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Reading as a Learning Strategy for Mathematics

Monte Else

McCook, NE

Math in the Middle Institute Partnership

Action Research Project Report

in partial fulfillment of the MAT Degree

Department of Mathematics

University of Nebraska – Lincoln

July 2008

Reading as a Learning Strategy for Mathematics

ABSTRACT

In this action research study of 55 sophomore and junior students in my Algebra II/Trigonometry classrooms, I investigated a reading strategy of learning mathematics. Students were given background information about reading and explored the benefits of reading for themselves. Next, students were taught to read their textbook, analyzing one section of the textbook at a time. Throughout the research project, students were given reading guides to fill out during class with whole class discussion following the reading time. I discovered that students are able to read a mathematics textbook with understanding and students who are gone for activities can learn independently. Teacher observations, student surveys, and student interviews provide quantitative evidence of increased student understanding and achievement. As a result of this research, I plan to continue utilizing the reading guides and incorporating reading as a method of learning mathematics within my classrooms.

Introduction

“I don’t understand”, “I was gone, how am I suppose to know this,” and “When did we learn this” are common phrases I have heard in my classrooms over the years. I have struggled for many years with having students miss class frequently due to absences or activities. My high school is located in a remote part of Nebraska, which creates a large amount of travel time for any extra-curricular activities. If students are in sports at my high school, they usually miss half the day anytime the school has an away activity. Depending on the activities schedule, students may come to class one to three times a week. For instance, golf and tennis activities have students miss the whole day every Tuesday and Thursday for months at a time. If these students are in other activities such as band, newspaper, FBLA, FFA, etc, they could miss even more days in the week. Trying to teach students who are gone has been a big challenge for me and other teachers who have students consistently miss 40% to 60% of class time. In turn, these students miss the opportunity to learn mathematics in class and usually have a hard time catching up.

In searching for strategies to keep students learning, I came to look at what constant is always present for students to learn from. As the teacher, I cannot go to every activity with students, but their textbook can. The mathematics textbook is a constant learning source for students, whether in the classroom or gone for activities. From this idea came the strategy of reading mathematics to learn mathematics.

In the past, I did not have a strategy to ensure students who were gone for activities or illness had a way to keep learning. Absent students would rely upon understanding the text themselves to gain an understanding of the material. However, students in my classes have a hard time reading the math textbook with understanding. Could the students not be gaining understanding from their textbook due to lack of effort? Or do my students simply not know how to read a

mathematics textbook for understanding? If students did read the textbook with understanding, then the students who missed class for activities would be able keep learning mathematics even while they are absent. My students who are gone for activities are not gone everyday, so I do not necessarily need a total reliance upon the textbook. Yet I do need students to be able to read with some understanding of the material. Reading assignments integrated into my lessons would be a strategy to help with absent student understanding.

Problem Statement

In my action research, I wanted to change my classroom to a more independent classroom: a classroom in which students would learn to read a math textbook. Then the students would be able to utilize the textbook more fully to become independent learners whether in my classroom or on the bus traveling to or from an activity. I also hoped that by increasing our reading of the text and discussion of the material, students would gain a better understanding of the material. I wanted my students to be able to see math in new ways, by learning from the text and from each other.

This study focuses on reading as a strategy of learning mathematics not just for absent students but also for students who are in class every day. Many students who are in class everyday need to develop the skill of being able to read a mathematics textbook for understanding. Reading a mathematics textbook for understanding is an important skill for all students, especially students who are college bound, which is the group of students in this study. Thus, whether a student is absent for activities or in class, reading as a strategy of learning mathematics should be beneficial to all students.

Literature Review

Struggling with common absences, whether for illness or for activities, is a challenge presented to every teacher. Students who are absent from class miss an opportunity to learn from face-to-face interaction. Yet the mathematics textbook is a constant in the lives of these students. Therefore I began to look at research pertaining to reading strategies. I was specifically interested in reading of math textbooks.

In looking at the research on reading in mathematics, there are two types of texts which have been used in reading research in mathematics: non-traditional texts and traditional textbooks. In both the traditional and non-traditional text research, four main themes appeared. The themes were the challenges to reading, importance of reading, motivating students to read and discussions of readings.

Non-traditional texts are historical and philosophical essays on specific aspects of mathematics, articles on applications of mathematical concepts or topics, and mathematical stories or cartoons. Non-traditional texts are primarily used to enhance student learning of a topic but not to learn a new mathematical topic. Non-traditional texts compose the bulk of the research on reading in a mathematical setting. However, my focus will be on strategies of reading traditional texts because in the students' traditional mathematics textbook is where the mathematical concepts are presented and where independence for the student can be gained

Traditional textbooks are the commonly used text of mathematics' classes. They contain chapters with broad mathematical topics. Mathematical texts contain sections within each chapter that have more specific mathematical topics presented with exercise problems which are related to the broad chapter topic. Traditional textbooks are often used as a reference by teachers and students rather than a source for learning mathematical material.

In looking at research directed at reading traditional mathematical texts, the utilization of a traditional textbook could be effective for learning new mathematical concepts if the students read the text with understanding. In the practice of their own collegiate mathematics classes, Boelkins (2000) of Grand Valley State University and Ratliff (2000) of Wheaton College have been integrating an email-based approach to reading assignments that has been effective in achieving student pre-reading before class for seven semesters. Boelkins and Ratliff explain, “This [reading] encourages greater independence, and more lively interactions, among students... the challenge is getting students to read the text” (2000, p. 1). From Boelkins and Ratliff’s experience, reading traditional textbooks has been effective at learning the basics of a new mathematical concept and allowing for more lecture time to be used for in-depth discussion of the material.

