than 0.05, I failed to reject my null hypothesis. Hence, the assessment means of the base class and intervention class before the intervention took place were not significantly different. This means that the two classes were academically comparable regarding assessment performance before student-led classroom was implemented.
Table 8 includes the descriptive statistics of the common assessments given to the base and intervention classes during the intervention. Table 9 shows the results of the $t$-test analysis comparing the common assessment means of the two classes during the intervention. For each assessment, my null hypothesis was no difference between the means of the two classes, and my alternative hypothesis was the mean of the intervention class would be significantly greater than the mean of the base class using a 0.05 significance level. Since the $p$-values for all three assessments were above 0.05, the intervention class did not have significantly higher mean scores on the assessments given during the intervention than the base class; thus, the intervention class did not outperform the base class during the intervention.

### Table 8

*Descriptive Statistics of Assessments Given During the Intervention*

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Intervention Class</th>
<th>Base Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td>Exponent Quiz</td>
<td>21</td>
<td>13.524</td>
</tr>
<tr>
<td>Radical Quiz</td>
<td>21</td>
<td>20.238</td>
</tr>
<tr>
<td>Inq. Abs Quiz</td>
<td>21</td>
<td>18.190</td>
</tr>
</tbody>
</table>

*Note.* Inq. Abs Quiz = Inequalities and Absolute Value Quiz

### Table 9

*T-Test Results of Assessments Given During the Intervention*

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Difference in Sample Means</th>
<th>Std. Err.</th>
<th>df</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exponent Quiz</td>
<td>$μ_I - μ_B$</td>
<td>0.444</td>
<td>31.946</td>
<td>-0.822</td>
<td>0.791</td>
</tr>
<tr>
<td>Radical Quiz</td>
<td>$μ_I - μ_B$</td>
<td>0.798</td>
<td>34.463</td>
<td>1.065</td>
<td>0.147</td>
</tr>
<tr>
<td>Inq. Abs Quiz</td>
<td>$μ_I - μ_B$</td>
<td>0.576</td>
<td>36.716</td>
<td>-0.055</td>
<td>0.522</td>
</tr>
</tbody>
</table>

*Note.* Inq. Abs Quiz = Inequalities and Absolute Value Quiz
Research journal. The last instrument used to collect data was my research journal that I wrote in daily to record the behaviors of students during days which student-led teaching took place (see Appendix L). I qualitatively analyzed the journal to find themes of occurrences and behaviors that affected the engagement of students, student ownership of learning, and the positive or negative academic climate that helped or hurt learning and the factors that caused it. Table 10 displays the common themes that arose during the qualitative analysis of the journal. Since all six groups led the classroom four times each, student-led teaching took place 24 times during the project study. Because of this, only themes with a frequency of at least six (one-fourth of the total times) were considered to be significant.

Table 10

<table>
<thead>
<tr>
<th>Common Themes of Research Journal</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaders of the day worked noticeably well in groups</td>
<td>17</td>
</tr>
<tr>
<td>A presenter provides a detailed, high quality explanation</td>
<td>17</td>
</tr>
<tr>
<td>A student questions or corrects the group leading</td>
<td>16</td>
</tr>
<tr>
<td>A back and fourth discussion takes places between the group leading and the class</td>
<td>14</td>
</tr>
<tr>
<td>Class is very attentive while a group is leading</td>
<td>13</td>
</tr>
<tr>
<td>A presenter provides no explanation or just reads answer</td>
<td>12</td>
</tr>
<tr>
<td>Leaders of the day ask the teacher a question during group work</td>
<td>10</td>
</tr>
<tr>
<td>While leading, group checks for understanding by asking the class a question</td>
<td>10</td>
</tr>
<tr>
<td>While leading, all group members were noticeably involved well while teaching</td>
<td>9</td>
</tr>
<tr>
<td>Many students are inattentive or off task while a group is leading</td>
<td>8</td>
</tr>
<tr>
<td>Class has no questions or comments for the group leading</td>
<td>7</td>
</tr>
<tr>
<td>Leaders of the day checked each other’s group worked for correctness</td>
<td>6</td>
</tr>
<tr>
<td>Teacher intervened during students leading the classroom</td>
<td>6</td>
</tr>
</tbody>
</table>

The most frequent theme, noted 17 times in my journal, was productive group function when students knew they would lead the classroom. Students asked me questions to ensure their
work was correct with a frequency of 10. The most common themes observed while a group led the classroom were the following: a presenter providing a high quality explanation; a student not presenting, questioning, or correcting the leaders; a back and forth discussion that took place between the class and leaders; and a presenter who provided no explanation for their solution of a problem. The frequencies of these events were 17, 16, 14, and 12 respectively.

The results also show that class engagement noticeably varied depending on the effectiveness of the group. On eight occasions many students were inattentive or off task while their peers were leading the classroom, and 13 times the class was noticeably very attentive while their peers were leading. Out of the 24 instances of student-led teaching, I as the teacher only intervened six times for various reasons.

**Interpretation of Results**

In this section I summarized the answers to my research questions by examining the three parts separately. The first part being whether engagement increased due to student-led teaching; the second is whether student ownership of the learning that took place in the classroom increased due to student-led teaching; and the third being whether the student-led class had significantly higher academic performance than the teacher-led class.

**Engagement.** I initially hypothesized engagement would increase as a result of student-led teaching. After analyzing the data, I have sufficient evidence through survey, interview, and research journal findings to determine that engagement of students generally increased due to student-led teaching. Student engagement in class substantially increased when it was their turn to lead, with mixed results of increased engagement when it was not their turn to lead.

