How Integrating Mathematics-Based Children's Literature into the Investigations Curriculum Impacts Students' Acquisition of Mathematical Concepts and Vocabulary in Meaningful Contexts

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How Integrating Mathematics-Based Children's Literature into the *Investigations* Curriculum Impacts Students' Acquisition of Mathematical Concepts and Vocabulary in Meaningful Contexts.

by

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APPROVED BY:

[Signatures and dates]
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ABSTRACT

This research attempted to investigate how integrating mathematics-based children’s literature into the *Investigations* curriculum impacts students’ acquisition of mathematical concepts and vocabulary in more natural, familiar, and meaningful contexts. The researcher collected data from twelve, third grade students in an urban school to find out how the integration of mathematics-based children’s literature affected students’ interest in math, understanding of mathematical vocabulary, concepts and content of math literature and curriculum. The researcher used student surveys, pre and post tests, Math Literature Center worksheets, teacher journal, and daily choice time logs to collect data. The data was analyzed to find generalizations about the impact of integrating mathematics-based children’s literature into the *Investigations* curriculum. Based on the generalizations found integrating mathematics-based children’s literature seems to spark students’ interest in mathematics, influence student understanding of mathematical vocabulary, and receives positive responses from students on concepts and content of the literature.
Chapter 1

INTRODUCTION

Background

The National Council of Teachers of Mathematics (NCTM) has recently made recommendations for the mathematics curriculum to include development of language and symbolism to communicate mathematical ideas and relationships (Whitin and Whitin, 2004). Given this recommendation, the researcher seeks to study the impact of integrating mathematics based literature into the current math program in one elementary classroom, as one strategy for improving students' acquisition of mathematical concepts and increasing their development of mathematical language and vocabulary. Literature and language skills are often neglected in the mathematics curriculum. This study will examine the integration of mathematics based children's literature into the current math program, *Investigations* (Mokros and Russel, 1998).

Research Question

This study seeks to investigate how integrating mathematics-based children's literature into the *Investigations* curriculum impacts students' acquisition of mathematical concepts and vocabulary in more natural, familiar, and meaningful contexts.
Limitations of Study

Findings in this study are limited to one third grade classroom in an urban school district in Western New York. Given the small number of participants in the study, data collected can not be generalized to other third grade classrooms. The results are more likely to be generalized if the data collected used a larger sample of students, in diverse settings, across urban and suburban schools for a longer period of time.

Definitions

Integration

A process intended to further students' understanding by establishing relationships among knowledge from more than one discipline or subject area.

Mathematics Children's Literature

A tool used to teach students important and basic mathematics concepts and skills, motivating them to think and reason mathematically, engaging them in problem-solving experiences, and building their appreciation for both mathematics and literature (Burns, 2005).

Investigations

*Investigations* is a complete K-5 mathematics curriculum, developed at TERC in Cambridge, Massachusetts. It is designed to help all children
understand the fundamental ideas of number and arithmetic, geometry, data, measurement and early algebra (Mokros and Russel, 1998).

**Choice Time**

Students work simultaneously on different activities focused on the same mathematical ideas. Students choose which activities they want to do, and they cycle through them (Mokros and Russel, 1998).
Chapter 2
REVIEW OF THE LITERATURE

Introduction

Due to the recent recommendations and changing standards, educators have been pursuing different methods and approaches to incorporate language arts into the mathematics curriculum. "Literature and language skills are often neglected in the mathematics area of the curriculum. Educators are now discovering ways to incorporate reading into mathematics through children’s literature" (Kolstad, Briggs and Whalen, 1996, p. 423). The integration of mathematics based children’s literature is an excellent way to spark children’s mathematical imaginations in ways that exercises in textbooks and workbooks often do not (Burns, 2005). The researcher strongly believes that through the integration of literature into mathematics, students will gain a greater understanding of the concepts they are learning and a greater interest in math as a core subject.

What is Investigations?

Based on the primary research question, the researcher will be integrating mathematics based children’s literature into the school’s current math curriculum, *Investigations*. *Investigations* is an inquiry-based mathematics curriculum that does not directly include the integration of math literature into math lessons. It is a very hands-on approach to teaching mathematics through the use of manipulatives and problem solving. Within the *Investigations* curriculum there is a “list” of suggested
children’s literature for each unit. The publisher states that the suggested literature can be used to support the mathematical ideas in the unit, but activities can be adapted and taught without the literature (Mokros and Russel, 1998). As the researcher explored the curriculum it was found that the “list” of suggested children’s literature for each unit consisted generally of one title for each unit. Each unit usually consists of approximately five investigations covering several mathematical concepts.

Based on these findings regarding the *Investigations* curriculum and other research, the researcher intends to examine the effects of presenting mathematical concepts and strategies through the direct use of children’s literature into the *Investigations* curriculum. The researcher’s intent is to instill in students a greater understanding of the concepts and strategies they are currently learning.

**Why Integrate Mathematics-Based Children’s Literature?**

As stated previously the National Council of Teachers of Mathematics (NCTM) has made recommendations for the mathematics curriculum to include development of language and symbolism to communicate mathematical ideas and relationships. Within these standards, NCTM stresses that all children need to learn mathematics with understanding and be able to use it in everyday life. Whitin and Whitin (2004) explain that being mathematically literate in today’s society is extremely important. They give examples of how individuals need to be prepared to solve complex problems, make decisions through evaluating alternatives, and communicate effectively. Therefore, based on the NCTM standards and
recommendations by several math experts, what better way to meet these standards than through the use of mathematics children’s literature?

Children’s books provide an invitation into the world of mathematics in different contexts. Marilyn Burns (2005), a renowned author of children’s books, educational resources, and an educator, states that children’s books spark children’s mathematical imaginations and help dispel the myth that math is dull, unimaginative, and inaccessible (Burns, 2005). Mathematics is a core subject in which individuals often struggle because of the complexity of it as a whole. Therefore, the link between literature and mathematics when presented through meaningful context, allows learners the opportunity to build their confidence in their own mathematical abilities (Ezell, 1997). Linking math and literature in the classroom will help students gain confidence in their mathematics abilities, learn problem solving, and develop other valuable math skills while enjoying literature (Kolakowski, 1992).

Kolstad, Briggs and Whalen (1996) show the example of putting the mathematical concept of division into the familiar context of sharing through the explanation of *The Doorbell Rang* by Pat Hutchins (1986). Within this text two children are preparing to share a dozen cookies when the doorbell rings and two more children enter the house. As soon as the children in the story decide how many cookies each gets through sharing the doorbell continues to ring. The pattern of dividing/sharing continues throughout the text. This book is an example of introducing students to the mathematics concept of division in the familiar context of sharing and eating cookies (Kolstad, Briggs, and Whalen 1996). This is one example
of how mathematical concepts can be presented in meaningful contexts for students. In doing so, literature can be used to capture and engage more students’ attention and interest in mathematics (Ward, 2005).

**Types of Mathematics Based Children’s Literature**

"Just as stories and non-fiction texts provide contexts for exploring personal issues and social issues, investigating language...they also pride contexts for exploring mathematics and for solving problems using mathematics" (Griffiths and Clyne, 1994, p. 56). There are a variety of mathematics based texts which support and extend their learning in the area of mathematics as well as other areas across the curriculum. Griffiths and Clyne (1994) suggest that books and other written materials are needed to stimulate children’s interests, provide models for communicating information to others, and helping students with answering and posing questions. They also present different kinds of written material that can play different roles in developing mathematical thinking.

The types of written materials they suggest in their text *Language in the Mathematics Classroom* (1994) are, narratives, factual texts, interactive texts, procedural texts, newspapers, magazines, children’s writing, and mathematical texts. Each type of text can play a role in the learning of mathematics. Narratives can be used in relating mathematics to the human world through stories that may illustrate mathematics concepts, pose problems, suggest investigations, or provide models for children’s writing. Factual texts can provide both starting points and mathematical
information needed for projects and investigations. Griffiths and Clyne (1994) suggest *The Guinness Book of Records* as a wonderful source for mathematical information and investigations. Interactive texts provide the opportunity for students to be responsive and involved in the text while reading. It may present itself in a way for students to focus on solving problems using technology, and use many mathematical concepts and skills. Procedural texts involve children in applying their knowledge. These texts are often used to focus on the particular language patterns associated with these texts. The use of newspapers and magazines can often be challenging to use, but can be very beneficial to student’s learning if used appropriately.