Challenges of Reading Mathematics Text

There are many reasons why reading is not utilized more and why there is this “challenge”, as noted earlier by Boelkins and Ratliff (2000), in making students read. Barton and Heidema (2000) have identified some of the reasons why reading in mathematics classrooms is avoided in their book, *Teaching Reading in Mathematics*. Barton, an adjunct faculty member of California State University since 2006 teaches communication in business. Heidema is a senior research associate for the RMC Research Corporation. Both Barton and Heidema are nationally known presenters, training thousands of teachers and administrators across the United States and Canada in content-area reading and writing instruction. The books they have co-authored on literacy have been best-sellers published by the Association for Supervision and Curriculum Development. Both Barton and Heidema have also authored numerous articles on curriculum and instruction, literacy, and learning.

Barton and Heidema (2000) answer why reading is not used more in their book, *Teaching Reading in Mathematics*. The first reason Barton and Heidema list is the fact that a mathematics text demands that readers use additional, content-specific reading skills.

Students must be able to read not only from left to right, as they do in other subject areas, but also from right to left (consider an integer number line), from top to bottom or vice versa (with tables), and even diagonally (with some graphs)! (Barton and Heidema, 2000, p. 7).

Reading mathematics requires a mixture of reading skills which many students struggle with.

The second reason Barton and Heidema list is that “mathematics texts contain more concepts per word, per sentence, per paragraph than any other kind of text” (2000, p. 7). In addition, they noted that the mathematical concepts presented are usually abstract, making it difficult to visualize the meaning of the text for the reader (Barton & Heidema, 2000). Mathematical texts are challenging texts to read because of the higher level of writing used within them.

A third reason for limited use of mathematics text in the classroom that Barton and Heidema (2000) give is that authors of mathematics texts generally write in a very terse or compact style. Each sentence contains a lot of information and there is little redundancy. In mathematics texts, sentences and words often have precise meanings and connect logically to surrounding sentences. Mathematics texts cannot be read quickly as noted by Barton and Heidema when they wrote, “Students who want to read mathematics texts quickly – as they might a short story in their English language arts class – may miss significant details, explanations, and the underlying logic” (p. 7). Barton and Heidema also include the syntax or “the way an author puts words together to form phrases, clauses, and sentences,” as a reason that reading mathematics is

difficult (p. 13). The density of mathematics texts makes the reading heavy for students and thus is avoided by teachers and students.

The last reason Barton and Heidema (2000) give is that, “many mathematics textbooks are written above grade level for which they are intended” (p. 8). Thus, the vocabulary and sentence structure or syntax in mathematics textbooks is written above the level of understanding for the very students for whom the textbook was written. In these four reasons, it is clear why the reading of traditional mathematics textbooks is avoided in most mathematics classrooms.

With so many reasons not to read a traditional mathematics text, maybe reading in mathematics is not important. Not according to Cowen (1991), a professor at Purdue University in the Department of Mathematics, who has been integrating reading of mathematics textbooks for understanding into his classes for several years. In a paper Cowen wrote on the importance of teaching and testing mathematics reading, he said, “We should teach our students to read and understand mathematics” (p. 50). Cowen has not done a comparative analysis of his classes to see if teaching reading makes a difference in how much a student learns. However, he believes reading is important and has implemented reading for understanding into his courses by utilizing reading assignments and placing mathematical readings on his tests that must be read with understanding to prove a theorem.

Cowen (1991) points to students’ future careers as a reason to teach students to read mathematics with understanding. “Many of them [students] will have to read and understand mathematical writing to apply new ideas to the problems of their jobs” (p. 50). Reading for understanding is something students will need in their future whether they believe it or not. Reading mathematics is an important skill to foster. The importance of reading was not only noted by Cowen, but also by Boelkins and Ratliff (2000) in the benefits of reading traditional

texts to encourage greater independence, more lively interactions, and free up more class time for in-depth topics instead of surface topics.

Motivating Students to Read Mathematics

Seeing the importance of reading in a mathematics classroom, recent research has shown that there can be effective strategies to reading with understanding in a mathematics classroom. The main strategy in the research is to motivate the students. This is done through explaining the importance and benefits of reading to the students, giving rewards or points for reading, using class time for reading and to re-enforce the reading by incorporating discussion.

The first of these motivating factors is to explain why reading is being used in a mathematics course. The idea of reading to learn mathematics is very foreign to students, who are normally just required to use their textbooks to find the homework problems assigned at the end of the period. If reading has not been used in the past to learn mathematics, providing a basis for why reading is going to be used now was seen as an effective strategy to motivate students to read.

Cowen (1991) writes:

If we communicate to the students that we think it is reasonable that they read mathematics and understand it and that we expect it of them, then they may come to expect it of themselves. We will all be better off if the students view the textbook as a source of information, not just as a list of exercises interspersed with messages for the instructor (p. 53).

Reading for understanding is important and must first be treated so by the instructor to send this message to students. Once students see the importance placed upon reading with understanding from the instructor, then the students will also view reading as an important learning strategy.