The survey data revealed that 75% or more of students marked “agree” or “strongly agree” to items 2, 3, and 4, which were items of engagement. This means that 75% or more of
students increased their efforts to learn the material, paid more attention to teacher explanations, and admittedly worked better in groups on days in which they were responsible for leading the classroom. On item 8 concerning engagement, 57.1% of students marked “agree” or “strongly agree” that they were more engaged when their peers led the classroom compared to when the teacher led it. The results of item 7 yields that 38.1% of students said they were more interested in class when it was their turn to lead the classroom, compared to 14.3% who disagreed. The means and medians of these items concerning engagement found in Table 2 support the percentage results showing increased engagement.

The interview data also showed increased engagement of students during student-led teaching. All six students interviewed stated that they worked harder, and thus were more engaged in learning when it was their turn to lead the classroom. Five of the six students interviewed said they were more willing to get involved in answering questions and participating in class discussions when their peers led the classroom. This increased involvement is another way of saying increased engagement.

The following are quotes from 5 of the 6 students that describe their increased engagement when it was their turn to lead the classroom. One student said, “We had to stay more focused to make sure we had it done to share it with the class.” Another mentioned, “We had to make sure we understood what we were learning, so we were more focused because of that.” “I was definitely more involved because I got to teach the class, when you go to every single class there is a teacher up there so it gets kinda boring so it was fun to know you get to get involved in teaching and learning,” mentioned a student. One commented, “You’re not just sitting in the desk watching the teacher do it all, so I was more engaged in that way.” Finally,
one student remarked, “I feel we are engaged more because we can go up and show what we got and help each other out.”

One student, who experienced no difference in engagement when it was his turn to lead, said, “I don’t really see a difference because math isn’t very fun for me.” In total, 5 out of the 6 students commented positively on increased engagement.

The observations from my daily research journal and the themes that arose out of it by qualitative analysis also indicate engagement increased due to student-led teaching. Of the 24 total occurrences of student-led teaching, the leading groups worked noticeably well together during 17 of these times. Ten times they asked me for help, which was a noticeable increase compared to when not leading the classroom. Fourteen times during student-led teaching a back and forth discussion between leaders and class took place, engaging all who were involved. Sixteen times students were engaged enough to question or correct the group leading about their results. Also, 13 of the 24 times, the class was very attentive while learning from their peers leading the class. This may not seem like much, but often times they were of normal attentiveness. These 13 occurrences represent an improvement in attentiveness compared to normal.

As engagement increased on days when students led the classroom, engagement of students when they did not lead had mixed results. While 13 times the class was very engaged, 8 of the 24 times many students were inattentive or off task, and thus unengaged when their peers presented. When the six interviewees were asked the question, “How engaged were you when your peers led the classroom compared to when the teacher leads the room?” one said engagement increased, one said it decreased, two said there was no difference, and the other two said it went up or down depending on the effectiveness of the presenter. Engagement of students
listening to their peers lead the classroom largely depended on the effectiveness of the group leading. This explains why 54% of the time students were very engaged (13 of the 24 times), only 12.5% of the time students had average engagement (3 of the 24 times), and 33.5% of the time students were off task and had very low engagement (8 of the 24 times).

The interviews also revealed that, when students knew they were not leading the classroom, their engagement and attentiveness during group work also dipped. A student commented, “We weren’t as focused as we would have been if we were teaching it.” Another stated, “When we found out that someone else was teaching it we didn’t care as much because someone else was doing (leading) it.” When I asked for suggestions of how to improve student-led teaching, two students suggested not telling which group would be presenting until the end of group work. Waiting would prevent students from becoming less engaged once they knew they were off-the-hook from presenting. However, one student said she still was very engaged in her group work when not presenting because she didn’t know if the presenting group would have the correct answers or not, and she wanted to know for sure.

The results of increased engagement do not surprise me as I predicted that students would be more engaged with the increased responsibility of leading their peers. I am also not surprised that engagement varied from student to student when it was not their turn to lead, because of the diversity of students I have and the aspect of human nature that causes people to become less engaged in something when not fully responsible for it.

**Ownership.** I wanted to determine whether a student-led classroom involving collaborative group work would increase students’ sense of ownership of the learning that took place in the classroom. I hypothesized that this ownership would increase as a result of student-led teaching. Sufficient evidence gained through survey, interview, and research journal findings
indicate that students’ sense of ownership for the learning that took place in the room increased as a result of student-led teaching.

On the survey, all ownership items, which were 6, 9, 10, and 13, yielded results showing increased ownership: 57.2% of students felt a greater sense of responsibility of the learning of themselves and their peers when they led the classroom; 47.6% of students were more willing to question peers when they led the classroom compared to questioning the teacher; 51.9% of students were more willing to participate in discussions during student-led teaching, making themselves an integral part in the learning process and increasing ownership for learning; and finally 38.1% of students “agreed” or “strongly agreed” compared to 19.2% who “disagreed” or “strongly disagreed” to feeling more confident teaching and helping others as a result of student-led classrooms. The means and medians of these items concerning ownership found in Table 2 support the percentage results showing increased ownership.