Children’s writing can also be used as a valuable tool in the mathematics classroom. Many activities can be created based around a student’s piece of writing. For example, when children have completed a task, give them time to share what they have done with others in small groups, displaying their work, or by making class books. These are all very creative ideas that can be done using children’s writing. Mathematical texts can also be very effective if used appropriately. Children will need specific knowledge and skills to be able to read and understand mathematical texts. “Reading mathematical text aloud, and explaining what the text means, are important” (Griffiths and Clyne, 1994, p. 66).

“Reading and writing are essential skills for learning mathematics in our culture, and children need to be given opportunities to read and write about mathematics in ways that will extend their understandings of mathematics” (Griffiths
Reading contributes to learning mathematics, and mathematics contributes to understanding what we read. Therefore by integrating mathematics and reading will set up contexts for problem solving and deeper mathematical thinking. Mathematics based children’s literature can provide an initial stimulus for an investigation by presenting the literature to activate student’s prior knowledge and interest, present illustrations of different concepts, and bring together the learning’s of a concept. Each type of text described by Griffiths and Clyne (1994) can be beneficial to student’s learning if used appropriately as stated.

Choosing Mathematics Based Children’s Literature

With the goals of developing communication, problem solving, and connections based on the NCTM standards, many educators have established criteria for selecting appropriate mathematics-based children’s literature. Having a set of criteria for selecting mathematics-based children’s literature is extremely important for being successful in integrating the literature. Whitin and Whitin (2004) in their text, New Visions for Linking Literature and Mathematics, present criteria for selecting appropriate texts from two different perspectives: the mathematical and the language arts. They believe that good mathematics-based literature should demonstrate mathematical integrity, potential for varied response, an aesthetic dimension, and ethnic, gender, and cultural inclusiveness. Each of the criteria stated are explained extensively and are aligned with math and language arts standards.
Their purpose is to specify criteria that focus on mathematics books that convey sound and actuate content, and that promote healthy attitudes and dispositions about mathematics.

Marilyn Burns (2005) established the *Marilyn Burns Classroom Math Library*, which is a collection of 25 quality children’s books. In her handbook she explains how to use each title to launch a classroom math lesson, targeting topics at the core of the third grade mathematics curriculum. Burns explains the primary criteria she used for selecting books to place in her math library. The criteria she used were the quality of their content and illustrations, and the appropriateness of the math content to address important grade-level topics (Burns, 2005). The basis for these criteria was the math standards as described by the National Council of Teachers of Mathematics (NCTM) in *Principles and Standards for School Mathematics* (NCTM, 2000). It is imperative for teachers to establish criteria when selecting math literature to use within a math program.

As well as the criteria stated above, there are numerous reference lists of well researched, appropriate mathematics-based children’s literature. Griffiths and Clyne (1988) provide a list of forty different math stories and poems, including a lesson outline and activities for each in their text, *Books You Can Count On*. Whitin and Whitin (2005) also include an annotated list of the best math related literature in their text, *New Visions for Linking Mathematics and Literature*. There are many sources available on the web and other texts that can be very useful when selecting appropriate literature to integrate into the mathematics curriculum. Smith urges
educators that selections made should encourage teachers and students to make authentic connections to mathematics (Smith, 1995).

**How to Integrate Mathematics Based Children’s Literature**

The integration of mathematics-based children’s literature provides students with a better learning perspective in both mathematics and literature (Kilman, 1993). In her article Kilman goes on to explain ways for incorporating literature into mathematics instruction. She suggests beginning with an engaging and mathematically rich story that contains mathematical ideas and information that can be used for an interdisciplinary approach. She then suggests allowing students to role play the characters in the story. Kilman states that having students play the characters in the story helps them to focus on relevant mathematical information within the text. The next step Kilman suggests is introducing the mathematics that is appropriate to the story. By presenting the literature first, the story can serve as a springboard for a range of mathematical investigations. Lastly, the class should discuss and communicate about the story in groups or as a whole.

Marilyn Burns (2005) also suggests a similar approach to integrating mathematics-based children’s literature. Burns suggests launching a math lesson after reading a book aloud and discussing the text aloud with the class. She states that once students have shared their reactions, it is appropriate to reread the book and shift their attention to the math content of the lesson. In her teacher handbook Burns also lists suggestions for structuring math instruction around a children’s book:
1. Gather students and read the book aloud.

2. Allow time for class discussion of the book.

3. Reread the book, making the math connection by engaging students with the lesson.

4. When appropriate, give a follow-up assignment for students to work on individually or in small groups.

5. Make the books available for students to revisit on their own or take home to enjoy with their families.

Griffiths and Clyne (1988) suggest that mathematics should not be imposed upon a work of literature, because this would defeat the purpose of integrating the subject areas. Rather, the mathematics should flow from, and be a natural part of the book. Not all mathematics can or should be taught through literature. Real-life experiences, games, manipulatives, and appropriate worksheets or pages from a text book all have their place in mathematics programs. Using literature to teach mathematics is an additional and very useful strategy to add to teachers’ storehouse of techniques.

Math is a more difficult area to integrate. Math needs to be taught in a sequential way, building skill upon skill for better understanding. It is important for students to see ways that math is applied in real-life problem-solving situations. Literature is one approach to introduce these math concepts within the classroom in a natural and familiar way. Stories require children to listen, interpret, and reflect on the content. Stories also help to explore math concepts through active participation, to integrate new ideas, and to predict new outcomes (Burnett and Wichman, 1997).
Therefore there are multiple ways teachers can integrate mathematics-based children’s literature. Teachers need to plan accordingly, outline major concepts and strategies being presented, and determine the best way to present the literature to build student understanding. Math literature books can be used to pose problems, introduce new strategies, and/or show another representation of a mathematical idea. There are many reasons why the integration of mathematics-based children’s literature can be beneficial to student learning, and a variety of ways to integrate it into the curriculum.

Supporting Student Learning Through the Integration of Mathematics-Based Children’s Literature

What problem solving strategies can students learn from mathematics-based literature and how can they apply it to math lessons? How does integrating mathematics-based children’s literature contribute to the development of mathematical language and vocabulary?

Mathematical children’s literature should support student learning through the use of math vocabulary, problem solving strategies, real life connections to the text, and should promote student interest in mathematics. Kolstad and Briggs (1996) suggest that mathematics literature should model mathematical ideas, challenge students, encourage investigation, and illustrate concepts. “The language of mathematics is a stumbling block to many students. Children throughout their mathematical education need to be given time in situations which allow them to use
language to describe, explain, report, investigate and question” (Griffiths and Clyne, 1988, p. 6). These authors also state that in order for children to appreciate the purpose and usefulness of mathematical language and vocabulary they need to establish a purpose for it. They suggest that through the context of stories and problems arising from literature provides such meaning and purpose for children’s exploration of mathematical language.

Literature gives students an opportunity to raise questions, make personal connections, frame mathematical ideas in their own language, and extend stories in their own ways. Therefore, by using literature, we celebrate children’s voices and build inquisitive mathematical communities (Whittin, 2002). Marilyn Burns (2005) also states that using children’s literature for teaching a math lesson is effective for teaching students important and basic mathematics concepts and skills, motivating them to think and reason mathematically, engaging them in problem-solving experiences, and building their appreciation for both mathematics and literature.

Referring back to Whittin’s and Whittin’s (2004) criteria for selecting math-related books, one of the criteria was mathematical integrity. The authors elaborated on this criterion by stating that mathematical components should be accurate. Using vocabulary appropriately is part of the Communication Standard. Although the focus of math-related books should not be on teaching mathematics vocabulary in a didactic way, when vocabulary is presented accurately and in meaningful contexts, the literature can be powerful teaching tools for language/vocabulary development, as
well as mathematical concepts (Whitin and Whittin, 2004). Whitin and Whittin also suggests that the text should demonstrate problem solving, representation, and reasoning.

Mathematical language and vocabulary development, as well as problem-solving strategies are part of the foundations of mathematics. These are areas in which students need to develop understanding in order to achieve success in mathematics as a whole. Thus, given that many mathematical ideas and concepts are abstract or symbolic, children’s literature has a unique advantage in the mathematics classroom because these ideas and concepts can be presented within the context of a story, using pictures and more informal, familiar language (Ward, 2005). The researcher believes that these aspects of mathematics can be developed when presented through the integration of mathematics children’s literature.