The next motivating factor was rewarding the students for their reading. In Boelkins and Ratliff's (2000) experience, it seemed that rewarding the students, usually with grade points, was an effective strategy to ensure reading was being done with some understanding. In Boelkins' and Ratliff's classes, reading assignments counted for 5 % of the students' final grades (2000). Using reading as an assignment was taken a step further by Cowen (1991) who asserted, "to reinforce our effort, we must test their ability to do so" by inserting mathematical readings with understanding as part of his tests (p. 50). Boelkins and Ratliff's and Cowen's examples of using grades as a motivating factor show the effectiveness of motivating students to read with grades.

The next strategy in motivating students to read mathematics text was showing the importance of reading by using precious class time for reading. Research has shown that reading assignments need to be in place of other assignments, not in addition to. Boelkins and Ratliff (2000) note that, "It is important that these reading tasks not simply be added to the list of things required of students, but that their addition is reasonably accommodated in an overall vision for expectations of students" (p. 7). Cowen (1991) and Boelkins and Ratliff (2000) did not give class time for their assignments to be read but did make overall accommodations to their normal class assignments.

In addition to motivating students to read with the previous strategies, the research also pointed to using discussions after reading to re-enforce the reading or to help with understanding of the material. Discussion led by both students and teachers seemed to be effective as long as the focus was on understanding the material and answering students questions. These answers will hopefully come from other students' understanding of the reading, reinforcing the fact that answers to students' questions are in the reading.

The four main motivating strategies were explaining the importance of reading, rewarding the students with grades for reading, reading in class or accommodating other class assignments for reading and discussions of the assigned readings. These four motivating strategies were used and seen to be effective in getting the students to read.

Benefits of Implementing Reading Strategies

After implementing these motivating strategies, the positive effects were clear from the research. “Students read to learn mathematics, explain their mathematical ideas in prose, discussions become more lively, instructor gets individual feedback, class time is spent more efficiently, deeper mathematics is considered, and students even profess to like the assignments” (Boelkins & Ratliff, 2001, p. 9). The benefits of reading go beyond simply learning mathematics; it encompasses explaining mathematics, communicating mathematics, adding greater depth. Discussions were found to enhance the reading as an unintentional by-product noticed by Cowen (1991) and Boelkins and Ratliff (2000).

Conclusion

With all of the research in mind, it seems that reading can be an effective tool to learn mathematics and help to create independent learners who are able to keep learning even while gone for activities. Research has shown that students not only learn mathematics, but students learn mathematics with greater depth and understanding with now having additional sources of information than just the instructor. Students now have the instructor, textbook and fellow students as sources to learn from.

In my study, I use a traditional mathematics textbook within the secondary school setting. My research is similar to Cowen (1991) and Boelkins and Ratliff (2000) who did use a traditional mathematics textbook, but their research focuses on the collegiate setting. In my

study, I also planned to implement motivational strategies to help students learn such as explaining the importance of reading mathematics, giving grades for reading, and giving class time for reading. Unlike any research I read, I implemented a reading guide to focus student reading of a mathematics text. I also specifically focused not only on students who were in the classroom but on students who were absent due to illness or activities.

Purpose Statement

The purpose of my project was to see the impact of implementing reading in a mathematics classroom. I examined the variables of homework and confidence of students to use their textbook for understanding the content. My research questions are as follows.

- What will happen to student's understanding of mathematical content by implementing a reading strategy of learning?
- What will happen to students', specifically students who are absent, understanding of mathematical content by implementing a reading strategy of learning?
- What happens to my teaching when I integrate more reading of the textbook in my mathematics curriculum?

As students are involved with reading as a learning strategy, some will be challenged by changing how they learn mathematics. Students will have to adapt to a new way of learning mathematics not previously seen in other mathematics classes. Therefore, the focus will be to encourage all students to utilize the reading and reading guides as a mathematical experience designed to set them up for mathematical success.

Method

My implementation of the reading strategy was limited to three classes of Algebra II/Trigonometry students consisting of 55 students for the Spring Semester of 2008. Prior to beginning the study, my students had no formal training on how to read a mathematics textbook. In preparing my students for this change, I did a lot of background work with my students about the benefits and purposes of reading a mathematics textbook, as well as analyzing the different parts of a textbook. After completing this background phase, students were then given a reading guide to fill out (see Appendix A for reading guide). The purpose of the reading guide was to guide students' readings, helping them find the important information within the text.

To investigate my questions, I used three instruments to collect data: student surveys, teacher journal prompts, and student interviews. Student surveys were collected at each stage of my research. The first student survey was collected on January 9, 2008 in my Algebra II/Trigonometry classes before the implementation of the reading strategy (see Appendix B for survey). A mid survey was collected on February 20, 2008 (see Appendix C for mid-survey). Finally a post survey was collected April 15, 2008 (see Appendix D for post survey). Results from these three surveys were compared to identify changes in student opinion. Averages were calculated for each question response and compared across all three surveys (See Appendix G for survey results).

My second form of data collection was journaling. Each week, I kept a journal responding to journal prompts relating to my problem of practice and research questions (see Appendix E for journal prompts). Every Friday, I would journal for 15 to 30 minutes responding to my journal prompts. In my journal I would note how the implementing of this new reading program was progressing. I would also include within my journal personal notes about my thoughts on how

the students were accepting this new way of learning mathematics. In addition, I also included information on how my teaching was changing as a result of implementing reading for learning mathematics.