The interview results also suggest student ownership for learning increased. When asked question 4, “How did leading the classroom affect your sense of ownership for learning?” all six students responded that ownership increased for them. Two of the six simply said that they felt more ownership for learning during student-led teaching. Two of the six replied their ownership for learning increased as they made it a point to know the material well in order to lead the classroom effectively. The other two students’ responses were a combination of the others’ replies. When asked question 7 about students’ willingness to get involved in answering questions and class discussions, one student said there was no difference, but five out of six said they were more willing to participate, and thus have more ownership for learning during student-led teaching compared to teacher-led instruction. Four of these five said they wanted to know
the correct solution, and would participate in discussion and answer questions in order to arrive at the correct answer, compared to taking the teacher’s word as infallible.

The following quotes are from the six students whose sense of ownership increased during the study. These quotes provide insight to why student-led teaching increased their sense of ownership. One student said, “We actually did the work and showed it in front of everyone, and we had to get the work done for everybody to understand it.” One student simply said, “Yeah, I felt a bigger sense of ownership.” Another stated, “You had to know your stuff well because you had to teach it to a bunch of other kids, and if you didn’t know it then the other kids won’t learn it from you so it’s a big responsibility.” “If you don’t know it and other kids don’t know it then nobody’s learning it, the teachers they know it, but we’re learning it so you have to know it to go up there and teach it,” remarked a student. This student discussed increased ownership in a roundabout way, “We were teaching everybody and if they didn’t know how to do it and we would be teaching them, then they would have to learn that so you don’t really want to teach it the wrong way.” And finally, “If you teach them the wrong answer you won’t help them and I want to teach them well.”

The research journal results also supported increased student ownership. While leading the classroom, a presenter provided a high quality explanation to teach the class well on 17 of 24 student-led teaching classes. The leading group checked the class’s learning by asking them a question 10 times. While watching a group present, a student questioned or corrected the group that was leading 16 times, and 14 times a back and forth discussion took place between the group leading and the class. These results show that students had ownership for learning even while they were not presenting.

I am not surprised by the findings that student ownership for the learning that took place
in the classroom increased as a result of my study. Since the essence of a student-led classroom has students taking on more responsibility and becoming the mathematical authority in the classroom, I fully expected students’ sense of ownership of learning to increase the way it did.

**Academic performance.** As the final part of my research question, I wanted to know if students who participated in student-led teaching had significantly higher academic performance than those who did not. I hypothesized they would. *T*-tests of independent samples were used to compare the common assessment means of the base and intervention class before and during the intervention. The first set of *t*-tests compared the common assessments of the two classes before the intervention. The results indicated no significant differences between the classes on any of the assessments; meaning, the base and intervention classes were academically comparable before the intervention. The second set of *t*-tests compared the common assessments of the two classes during the intervention. The results indicated the intervention class did not outperform the base class on any of the assessments during the intervention; hence, the base and intervention classes were academically comparable during the intervention.

I am slightly surprised that the academic performance of the intervention class was not significantly higher than the performance of the base class as a result of student-led teaching. I hoped that allowing students to become the main providers of knowledge in the classroom would help them learn the material better and as a result, to perform significantly better on assessments than the base class. This result is only slightly surprising when I consider the situation; I taught the base class normally and provided them the best education I could, while students in the intervention class were responsible for the bulk of their learning for the first time in their math careers. Considering this situation, both classes received similar material, the same assignments, and I was always present in the intervention class to make sure the content was presented
appropriately; so it is not surprising the assessment results varied so little. It is also not surprising that the assessments for the two classes were academically the same considering that all students were in Algebra, which is an enriched eighth grade class. This means that students in both classes are advanced in math and possess good math reasoning skills regardless of the instruction they receive; so the type of the instruction probably has a lesser impact on learning compared to students with average or below average mathematical ability.

Summary

Analysis of surveys, interviews, research journal, and common assessments comparing the base and intervention class provided me with a large amount of information to answer my research question of whether student engagement and ownership for learning increased, and whether the intervention class had higher academic performance than the base class as a result of student-led teaching. Analysis of these data yields that student engagement increased for the group of students who led the classroom, while student engagement varied for students who were not responsible for leading the classroom that particular day. The analysis results also revealed student ownership for their learning of themselves and the learning of their peers substantially increased. However, the results yielded that academic performance of the intervention class was not significantly greater than that of the base class.
Chapter Five

Conclusions, Action Plan, Reflections, and Recommendations

The implementation of a student-led classroom has been a terrific learning experience for both my students and myself. The process of designing and implementing the study has further developed me as an educator and allowed my students to develop positive leadership skills while becoming more active in their learning of mathematics. This chapter includes my final conclusions of the study, my thoughts on continuing student-led teaching in my classroom, and recommendations for other educators who wish to use a student-led format in their classrooms.

Conclusions

Too often I observed disinterested and apathetic behavior in my students. The student-led teaching method I developed and implemented as the whole of this study was my way of doing something to get my students more involved in learning. I wanted to find out if a student-led classroom involving collaborative group work would increase student engagement, academic performance, and student ownership of learning.

Through researching my topic, developing a plan of action, implementing my plan of action, recording various results and observations, and analyzing the resulting data, I arrived at the following conclusions to my research questions. Through student surveys and interview analysis, my research journal analysis, and assessment analysis, I confidently state that, overall student engagement and ownership of learning increased as a result of the student-led classroom, while academic performance of those in the student-led classroom was not significantly greater than that of the students in the teacher-led classroom.