**Research Studies That Have Investigated the Impact of Literature in Math Classes**

A growing body of research in the fields of mathematics education and literacy shows great support for the inclusion of children’s literature into mathematics instruction and learning (Ward, 2005). Burnett and Wichman (1997) completed an action research project in May, 1997 promoting mathematics and literature as an approach to success. Their study was done to decrease students’ anxieties toward mathematics and increase their ability to problem-solve in real-world situations. Their main objective was to use literature as a bridge to integrate authentic
experiences with math. The researchers integrated math and literature into the current math program by creating literature-based math lessons, which were taught on an average of two literature-based math lessons a week. Authors and topics were chosen that children would relate to best and a lesson consisted of a story that corresponded to the math topic that was being taught. Students were read a story by the researchers and then they were asked to solve problems involving facts from the story. Surveys were also distributed to students as well as pre and post tests to determine differences in student anxiety from the start of the research project until the end.

The researchers determined that students' anxiety decreased throughout the research period, and the students described learning math through literature as "doing fun math." Students related this to the times they used math at home or during play and doing routine activities in class. Therefore, it was evident that students were able to identify their use of math. According to the researchers this was a sign that anxiety had decreased, therefore accomplishing the goal of their research study. Burnett and Wichman (1997) suggested that mandating two math and literature lessons a week is unrealistic, because there cannot be a set number of lessons during a certain period of time. "Math and literature should not be the only intervention in a math program. Literature is only one approach to use. There are other wonderful ideas and materials produced to decrease math anxiety and increase the use of math in real-life problem solving" (Burnett and Wichman, 1997, p. 52). Mathematics-based children's literature has proven to be a successful tool in regards to the questions posed in this research study.
In the text *Math is Language Too* (2000), the authors present stories describing events that took place over a period of four years in a fourth-grade classroom. The researchers Phyllis Whitin and David Whitin conducted this study to present their beliefs of encouraging the use of multiple avenues for expressing understandings in mathematics, as well as valuing learners as constructors of their own knowledge, and recognizing the social nature of how learners construct that knowledge. The authors researched how using children’s literature to understand mathematical vocabulary can be an avenue for students to explore the meaning of mathematical vocabulary. Within the text they gave examples of how students explored the ideas in a story that was read to them. The students were given the opportunity to complete a hands-on activity surrounding the concepts of the text that was read to them. Through this activity they were able to relate their everyday language to mathematical language and symbols based on the standards.

Many activities similar to the one previously discussed using children’s literature were used in ways to help students value the process, honor surprise, acknowledge contributions of others, and grow through reflection. These aspects that the authors referred to have significant meanings when using children’s literature in a strategic way. Students begin to value the process when they are given time to work through their own problems, presented through literature, and they appreciate the contributions of others by acknowledging a wide range of responses when literature is shared and discussed. “It is in these ways that the strategic use of children’s literature can open the potential for much writing and talking about mathematical ideas. It is
through stories that students can stake out their own personal identities as well as contribute to the collective pool of mathematical understanding” (Whitin and Whitin, 2000, p. 67).

Summary

Mathematics-based children’s literature is an essential tool that can be used to promote increased language and vocabulary development, to communicate mathematical ideas and relationships, and to acquire mathematical concepts. Literature can be used in many ways to spark students’ interests, learn problem solving strategies, and present mathematics in real world contexts. It is important to establish criteria for selecting mathematics based literature that encourages teachers and students to make authentic connections to mathematics. Mathematics-based children’s literature should also be appropriately integrated in order to promote and support success for student learning. The purpose of this research is to integrate mathematics-based children’s literature into the Investigations math program to impact students’ acquisition of mathematical concepts and vocabulary in more natural, familiar, and meaningful contexts.
Chapter 3

METHODOLOGY

Introduction

This study was carried out in an urban elementary school (Grades K-6) located in Western New York. The researcher sought to determine how integrating mathematics-based children’s literature into the *Investigations* mathematics curriculum might impact students’ acquisition of mathematical concepts in more natural, familiar, and meaningful contexts.

Subjects

This study was conducted in a third grade classroom in an urban elementary school in Western New York. There were twelve subjects who participated in this study, four girls and eight boys. The ethnic make-up of the subject group was as follows: eight African American, two Caucasian, one Hispanic, and one Middle Eastern. Two students had Individualized Education Plans (IEPs) and received additional assistance from a consultant teacher daily. One student received speech and language services and English as a Second Language (ESL) services. Eight of the twelve subjects received free or reduced lunch. Subjects were selected based on return of a letter of informed consent sent to parents and read to the participants. One student was transferred to a different school more than halfway through the study. Data was collected and analyzed for the time period that the subject was part of the study.
Two teachers worked in the classroom: the general education teacher and the researcher, who was an intern teacher (15 hours a week) while completing full time graduate coursework. Additional assistance from a consultant teacher was given daily to the two students who had Individualized Education Plans.

Research Design

The researcher collected data for eight weeks during the second half of the school year. Collection of data began after a human subjects proposal was submitted to and approved by the Institutional Review Board (IRB) at SUNY College at Brockport (Appendix A). A letter of informed consent (Appendix B) was read to the participants and sent to their parents to explain the purpose of the study. Parents and subjects were informed that there were no anticipated risks in participating and this activity would be done as part of our daily routine during mathematics instruction.

The researcher collected the data in an attempt to examine the research question: How does integrating mathematics-based children’s literature into the Investigations curriculum impact students’ acquisition of mathematical concepts and vocabulary in more natural, familiar, and meaningful contexts?

Data Collection Instruments

Data was collected during 3 Investigations: Combining and Comparing (Investigation 4 and 5), and Fair Shares (Investigation 1). Mathematics literature was used at the beginning of math lessons, during math lessons (when appropriate), the
closing of math lessons, and during math centers. The time of use of mathematics literature throughout the study was determined by the *Investigation* being covered. Pre and post tests (Appendix C) based on the content and vocabulary of each unit were created and administered by the researcher throughout the research period. These forms of data collection were used to determine whether there was a significant difference in student achievement, acquisition of mathematical concepts, and vocabulary due to the integration of mathematical children’s literature.

A very significant part of the *Investigations* curriculum is “Choice Time.” This is when students are allowed to choose a game or an activity they would like to do at the end of a math period. Mathematics literature was integrated as one of the choices during Choice Time. Subjects were responsible for answering four to five short questions at the literature center about the book they chose to read. The questions were used to determine: whether the student enjoyed the book, if they were able to identify the major mathematical concepts and vocabulary within the text, how they responded to the concepts and the content of the literature, if they were appropriately responding to questions about the math literature, and their overall rating of the book. To determine how often students made the math literature center a choice, a daily log was also placed at the math centers during Choice Time.

Each subject participated in two student surveys throughout the research study. With the collection of the student surveys, the researcher intended to determine students’ perception of the integration of mathematics literature into their daily math period. The researcher also kept a research journal as a narrative
technique to record events, thoughts, and feelings that were important regarding the research study.

**Pre-tests and post-tests.**

A pre-test and post-test (Appendix C) was administered for each of the three Investigations covered during the research study. Pre-tests were given before the start of a new Investigation, which usually consisted of five or six sessions. Post-tests were given upon completion and review of each Investigation. Each test consisted of 10-12 questions, based on the content, vocabulary, and literature that were read during the instructional period of that Investigation. The questions on the tests consisted of short response and multiple choice. Subjects were given as much time as they needed within the math period (one hour) to complete the test.

**Student surveys.**

Student surveys were created and administered by the researcher two times throughout the research study (Appendix D). Surveys consisted of seven questions: five direct yes or no questions, and two short response questions. The five direct questions were used to determine students’ feelings toward having math books become part of their daily instruction. The two short response questions on the surveys required students to write a written response about things they learned from math books that were read together as a class, and also books that they read independently. These questions focused on vocabulary and mathematical concepts.
These surveys were used as a tool to determine students’ attitudes and interests toward mathematics-based children’s literature as well as a means of assessing some concepts and vocabulary that they learned through the literature.

*Math literature center questions (Choice Time).*

During choice time students were responsible for reading a mathematics-based children’s text, as well as completing a worksheet that was created by the researcher. A mathematics-based text was chosen based on the content and concepts that were being covered during the *Investigation*. Math centers were used daily, in which students rotate through a number of activities every eight days. Therefore, a new mathematics-based text was chosen every eight days. The texts chosen consisted of various titles by renowned authors of children’s books. (Appendix G).

The worksheets (Appendix E) which students were required to complete during center time, consisted of five to ten questions based on the concepts, vocabulary, and content of the literature. Students were given a list of math concepts, and were required to circle concepts they read about in the assigned book. They were also given a list of vocabulary words and were required to circle any math vocabulary words that they found in the book. Each worksheet asked students to tell one thing they learned from the book, as well as rate the book on a scale of one to four, with four being the highest rating. The final part of the worksheet required students to complete questions related directly to the content of the text. Questions varied from multiple choice, short response questions, fill in the blanks, and/or playing a game.
with a partner. The information collected by this tool allowed the researcher to
determine what the students learned from the text as well as their feelings toward the
text that was read.