My last form of data collection was student interviews (see Appendix F for interview questions). At the end of the study, a colleague assisted me in randomly selecting three students to personally interview about their experiences. Each interview was conducted personally and tape recorded for further analysis.

During the course of my action research I saw the need to make some changes to my original plan. I originally had planned to analyze student questions throughout the research project. However, as the project progressed, this item became a distracter from my main research. Another challenge was adjusting my action research to my teaching schedule and school events. As an assistant varsity boys' basketball coach, I was elated when our team made it to the state basketball tournament. This resulted in two weeks of very intense preparation for basketball and little to no time for working on my action research.

Findings

The typical schedule during my researching time frame included one day with a reading guide and discussion followed by lecture and guided practice the following day. At the beginning of each section, students were given a reading guide to complete in class and approximately 20 minutes of class time to read the section while filling out the reading guide. After the reading guides were filled out, the next 20 minutes was spent on discussing what students had read and sharing with each other the information found in the text. The last 10 minutes of class was reserved for final questions and a look at the star problem.

The information required on a reading guide was the chapter heading, section heading, give a description of the first paragraph which was usually a story, list key terms such as vocabulary or formulas, list what they will learn (objectives) and why is it important (related fields of study). They were also required to ask one good question from the reading and complete a star problem. A star problem was a problem from the homework exercises that I would select which was representative of the material in the section. The problem was a beginning type of mathematical exercise that the students should be able to complete after reading.

Research question 1: What will happen to student's understanding of mathematical content by implementing a reading strategy of learning?

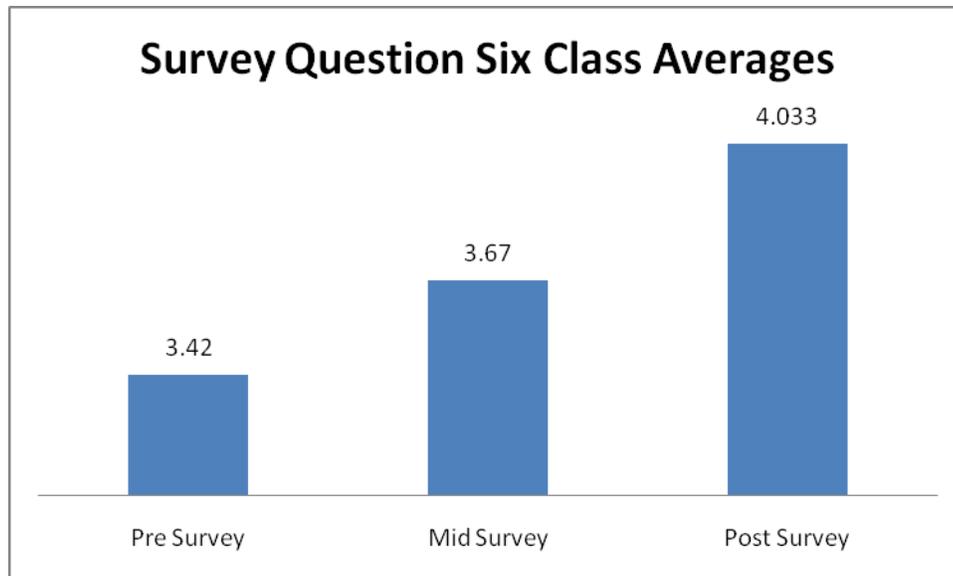
My first theme is that students are more prepared for the math lesson and for completing their homework after reading the section. I noted in my journal that my students are reading the material and gaining knowledge about the mathematical topics of the lesson.

...most students seem to like them (reading guides) and feel it is beneficial. Many students notice things in the section when reading that they would not notice if I was just lecturing or things that I might not have time to cover in a lecture. (Personal Journal, February 1, 2008)

From this journal entry, students accepted the reading guides and believed in the academic value of them. Also contained within my journal, I noted that students are asking questions after reading that I would have normally expected them to ask during a lecture.

Another measure of student preparedness was seen in the student surveys. In comparing the pre surveys, mid surveys and post surveys the biggest increase in student response was on question six. Question six stated, "Reading over the lesson before we

discuss it helps me understand the lesson better.” The average of all my classes went from a 3.42 in the pre survey (on a scale from 1 to 5, with 1 being low) to 3.67 in the mid survey to 4.033 in the post survey, showing a .613 increase from the pre-survey to mid-survey to post-survey for the 55 students who took the surveys.



Another piece of evidence was student’s responses to another survey question. Survey question 17, asked students to complete the statement, “The easiest part of mathematics class is...”. In the pre survey 17 out of 55 students said the homework was the easiest. In the mid survey 36 out of 55 listed the homework as the easiest part. In the post survey, 35 out of 55 listed homework as the easiest part of math class. This data indicates the reading guides and strategies better prepared the students to complete the homework problems. In the students responses in the mid and post survey twice as many students listed homework as the easiest part of mathematics class as compared to the pre survey.

In my student interviews, the responses to questions 8, 13, and 14 were uniform. The first of these questions was question 8 which stated, “Does it help you to learn math by reading the

section?” All students responded with yes. Another question which supports student preparedness and readiness to complete homework was question 13 which was, “As I plan how to conduct my math classes next year, what advice would you give me about having students read their math textbooks.” Every student I interviewed suggested that I keep using the reading guides. Madison, a student interviewed, replied to this question with, “to keep doing the reading guides, but to use them for every section” (Student Interview, April, 2008). Alex replied, “Keep doing them, but add more of the star problems” (Student Interview, April, 2008). These comments from students during the individual interviews show that students believe the reading guides prepared them to learn the mathematical material as well as prepared them to complete the homework. Using reading guides helps students because it gives them an opportunity to learn the material before I lecture over the material. Prior to using reading guides, students seldom viewed their textbook as an instructional source. Instead, they saw their textbook containing lists of exercises or homework problems.

Research question 2: What will happen to students’, specifically students who are absent due to activities, understanding of mathematical content by implementing a reading strategy of learning?

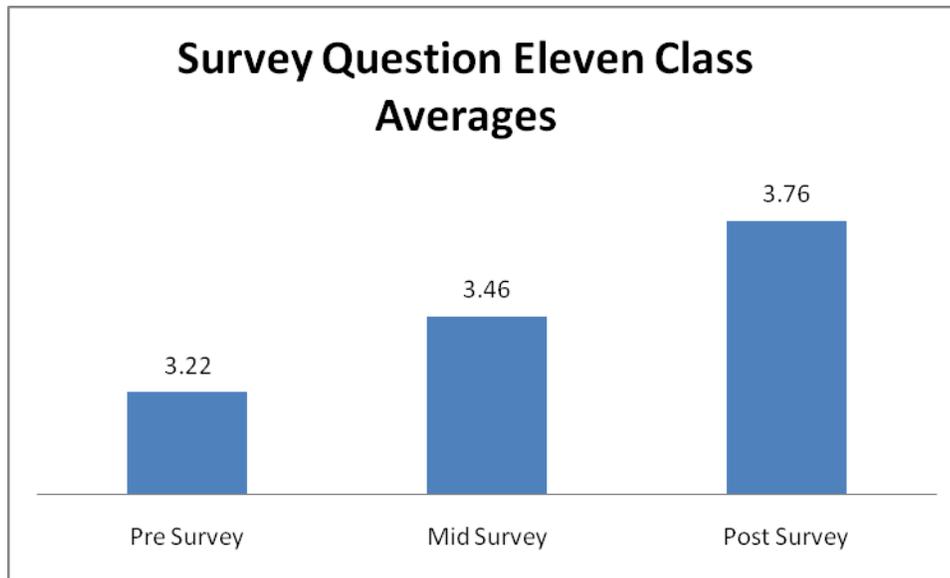
The second theme that arose from my data was that students’ understanding of mathematical content has increased. The increase in understanding is especially noticeable in students who were absent due to activities. My research indicates that the increase in student understanding is largely a result of students completing the reading guides on their own. I noted in my journal that students who are gone completed the reading guides. When these absent students returned to class they participated with a similar understanding as the students who were in class the day we discussed the concept.

The reading guides looked very good, definitely seems to be something that the students can do on their own and it seems effective in helping them in doing the homework because most of the students gone did get the homework done.

(Personal Journal, January 22, 2008)

From this journal entry, not only students who were in class but also students who were absent were able to complete the reading guide and prepared them to complete the homework.

Another document to support students understanding, especially students who were gone for activities, were the student surveys. The biggest increase in the response from survey questions in which students who were gone more than one day every two weeks answered was on question 11. Question 11 stated, "When I am gone for activities, the textbook and reading guide helps me understand the material that I missed." The number of students who responded to this question were 33, 37 and 36 in the pre, mid, and post survey, respectively. The average of those who answered this question on the pre survey was 3.22. In the mid surveys, the average for those who answered this question was 3.46 and for those who answered the post survey the average was 3.76. This shows an average increase of 0.54. The survey results indicated that students who were gone for activities believed the reading guides were helping them understand the material.



Another question from the survey which had a very high response from the student in both the mid and post survey was question 13. Question 13 read, “My understanding of the mathematical content of this class has improved with reading assignments.” The students did not respond to this question for the pre survey since we had not started using the reading guides. However, this item had one of the highest responses from students; an average value of 3.74 on the mid survey and 3.83 on the post survey on a scale of 1 to 5. The high response to this statement suggests that students believed their understanding of the mathematics increased by using the ready guides when they were absent.

In the student interviews, there were responses to two of the questions which directly spoke to the topic of students who are absent for activities. Question three asks, “When gone for activities, what methods have you used in the past to learn the material?” All responses from students showed that either they had no method of learning the material while gone or a poor method prior to the reading guides. Alex replied that he, “wings it” (Student Interview, April, 2008) when gone. Hanah said that she “asks other classmates for help if they are available”

(Student Interview, April, 2008). These responses indicate that prior to the reading guides, students did not have a method to learn math concepts when they were gone for activities.

Again, the responses to question four from the student interviews supported the use of reading guides as a method for learning the material when gone for activities. Question four asks, “When gone for activities, has reading improved your understanding of the mathematics we are studying?” Alex said, “Yes, I actually read and look at the examples” (Student Interview, April, 2008). Hanah said, “Yes, I don’t get behind when we do the reading guides” (Student Interview, April, 2008). Madison said, “Yes, because I can teach myself” (Student Interview, April, 2008). Alex and Hanah were both students who were gone every Tuesday and Thursday for activities during the course of this study. In their responses, I saw that the students who are gone now have a method to keep learning while absent. From my journal responses, to student surveys and student interviews, it is clear that the reading guides increased absent students’ understanding of the material.

Research Question 3: What happens to my teaching when I integrate more reading of the textbook in my mathematics curriculum?

The final emerging theme was while implementing a new teaching strategy time is needed to become comfortable with a new style of teaching. I noted in my journal that at first I felt very uncomfortable using this strategy of teaching. In particular I felt like I was not doing anything when students read. Below is a journal entry noting this:

Today, I really felt as if I did not teach. It feels weird to sit at my desk and let students read. I sometimes walk around but it just feels like I am not doing anything. I also noticed that I am not as tired at the end of the day, much more relaxing day. (Personal Journal, January 11, 2008)

This journal entry shows how uncomfortable it was for me to adjust to this new type of student learning. This uncomfortable feeling passed as time went on, “This week, I am starting to feel that students do not need me to do everything for them” (Personal Journal, February 1, 2008). Although the silence of the reading was awkward to me, I realized I was allowing an opportunity for my students to explore and discover new concepts by themselves.

This theme, I believe, corresponds to how any teacher would feel when trying a new teaching strategy. At first, a teacher may be uncomfortable with a new strategy and unsure of the benefits. As time progresses, both the teacher and the students become familiar with a new strategy. After experience has been gained using the strategy, the strategy can be accepted or rejected.

Conclusions

As a result of this study, I have gained immeasurable experience about how students learn in the mathematics classroom. The purpose of education is student learning and this can and should happen through many avenues. Reading to learn mathematics is one of these avenues that needs to be pursued by more teachers at all levels. The benefits of having students read for learning mathematics were dramatic and surprising in my study. I am convinced that reading in mathematics is not just a good idea but a necessity in today’s classrooms. The need is especially high in a school with frequent absences due to activities. Students need a way to learn that is independent of their teacher and is dependent upon themselves. Utilizing a textbook is not only a method for those who are gone for activities but also for students who are in attendance in class. The future implications of teaching students to read their textbook is another benefit which needs to be considered as more and more college professors are remarking that students cannot read their math textbooks.

The research study found that reading the textbook was an effective strategy for students to increase their understanding of the mathematical material, whether a student was gone for activities or not. This finding was true for all students, especially students who are gone for activities. Previously, students who were gone for activities had no method for learning the material while being gone. According to our findings, the reading of the mathematics material proved to be effective in helping students understand the material.

My findings agreed with other researchers who had used traditional textbooks in their own classes, such as Boelkins and Ratliff's (2000). In their experiences, reading traditional textbooks has been effective in learning the basics of a new mathematical concept and allowing for lecture time to be used for in-depth discussion of the material. This finding was echoed by Cowen (1991), when he wrote an article on the importance of teaching and testing mathematics reading. Cowen said, "We should teach our students to read and understand mathematics" (p. 50). My findings agree with the findings of Boelking and Ratliff and Cowen. My students did learn the basics of a new mathematical concept through reading and gained mathematical understanding through reading.

Implications

Next year, I plan to continue using the reading guides. I believe a similar approach to introducing the students will be needed to give them a background in the benefits of reading. A change to the process I have used will be to incorporate a few more star problems or problems from the homework as part of the reading guides. This past year, as students become more familiar with the reading guides they also became more efficient with them. This efficiency led to an extra 10 minutes of class time in which I started to discuss more problems from the

textbook. Students seemed to appreciate this process of reading, discussing and working a few problems from the homework on the board to relate the readings and discussion to.

I also plan to share what I have learned with others at conferences and in-service programs. I intend to share what I have gained through this research project at my local Educational Service Unit and at state and national conferences. My advice to those who want to start a reading program is to do their homework. Understand starting a reading program for learning mathematics is going to take some time to allow students to adjust to a very foreign way to learn mathematics. This foreignness was noted by one of my students, "I feel like I am in English class" (Student Interviews, April, 2008). To develop any new teaching method is going to take time, patience and a willingness to be uncomfortable. However, the benefits are well worth the process.

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Appendix A

Reading Guide

Name: _____ Date: _____



S.E.A.L.S. – Slow down, Examine vocabulary, Ask questions to yourself,

Look at examples carefully, Summarize text into your own words.

Chapter Heading ($\frac{1}{2}$ pt)

What You'll Learn (1 pts)

Section Heading ($\frac{1}{2}$ pt)

Connection, Integration, or Real World
Application – What is it about? (2 pts)

Why is it Important (1 pts)

Key Terms (2 pts) – Define terms

 Star Problem – Show your work!

Formulas/ Properties/ Vocabulary

Explain the process! (2 pts)

One Good Question after Reading (1 pts)

Look again at the section, can you find answers in the textbook to your questions?

Appendix B

Student Pre-Survey

Please give your honest response to each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I can read and understand the majority of content found in my math textbook	5	4	3	2	1
2. I can reword the majority of math content in my textbook into my own words	5	4	3	2	1
3. If I have a question, I can use my textbook to help me find an answer to my question	5	4	3	2	1
4. Reading over the lesson before we discuss it would help me understand the lesson better	5	4	3	2	1
5. I ask more knowledgeable questions after reading	5	4	3	2	1
6. I can find answers to my questions in my textbook	5	4	3	2	1
7. I can understand math through reading my textbook	5	4	3	2	1

Answer 8-9 if you are a student who has missed class due to activities.

(more than 1 day every two weeks)

8. When I am gone for activities, the textbook helps me understand the material I missed

	5	4	3	2	1
--	---	---	---	---	---

9. When I am gone for activities, I have been able to discuss the material with other students who are gone for the same activity

	5	4	3	2	1
--	---	---	---	---	---

(Fill in the blank)

10. In an average week, I miss _____ days of mathematics class due to school related activities.

Write a quick comment to finish each of the following statements.

11. What helps me most in mathematics class is...

12. The hardest part of mathematics class is ...

13. The easiest part of mathematics class is...

14. When I don't understand a mathematics assignment I ...

Appendix C

Student Mid-Survey

Please give your honest response to each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I can read and understand the majority of content found in my math textbook	5	4	3	2	1
2. I can reword the majority of math content in my textbook into my own words	5	4	3	2	1
3. If I have a question, I can use my textbook to help me find an answer to my question	5	4	3	2	1
4. The reading guide helps me better understand the content in my textbook	5	4	3	2	1
5. The reading guide helps me complete the homework	5	4	3	2	1
6. Reading over the lesson before we discuss it helps me understand the lesson better	5	4	3	2	1
7. The discussion after reading has helped me understand the material	5	4	3	2	1
8. I ask more knowledgeable questions after reading	5	4	3	2	1
9. I can find answers to my questions in my textbook	5	4	3	2	1

10. I can understand math through reading my textbook	5	4	3	2	1
---	---	---	---	---	---

Answer 11-13 if you are a student who has missed class due to activities.

(more than 1 day every two weeks)

11. When I am gone for activities, the reading assignments have helped me understand the material I missed	5	4	3	2	1
--	---	---	---	---	---

12. When I am gone for activities, I have been able to discuss the material with other students who are gone for the same activity	5	4	3	2	1
--	---	---	---	---	---

13. My understanding of the mathematical content in this class has improved with reading assignments	5	4	3	2	1
--	---	---	---	---	---

14. (Fill in the blank)

In an average week, I miss _____ days of mathematics class due to school related activities.

Write a quick comment to finish each of the following statements.

15. What helps me most in mathematics class is...

16. The hardest part of mathematics class is ...

17. The easiest part of mathematics class is...

18. When I don't understand a mathematics assignment I ...

Appendix D

Student Post-Survey

Please give your honest response to each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I can read and understand the majority of content found in my math textbook	5	4	3	2	1
2. I can reword the majority of math content in my textbook into my own words	5	4	3	2	1
3. If I have a question, I can use my textbook to help me find an answer to my question	5	4	3	2	1
4. The reading guide helps me better understand the content in my textbook	5	4	3	2	1
5. The reading guide helps me complete the homework	5	4	3	2	1
6. Reading over the lesson before we discuss it helps me understand the lesson better	5	4	3	2	1
7. The discussion after reading has helped me understand the material	5	4	3	2	1
8. I ask more knowledgeable questions after reading	5	4	3	2	1

9. I can find answers to my questions in my textbook	5	4	3	2	1
10. I can understand math through reading my textbook	5	4	3	2	1

Answer 11-13 if you are a student who has missed class due to activities.

(more than 1 day every two weeks)

11. When I am gone for activities, the reading assignments have helped me understand the material I missed	5	4	3	2	1
12. When I am gone for activities, I have been able to discuss the material with other students who are gone for the same activity	5	4	3	2	1
13. My understanding of the mathematical content in this class has improved with reading assignments	5	4	3	2	1

14. (Fill in the blank)

In an average week, I miss _____ days of mathematics class due to school related activities.

Write a quick comment to finish each of the following statements.

15. What helps me most in mathematics class is...

16. The hardest part of mathematics class is ...

17. The easiest part of mathematics class is...

18. When I don't understand a mathematics assignment I ...

Appendix E

Teacher Journal Prompts

Guidelines for keeping my weekly journal:

- Each day, I will take 60 seconds and jot down notes of possible things I can write about, related to my research questions (i.e., one student, one part of the reading, one conversation).
- I will type up my journals on either Friday or Saturday each week. I will write for approximately 20 minutes per week; 10 minutes on describing the 1-2 events, and then 10 minutes writing the reflection.
- *Reminder to self* respond to 1-2 of the questions below. This writing should be part description of the event and part reflection on why I chose this event, how it relates to my research question(s), and what it means to me.

Journaling Reflection Questions in Response to my research questions:

What will happen to student's understanding of mathematical content by implementing a reading strategy of learning?

What will happen to students', specifically students who are absent due to activities, understanding of mathematical content by implementing a reading strategy of learning?

- Did students, who were gone for activities, read the material on their own?
List evidence.
- During class discussion, did students ask questions about the reading?
- Was this reading assignment worthwhile? And should the section be read next year? Does the teacher need to give any guidance prior to reading? Should the reading guide be changed for next year?
- How is the reading effecting student's understanding? How did it affect the understanding of student's who were gone for activities?

Appendix F

Student Interview Questions

Students will be asked to expand or explain their answers to each question.