Action Plan

Although students in the intervention class did not significantly outperform academically
those in the base class, academic performance was not adversely affected by student-led teaching either. This result was the closest thing to a significant drawback the student-led intervention possessed, which is great, because it is not a drawback at all. Considering this, I am very pleased with the outcomes of student-led teaching. Academic performance remained of high quality while increasing students’ engagement in the classroom and substantially increasing student responsibility and ownership of their learning and that of their peers. Because of this good fruit that student-led classrooms bear, I plan on using this format of teaching in the future with slight modifications.

The bulk of the process will remain the same when I implement it again in the future. I will wait until the second semester of classes so I will know the students well enough to structure groups for success as I did with this intervention. Starting this type of teaching format too early would be ineffective for the following reasons: the students may not fully know my behavioral and academic expectations for them; without knowing students well, groups could be created with poor chemistry and low abilities, setting them up for failure; and the students may not be comfortable enough with each other to teach, question, and discuss with one another. I will again explain in detail what I expect from student-led teaching, as I did before this intervention, and the daily process will be the same.

The minor things I will modify are as follows. Now that I have completed student-led teaching with one class, I will use it for multiple classes at the same time. I will use it with every class with whom I feel comfortable that they are mature enough to handle it. Looking at my classes this year, I would use it with three of my five math classes, as I feel the other two are too immature for this type of classroom environment, where success totally depends on the maturity level and work ethic of the students involved. I say this because in my research journal I noticed
several reoccurring comments about one immature student (by immature I mean, a student who is distracted easily, who needs constant reminders to stay on task, and who frequently talks to others at inappropriate times). He often distracted the leading group by his misbehavior, and while presenting, he more that once provided little or no explanations about the questions he presented and would then cause distractions by talking to a classmate while his fellow group mates were presenting. As the teacher I pointed out his faults and taught him correct behaviors, but he still continued his disruptive behavior, damaging the learning environment of the classroom. If there were too many students like this in one class I would not use the student-led method, as I don’t believe it would be successful. With this being said, if I felt a class was on the borderline of having adequate maturity, I would implement it anyway and let the class’ performance decide if the intervention would continue.

Another change I will make is I will not tell students which group will lead until group work time has completed. I am making this change for three reasons. First, during the interviews, some students said that their engagement level dropped when they knew they were off-the-hook on days when their group wasn’t responsible to teach the class. Second, two students recommended I do this to improve the learning that took place during days of the intervention. Third, my research journal observations noted that on 17 of the 24 student-led intervention times, the group leading worked quite well together during their group work, noticeably better than the groups not leading the classroom. It is my hope that waiting to inform students until the end of group work time will motivate all groups to work well every day that student-led teaching takes place.

I will also not keep a detailed research journal during future implementations. I will still record interesting and noteworthy happenings as they occur, but I will not keep as detailed an
account, as I now am familiar with this method of teaching.

I will make these minor modifications when I continue to use a student-led model of teaching in my future classes while reflecting day to day on how I can improve the overall process, and how I can make particular improvements for a particular class.

**Reflections and Recommendations for Teachers**

The greatest benefits of my student-led teaching model are that students perform well academically on assessments, and their engagement and ownership of the learning that happens in class increase. Other benefits not addressed in my research questions arose throughout the study and are listed in the following paragraphs.

It was great for me to see my students in leadership roles. Regardless of whether they shined as a leader or exhibited poor leadership skills, it allowed me to know and understand my students better by seeing them in a different way. I made a little deeper personal connection with them that I would not have made without implementing my study. Because of the intervention I was privileged to see some normally whisper-quiet students display strong, confident leadership skills I never knew they had. Now these students have a certain swagger in my class they did not have before because they were given opportunity to practice and exhibit their leadership skills, and their peers were able to take note of it.

It was also wonderful to see a social outcast have successful positive peer experiences when working well in groups. I chose his group carefully, and while his interaction with his group wasn’t always great, many times it was positive. He also surprised me with his ability to explain his work with confidence to the rest of the class. I was very concerned with how his presentations would go, but they went fine, which was great to see as a concerned educator.

My advice to other teachers who are interested in using a student-led model of teaching is
to jump in and do it, because it’s worth it. The first time through I recommend choosing one of
the best, most mature classes until the teacher is comfortable with the process and underests
the idiosyncrasies of it. During implementation, I would follow the process I laid out in Chapter
Three along with the modifications I mentioned above under the Action Plan heading. I think
student-led teaching is worth the try; the students will benefit from it, and the teacher will grow
as an educator much like I have grown. My students enjoyed leading the classroom because it
was different than the typical lesson. Five out of the six students I interviewed mentioned they
liked it because it was “something different.” All of the six answered “yes” to question 11 of my
interview, in which I asked them if I should use student-led teaching in my future classes.

Also, be prepared to spend more time covering a topic using the student-led method
compared to traditional teaching. Some more perfectionistic groups will need more time to
ensure everything is correct and the work they write on the board is neat and organized.
Generally groups will take more time when it is their turn to present; they spend time ensuring
they know the material enough to teach it without being embarrassed in front of their peers.
When a teacher teaches normally, the teacher can change the pace of the lesson as needed.
When students are presenting, they often go at their pace, which I found to be consistently slower
than mine. Sometimes things will go great and a back and forth discussion between class and
presenters will take place. It is wonderful to see students reason and debate with each other
about why they think something is right, but it is also very time consuming. The time used
during student-led teaching can be considerable, but more than worth it considering the benefits
of the process.

Lastly, the action research is a process that is quite involved and takes getting used to, but
is well worth the effort. The amount of time it takes to effectively complete action research can
be frustrating, but I think the diverse knowledge gained is beneficial. I have a much better understanding of the legalities of shared information, the depth of things to consider when developing a good plan, how to conduct research, how to gather and analyze data, statistics, and how to arrive at well triangulated, rigorous results in which a researcher can be confident. To put it simply, the good outweighs the bad.