"Choice Time" texts were also selected for students that made the math
literature center a "choice," when not already assigned. These texts were chosen as
often as needed, based on the frequency of students choosing to go to the math
literature center. If students made this a choice, they were given a book, along with
questions on an index card to answer in their math notebooks.

**Daily choice time log.**

Students were responsible for keeping track of the math center they attended
daily. Each day two or three students were given a "choice" of what math center
activity they wanted to do, based on the eight day rotation. Each student that had a
"choice" was responsible for writing his/her name and the activity he/she chose to do
on the daily choice time log. This log (Appendix F) was used to determine if and
how frequently students chose to go to the math literature center when given a choice.

**Teacher journal/field notes.**

The researcher kept a teacher journal, which was used to take anecdotal notes
and observations on a regular basis. These notes were kept in a notebook and kept
confidential at all times throughout the research period. The researcher took notes on
student observations during center time, as well as part of the regular math work
period. Significant student comments, behaviors, and attitudes were also recorded based on their relevance to the study. The teacher journal was used as another tool for determining students’ interest in mathematics-based children’s literature, and the effect on their learning.

**Triangulation of Data**

The researcher used several data collection instruments in order to triangulate data and ensure reliability. The chart below shows how the data collection instruments assess different areas of integrating mathematics-based children’s literature as a means to answer the research questions posed in this study.

*Figure 1*

<table>
<thead>
<tr>
<th>Questions/Focus</th>
<th>Data Source #1</th>
<th>Data Source #2</th>
<th>Data Source #3</th>
<th>Data Source #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will the incorporation of mathematical children’s literature spark students’ interest in a math lesson?</td>
<td>Teacher Journal/Field Notes</td>
<td>Student Surveys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does literature influence the understanding of mathematical vocabulary?</td>
<td>Pre-Test</td>
<td>Post-Test</td>
<td>Student Surveys</td>
<td>Math Literature Center Questions</td>
</tr>
<tr>
<td>How do students respond to the concepts and content of the literature?</td>
<td>Pre-Test</td>
<td>Post-Test</td>
<td>Student Surveys</td>
<td>Math Literature Center Questions</td>
</tr>
<tr>
<td>Do students choose to go to the Math Literature Center at Choice Time?</td>
<td>Daily Choice Time Log</td>
<td>Student Surveys</td>
<td>Math Literature Center Questions</td>
<td></td>
</tr>
</tbody>
</table>
**Procedure**

The research study was completed over a nine week period, in which the integration of mathematics-based children’s literature was integrated daily into mathematics instruction. The researcher determined which *Investigations* would be used to integrate mathematics-based children’s literature, based on approval of the Institutional Review Board (IRB). As the *Investigations* were chosen, the researcher created pre and post tests for each *Investigation*.

A pre-test for each *Investigation* of the Combining and Comparing and the Fair Shares units were administered before the start of each *Investigation*. Students were given as much time as they needed to complete the pre-test during the mathematics instructional period (1 hour). Upon completion, students were given the opportunity to go to a math center; this began a new eight day rotation.

Each *Investigation* consisted of four to six sessions in which students completed various activities and group work on a daily basis based on the *Investigations* curriculum. Several mathematics-based children’s books (based on combining and comparing mathematics concepts) (Appendix G) were read on a daily basis to students. Books were usually read aloud to the class at the beginning of the math instructional period as students gathered on the carpet. As students returned back to their seats, the researcher recorded any observations and/or field notes into the teacher journal.

Based on the *Investigations* curriculum, students are given approximately 20-30 minutes of center time, or “choice time,” in which they complete math activities
that correspond to the lessons taught during an *Investigation*. During this time students are assigned to a center daily, with the exception of two to three students, who are given a “choice” of which activity they would like to do. The mathematics literature center was integrated as part of center time and “choice time.” Therefore, students were given an opportunity to interact with a piece of mathematics-based children’s literature daily, as well as completing the worksheet that goes along with each text.

Upon completion and review of a complete *Investigation*, the researcher administered a post-test to review content, concepts, and vocabulary. Students were given the same opportunity as with the pre-test, in which they were able to have a full mathematical instructional period to complete the test. Upon completion students were given an opportunity to choose a mathematics-based children’s book from the classroom math library to read independently. This gave students the opportunity to choose a math text on their own, for their own personal enjoyment.

Student surveys were administered three times throughout the study, usually on the same day as the post-test. The researcher read aloud instructions, as well as each question to the entire class for clarity. Students were given extra time if needed to complete surveys outside of the math period.

**Data Analysis**

Data was analyzed by scoring pre and post tests that were administered to students by the researcher, scoring math literature center questions, and finding patterns on student surveys.

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The researcher looked for themes and patterns on all short response questions, as well as scale questions on student surveys. Generalizations were developed comparing pre-tests and post-tests, three student surveys, math literature center questions, and the teacher journal. A coding system was used by the researcher to maintain confidentiality throughout the research process. Each student was assigned a number to correspond with their identity.
### Time Schedule

Figure 2

<table>
<thead>
<tr>
<th><strong>1st Investigation</strong></th>
<th><strong>2nd Investigation</strong></th>
<th><strong>3rd Investigation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test: <em>Investigation 4</em> (Combining and Comparing) Math Centers (Day 1) <em>Book/Worksheet</em> Teacher Journal</td>
<td>Pre-Test: <em>Investigation 5</em> (Combining and Comparing) Math Centers (Day 1) <em>Book/Worksheet</em> Teacher Journal</td>
<td>Pre-Test: <em>Investigation 1</em> (Fair Shares) Math Centers (Day 1) <em>Book/Worksheet</em> Teacher Journal</td>
</tr>
<tr>
<td>Session 1 Math Centers (Day 2) Teacher Journal</td>
<td>Session 1 Math Centers (Day 2) Teacher Journal</td>
<td>Session 1 Math Centers (Day 2) Teacher Journal</td>
</tr>
<tr>
<td>Session 2 Math Centers (Day 3) Teacher Journal</td>
<td>Session 2 Math Centers (Day 3) Teacher Journal</td>
<td>Session 2 Math Centers (Day 3) Teacher Journal</td>
</tr>
<tr>
<td>Session 3 Math Centers (Day 4) Teacher Journal</td>
<td>Session 3 Math Centers (Day 4) Teacher Journal</td>
<td>Session 3 Math Centers (Day 4) Teacher Journal</td>
</tr>
<tr>
<td>Session 4 Math Centers (Day 5) Teacher Journal</td>
<td>Session 4 Math Centers (Day 5) Teacher Journal</td>
<td>Session 4 Math Centers (Day 5) Teacher Journal</td>
</tr>
<tr>
<td>Session 5 Math Centers (Day 6) Teacher Journal</td>
<td>Session 5 Math Centers (Day 6) Teacher Journal</td>
<td>Session 5 Math Centers (Day 6) Teacher Journal</td>
</tr>
<tr>
<td>Review Math Centers (Day 7) Teacher Journal</td>
<td>Session 6 Math Centers (Day 7) Teacher Journal</td>
<td>Session 6 Math Centers (Day 7) Teacher Journal</td>
</tr>
<tr>
<td><strong>Post-Test:</strong> <em>Investigation 4</em> 1st Student survey Math Centers (Day 8) Teacher Journal</td>
<td>Review Math Centers (Day 8) Teacher Journal</td>
<td>Review Math Centers (Day 8) Teacher Journal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Summary

The generalizations developed in this study are limited to twelve students in one third grade class in an urban school district. Data gathered from these participants can be used to inform other teachers and educational researchers about how the integration of mathematics-based children's literature can be used to spark students' interest in mathematics, influence the understanding of mathematical vocabulary, concepts, and content. However, data can not be generalized to other groups of third grade students in other school settings.
Chapter 4

FINDINGS

Research Results

The research question that focused this study was: How will integrating mathematics-based children's literature into the *Investigations* curriculum impact students' acquisition of mathematical concepts and vocabulary in more natural, familiar, and meaningful contexts. The underlying sub questions of this study are: Will the incorporation of mathematics-based children's literature spark students' interest in math? Does literature influence understanding of mathematical vocabulary? How do students respond to the concepts and content of the literature? Do students choose to go to the Math Literature Center at Choice Time? The researcher examined each of these aspects during the course of eight weeks, through the collection of data using various tools. The researcher kept a teacher journal, created and administered pre-and post-tests for each *Investigation*, created and administered three student surveys, created Math Literature Center questions, and kept a daily "Choice Time" log. The data collected was then analyzed both quantitatively and qualitatively for each student. Upon analysis and evaluation, the researcher made generalizations that are described below.

Will the incorporation of mathematics-based children’s literature spark students’ interest in math?

*Generalization 1: The incorporation of mathematics-based children’s literature does spark students’ interest in math.*
Two sources were analyzed to determine how the incorporation of mathematics-based children’s literature affected students’ interest in math. The researcher used data from the two student surveys that were administered during the research period. The first survey was administered two weeks into the research period, and the second survey was administered during the final week of the research period. The researcher also looked at anecdotal notes that were taken, focusing on significant student comments, behaviors, attitudes, and other observations related to the study.

The first survey that was administered to students showed a significantly positive attitude toward each question that was presented. The first, second, and fifth questions on the survey addressed students interest in mathematics-based children’s literature. Eleven out of the twelve participants responded that they enjoyed reading math picture books. All participants responded that they enjoyed looking at the pictures in math books. Finally, eleven out of the twelve participants responded that they enjoyed having a math literature center. It was evident that students showed a positive interest in mathematics-based children’s literature.

The second survey that was administered to students after eight weeks did not show significant changes in students’ attitude and interest towards mathematics-based children’s literature. All students’ responses remained mostly positive as they did on the first survey. Participants responded positively to questions: one, two, and five. This generalization is demonstrated below.
The observations made by the researcher and recorded into the teacher journal, also showed a consistency of positive attitudes and sparked interest in the mathematics-based children's literature. Students expressed interest and excitement of math literature before the math instructional period began, during the opening, as
well as throughout math center and choice time. Often times throughout the research period, students asked the researcher “if we were going to read a math book together today?” and they expressed excitement whenever called to the carpet to hear a mathematics-based children’s book read to them.

Students showed attentiveness, as well as minimal behavioral problems during the reading of a math book. Many of the mathematics-based children’s texts that were chosen and read to the class were interactive texts. These texts required students to repeat what the reader said and/or use problem solving strategies to solve problems throughout the text. Students were engaged during these times, and expressed excellent behaviors and attitudes toward each other, the researcher, and the text that was being presented.

**Summary of Findings**

Based on student responses on surveys, teacher observations, and anecdotal notes, it could be concluded that the incorporation of mathematics-based children’s literature did spark student’s interest in math. Students expressed positive responses and interest towards math books, and having a math literature center. Students also demonstrated a consistency in positive behaviors, attentiveness, attitudes, and interest during the reading of math literature by the researcher throughout the research study.

**Does literature influence the understanding of mathematical vocabulary?**

*Generalization 2: Mathematics-based children’s literature has some influence on the understanding of mathematical vocabulary.*
Throughout the eight weeks of the research study, the researcher administered three pre and post tests, and four sets of Math Literature Center worksheets to the participants. The influence of literature on the understanding of mathematical vocabulary was analyzed by comparing the vocabulary questions on the pre and post tests, as well as vocabulary questions on the Math Literature Center worksheets.

Each student experienced differences in scores on their pre and post tests. Literature had some influence on the understanding of mathematical vocabulary although there were not many new math vocabulary words learned by students as analyzed by the pre and post tests. Since most students knew from three to eight of the vocabulary words as measured on the pre test, there was not a significant increase in new math vocabulary words learned by the students as measured on the post test. However, students did learn from one to three new math vocabulary words per Investigation. This generalization is illustrated with graphs four to nine below.

Graph 4

Investigation 4 Pre-Test "Known Math Vocabulary"

Investigation 4 Post-Test "Learned Math Vocabulary"

Graph 5
Students were also responsible for completing Math Literature Center Questions, in the format of a worksheet, for each of the four mathematics-based children's books assigned during math centers. The researcher analyzed the questions on the worksheets to learn about students' knowledge of vocabulary found within the text after students' reading of the text. Each text contained between seven to ten math vocabulary words within the literature. Students were responsible for identifying any math vocabulary words found within each text they read by circling the words on the worksheet.

The researcher found that some participants exceeded standards but the majority met standards for the first text read Pigs Will Be Pigs (Axelrod, 1994). Eight out of the ten students that data was collected from exceeded standards for the text The Pentathlon (Irons, 2003), as well as two students meeting standards. Within the third text that was read by students How Much, How Many, How Far, How Heavy, How Long, How Tall is 1000? (Nolan, 2001), ten out of the twelve students exceeded standards in identifying vocabulary within the text, and two students fell below standards. Tables one to three below show how students identified the vocabulary words found in three of the four texts that they were responsible for reading.
### Table 1

<table>
<thead>
<tr>
<th>Code #</th>
<th>Number of Vocabulary Words Found in text (10)</th>
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<tbody>
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<tr>
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</tr>
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<td>N/A</td>
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<td>12</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

7-10 Exceeds Standards
4-6 Meets Standards
1-3 Below Standards

### Table 2

<table>
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<tr>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
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<td>3</td>
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<tr>
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<td>N/A</td>
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<td>12</td>
<td>9</td>
</tr>
<tr>
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<td>4</td>
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</table>

7-10 Exceeds Standards
4-6 Meets Standards
1-3 Below Standards

### Table 3

<table>
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<td>7</td>
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<td>2</td>
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<td>4</td>
<td>7</td>
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<td>9</td>
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</tr>
<tr>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

6-7 Exceeds Standards
3-5 Meets Standards
1-2 Below Standards

**Summary of Findings**

The researcher found that through analysis of pre and post tests that were administered to students, as well as Math Literature Center worksheets completed by students, that mathematics-based children's literature does have some influence on
the understanding of mathematical vocabulary. Students were able to show a difference in comprehension of mathematical vocabulary on pre and post tests. Most participants learned between one to three new mathematics words after the post test was analyzed. Math Literature Center worksheets that were completed by students also showed that students were able to identify and understand math vocabulary that was found within the text that was read.

How do students respond to the concepts and content of the literature?

Generalization 3: Students had an overall positive response to the concepts and content of the literature.

Four sources were analyzed to determine how students responded to the concepts and content of the literature. The researcher compared student surveys, two specific math literature, center questions, and questions from each pre and post test. The questions analyzed on the student surveys determined how students felt about pictures in math books helping their understanding of math concepts, as well as how they felt math books helped or did not help them to better understand math. Math Literature Center questions were analyzed by looking at what students stated they learned or liked about the book they read, as well as their rating of the book. Pre and post tests were analyzed looking at specific questions related to the content of the literature that was read aloud to students, as well as read independently by students.

Based on the first student survey administered two weeks into the research study, ten out of twelve participants felt that the pictures within the text of the mathematics-based children’s literature read, helped them to understand what math
concept was being presented. On the second survey nine out of the twelve participants felt that the pictures within the text helped them to understand what math concept was being presented. Two participants changed their responses from the first to second survey. Participants were also asked to respond if they felt reading math books helped them to better understand math. After analysis, there were no significant changes between the first and second survey of student responses. This generalization is illustrated below in Tables four and five.

Table 4

<table>
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<tr>
<th>Code #</th>
<th>Survey 1</th>
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<tbody>
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<td>Y</td>
</tr>
<tr>
<td>5</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>7</td>
<td>Y</td>
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<td>2</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>4</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>9</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>11</td>
<td>Y</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>1</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>8</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>12</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>6</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Table 5

<table>
<thead>
<tr>
<th>Code #</th>
<th>Survey 1</th>
<th>Survey 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>A lot</td>
<td>A lot</td>
</tr>
<tr>
<td>5</td>
<td>Not at All</td>
<td>Not at All</td>
</tr>
<tr>
<td>7</td>
<td>A little</td>
<td>A little</td>
</tr>
<tr>
<td>2</td>
<td>A lot</td>
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</tr>
<tr>
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<td>A lot</td>
<td>A little</td>
</tr>
<tr>
<td>11</td>
<td>A lot</td>
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</tr>
<tr>
<td>3</td>
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<td>A little</td>
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</tr>
<tr>
<td>12</td>
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<td>A little</td>
</tr>
<tr>
<td>6</td>
<td>A lot</td>
<td>A lot</td>
</tr>
</tbody>
</table>

Math Literature Center questions were also analyzed to determine student responses to the concepts and content of the literature. All students had a general
positive response to the content and concepts within the literature. Student responses ranged from things they liked about a text or something they learned from the text. The researcher found that their responses were positive because each student was able to identify the major concepts and content within the text. Students were also responsible for rating the text from one to four, with four representing that they like it a lot, three meaning they liked it, two meaning it was OK, and one meaning that they did not like it. This generalization is represented in graphs 10 to 12 below.

Chart 10

Chart 11

Chart 12
Questions presented on pre and post tests were also analyzed to make the generalization that students had an overall positive response to the concepts and content presented through the literature. Eleven out of the twelve students were able to respond correctly to the first two questions on the third post-test which was taken directly from the text *Give Me Half* (Murphy, 2001). This number increased significantly from student responses on the pre-test. Students also showed a significant increase in their understanding and responses of the literature on the second pre and post test. Ten out of the twelve students tested were able to answer correctly to question number four on the post-test, which was directly taken from the text *Schools around the World* (Mitchell, 1997). This data was compared to the pre-test, in which only one out the twelve students was able to answer the question correctly based on prior knowledge.

**Summary of Findings**

The researcher concluded that students did have an overall positive response to the concepts and content presented through the literature. Students responded positively on student surveys when asked about the pictures within math texts, and how reading math texts helps them to better understand what concepts are being presented. The researcher also analyzed student responses on math literature center worksheets, in which students were responsible for rating the text that was read. Students were also responsible for identifying one thing that they learned or liked about the text, through a written response on the worksheet. Student responses all
reflected that they understood the concepts that were being taught throughout the text, as well as how much they enjoyed reading the text. Pre and post tests were also analyzed, in which the researcher determined that students made significant changes in their responses on questions directly related to the literature that was either read to them, or which they read independently.

Do students choose to go to the Math Literature Center at Choice Time?

Generalization 4: Students did not often choose to go to the Math Literature Center at Choice Time.

Two sources were analyzed to come to the generalization that students did not often choose to go to the Math Literature Center when they were given a “choice” of what math activity they wanted to do, during the eight day center rotation. Based on the analysis of students’ choice time logs, and Math Literature Center questions it was evident that very few students made this a “choice.”

Student’s daily choice time logs showed that only three students chose to go to the Math Literature Center as a “choice” during the entire eight week research period. Many students opted to go to the Math Group Center, or the Computer Center as a choice, rather than the Math Literature Center. Most students that chose the Math Group Center stated that they enjoyed working closely with the classroom teacher or the researcher during this time. Other students enjoyed using the computer to playing educational math games.

Of the three students that made the Math Literature Center a choice, they rated the book they each read a four on a scale of one to four, with four being the highest.
Each of these students answered four questions in his/her math notebooks, which were analyzed for comprehension. All students answered each question correctly without any mistakes. It is evident that the students that made the Math Literature Center a choice did enjoy the books, as well as understood the content and concepts that were being presented within the literature.

Summary of Findings

Based on data collected and analyzed it was evident that students did not often choose to go to the Math Literature Center. Student daily choice time logs as well as Math Literature Center questions were analyzed to determine this generalization. Although only three students made this a choice throughout the entire research period, it was evident that these students enjoyed and comprehended the text that they chose to read.
Chapter 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

Over the course of eight weeks, the researcher integrated mathematics-based children’s literature into the *Investigations* math curriculum on a daily basis. According to the data collected, integrating mathematics-based children’s literature seems to spark students’ interest in mathematics, influence student understanding of mathematical vocabulary, and receives positive responses from students on the concepts and content of the literature. Students seemed to enjoy the integration of mathematics-based children’s literature as part of their daily math instruction.

The researcher believes that through the use of mathematics-based children’s literature, students’ learned problem solving skills, and developed other valuable math skills while enjoying the literature, as suggested by Kolakowski (1992). Students were able to use problem solving strategies from the text while completing Math Literature Center worksheets, and answering questions on pre and post tests. The participants in the study also made comments regarding information they learned and enjoyed from the math literature that was read (Appendix H).

Through observations and analysis of data it was evident that students truly enjoyed the integration of mathematics-based literature into the math curriculum. Math literature was used to present mathematics concepts in familiar contexts on a regular basis throughout the research period as recommended by Kolstad, Briggs and Whalen (1996). For example, the researcher used the text *The Doorbell Rang*.
(Hutchins, 1986) to present the concepts of sharing during the Fair Shares Investigation, in which students were learning about fractions. Real cookies were brought in and used to present the text to the students. By doing this, the researcher was able to capture and engage students’ attention and interest in learning more about fractions. This is usually a difficult math concept for students to grasp. By being able to visualize and understand the concept through the use of literature, students were successful at understanding the concept.

**Conclusion**

The incorporation of mathematics-based children’s literature into the Investigations curriculum was successful. The literature did have some influence on students’ mathematical knowledge, vocabulary development, as well as their overall enjoyment of mathematics as a whole. Mathematics-based children’s literature did have a positive effect on language development and student communication of mathematical ideas and relationships as recommended by the National Council of Teachers of Mathematics (NCTM). Students were able to discuss texts, as well as respond successfully to comprehension questions related to the literature. The research study was enjoyable for the participants and the researcher. The study did have an impact on the participants of the study in many ways. Students were able to practice and develop problem solving skills, develop mathematical vocabulary, as well as engage in reading authentic mathematics-based children’s literature daily.
Recommendations

For Future Research

- To gain further knowledge on how the integration of mathematics-based children's literature affects students' acquisition of math concepts and vocabulary, the researcher might take a longer period of time to conduct the research.
- The researcher could include research with other math curriculums.
- Data could be collected in different schools, suburban and urban, to represent a wider range of students.
- The researcher could also look at retention of vocabulary.
- The researcher could introduce more math vocabulary words at a time to students.
- The research could include videotaping of students during Math Literature Center time, as well as times when literature is read aloud to the class and/or used during instruction.
- The researcher could look at the characteristics of students who chose other centers for "choice time."
- The researcher could interview students, rather than just using student surveys to analyze the affect of mathematics-based children's literature on students' interest and attitudes toward math.
**For Practitioners**

The following are recommendations for practitioners that would like to implement mathematics-based children’s literature into their classrooms and/or into their mathematics curriculum as a whole. The use of mathematics-based literature provides many approaches to teaching and learning mathematics. The researcher believes that when integrated or implemented effectively, the outcome can support student learning, as well as bring increased success in the mathematics classroom.

- Using mathematics-based children’s literature as part of mathematics instruction to engage students in understanding mathematical concepts and content.

- Select appropriate texts that demonstrate mathematical integrity, potential for varied response, an aesthetic dimension, and ethnic, gender, and cultural inclusiveness (Whitin and Whitin, 2004).

- Choose texts that correspond with the content being taught.

- Use mathematics-based children’s literature for multiple math center activities. Choose texts that allow students to problem solve and/or be able to interact with the text.

- Allow students to have an opportunity to choose math literature that they would like to read independently.
Never feel the need to finish reading a text aloud to students at one time. Use texts over a period of time, as well as revisit texts with students and/or recommend texts for students to read independently.
References


Retrieved October 8, 2006, from Education Research Complete databases.


Whitin, D.J. (2002). The potentials and pitfalls of integrating literature into the mathematics program. *Teaching Children Mathematics, 8*, 503-504.


Appendix A
To: Wenella Reyes  
From: Ralph Trecartin, IRB Coordinator  
Date: February 14, 2007  
Re: Project #: 2006-132  

Project Title: Integrating Mathematics Children's Literature Into the Investigations Curriculum  

Your proposal "Integrating Mathematics Children's Literature Into the Investigations Curriculum" has been approved for one year from this date.

You must use only the approved consent form or informational letter and any applicable surveys or interview questions that have been approved by the IRB in conducting your project. If you desire to make any changes in these documents or the procedures that were approved by the IRB you must obtain approval from the IRB prior to implementing any changes.

If you wish to continue this project beyond one year, federal guidelines require IRB approval before the project can be approved for a second year. A reminder continuation letter will be send to you in eleven months with the specific information that you will need to submit for continued approval of your project. Please note also that if the project initially required a full meeting of the IRB (Category III proposal) for the first review, then continuation of the project after one year will again require full IRB review.

Please contact Ralph Trecartin, IRB Coordinator, Office of Academic Affairs, at immediately if:

- the project changes substantially,
- a subject is injured,
- the level of risk increases
- changes are needed in your consent document, survey or interview questions or other related materials.

Best wishes in conducting your research.
Appendix B
Dear Parents & Guardians:

As part of our daily routine, we will be integrating mathematics literature into the Investigations math curriculum. We hope to see how students acquire mathematical concepts when presented through the integration of math literature. Math literature is a tool used to teach students important math concepts and skills through literature, while also building their appreciation for both mathematics and literature. Studies suggest that integrating math literature into the math curriculum can assist students in developing and strengthening problem solving strategies, and can improve their ability to communicate mathematical ideas and concepts. I am currently a graduate student at SUNY College at Brockport pursuing a Master's in Curriculum Specialist (MS. Ed), which is a part of the Education and Human Development department. As part of my research project for my Master's program I would like to observe how our students respond to the math books that are being read. No child's name will be used in this research. Each student will be assigned a number by which they will be identified. Your child can choose to not be a part of the study at any time without penalty, even after the study has begun. However, I would appreciate your permission to include your child's work as part of my research study. With your permission, your child may be asked to answer a brief survey during class time. There are no personal risks or benefits for your child as a result of participating in this study. This research may however yield useful information or benefits to educators. All data collected will be kept in a secure locked location for the duration of the research, and then destroyed when the thesis is complete. I appreciate all of your support, and am looking forward to working with you and your child.

If there are any questions or concerns please feel free to call me at 458-3210, room 210. I will be happy to address any concerns you may have. Please return the bottom portion of this form signed and dated if you agree to let your child participate in my research study.

Sincerely,

Ms. Reyes & Mrs. Ussery

Please check off a box, sign below, and return. Thank You! 😊

☐ Yes, I give consent for my child ___________________________ to participate in this research study.

☐ No, I do not wish for my child ___________________________ to participate in this research study.

Parent/Guardian Signature ___________________________ Date: __________
Oral Informed Consent Statement for Students

As part of our daily routine, we will be reading math literature (books) before, during, and after math lessons. Math books will also be used during Choice Time. The reason for using math books while we do our Investigations is for you to learn math concepts in a different way.

Using math books during math lessons may help us to understand math concepts in a different way, use problem solving strategies in stories, and may help us to improve our math vocabulary.

The teachers in this classroom will be observing how using math books during math lessons affect the way you learn math. We will be observing you during math Investigations throughout the school year. Each of you will be responsible for answering some questions about math books. Also, there will be times when we may interview a few of you, to learn some of your specific ideas and comments about math books. Your identities throughout this research will be kept confidential. You may choose not be in the study or change your mind at any time to be a part of this study, without any penalty. If you choose to do so please identify Ms. Reyes or Mrs. Ussery. These observations will help Ms. Reyes to complete a research study for school. If you have any questions you can place them in my mailbox. Thank You!

Ms. Reyes & Mrs. Ussery

Student Consent! ☺

☐ Yes, I ___________________________ will participate in this research study.

☐ No, I ___________________________ do not wish to participate in this research study.

Student Name ___________________________ Date: ____________
To Whom It May Concern:

I have read the following research proposal and give my permission for the research to be done at School #34 pending approval by the Human Subjects Committee at SUNY Brockport.

Proposal Title:
How Integrating Mathematics-Based Children's Literature into the Investigations Curriculum Impacts Students' Acquisition of Mathematical Concepts and Vocabulary in Reading

Researcher:
Ms. Wrenella Reyes

Debra Rampuge
Signature of Principal/Assistant Principal
Appendix C
Combining and Comparing
Investigation 4: Pre-Test

1. Estimate the difference: About how many more beans did I hold in my right hand? How do you know? Explain.
   
   Right Hand: 801 beans  
   Left Hand: 763 beans
   
   a. 30 beans  b. 50 beans  c. 80 beans

2. There were 250 paper clips on the shelf. Someone put 325 more on the shelf. How many of there now?

   a. 425 paper clips  b. 575 paper clips  c. 645 paper clips

3. What is a pentathlon?
   
   a. an animal race  
   b. an athletic event consisting of 5 events  
   c. a bird race

4. Circle all of the words that you **KNOW** the definition of.
   
   addition  subtraction  total  calculate  points  
   combining  comparison  difference  data  hundreds  
   thousands  estimates  group  line plot  bar graph  
   range  interval  outlier  standard notation
Combining and Comparing
Investigation 4: Post-Test

1. Estimate the difference: About how many more beans did I hold in my right hand? How do you know? Explain.
   Right Hand: 801 beans    Left Hand: 763 beans

   a. 40 beans    b. 50 beans    c. 80 beans

   ___________________________________________________________________

2. There were 650 paper clips on the shelf. Someone put 275 more on the shelf. How many of there now?

   a. 825 paper clips    b. 975 paper clips    c. 925 paper clips

3. What is a pentathlon?

   a. an animal race
   b. an athletic event consisting of 5 events
   c. a bird race

4. addition

   a. the process of combining numbers to get a total
   b. the process of taking numbers away to find a difference
   c. the process of estimating to find the closest number
5. difference
a. the answer in an addition problem
b. the answer in a division problem
c. the answer in a subtraction problem

6. subtraction
a. the process of combining numbers to get a total
b. the process of taking numbers away to find a difference
c. the process of estimating to find the closest number

7. estimate
a. making an unrealistic guess to find out how many
b. making a realistic guess to find out how many by rounding
c. making an array with two numbers

8. data
a. information collected only about animals
b. information collected about toys and placed on a graph
c. information collected about people or things

9. Circle the hundreds place in the number
   843

10. Circle the thousands place in the number
    1,247
Combining and Comparing
Investigation 5: Pre-Test

1. Mike's birthday is April 28. How long is it until his birthday? Show how you figured it out?

2. David's birthday was 12 days ago. What is the date of his birthday?

3. What country do students go to school the fewest days of the year?
   a. Jamaica
d. Japan
   b. United States
e. Flemish Belgium
   c. Bolivia
f. Mexico

4. What country do students go to school the most days of the year?
   a. Jamaica
d. Japan
   b. United States
e. Flemish Belgium
   c. Bolivia
f. Mexico

5. How many weeks are in a year?
   a. 32
   b. 56
   c. 52
6. How many days are in a year?
   a. 325
   b. 180
   c. 365

7. How many months are in a year?
   a. 16
   b. 9
   c. 12

8. How many hundreds are in a thousand?
   a. 10
   b. 100
   c. 1000

9. How many dimes are in 10 dollars?
   a. 10
   b. 100
   c. 1000

10. How many minutes are in 5 hours?
    a. 100
    b. 200
    c. 300
Combining and Comparing
Investigation 5: Post-Test

1. Mike’s birthday is April 28. How long is it until his birthday? Show how you figured it out?

2. David’s birthday was 12 days ago. What is the date of his birthday?

3. What country do students go to school the fewest days of the year?
   a. Jamaica  
   b. United States  
   c. Bolivia  
   d. Japan  
   e. Flemish Belgium  
   f. Mexico

4. What country do students go to school the most days of the year?
   a. Jamaica  
   b. United States  
   c. Bolivia  
   d. Japan  
   e. Flemish Belgium  
   f. Mexico

5. How many weeks are in a year?
   a. 32  
   b. 56  
   c. 52
6. How many days are in a year?
   a. 325
   b. 180
   c. 365

7. How many months are in a year?
   a. 16
   b. 9
   c. 12

8. How many hundreds are in a thousand?
   a. 10
   b. 100
   c. 1000

9. How many dimes are in 10 dollars?
   a. 10
   b. 100
   c. 1000

10. How many minutes are in 5 hours?
    a. 100
    b. 200
    c. 300
Fair Shares: Investigation 1 Pre-Test

1. 4 people share a cookie. Each person gets  \( \frac{1}{4} \).

2. 6 people share a cookie. Each person gets  \( \frac{1}{6} \).

3. fraction
   a. A number that names pieces of a pizza pie.
   b. A number that names part of a whole or part of a group.
   c. A number that names the difference of two numbers.

4. equal parts
   a. When all parts are the same. (size, shape, amount)
   b. When all parts are half the same.
   c. When all parts are sometimes the same.

5. denominator
   a. The number used to find the difference in a fraction.
   b. The number below the bar in a fraction.
   c. The number above the bar in a fraction.

6. numerator
   a. The number used to find the difference in a fraction.
   b. The number below the bar in a fraction.
   c. The number above the bar in a fraction.
7. mixed number
   a. A number that is made up of two fractions.
   b. A number that is made up of three fractions.
   c. A number that is made up of a whole number and a fraction.

8. Which picture represents one half (1/2).
   a.  
   b.  
   c.  

   a.  
   b.  
   c.  

10. Which picture represents two thirds (2/3).
    a.  
    b.  
    c.  

11. Draw a picture to represent one whole.

12. How would you share a pizza that has 8 slices, with 2 people? How many slices will each person get? Show all your work.
    _____ slices
Fair Shares: Investigation 1 Post-Test

1. 4 people share a cookie. Each person gets __________. *write a fraction in the box.

2. 6 people share a cookie. Each person gets __________. *write a fraction in the box.

3. fraction
   a. A number that names pieces of a pizza pie.
   b. A number that names part of a whole or part of a group.
   c. A number that names the difference of two numbers.

4. equal parts
   a. When all parts are the same. (size, shape, amount)
   b. When all parts are half the same.
   c. When all parts are sometimes the same.

5. denominator
   a. The number used to find the difference in a fraction.
   b. The number below the bar in a fraction.
   c. The number above the bar in a fraction.

6. numerator
   a. The number used to find the difference in a fraction.
   b. The number below the bar in a fraction.
   c. The number above the bar in a fraction.
7. mixed number
   a. A number that is made up of two fractions.
   b. A number that is made up of three fractions.
   c. A number that is made up of a whole number and a fraction.

8. Which picture represents one half (1/2).

   a. 
   b. 
   c. 


   a. 
   b. 
   c. 

10. Which picture represents two thirds (2/3).

    a. 
    b. 
    c. 

11. Draw a picture to represent one whole.

12. How would you share a pizza that has 8 slices, with 2 people? How many slices will each person get? **Show all your work.**

    ________ slices
Appendix D
Student Survey Questions

Directions:
- Questions 1-5, please read each question and circle Yes or No.
- Questions 6-7, please read each question and write your answers in the boxes provided.

1. Do you enjoy reading math picture books?
   - Yes
   - No

2. Do you enjoy looking at the pictures in math books?
   - Yes
   - No

3. Do the pictures help you to understand what math concept is being presented?
   - Yes
   - No

4. Does reading math books help you to better understand math?
   - Yes
   - No

5. Do you like having a math literature (books) center?
   - Yes
   - No

Please Return Survey to Ms. Reyes' Mailbox. Thank You! ☺
6. What are 2-3 things that you have learned from the math books we have read in class together?

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7. What are 2-3 math words you have learned from reading math books?

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Appendix E
Title of Book Read: Pigs Will Be Pigs
Author: Amy Axelrod

1. What was the math concept(s) you read about in this book? (Circle)
   - addition
   - subtraction
   - geometry
   - multiplication
   - division
   - fractions
   - money
   - shapes
   - measuring
   - the number system
   - data

2. Circle any math vocabulary words found in this book?
   (Circle)
   - how many
   - how many more
   - five
   - quarter
   - combine
   - graph
   - penny
   - total
   - second
   - all together
   - points
   - time
   - first
   - fifth
   - data
   - subtract
   - money
   - third
   - fourth
   - last
   - calculate
   - multiply
   - added
   - equal

3. Tell me about one thing you learned or liked about this book.

________________________________________________________________________

________________________________________________________________________

Please rate this book: (Place your number in the circle below.)

- 4- I liked it a lot
- 3- I liked it
- 2- It was OK
- 1- I didn't like it
1. How much money did Mrs. Pig find on page 10? (add)
   She found:
   
   o two nickels
   o five pennies
   o one quarter

2. How much money did the pigs find in the front hall closet? (add) They found:
   
   o four quarters
   o ten dimes
   o one fifty-cent piece
   o seventeen pennies

3. How much would it cost if Mrs. Pig ordered Nacho chips with salsa for an appetizer, a cup of Black bean soup and Cheese Enchiladas for dinner? (add)

   - Nacho chips with salsa $1.50
   - Cup of Black bean soup $1.25
   - Cheese Enchiladas $4.99
Title of Book Read: The Pentathlon  Author: Calvin Irons

1. What was the math concept(s) you read about in this book? (Circle)
   - addition  - multiplication  - division  - fractions
   - subtraction  - money  - shapes  - measuring
   - geometry  - the number system  - data

2. Circle any math vocabulary words found in this book? (Circle)
   - how many  - how many more  - five  - quarter
   - combine  - graph  - penny  - total  - second
   - all together  - points  - time  - first  - fifth
   - data  - subtract  - money  - third  - fourth
   - last  - calculate  - multiply  - added  - equal

3. Tell me about one thing you learned or liked about this book.

__________________________________________________________

Please rate this book: (Place your number in the circle below.)

- 4- I liked it a lot
- 3- I liked it
- 2- It was OK
- 1- I didn't like it
Title of Book: The Pentathlon: A Story About Addition and Subtraction  
Author: Calvin Irons

1. How many more points did the Tortoise have than the Kangaroo in the swimming race?
   a. 20 points  
   b. 30 points  
   c. 40 points  
   d. 50 points

2. How many more points did the Hare have than the Flamingo in the running race?
   a. 20 points  
   b. 30 points  
   c. 40 points  
   d. 50 points

3. How many points did each animal have altogether at the end of the race?

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Math Literature Center

Title of Book Read: How Much, How Many, How Far, How Heavy, How Long, How Tall is 1000?  
Author: Helen Nolan

1. What was the math concept(s) you read about in this book? (Circle)
   -addition  -tens  -hundreds  -thousands
   -subtraction  -money  -multiplication  -shapes
   -measurement  -division  -fractions  -geometry
   -time  -the number system  -data  -counting

2. Circle any math vocabulary words found in this book? (Circle)
   -how many  -how many more  -five  -minutes
   -combine  -thousand  -penny  -count  -second
   -all together  -points  -time  -first  -fifth
   -heavy  -million  -money  -days  -fourth

3. Tell me about one thing you learned or liked about this book.

________________________________________

Please rate this book: (Place your number in the circle below.)

- 4- I liked it a lot
- 3- I liked it
- 2- It was OK
- 1- I didn't like it
Math Literature Center

Directions: Take turns spinning the spinner with your partner. Record the number that you land on, for each spin. Solve the problem and record in the boxes below.

"Math Books Spinner"

1st Spin: ___________________________ 2nd Spin: ___________________________
# __ # __

3rd Spin: ___________________________ 4th Spin: ___________________________
# __ # __

5th Spin: ___________________________ 6th Spin: ___________________________
# __ # __
Math Literature Center

Title of Book Read: *Give Me Half*
Author: Stuart J. Murphy

1. What was the math concept(s) you read about in this book? (Circle)
   - addition - tens - hundreds - thousands
   - subtraction - money - multiplication - shapes
   - measurement - division - fractions - geometry

2. Circle any math vocabulary words found in this book? (Circle)
   - how many - half - five - whole - combine
   - thousand - penny - count - together
   - all together - two - share - one - fifth

3. Tell me about one thing you learned or liked about this book.

__________________________________________________________________________

Please rate this book: (Place your number in the circle below.)

1. 4- I liked it a lot
2. 3- I liked it
3. 2- It was OK
4. 1- I didn’t like it
4. How can a pizza with *eight* slices be shared between *four* people? How many slices will each person get? Draw a picture and show your work.

5. How would *six* people share *eighteen* cookies? How many cookies will each person get? Draw a picture and show your work.

6.
   a. $\frac{1}{2} + \frac{1}{2} =$
   b. $\frac{3}{4} + \frac{2}{4} =$
   c. $\frac{1}{8} + \frac{4}{8} =$
### Daily Choice Time/Math Centers Log

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83
Appendix G
List of Mathematics-Based Children’s Literature

Used in Research Study

Read to Class/Instructional

- *Pigs Will be Pigs* by Amy Axelrod, illustrated by Sharon McGinley-Nalley. (1994) Published by Scholastic Inc.


- *Count to a Million* by Jerry Pallotta, illustrated by Rob Bolster. (2003) Published by Scholastic Inc.


- *Math For All Seasons* by Greg Tang, illustrated by Harry Briggs. (2002) Published by Scholastic Inc.

- *Max’s Money* by Ted Slater, illustrated by Anthony Lewis. (1998) Published by Scholastic Inc.
• *Schools Around the World* by Donald Mitchell. (1997) Published by Steck-Vaughn Co.

• *Betcha!* By Stuart Murphy. (1996) Published by Scholastic Inc.

• *One Hundred Hungry Ants* by Elinor Pinczes, illustrated by Bonnie MacKain. (1993) Published by Scholastic Inc. by arrangement with Houghton Mifflin Company.

• *Pizza Pizzazz!* by Carol Losi, illustrated by Jackie Snider. (2002) Published by Scholastic Inc.

*Used at Math Literature Center/Choice Time*


• *The Pentathlon* by Calvin Irons. (2003) Published by Mimosa Publications.

• *Pigs Will be Pigs* by Amy Axelrod, illustrated by Sharon McGinley-Nalley. (1994) Published by Scholastic Inc.

• *The 512 Ants on Sullivan Street* by Carol Losi, illustrated by Patrick Merrell. (1997) Published by Scholastic Inc.