1. When reading through sections in your textbook, what do you look at most? least?
2. As you read through a mathematics section, do you ever get confused? What confuses you the most? How have you been able to become unconfused?
3. When gone for activities, what methods have you used in the past to learn the material?
4. When gone for activities, has reading improved your understanding of the mathematics we are studying? Explain.
5. Do you think the types of questions you ask have changed because of reading the text?
6. Can you find answers to your questions by searching the text or through class discussion of the text?
7. Why do you think I have been asking students to read their math textbooks more in class?
8. Does it help you to learn math by reading the section?
9. Does it help you to learn math by having the teacher explain the examples to you?
10. Does it help you to learn math by taking notes or using your reading guide?
11. Does it help you to learn math by discussing after reading?
12. Which of the above 4 methods have helped you the greatest? The least? And why.
13. As I plan how to conduct my math classes next year, what advice would you give me about having students read their math textbooks?
14. What has helped you the most this year in mathematics? The least?
15. What makes math easy or difficult for you? Do you like mathematics as a subject? Why or why not?
16. What study skills have you learned in math this year that you feel you will continue to do next year?
17. Is there anything you want to know from me?
18. Is there anything else I should know about you to better understand your views in math or your general math experience?

Appendix G

Student Survey Results

	Pre-Survey Averages		Mid-Survey Averages		Post-Survey Averages					
	1st	7th 9th Overall	1st	7th 9th Overall	1st	7th 9th Overall				
1. I can read and understand the majority of content found in my math textbook	3.86	3.73 3.74	3.76	3.9	3.8 3.6	3.76	4.1	4	3.7 3.93	
2. I can reword the majority of math content in my textbook into my own words	3.43	3.45 3.47	3.45	3.4	3.3 3.4	3.34	3.5	3.6 3.5	3.53	
3. If I have a question, I can use my textbook to help me find an answer to my question	3.43	3.30 3.82	3.51	3.5	3.6 3.6	3.54	3.6	4	3.5 3.7	
4. The reading guide helps me better understand the content in my textbook				4	3.4 3.5	3.6	4.3	3.6 3.5	3.8	
5. The reading guide helps me complete the homework				3.6	2.9 3.2	3.22	3.9	3.1 3.2	3.4	
6. Reading over the lesson before we discuss it would help me understand the lesson better	3.86	3.48	3	3.42	4.3	3.5 3.4	3.67	4.5	3.7 3.9 4.03	
7. The discussion after reading has helped me understand the material				4.3	3.9 4	4.07	4.5	4.1 4.1	4.23	
8. I ask more knowledgeable questions after reading	3.07	2.95	3.05	3.02	3.3	2.9 3.3	3.15	3.3	3.1 3.2 3.2	
9. I can find answers to my questions in my textbook	3.5	3.43	3.53	3.48	3.4	3.3 3.4	3.36	3.6	3.8 3.5 3.63	
10. I can understand math through reading my textbook	3.13	3.00	3.16	3.09	3.3	3.2 3.2	3.2	3.4	3.4 3.2 3.33	
Answer 11-13 if you are a student who has missed class due to activities. (more than 1 day every two weeks)										
11. When I am gone for activities, the textbook & reading guide helps me understand the material I missed	3.22	3.36	2.93	3.16	3.5	3.2 3.6	3.46	4.1	3.6 3.6 3.77	

12. When I am gone for activities, I have been able to discuss the material with other students who are gone for the same activity
 13. My understanding of the mathematical content in this class has improved with reading assignments

3.44 3.50 3.5 3.49 2.9 3.6 3.7 3.4 3.6 3.9 3.2 3.57
 4 3.5 3.8 3.74 4.2 3.8 3.5 3.83

14. In an average week, I miss _____ days of mathematics class due to school related activities

0.69 0.76 0.76 0.75 0.6 0.6 0.8 0.69 0.6 0.8 0.8 0.73

15. What helps me most in mathematics class is...
 teacher
 discussion/notes
 examples worked in class

Total	1st	7th	9th	Total	1st	7th	9th	Total	1st	7th	9th	Total
11	3	6	2	14	4	8	2	14	4	2	1	7
24	7	7	10	23	6	8	9	23	8	8	8	24
31	7	14	10	31	8	8	7	23	5	12	7	24

16. The hardest part of mathematics class is ...
 being gone
 tests/quizzes
 homework
 equations

Total	1st	7th	9th	Total	1st	7th	9th	Total	1st	7th	9th	Total
7	4	1	2	7	4	1	7	12	5	5	4	14
4	1	2	1	4	1	2	4	7	3	4	6	13
11	4	5	2	11	3	4	4	11	4	4	4	8
18	4	7	7	18	5	8	2	15	2	6	5	13

17. The easiest part of mathematics class is...
 listening/understanding
 homework
 simple equations
 quizzes with notes

Total	1st	7th	9th	Total	1st	7th	9th	Total	1st	7th	9th	Total
13	3	6	4	13	3	3	0	6	1	3	2	6
17	6	7	4	17	10	10	16	36	10	12	13	35
12	3	5	4	12	3	4	1	8	2	2	3	7
5	3	3	2	5	0	1	2	3	3	3	3	3

18. When I don't understand a mathematics assignment I ...
 ask teacher
 ask friend/family
 look in book/notes

Total	1st	7th	9th	Total	1st	7th	9th	Total	1st	7th	9th	Total
10	8	12	10	30	7	13	10	30	5	14	12	31
8	5	10	8	23	7	9	7	23	4	7	5	16
13	3	8	2	13	6	3	3	12	6	7	3	16