Summary

Implementing a student-led method of teaching was worth the effort. Because of my study, student engagement and ownership for learning increased while academic performance remained comparable to that in a non-student-led classroom. I plan on continuing to use student-led teaching in my future classes with minor adjustments in hopes of making it more successful for my students than it already has been. I believe that as I continue to better myself as a teacher and continue to make improved student connections, my use of student-led classrooms will help students to grow and develop themselves as better learners and teachers of mathematics.
References


Appendices
Appendix A

An Example of a Problem Set

✔️ **Develop & Understand: A**

1. Look again at the list from Explore.
   
   2, 4, 8, 16, 32, 64, 128, ...
   
   a. Use an exponent to write 128 as a power of 2.
   
   b. Write an expression for the nth number in the list.
   
   c. Is 6,002 in this list? How do you know?
   
   d. Is 16,384 in this list? How do you know?

2. Shanequa started another list of numbers using positive integer powers with 4 as the base.
   
   a. What are the first ten numbers in Shanequa list?
   
   b. Is 2,048,296 in her list? How do you know?
   
   c. The number 262,144 is in her list. Is it also a number in the list in Exercise 1? How do you know?
   
   d. The numbers 4,096 and 8,192 are in the list in Exercise 1. Are they also in Shanequa’s list?
   
   e. **Prove It!** Shanequa made the conjecture that every number in her list is also in the list in Exercise 1. Explain why her conjecture is true, or give a counterexample.

Source: *Impact Mathematics Course 3* (Ruopp, 2009, p. 141)
Appendix B

Student Role Guide for Student-Led Teaching

Student-led Teaching: Student Roles

The goal: to become better learners of math by teaching and leading the class, to be more engaged in the class, and for everyone to have ownership in the learning that takes place.

When it is your group’s turn to lead your group will be told what problem set you will present to the class at the beginning of the period. Once most of the class has finished with the problem set, your group will present to the class your answers and explain how you found them as a teacher would. You are expected to use the SmartBoard and Whiteboard to help explain your answers when appropriate.

Presenter Roles: (note: when presenting, you are the teacher, which means you are the boss!)

- Your group will share the presenting equally. The easiest way to do this is to split up the number of problem each person presents equally, or if one problem is more complex that problem may be all one person does. However your group does it, each person must contribute equally.
- More than one person can explain the same problem. Since the goal is to teach the class to solve the problems in the best way possible, many group members can and should help explain how to do the problem so the class gets the best possible explanation.
- Do not do nothing while you wait to present your problem. Write your work out on the smart/whiteboard, draw your graph, or make your table while your group member is presenting his/her problem so you are ready to explain your problem once it is your time to do so.
- You may ask the class an appropriate question at any time. If your group is unsure how about something, ask the class! You will not know every answer, so use your classmates for help. We are all in this together!
- All group members must be ready to help each other out when explaining a problem or answering a question from the class. Work together!
If while presenting, if something interesting comes up that is a little off topic, but still math related, feel free to talk about it or to ask the class what they think about it. You may lead any kind of class discussion as long as it concerns math in some way.

Once your group is finished presenting all the problems, someone must ask the class if they have any questions. Be prepared to answer any questions that may come up.

While your group mates are presenting a problem, you may walk around the room checking with your classmates to see if they have any questions, just as a teacher would.

Class role while a group is presenting:

- Be respectful and listen at all times. You are responsible for knowing the information the presenting group is explaining. The group presenting are the teachers, so be respectful and listen to them.
- Ask questions. If you didn’t understand an explanation, ask the presenting group to clarify the explanation.
- If your answers differ from the presenter’s answers, respectfully let them know so you can find the correct solution together.

Mr. Loff will be in the back of the class as an observer only. I will only get involved in the class while a group is presenting if someone is misbehaving or if the class is way off track. With this being said, I should not have to intervene.
Appendix C

IRB Approval Letter

Minot State University
Institutional Review Board

Notice of IRB Approval

Name of Principal Investigator: Christopher Loff
University Address: Mathematics & Computer Science
Title of Project: Using Student-Ld Classrooms to Increase Engagement, Ownership
Protocol Number: 1194

December 8, 2011

The above project has been reviewed and approved by the IRB under the provisions of Federal Regulations 45 CFR 46.

This approval is based on the following conditions:

1. The materials you submitted to the IRB provide a complete and accurate account of how human subjects are involved in your project.

2. You will carry on your research strictly according to the procedures as described in materials presented to the IRB.

3. You will report to the chair of the Institutional Review Board any changes in procedures that may have a bearing on this approval and require another IRB review.

4. If any changes are made, you will submit the modified project for IRB review.

5. You will immediately report to the IRB Chair any problems that you encounter while using human subjects in your research.

Dr. Vicki Michels
Chair, Minot State University’s IRB

500 University Ave W, Minot, ND 58707 701-858-3594 1-800-777-0750 FAX 701-858-4260
Appendix D

Parent/Guardian Consent Form: Intervention Class

Using Student-Led Classrooms to increase engagement, ownership for learning, and academic performance in the Mathematics Classroom

Chris Loff

Invitation to Participate
Your child is invited to participate in a study to determine if students taking a more active role in the classroom, by fulfilling some roles of a teacher, increases student engagement, ownership for learning, and academic performance.

Basis for Subject Selection
Your child has been selected because your child is in eighth grade Algebra. Algebra lends itself well for the research I am doing. Also I teach two Algebra classes, which is convenient number for comparison, as I will be analyzing quiz and test results of the two classes to determine how having students fulfill some roles of the teacher affects academic performance. The two Algebra classes have approximately 20 students each. These similar numbers help with consistent implementation and analysis of the study.

Purpose of the Research
I am currently completing work toward my Master of Arts in Teaching: Mathematics degree through Minot State University. For my final degree requirement, I am conducting an action research project during Quarter 3, January 16 to March 16, to determine if student-led classrooms, which means students will take a more active role in the Algebra classroom, increases engagement, ownership of learning, and academic performance.

Specific Procedures
In Algebra, students frequently work on inquiry-based problem sets during class time in pairs or small groups. Student group work is then followed by me reviewing the solutions to the problem sets, asking questions about the topics covered in them, and leading discussions concerning the key concepts presented in the problem sets. During the third quarter, instead of me, the teacher, doing these tasks, at times small groups of students will be responsible for doing so, effectively “leading” the classroom. Each group will “lead the classroom” in this way three times throughout the quarter. I will be present to facilitate this process and help correct any mistakes students might make.

At the end of the quarter students will complete a survey on the effectiveness of leading the classroom in regards to engagement, ownership for learning, and academic performance. Some students may also be interviewed for their opinions. Survey responses, interviews, my observations, and student assessment (quizzes and tests) results will be analyzed to determine whether a student-led classroom increases student engagement, ownership, and academic performance. Assessment results will be compared with the other algebra class that I am teaching traditionally to compare academic performance. My results will be summarized and
included in my research paper. No students will be identified in my results. This research study has been approved by the district office.

Confidentiality
The researcher (myself) will treat all data confidentially. All data including student assessments, surveys, and interviews will be kept safe in a locked cabinet or on my password-protected computer. All data will be destroyed once the paper has been defended. The researcher agrees to maintain strict confidentiality; which means your student’s name will not be discussed or divulged with anyone.

Voluntary Nature of Participation
During this study, the survey responses and assessment data of your student do not have to be included and your student does not have to participate in an interview. However, I hope you approve of your student being involved in this study because a large sample size improves the accuracy of the results of my study. If you decide to participate, you are free to withdraw your consent at any time. If you do not consent or withdraw your consent, your student’s data will not be included in my results and your student will not complete the survey nor be interviewed, but your student will still participate in leading the classroom as it is part of the course work.

Human Subject Statement
The Institutional Review Board of Minot State University has given me permission to conduct this research. If you have questions regarding the right of research subjects please contact the Chairperson of the MSU Institutional Review Board (IRB), Dr. Vicki Michels at 701-858-3594 or Vicki.Michels@minotstatu.edu.

Offer to Answer Questions
If you have any questions or concerns now or during the study, feel free to contact me at Christopher.loff@gfschools.org, or call the school at (701)-746-2345 and ask for me before 8:30 or after 3:30. Thank you for your consideration.

Consent Statement
You are voluntarily making a decision whether or not to participate in this study. With your signature below, you are indicating that upon reading and understanding the above information, you agree to allow your student’s survey, interview, and assessment results to be used in this study.

Participant (Please Print Student’s Name)

______________________________
Signature of Parent or Guardian  Date

______________________________
Signature of Researcher  Date
Appendix E

Parent/Guardian Consent Form: Base Class

Using Student-Led Classrooms to increase engagement, ownership for learning, and academic performance in the Mathematics Classroom

Chris Loff

Invitation to Participate
Your child is invited to participate in a study to determine if students taking a more active role in the classroom, by fulfilling some roles of a teacher, increases student engagement, ownership for learning, and academic performance.

Basis for Subject Selection
Your child has been selected because your child is in eighth grade Algebra. Algebra lends itself well for the research I am doing. Also I teach two Algebra classes, which is convenient number for comparison, as I will be analyzing quiz and test results of the two classes to determine how having students fulfill some roles of the teacher affects academic performance. The two Algebra classes have approximately 20 students each. These similar numbers help with consistent implementation and analysis of the study.

Purpose of the Research
I am currently completing work toward my Master of Arts in Teaching: Mathematics degree through Minot State University. For my final degree requirement, I am conducting an action research project during Quarter 3, January 16 to March 16, to determine if student-led classrooms, which means students will take a more active role in the Algebra classroom, increases engagement, ownership of learning, and academic performance.

Specific Procedures
In Algebra, students frequently work on inquiry-based problem sets during class time in pairs or small groups. Student group work is then followed by me reviewing the solutions to the problem sets, asking questions about the topics covered in them, and leading discussions concerning the key concepts presented in the problem sets. I will teach your student’s algebra class in this way while in my other algebra class small groups of students will be responsible for performing these teacher duties, effectively “leading” the classroom.

I will use both classes’ quiz and test results in comparison to each other to see whether students “leading” the classroom results in higher academic achievement. My results will be summarized and included in my research paper. No students will be identified in my results. This research study has been approved by the district office.

Confidentiality
The researcher (myself) will treat all data confidentially. All data will be kept safe in a locked cabinet or on my password-protected computer. All data will be destroyed once the paper has been defended. The researcher agrees to maintain strict confidentiality; which means your student’s name will not be discussed or divulged with anyone.
Voluntary Nature of Participation
During this study, the quiz and test results of your student do not have to be included. However, I hope you approve of your student being involved in this study because a large sample size improves the accuracy of the results of my study. If you decide to participate, you are free to withdraw your consent at any time. If you do not consent or withdraw your consent, your student’s data will not be included in my results.

Human Subject Statement
The Institutional Review Board of Minot State University has given me permission to conduct this research. If you have questions regarding the right of research subjects please contact the Chairperson of the MSU Institutional Review Board (IRB), Dr. Vicki Michels at 701-858-3594 or Vicki.Michels@minotstatu.edu.

Offer to Answer Questions
If you have any questions or concerns now or during the study, feel free to contact me at Christopher.loff@gfschools.org, or call the school at (701)-746-2345 and ask for me before 8:30 or after 3:30. Thank you for your consideration.

Consent Statement
You are voluntarily making a decision whether or not to participate in this study. With your signature below, you are indicating that upon reading and understanding the above information, you agree to allow your student’s quiz and test results to be used in this study.

____________________________________
Participant (Please Print Student’s Name)

____________________________________
Signature of Parent or Guardian                Date

____________________________________
Signature of Researcher                  Date
Appendix F

School Principal Consent Form

Dear Mrs. Dutot:

I am completing work toward the Master of Arts in Teaching: Mathematics degree through Minot State University. As a degree requirement, I am to conduct a research project in my classroom during the third quarter this year. I am planning to implement survey, interview, and assessment results to determine whether student-led teaching increases student engagement, ownership for learning, and academic performance. To accomplish this, I would like to work with the students in my first period Algebra class.

In Algebra, students frequently work on inquiry-based problem sets during class time in pairs or small groups. Student group work is then followed by myself reviewing the solutions to the problem sets, asking questions about the topics covered in them, and leading discussions concerning the key concepts presented in the problem sets. During the third quarter, instead of myself as a teacher doing these tasks, at times small groups of students in my first period Algebra class will be responsible for doing so, effectively “leading” the classroom. During this time I will teach my second period Algebra class normally. The same assessments will be given to both Algebra classes and will be used for data analysis. I will also be recording observations in my research journal. At the conclusion of the study, students in my first period Algebra class will complete a survey and some will be interviewed concerning the effectiveness of student-led teaching.

At the completion of the study, I will analyze the data from the assessments, surveys, interviews, and my research journal to determine the results. Classroom and student confidentiality will be observed regarding all data collected and no individual will be identified by name.

Before the study begins, I will send home consent forms for parents/guardians to notify them of this project and request their permission allowing their student to participate in the research study. A copy of this letter is attached for your inspection.

I am requesting that you permit me to carry out this research in my classroom. Please contact me if you have any questions. Thank you for your consideration.

I grant permission for Christopher Loff to conduct the above mentioned research in his classroom.

I do not grant permission for Christopher Loff to conduct the above mentioned research in his classroom.

Signature of Mrs. Nancy Dutot, Principal at South Middle School

Date
Appendix G

Student Assent Form: Intervention Class

Using Student-Led Classrooms to increase engagement, ownership for learning, and academic performance in the Mathematics Classroom.

Chris Loff

Invitation to Participate
You are invited to participate in a study to determine if students taking a more active role in the classroom, by fulfilling some roles of a teacher, increases student engagement, ownership for learning, and academic performance.

Basis for Subject Selection
You have been selected because you are in eighth grade Algebra. Algebra lends itself well for the research I am doing. Also I teach two Algebra classes, which is convenient number for comparison, as I will be analyzing quiz and test results of the two classes to determine how having students fulfill some roles of the teacher affects academic performance. The two Algebra classes have approximately 20 students each. These similar numbers help with consistent implementation and analysis of the study.

Purpose of the Research
I am currently completing work towards my Masters of Arts of Teaching: Mathematics degree through Minot State University. For my final degree requirement, I am conducting an action research project during Quarter 3, January 16 to March 16, to determine if student-led classrooms, which means students will take a more active role in the Algebra classroom, increases engagement, ownership of learning, and academic performance.

Specific Procedures
In Algebra, you frequently work on inquiry-based problem sets during class time in pairs or small groups. Your group work is then followed by myself reviewing the solutions to the problem sets, asking questions about the topics covered in them, and leading discussions concerning the key concepts presented in the problem sets. During the third quarter, instead of myself as a teacher doing these tasks, at times small groups of students will be responsible for doing so, effectively “leading” the classroom. Each group will “lead the classroom” in this way three times throughout the quarter.

At the end of the quarter you will complete a survey on the effectiveness of leading the classroom in regards to engagement, ownership for learning, and academic performance. Some of you may also be interviewed for your opinions. Survey responses, interviews, and my observations, and assessment (quizzes and tests) results will be analyzed to determine whether a student-led classroom increases student engagement, ownership, and academic performance. My results will be summarized and included in my research paper. None of your names will be identified in my results. This research study has been approved by the district office.
Confidentiality
The researcher (myself) will treat all data confidentially. All data including student assessments, surveys, and interviews will be kept safe in a locked cabinet or on my password-protected computer. All data will be destroyed once the paper has been defended. The researcher agrees to maintain strict confidentiality; which means your name will not be discussed or given to anyone.

Voluntary Nature of Participation
During this study, the survey responses and interviews do not have to be included. However, I hope you approve of being involved in this study because a large sample size improves the accuracy of the results of my study. If you decide to participate, you are free to withdraw your consent at any time. If you do not consent or withdraw your consent, your data will not be included in my results and you will not complete the survey nor be interviewed, but you will still participate in leading the classroom, as it is part of the course work.

Human Subject Statement
The Institutional Review Board of Minot State University has given me permission to conduct this research. If you have questions regarding the right of research subjects please contact the Chairperson of the MSU Institutional Review Board (IRB), Dr. Vicki Michels at 701-858-3594 or Vicki.Michels@minotstatu.edu.

Offer to Answer Questions
If you have any questions or concerns now or during the study, please voice them to me. Also, feel free to contact me at Christopher.loff@gfschools.org.

Consent Statement
You are voluntarily making a decision whether or not to participate in this study. With your signature below, you are indicating that upon reading and understanding the above information, you agree to allow your survey, interview, and assessment results to be used in this study.

Participant (Please Print Name)

____________________________________
Signature of Participant

____________
Date

____________________________________
Signature of Researcher

____________
Date
Appendix H

Student Assent Form: Base Class

Using Student-Led Classrooms to increase engagement, ownership for learning, and academic performance in the Mathematics Classroom

Chris Loff

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**Offer to Answer Questions**
If you have any questions or concerns now or during the study, simply tell me about your concerns or feel free to contact me at Christopher.loff@gfschools.org. Thank you for your consideration.

**Consent Statement**
You are voluntarily making a decision whether or not to participate in this study. With your signature below, you are indicating that upon reading and understanding the above information, you agree to allow your quiz and test results to be used in this study.

____________________________________
Participant (Please Print Name)

____________________________________
Signature of Participant Date

____________________________________
Signature of Researcher Date
Appendix I

Assessment Example

Section 4.2 Exponential Growth and Decay Quiz       Name____________

1. Tell whether each expression represents exponential growth, exponential decay, or neither.
   a) $10x$  
   b) $\left(\frac{1}{10}\right)^x$  
   c) $10^x$  
   d) $x^{10}$  
   e) $325 \cdot .7^x$

2. Create a table that shows exponential growth.

<table>
<thead>
<tr>
<th>$X$</th>
<th>$Y$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. A bacteria’s population during an experiment can be described by the equation $p = 20,000 \cdot (1.2)^d$, where $p$ is the population and $d$ is the number of days.
   a) What is the population of the bacteria at the beginning of the experiment?
   b) What percent is the population increasing by each day?

4. Using complete sentences, describe a quantity that decreases at an exponential rate. Write an equation describing the situation.
Appendix J

Student Survey

The purpose of this survey is to help me understand whether using student-led teaching is effective in the classroom. Your responses are anonymous; please do not put your name anywhere on this survey. Please be completely honest when completing this survey. Your honesty is appreciated.

For questions 1-13 use the following rating scale when answering. Please check the one corresponding box that best agrees with your personal opinion and experience.

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>No Opinion/Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>2.</td>
<td>When it was my turn to lead the classroom, I made a greater effort to learn the material because I knew I would be leading the classroom.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>When it was my turn to lead the classroom, I paid more attention to the teacher explaining things.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>When it was my turn to lead the classroom, I worked better with my group members.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Leading the classroom helped me to learn the material better.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>I felt a greater sense of responsibility for my peers learning and myself learning when I led the classroom.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>I was more interested in class when it was my turn to lead the classroom.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>I was more interested when my peers led the classroom compared to the teacher leading it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>I was more willing to question my peers when they led the classroom compared to when the teacher led it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>I was more willing to participate in discussions when my peers led the classroom compared to when the teacher lead it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>I learned better from my peers leading the classroom than when the teacher led it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>I feel more comfortable in front of a group of people than I did before leading the classroom.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>I feel more confident teaching and helping others as a result of leading the classroom.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Short Answer

14. Write about the things you liked about the student-led classroom experience. What did you enjoy? How did it help you learn better compared to the teacher leading the classroom?

15. Write about the things you disliked about the student-led classroom experience. What you did not enjoy? How did your learning suffer compared to the teacher leading the classroom?
Appendix K

Student Interview Questions

1. How did knowing that it was your turn to lead the classroom affect your group’s work?
   a. What accounted for this change? /Why was there no change?

2. How did you feel while leading the classroom.
   a. Did your comfort level change over time?
   b. What affected how comfortable you felt when leading the classroom? Why?

3. How did being in front of the classroom leading your peers affect your learning, meaning did leading the classroom help you learn more, less, or neutral?
   a. What were the reasons for this?

4. How did leading the classroom affect your sense of ownership for learning?
   a. Why was this so?

5. How did leading the classroom affect your overall interest and engagement?
   a. What are some factors that caused this?

6. How engaged/interested were you when your peers led the classroom?
   a. Why is this so?
   b. How did this compare to when the teacher led it?

7. Were you more willing to get involved in answering questions and class discussions when your peers led the classroom?
   a. Why do you think this is?
   b. How did this compare to when the teacher led it?

8. Do you think you learned well when your peers led the classroom?
   a. What are the factors causing this?
   b. How does this compare to when the teacher led the classroom?

9. Do you think this experience has helped you become more comfortable in front of groups and teaching others?
   a. Why is this so?
   b. Is there anything else that you gained from this experience?

10. What suggestions do you have to make student-led classrooms more effective?
    a. What change would help you the most?

11. Do you think I should use student-led teaching in my future classes? Why?
Appendix L

Research Journal Daily Log

Day: ____  Date: ___/___/12  Group # ____

Problem Set Led: ________________________

Comments

<table>
<thead>
<tr>
<th>Group Work</th>
<th>Group Leading</th>
<th>Class Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other: