2012

Concept-Based Picture Books for Mathematics

Miranda E. Kral
University of Northern Iowa

Concept-Based Picture Books for Mathematics

Abstract

New picture books are published every year. Teacher librarians continuously search for new titles to add to their collections through collection development. A resource was not available that provided a list of children's picture books that include a conceptual approach to mathematics. The purpose of this project was to develop an annotated bibliography of children's picture books which, after analysis by the researcher, included materials that take a conceptual approach to mathematics learning for upper elementary students.

The project was completed by selecting children's picture books, meeting selection 13 criteria, found in WorldCat that included multiplication or division concepts. The selected books were analyzed using a tool designed by the researcher. An annotated bibliography was then generated which included a summary, identification of mathematical concepts, methods of conceptual development, and extension activities for each title.

The completed project will be made available on the Iowa Teacher Librarian Ning.

CONCEPT-BASED PICTURE BOOKS FOR MATHEMATICS

A Graduate Research Project
Submitted to the
Division of School Library Studies
Department of Curriculum and Instruction
In Partial Fulfillment
Of the Requirements for the Degree
Master of Arts
UNIVERSITY OF NORTHERN IOWA

by
Miranda E. Kral
May 2012

This Research Project by: Miranda E. Kral

Titled: Concept-based Picture Books for Mathematics

has been approved as meeting the research requirement for the

Degree of Master of Arts.

Jean Donham

4/17/2012
Date Approved

Graduate Faculty Reader

Karla Krueger

4/17/2012
Date Approved

Graduate Faculty Reader

Jill M. Uhlenberg

4-18-12
Date Approved

Head, Department of Curriculum and Instruction

ABSTRACT

New picture books are published every year. Teacher librarians continuously search for new titles to add to their collections through collection development. A resource was not available that provided a list of children's picture books that include a conceptual approach to mathematics. The purpose of this project was to develop an annotated bibliography of children's picture books which, after analysis by the researcher, included materials that take a conceptual approach to mathematics learning for upper elementary students.

The project was completed by selecting children's picture books, meeting selection 13 criteria, found in *WorldCat* that included multiplication or division concepts. The selected books were analyzed using a tool designed by the researcher. An annotated bibliography was then generated which included a summary, identification of mathematical concepts, methods of conceptual development, and extension activities for each title.

The completed project will be made available on the *Iowa Teacher Librarian Ning*.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

An unobtrusive observer is walking down the hallway of an elementary building. In one upper elementary classroom, the observer can see students busy learning about multiplication. The teacher has just finished reading a children's picture book and has instructed the students to inquire how a particular problem in the story can be determined using the provided math manipulatives. The observer can see that the students are being actively engaged in this conceptual approach to learning.

The observer takes a moment to look into another upper elementary classroom in the same building. This class is learning about the same mathematical concept. Students appear to be quietly following the instruction of the teacher through examples on the chalkboard and are completing the assigned problems from their textbook. It seems that students are learning in a more procedural fashion than the first-observed class. In one classroom students are learning mathematics in a step-by-step procedural way, and in the other students are discovering number relationships as they manipulate objects.

The purpose of this project is to identify children's picture books that lead to a conceptual understanding of mathematics for upper elementary students.

Justification

Conceptual and Procedural Learning

The National Council of Teachers of Mathematics (NCTM, 2000) discussed in their publication, *Principles and Standards for School Mathematics*, the importance of procedural and conceptual understanding, as well as securing a solid foundation of number sense. Conceptual ideas are crucial in the development of essential skills of

mathematical thinking. Tasks such as problem solving, reasoning, and justification promote and further develop a conceptual approach of learning (NCTM, 2000).

Conceptual learning engages students in higher-order thinking in students, but conceptual understanding cannot be the only mode of instruction in mathematics. Procedural understanding must also be attained. This notion has a long history as a research topic. Researchers have many theoretical viewpoints (Schneider & Stern, 2010; Star, 2005). "Most instruction iterates between a focus on concepts or procedures at some level, without exclusive attention to only one type of knowledge over the course of months" (Rittle-Johnson & Koedinger, 2009, p. 485). Along with this, Star (2005) argues "that both are critical components of students' mathematical proficiency and thus merit careful study." (p. 406) With this balance, students must develop both conceptual and procedural understanding.

When students learn in a conceptual way, they further develop and make connections with procedural knowledge they have previously gained (Rittle-Johnson & Alibali, 1999). Roberts (2010) discusses in her article, "The Conceptual Chicken and the Procedural Egg," the order of procedural and conceptual instruction. During her experiences in education and mathematics instruction, Roberts has become more convinced that "the interaction between procedural knowledge and conceptual knowledge and between concrete and abstract experiences was more of an ebb and flow, rather than a linear progression" (p. 197). The notion of ebb and flow which Roberts discusses could act as a motivational tool to some extent. Roberts suggests that the development of understanding why and how a mathematical procedure works through a conceptual lens is

a motivational factor to students. This conceptual approach gives students a deeper understanding of particular mathematical concepts.

The use of picture books in mathematics instruction provides students with the opportunity to identify, or create, a visual understanding of math concepts (McDonald & Rasch, 2004). With this visual understanding, students can have a change of heart that math is not dull or boring, but fun (Burns, 2010). The use of picture books in mathematics instruction provides not only opportunities for students to create a visual understanding and a change in disposition, but most importantly the opportunity to gain a conceptual understanding of mathematics.

Deficiencies

Librarians have access to numerous bibliographies of picture books with mathematical themes, for example, "Interacting with the Curriculum" (Johnson & Giorgis, 2001), "Picture-Book Math" (Krech, 2003), "All Around Math" (Meagher, 2005), "Books that Build Math Skills" (Sarama & Clements, 2006), and "A Thousand Words: The Picture-Perfect Link to the Curriculum" (Wysocki, 2004). However, these lists do not tend to address the pedagogical orientation of the text. What is needed is an annotated bibliography that identifies books with a conceptual rather than procedural orientation toward mathematical learning.

Significance

Teacher librarians who seek to collaborate with classroom teachers and support classroom learning will find such a bibliography helpful for connecting to mathematics units. Teachers may find this resource helpful in identifying books for use within their

classroom mathematics lessons. This source will include materials that undergo an analysis of the underlying pedagogical philosophy.

Problem Statement

Teacher librarians may not have educational training in mathematics. In such situations, this may limit their understanding of the mathematically themed books in their collections to appreciating the texts for their storyline, characters, illustrations, or layout. For those teacher librarians who are not mathematically inclined, a guide to books that feature a conceptual approach to mathematics learning will provide another perspective for their work in selection and reader advisory.

Purpose Statement

The purpose of this project is to develop an annotated bibliography of children's picture books which, after analysis by the researcher, includes texts that take a conceptual approach to mathematics learning for upper elementary students.

Research Questions

1. Which selected children's picture books, incorporating multiplication or division, meet the established criteria to provide a conceptual approach to learning mathematics?
2. Of the selected children's picture books incorporating multiplication or division, are there specific authors who tend to write, or publishers that tend to publish, titles which incorporate or infuse mathematical concepts?

Definitions

Conceptual - an understanding of an idea and all that it includes (Rittle-Johnson & Alibali, 1999)

Procedural - an understanding of a step-by-step process (Rittle-Johnson & Alibali, 1999)

Assumptions

Teachers and teacher librarians are continuously searching for picture books that provide a conceptual approach to mathematics learning. In addition, teachers are exploring ways to actively engage students and promote high-level discussion in instruction.

CHAPTER 2

LITERATURE REVIEW

Some teacher librarians may not have the required training to be a mathematics teacher. They may lack the knowledge and skills needed to identify picture books that possess a deeper mathematical connection, as opposed to criteria typically used to select picture books. A guide would be an excellent resource for their use. The purpose of this project is to develop an annotated bibliography of children's picture books which, after analysis by the researcher, include materials that take a conceptual approach to mathematics learning for upper elementary students.

The following literature review pertains to the present study in three categories: use of picture books in elementary instruction, reading in the content area, and mathematics instruction with a conceptual approach.

Use of Picture Books in Elementary Instruction

The use of picture books in elementary instruction provides opportunities for students to gain a different take on concepts. Farland (2006) studied the use of trade books in science instruction. The purpose of Farland's study was to determine how elementary students' view of scientists can be adjusted or influenced through the use of children's literature.

Farland's (2006) study revolved around the question "Does the inclusion of historical, nonfiction trade books, presenting scientists as people working with or developing an idea as part of kit-based instruction, influence third grade students' representations of the contemporary scientist and his or her work?" (p. 31). Two hypotheses posed by the researchers consisted of looking at the improvement of pre and

post-test scores. One focused on the results of the treatment group and the other looked at the lack of improvement in the control group.

Farland's (2006) study was made up of 13 heterogeneous classes containing 156 third-grade students, in a northeast Massachusetts public school district. Seven classes were randomly designated as the control group, and the remaining six were deemed the treatment group. The study looked at inquiry instruction using Full Option Science System (FOSS) science kits; the only means of instruction received by the control group. The treatment group received an additional component: non-fiction, historical trade books read by the teacher routinely for eight weeks. The selected trade books consisted of six traits:

1. contained a simplified story about scientists and their work that went beyond facts, dates, or time-lines of scientists' lives
2. demonstrated a nonstereotypical portrayal of scientists
3. contained accurate information
4. used age-appropriate language
5. displayed common theme of struggles these scientists faced and their perseverance
6. contained colorful illustrations and easy text that might be enjoyed over and over again (p. 35).

Students were administered a pre- and post-test. Those in the treatment group were also administered a delayed post-test (Farland, 2006). The test consisted of a Draw a Scientist Test (DAST) that was developed by Chambers in 1983. A modification to the DAST (mDAST) was made and included four questions designed to assist the scorer in the event that the student illustration was ambiguous. The data analysis, which was "independently by two trained coders," (p. 37) showed that the control and treatment groups corresponded in the tested categories, appearance and activity.

Results of the study proved promising in the effectiveness of using picture books in instruction. The first hypothesis was supported based on the significant increase

between the mean scores of the pre- and post-tests of students that received the studied treatment (Farland, 2006). The second hypothesis was also confirmed based on the data that there was no obvious improvement in the control group's mean scores of the pre- and post-tests.

Farland's (2006) findings showed an importance to the inclusion of picture books in classroom instruction. Through the use of picture books, students were able to gain a better interpretation of a scientist. This notion of the use of picture books in science instruction provided insight into the use of picture books in mathematics instruction.

Having a better perspective and a specific example of using picture books in the classroom, a different approach to the use of picture books in instruction can be explored. This approach consisted of looking at the viewpoint of teachers and teacher librarians and their use of picture books in instruction.

Pantaleo (2002) completed a study on the use of children's literature in elementary schools in Canada. Her focus was directed towards the data from a survey completed by teachers and teacher librarians on the use of children's literature in the different curricular areas of the classroom and the breakdown of genres used in instruction. This survey was presented to teachers and teacher librarians in the Ontario public and Catholic schools. Seventeen public schools and eleven Catholic schools participated in the study.

Pantaleo's (2002) survey posed a five-point Likert-type scale ranging from *never* to *extensively*. Pantaleo also provided space for written responses. The survey was distributed mid-school year, but participants were asked to consider a full school year when they completed the survey.

Pantaleo (2002) statistically analyzed the 1,027 returned surveys, which was 25.7% of the total dispersed. Statistical measures included mean, median and mode of the responses. Seventeen of the completed surveys were removed because they were completed by library associates or were incomplete. Limitations to this study included the percentage of unreturned surveys, the use of the Likert scale, the variance in interpretations of the scale by respondents, and bias in regards to responses including deception or courtesy.

Results of Pantaleo's (2002) survey showed that at 68.7%, language was the highest curricular area in which respondents extensively used picture books in instruction. The response for the highest curricular area marked "frequently used pictures books" (p. 221) was social studies at 41.5%. Data from the survey showed that "15.4% never, 21.9% seldom, 37.6% occasionally, 20.4% frequently, and 4.8% extensively" (p. 221) used picture books in mathematics instruction. Of the six curricular areas used in the survey (language, social studies, science and technology, the arts, math, and health and physical education), data showed that math ranked fifth in the use of picture books in classroom instruction. Health and physical education was the only curricular area below mathematics with a 35.7% response of never using picture books in instruction.

This survey concluded that teachers and teacher librarians think highly of the role of picture books in instruction, specifically language and social studies. Pantaleo's (2002) study indicated that children's literature was frequently incorporated into classroom instruction. Teachers and teacher librarians infrequently used children's literature in mathematics instruction.

An approach different from the teacher or teacher librarian's perspective on the use of picture books in various curricular area instruction, is how the illustrations of picture books can create learning opportunities for students in classroom instruction. This concept is one that is often overlooked.

Bisland (2010) studied the use of illustrations in picture books as a means of introducing the ancient silk routes. Her study focused action research on the impact visual literacy had on elementary students. Bisland asked elementary teachers to show illustrations from two books containing information on ancient silk routes. Students, ranged from first through sixth grades, studied various illustrations in each book and developed inferences about what took place.

Student inferences varied from lower elementary students literally telling what they saw to upper elementary students discussing their interpretation, or inference, of who people were and what they were possibly doing in the illustrations (Bisland, 2010). Discussions that took place in upper elementary were more authentic and thought provoking, while students in lower elementary participated in thoughtful discussion.

Although the study focused on visual literacy and the illustrations in picture books, it can be concluded that the use of picture books in instruction creates more meaningful learning (Bisland, 2010). Students inferred different aspects of the illustrations and how life may have existed during the time of the ancient silk routes. This experience occurred in a traditional approach of teaching using a textbook.

Reading in the Content Area

Williams et al. (2007) completed a study to determine the effectiveness of reading instruction implemented in social studies instruction for second grade at-risk students.

Reading instruction focused on the concept of the cause-effect relationship found in informational text. Williams et al. questioned whether the proposed instructional method would improve reading comprehension for studied at-risk students.

The population used in this study conducted by Williams et al. (2007) consisted of 243 students and fifteen classroom teachers at three elementary schools in New York City. The fifteen classroom teachers were "randomly assigned to one of three experimental conditions: a text structure program, a content-only program, or a no-instruction control" (p. 113). Twenty-two lessons were delivered by teachers throughout this study. The goal for each of the instructional programs, in regards to content, was for students to learn about "three historical communities in the United States" (p. 113). Biographies and other trade books were used to pull cause-effect paragraphs used during instruction.

Williams et al. (2007) collected data through pre- and post assessments which consisted of two sessions that were audiotaped. During one session, students completed a standardized test, which looked at "Word Identification and Passage Comprehension" (p. 115). The second session consisted of "three strategy and two outcome measures" (p. 115). "The strategy measures included locating clue words in a paragraph, locating cause-effect clauses, and recalling cause-effect questions" (p. 115). Similar tests were completed during the pre- and post assessments. Other forms of data collection in this study included classroom observations, student attendance for lessons, and teacher feedback, and a meeting to debrief the teachers on the purpose of the study so researchers would receive feedback on the instructional programs. Two scorers analyzed and blindly scored the data collected in this study.

Results from Williams et al.'s (2007) study, in regards to strategy measures, showed that the text structure instructional group had much higher scores than the other two groups. Findings of student comprehension showed that the text structure and content-only groups scored significantly higher than the no-instruction group, when looking at the noncasual question. "For the effect question … there was an effect on treatment; the text structure group scored significantly higher than either content-only or the no-instruction group" (p. 117). No difference was found between the content-only and the no-instruction group.

Williams et al.'s (2007) findings indicated that comprehension instruction in the content area benefited student learning and "can be effective at the primary-grade level" (p. 119). Reading comprehension instruction did not negatively affect content area instruction during this study. This proved that content instruction was not lost while comprehension strategies were infused into lessons.

Williams et al. (2007) looked at reading instruction in the social studies content area at the primary level. During instruction, where comprehension skills were incorporated, it was concluded that social studies content was not lost. The concept of reading instruction and comprehension is not only important in the social studies content area, but is also important in mathematics and other content areas. Specific to the current research, reading instruction and comprehension are important when reading children's literature to complete conceptual-based mathematics instruction. Similar to the previous study, Williams, Stafford, Lauer, Hall and Pollini (2009) completed a study where they looked at reading instruction in the science content area.

The purpose of Williams et al.'s (2009) follow-up study was "to extend the investigation of comprehension instruction focused on text structure" and to "begin development of an assessment instrument for the program" (p. 4). The study revolved around questions that pertained to text structure. One question posed was, "Can explicit instruction in text structure help second graders improve their comprehension of authentic text?" (p. 4).

The population of Williams et al.'s (2009) study consisted of fifteen classroom teachers and 215 second grade students. Participants were from four different schools in a large metropolitan area. The fifteen classroom teachers were randomly divided equally into three groups, two experimental groups and one control. The experimental groups implemented a text structure condition and a content condition. The various programs studied supplemented regular classroom instruction, but did not disturb regularly scheduled science or literacy instruction. Instruction was carried out over 22 lessons.

Williams et al. (2009) collected data through pre- and post-tests. Students were given 30-45 minutes each for two different sessions. The pre-test consisted of "word identification and passage comprehension" (p. 8) from a particular standardized test, and the assessment of students' "ability to perform several of the tasks to be taught in the instructional program" (p. 8). The post-test interview involved being "assessed [on] the effects of the text structure instruction" (p. 9). Williams et al. also observed the classroom to assess that completion of instruction was carried out in its entirety. At the conclusion of the study, Williams et al. debriefed the teachers on the purpose of the study and provided teachers with questionnaires on the tested instructional program.

The data collected from the study was analyzed through a detailed measurement and consisted of 19 different measures (Williams et al., 2009). These 19 measures fell under four clusters: "identification measures" (p. 9), "strategy measures" (p. 9), "comprehension outcome" (p. 9), and "content outcome" (p. 9). Assessments were scored by a "team of two scorers" (p. 10).

Results from Williams et al.'s (2009) study showed that the written responses, both free and prompted summary, used as assessments for comprehension of authentic text, were very low for all three groups. The results from the free summary response showed participants made improvements from pre- to post-test. The text structure group scored higher than the no-treatment group in the free summary response. Results of the content and control groups were similar. Significant differences were found in the prompted response. "The text structure group scored higher than the content group and the no-treatment group" (p. 11). No difference in the results between the content group and control group was found.

Findings in Williams et al.'s (2009) study showed that "expository text structure can indeed be taught effectively to primary-aged children" (p. 16). Knowledge students gained through instruction increased "their ability to comprehend novel text, both well structured and not-so-well structured" (p. 16). Comprehension skills can be strengthened at the same time as students are engaged in content instruction.

Williams et al.'s (2009) study focused on incorporating reading instruction into the science content area. This study looked at the skills in general and did not incorporate a specific curriculum into their study. Connor et al. (2010) investigated reading

instruction in the content area, as well as their designed implementation of a specific science curriculum.

The purpose of Connor et al.'s (2010) study was "to investigate whether implementing the ISI-Science curriculum unit contributed to second graders' science and literacy learning" (p. 479). Questions that the researchers posed reviewed student improvement of science knowledge and literacy skills from pre- to post-test.

Participants in Connor et al.'s (2010) study included 87 students from five different classrooms in a northern Florida school. Data were collected through the use of pre- and post assessments, which included a science unit test, and were given six weeks apart. Tests consisted of twelve multiple choice questions and three short answer questions. When grading the short answer responses on the pre- and post-tests, scorers used a rubric. The short answer questions were analyzed as a means of determining improvement in literacy skills.

Responses to the multiple choice questions of the studied curriculum unit of the Conner et al. (2010) study indicated that students' science knowledge improved from pre- to post-test. A 30% improvement in responses to short answer questions was achieved by students. Literacy skills also improved throughout the course of the unit. Post-test results showed that "students wrote an average of 17.55 more words in their test responses following the intervention and spelled an average of 10% more words correctly" (p. 482). Overall, Connor et al.'s study showed that the science curriculum that they generated and implemented supported student improvement in both science and literacy skills.

Connor et al.'s (2010) study relates to the current research through implementing a program which incorporates literacy skills into the content area, such as reading

comprehension into science or math instruction. It is important for students to comprehend text when using children's literature to explore math concepts in a conceptualized way.

Mathematics Instruction with Conceptual Influence

Ketterlin-Geller, Chard, and Fien (2008) studied mathematic interventions with lower achieving students. The study sought to determine "the effect of two mathematics intervention programs on student achievement" (p. 40). Conceptual mathematics intervention programs studied were Knowing Math and Extended Core. Knowing Math consisted of lessons revolving around conversations about math structures, mistakes or misconceptions. Extended Core consisted of reviewing the main mathematical focus by the teacher and engagement of students in the math strategy using concrete examples, justification of information, and multiple representations. The study explored the effect these two interventions had on student achievement, but paid particular attention to students' performance on a "state accountability test" and "publisher created posttest" (p. 36).

Several limitations were found in the study. The small sample size could have had an effect on the statistics gathered (Ketterlin-Geller et al., 2008). Another was the randomized distribution of students to the study groups. After this randomization took place, "teachers and administrators made minor modifications" (p. 44). A final limitation of this study included meeting students' needs. Students could have benefited more from a group other than the one to which they were assigned.

Participants were fifth grade students from "four elementary schools and two K-8 schools in a fast-growing district in the Pacific Northwest" (Ketterlin-Geller et al., 2008,

p. 36). The 52 fifth grade students were selected for the study "based on their performance on a grade-level district wide mathematics screening test" (p. 36). Three study groups were established to carry out this study. Of the 52 students, 17 were grouped using the Knowing Math intervention, 27 were grouped using the Extended Core intervention, and eight were designated to the control group. Thirteen teachers participated in this study. Seven teachers worked with the Knowing Math intervention and six teachers worked with the Extended Core intervention. Intervention strategies were administered in an after school program. Math instruction took place during the school day. The control group only received instruction during school.

Interventions took place four times a week for 30-45 minutes for 16-20 weeks (Ketterlin-Geller et al., 2008). After school, students in the treatment groups worked with teachers using the assigned intervention strategies. Data were collected to measure the effectiveness of the intervention programs using many different testing strategies including DIBELS (Dynamic Indicators of Basic Early Literacy Skills), Oral Reading Fluency (DORF), District Math Screener Test (established by researchers at the local university), Knowing Math Test (created by the authors of this intervention strategy), and Statewide Accountability Test in Mathematics. Before the beginning of the study, "all participants took the DORF and District Math Screener Test" as a pre-test (p. 39). At the end of the study, all participants took the District Math Screener Test and the Statewide Accountability Test in Mathematics. Those students in the treatment groups took a third post-test, Knowing Math Test. "The Statewide Accountability Test in Mathematics was administered within a 1-month window of testing of the Knowing Math and District Math Screener Test" (p. 40).

Results from the administered tests were analyzed based on a "series of analyses of variance (ANOVA)" (Ketterlin-Geller et al., 2008, p. 40). Based on the ANOVA completed for the Knowing Math Test given to students only in the treatment groups, a significant difference between the Knowing Math group and the Extend Core group was found. Additional ANOVAs were completed using the other test forms administered. No significant difference between control and treatment groups resulted.

The conclusion drawn from this study showed that implementation of a conceptualized approach in learning mathematics improved student achievement. Instruction revolving around student discussions of misconceptions or mistakes on mathematical concepts, like those in the Knowing Math group, promoted student learning and achievement.

Ketterlin-Geller et al.'s (2008) study on the effectiveness of a conceptual knowledge-based after school program for mathematics proved to be beneficial to student learning, but this approach lacked the implementation of conceptual learning in the general education classroom. Kazemi and Stipek (2001) studied the implementation of conceptual learning in the classroom.

The purpose of Kazemi and Stipek's (2001) study was to examine "ways in which classroom practices press students for conceptual mathematics thinking," as cited by the researchers from Blumenfeld, Puro, and Mergendoller (p. 60). Kazemi and Stipek sought to classify sociomathematical norms to engage students in conceptualized mathematics learning. The researchers hypothesized how different teaching strategies affect students' development and utilization of conceptualized mathematics.

Population for Kazemi and Stipeck's (2001) study consisted of four teachers who taught fourth or fifth grade at elementary schools in California. The data, or mathematics instruction carried out by the teachers, were collected through videotaped lessons. Lessons were rated on "nine motivational dimensions by two raters" (p. 61) using a scale of one to five, where one was "not at all like this teacher" (p. 61) and five was "very much like this teacher" (p. 61). From the videotaped lessons, Kazemi and Stipeck selected two lessons which had a conceptualized approach in instruction and two lessons which did not have a conceptualized approach, but had the opportunity to implement the approach and did not.

Data collected were analyzed in a qualitative manner (Kazemi & Stipeck, 2001). The videotaped lessons were transcribed so that documentation of where conceptual thinking or learning took place in each lesson could be recorded. In addition to the notation of conceptualized thinking, documentation on student participation was recorded.

Researchers concluded students who participated in the lessons which had conceptualized learning opportunities were able to engage in "deeper mathematical inquiry" (Kazemi & Stipek, 2001, p. 64). These students participated in discussions justifying their answers and debating errors or misconceptions of problems solved. Teachers in classes which did not participate in conceptualized learning missed crucial opportunities for their students to engage in higher order thinking skills and to discuss justifications, misconceptions, or errors in work completed throughout the lesson. Sociomathematical norms were achieved by those students in the conceptualized instruction class based on the high standards of understandings that were established.

Expanding on Kazemi and Stipek's (2001) study of the promotion or inclusion of conceptualized mathematics instruction in elementary classrooms, Mink and Frasier (2005) conducted a study designed to evaluate the effectiveness of a specific mathematics program and how it was implemented in the general education classroom. The studied mathematics program was titled Science and Mathematics Integrated with Literacy Experiences or Project SMILE.

Mink and Fraser (2005) evaluated the instructional program, Project SMILE, on its effectiveness in student learning at the elementary level. One research question focused on the change in students' attitudes of reading, writing, and mathematics when teachers participated in professional development of Project SMILE. Another question posed by researchers was based on the "congruence between actual and preferred classroom learning environment" (p. 70) after teachers participated in professional development of Project SMILE.

Mink and Fraser's (2005) study population included around 200 fifth grade students in six classrooms at two Florida elementary schools. Only 120 student results were used since they had completed all of the necessary documents or data to be analyzed effectively. Data were collected in a qualitative and quantitative manner and consisted of questionnaires, surveys, student work samples, and interviews.

Data from Mink and Fraser's (2005) study were analyzed based on the pre- and post-test attitude questionnaires completed by students. Data from these tests were used to determine the effectiveness of the professional development completed by teachers for Project SMILE. The areas analyzed were students' attitudes toward reading, writing, and mathematics. Results showed that, between the pre- and post-tests, students' attitudes

toward reading slightly decreased while attitudes toward writing and mathematics significantly increased. Project SMILE integrated the areas of writing and mathematics into reading; this could have been a cause for the increase.

Another area of analysis in Mink and Fraser's (2005) study included a survey, which measured the "congruence between actual environment present in these teachers' classrooms and that preferred by students" (p. 70). Results from the survey showed that students preferred less friction and competitiveness than what had occurred in the classroom. Also, they preferred more cohesiveness than what occurred in the classroom. Student preference for other areas of the survey, satisfaction and difficulty, were similar to what took place in the classroom. Results from this analysis provided teachers with a powerful evaluation tool for improvement in mathematics instruction.

Qualitative findings in Mink and Fraser's (2005) study showed teachers gained a different view on teaching reading and writing than they had prior to implementing Project SMILE. It was also found that teaching mathematics through Project SMILE, a conceptual approach to mathematics, was beneficial to student learning and achievement. Project SMILE provided students the opportunity to positively change their attitudes toward mathematics. In addition to student attitudes, the overall classroom environment improved through the implementation of Project SMILE.

Limitations to Mink and Fraser's (2005) study included the small sample size of 120 students. Also, the language deficiency of some participants may have led them to misinterpret or misunderstand questions in the questionnaires.

Mink and Fraser's (2005) study showed that a conceptual mathematics program, such as Project SMILE, benefits student learning and achievement as well as creates a

better classroom environment. Students' attitudes toward writing and mathematics improved.

Summary

Farland (2006) and Bisland's (2010) studies concluded that the use of picture books in elementary instruction benefits student learning. In Farland's study, students' view of a scientist was expanded. Bisland's study reviewed how illustrations from picture books benefited students in the introduction of a new unit. Pantaleo's (2002) study showed that children's picture books were used cross-curricular by teachers and teacher librarians. All of these studies support content learning using picture books.

Williams et al. (2007), Williams et al. (2009), and Connor et al. (2010) concluded that reading instruction incorporated into the content area can be effectively implemented without damage to student content area knowledge. Williams et al. (2007) focused on social studies content and concluded that the concept cause-effect in reading instruction did not harm information relevant to social studies. Williams et al. (2009) and Connor et al. (2010) focused on the science content area. In their studies, both concluded that science and reading or literacy skills improved throughout the study.

Ketterlin-Geller et al. (2008) and Kazemi and Stipek's (2001) studies focused on conceptualized mathematics instruction and student achievement. Their studies concluded that student learning improved through a conceptual approach to learning. Mink and Fraser (2005) implemented a specific conceptualized mathematics program in their study. They concluded that the implemented program benefited student learning and improved the overall environment of the class.

These studies indicated a need for information about children's picture books that support a conceptualized approach to mathematics instruction. Current research will result in a guide for children's literature that features a conceptual approach to mathematics learning. This guide will be useful for both teacher librarians and teachers to identify texts that support conceptualized mathematics.

CHAPTER 3

PROCEDURES

Presently, a resource is not widely available that can be used to identify picture books that hold a deeper mathematical connection for teacher librarians who do not have training to teach mathematics. Such a resource is needed for those teacher librarians who need assistance when selecting picture books with mathematical connections. The purpose of this project was to construct an annotated bibliography of children's picture books including a conceptual approach to mathematics learning for upper elementary students.

Project Description

The project consisted of constructing an annotated bibliography of children's picture books that teach multiplication or division applying a conceptualized approach to mathematics instruction. The project included selecting books, completing an analysis of the selected materials, and creating an annotated bibliography.

Book Selection

Books selected for this project were gathered using the online resource *WorldCat*. *WorldCat* contains the records of all Online Computer Library Center (OCLC) member libraries worldwide. Searches on the concepts of multiplication and division were completed. These two concepts are noted in the math standards for grades three through five established by NCTM (2000) in *Principles and Standards for School Mathematics*. The children's picture books used are confined to unpaged or having approximately 32 pages. This is standard in the picture book industry.

Book Analysis

An analysis of the selected books was conducted using a guide generated by the researcher based on information from Marilyn Burns, an expert in the area of mathematics education for students grades K-8. She not only is a dedicated educator, but also a renowned author in the field ("Marilyn Burns," 2011). Burns continuously works with students to explore learning habits in regards to mathematics. She looks at how students learn and works with them to develop a solid understanding of mathematics. Burns uses these experiences to write professional resources for teachers ("Marilyn Burns," 2011). For example, Burns (2002) completed a question and answer session in *Scholastic Instructor*, where she answered questions posed by educators across the nation. She also founded *Math Solutions Professional Development*; an organization focused on professional development in the field of mathematics for K-8 educators and has written more than ten children's picture books ("Marilyn Burns, Founder," 2011).

Burns (2010) generated a checklist for selecting children's picture books for math instruction used in the analysis project. Burns' checklist includes

- Is the book of high quality from a literary perspective?
- Does the book present content that is mathematically sound and grade-level appropriate?
- Does the book provide opportunities to introduce or reinforce mathematical symbolism?
- Is the book effective for supporting students to think and reason mathematically?
- Will the book help build students' appreciation of both mathematics and literature? (p. 40)

Procedure

Research began by identifying children's picture books to be analyzed in this project. *WorldCat*, an online resource, was used to search for book with multiplication and division concepts. These concepts are part of the NCTM standards for grades three

through five. When searching this resource, keywords of "multiplication" and "division and math" were used. Limiters including "2000-2012," "juvenile," "fiction," "books," and "English" were also used to focus search results to only books that meet these criteria. The publication year span of 2000-2012 was used based upon having current titles, particularly those in the 21st century, considered for library collections and use in math instruction. Resulting titles were then evaluated based on the industry standard of a picture book, those that are approximately 32 pages or unpaged, and were limited to those titles that are accessible in eastern Iowa counties including: Johnson, Linn, Black Hawk, and Scott, as identified by *WorldCat*. When accessing the books in print, two titles were removed from the selection process because they did not meet the criteria of having a copyright date of 2000 or newer. This selection process yields 13 titles for multiplication and three for division concepts. (See Appendix A).

Each book underwent analysis. The selected books were read twice. The researcher used an analysis tool based on Burns' (2010) criteria. (See Appendix B). The checklist generated by Burns (2010) for analyzing children's picture books for math instruction was consulted when the analysis tool was created. Information including a summary of the book, the portrayal of the conceptualized approach to mathematics, notation of the author and publisher of each title, and availability for possible extension activities was part of the analysis.

After the completed analysis, the researcher concluded the project by compiling an annotated bibliography for those books that provided a conceptualized approach to mathematics learning. The annotated bibliography highlights the resource, provides

insight into possible concept-based extension activities of mathematics learning, includes various math concepts, and the methods of concept development found in the title.

The methods of concept development include multiple examples, analogy, manipulatives or representations, and attributes. The multiple examples method consisted of presenting many opportunities in the text for students to form generalizations of concepts. Boulware and Crowe (2008) describe concept attainment through analyzing multiple examples of a concept in order to arrive at the meaning of the concept. The method of analogy is used to help students understand a concept. Orgill and Bodner (2004) recommended that analogies should be used when a difficult or challenging concept that cannot be visualized is introduced. On a similar note, Sarama, Clements and Swaminathan (2003) explored the effectiveness of using real-world analogies in teaching grids and coordinates in mathematics. Using manipulatives or representations provide students with the ability to understand the concept better. Moch (2001) describes the use of manipulatives to teach mathematical concepts. The method of attributes included creating opportunities for understanding concepts through the use of attributes of objects in the text. Taba, cited in Fraenkel (1994), asked students to group items on the basis of common attributes identified to arrive at a generalization or concept. The annotation for each title in the bibliography included a determination of which strategy had been applied in the book for developing understanding of the concept.

Limitations

Selected titles are limited to those held by OCLC member libraries. Also, when analyzing the selected titles, the researcher was not able to provide all possible conceptual-based extension opportunities for mathematics learning.

CHAPTER 4

PROJECT

The project is an annotated bibliography of children's picture books which includes a conceptual approach to mathematics learning for upper elementary students. Books selected for inclusion in the annotated bibliography underwent an analysis using an established guide. The analysis consisted of a summary of the book, the portrayal of the conceptualized approach to mathematics, notation of the author and publisher of each title, and availability for possible extension activities. In addition to the book analysis, the annotated bibliography includes information on the math concepts and method of concept development in each selected title.

Concept-based Picture Books for Teaching Multiplication and Division in Grades 3-5: An Annotated Bibliography

Created by Miranda Kral

This annotated bibliography was created to be used as a resource for teacher librarians and teachers. The purpose of this project was to develop an annotated bibliography of children's picture books which, after analysis by the researcher, included materials that take a conceptual approach to mathematics learning for upper elementary students. The project was completed by selecting children's picture books, meeting selection criteria, found in *WorldCat* that included multiplication or division concepts. Selection criteria included being published between 2000 – 2012, possessing a conceptual approach to learning, and including possible extension activities.

Brenner, M. (2000). *Stacks of trouble*. New York: Kane Press.

A boy takes on washing the dishes while his mom is away from home. The dishwasher is broken and he avoids washing the dirty dishes until it can wait no more.

Conceptual learning: Repeated addition, writing multiplication number sentences, multiplication using models

Methods for concept development: Analogy is used to help children understand the concept. To make the transition from repeated addition to multiplication students can work through the problems presented throughout the story; solving the problems both using repeated addition and multiplication.

Attributes of objects are found in the text and used in the understanding of the concept. Throughout the story, the family piles up dirty dishes to wash by hand; their dishwasher is broken. As the family continues to use dishes, the dirty dishes multiply.

Extensions to story: Exploration of various situations or scenarios of dirty dishes, student exploration of an extension or variation to the ending of the story

Bruce, S. (2001). *Everybody wins!*. New York: Kane Press.

Oscar and his friends enter several contests together to see if they can win. They split their prizes equally.

Conceptual learning: Writing division number sentences, division with whole numbers, division with remainders

Methods for concept development: Multiple examples are used to allow students to generalize and arrive at the meaning of the concept. A few examples of the use of division in the story include: contest prize of 150 pizzas split between two

people, contest fee of $12 divided by three people, and dividing a contest prize of a forty dollar gift card between four people.

Extensions to story: Students write an extension to the story or another situational problem where division is present and solve the problem, make adjustments to the problems presented in the story

Buckless, A. (2000). *Too many cooks!*. New York: Scholastic.

Three kids surprise their mom and grandparents with making soup for supper. The recipe gets wet and they are not able to read it so they interpret the recipe in their own way.

Conceptual learning: Writing multiplication number sentences, multiplication by doubling, multiplication by grouping, multiplication by repeated addition, multiplication using models

Methods for concept development: Analogy is used to help children understand the concept. Repeated addition and skip counting provides opportunities to transition to multiplication in the many problems presented.

Multiple examples are used to allow students to generalize and arrive at the meaning of the concept. Examples presented in creating the soup for six people, which relates to multiplication include: two tomatoes for each person, two cups of beans for each person, and five noodles for each person.

Manipulatives or representations of objects are used in the text to develop understanding of the concept. The representations of six groups of five carrots, six groups of five noodles, and six groups of two cups of beans are present to aid in the development of multiplication.

Extensions to story: Working in small groups to explore the connection between counting by a specific number, repeated addition, and multiplication; making adjustments to problems presented; create new problems as an extension of the story

Calvert, P. (2006). *Multiplying menace: The revenge of Rumpelstiltskin*. Watertown, MA: Charlesbridge.

Peter is celebrating his birthday when Rumpelstiltskin comes to the castle and demands the boy comes with him. Rumpelstiltskin has a multiplying stick, which he uses to create havoc. Peter must work to get everything back to normal.

Conceptual learning: Problem solving with multiplication, multiplying with whole numbers, multiplying with fractions, multiplying by zero, multiplication using models

Methods for concept development: Multiple examples are used to allow students to generalize and arrive at the meaning of the concept. Examples from the story that incorporate multiplication include: nose multiplied by six, one candle multiplied by eight, and four branches multiplied by ten.

Manipulatives or representations of objects are used in the text to develop understanding of the concept. Evidence of representations of multiplication includes grouping of stepping stones (nine groups of three stones).

Extensions to story: Student generated extensions to the story, exploration of various problems presented in the story, adjustment of numbers and situations

Calvert, P. (2011). *Multiplying menace divides!: A math adventure.* Watertown, MA: Charlesbridge.
Rumpelstiltskin is back again, but with a new stick that is a dividing stick. Matilda and Rumpelstiltskin are invading the village using the dividing stick to turn objects into frogs. Prince Peter must work quickly to save the village.

Conceptual learning: Problem solving with division, dividing with whole numbers, dividing with fractions, dividing by zero, division using models

Methods for concept development: Multiple examples are used to allow students to generalize and arrive at the meaning of the concept. Examples from the story that incorporate division include: 12 kittens divided by three, one horse divided by one-forth, and two piglets divided by one-fifth.

Manipulatives or representations of objects are used in the text to develop understanding of the concept. Evidence of representations of division includes dividing 12 kittens by three to transform into frog kittens (grouping the 12 kittens into three equal groups) and dividing a three by five array of dirt piles by 15.

Extensions to story: Generating an extension to the story, creating justifications of why larger numbers appear when dividing by fractions and vice versa when dividing by whole numbers

Dodds. D. A. (2004). *Minnie's Diner: A multiplying menu.* Cambridge, MA: Candlewick Press.
Brothers are sent to work on the farm. One by one they head to the diner to get lunch and each brother gets double what their younger brother gets until Papa comes to the diner to find them.

Conceptual learning: Multiplication by doubling

Methods for concept development: Multiple examples are used to allow students to generalize and arrive at the meaning of the concept. Examples in this story revolve around multiplication and include the youngest brother ordering lunch at

the diner, his next oldest brother comes in, who is double in size, and orders double his younger brother. The older brother now has two of everything the younger brother ordered.

Manipulatives or representations of objects are used in the text to develop understanding of the concept. Representations of objects in this story include both the siblings and the ordered food doubling in size.

Extensions to story: Exploring what the father ordered at the end, he only said to make it a double; exploring other scenarios, such as ordering different amounts of items, such as 1 soup, 1 salad, two sandwiches, and 1 hot cherry pie

Glass, J. (2000). *Counting sheep*. New York: Random House.

Boy is going to sleep and starts counting sheep they come by ones. Then come kangaroos come by twos, monkeys by threes, and bees by four.

Conceptual learning: Multiples of given numbers

Methods for concept development: Attributes of objects are found in the text and used in the understanding of the concept. As a boy sleeps, many animals come one by one, two by two, and so on. The number of animals that come in can be counted using multiplication.

Extensions to story: Providing hypothetical situations, such as "If ducks came in five at a time, how many ducks would there be if five groups came in?"; students could make their own extension of the story; writing number sentences for scenarios

McElligott, M. (2009). *The lion's share*. New York: Walker.

The King invites his friends to dinner. At dessert, a cake is brought out and all of the animals take half of what is presented to them until the ant has none to share with the King. The animals then try to "one-up" each other by baking twice as many cakes.

Conceptual learning: Division by halving, representation of a whole, multiplication by doubling, multiplication using models, division using models

Methods for concept development: Multiple examples are used to allow students to generalize and arrive at the meaning of the concept. Each time the cake is divided represents one more example of halving.

Manipulatives or representations of objects are used in the text to develop understanding of the concept. The cake is the object used to develop the concept.

Extensions to story: Extending the doubling and halving situations further and exploring what both notions mean, pose problems similar to those presented and

ask students whether they would want to participate or not and justifying their decision

McElligott, M. (2007). *Bean thirteen.* New York: G. P. Putnam's Sons.
Ralph and Flora are picking beans for dinner and pick thirteen beans. When it comes time to divide them up, there seems to be one remaining. Flora invites friends over so that the beans are used up, but it never seems to work out right until....

Conceptual learning: Division with remainders, division using models

Methods for concept development: Multiple examples are used to allow students to generalize and arrive at the meaning of the concept. Each attempt to divide the beans represents one more example to develop the concept.

Manipulatives or representations of objects are used in the text to develop understanding of the concept. The beans are the object used to develop the concept.

Extensions to story: Additional situations and scenarios, adjusting number of beans or people, creating an extension to the story, use manipulatives to explore and discuss the problem presented

Napoli, D. J., & Tchen, R. (2008). *Corkscrew counts: A story about multiplication.* New York: Henry Holt & Co.
Corkscrew has a birthday party where the four children in his family invite two friends each. After opening presents, they try to find a game to play, but Corkscrew and his friend Pirate seem to get in the way.

Conceptual learning: Writing multiplication number sentences, multiplication with whole numbers, multiplication by grouping

Methods for concept development: Analogy is used to help children understand the concept. To make the transition from repeated addition to multiplication students can work through the problems presented throughout the story; solving the problems both using repeated addition and multiplication.

Multiple examples are used to allow students to generalize and arrive at the meaning of the concept. Examples of multiplication include finding activities to keep all of the twelve children occupied during the party.

Extensions to story: Additional situations or adjustments to the problems could be created and explored by students, use the additional questions in the back matter to explore the concept of multiplication further

Ochiltree, D. (2004). *Sixteen runaway pumpkins*. New York: Margaret K. McElderry Books.

Sam is picking pumpkins in the pumpkin patch. She has four and then doubles for eight and doubles again for sixteen. The pumpkins fall out of the cart and crack, but she makes pumpkin pie with her Grandpa.

Conceptual learning: Multiplication by doubling

Methods for concept development: Analogy is used to help children understand the concept. The concept of addition can provide transition into multiplication while gathering the pumpkins.

Multiple examples are used to allow students to generalize and arrive at the meaning of the concept. Each doubling represents an example of the concept.

Extensions to story: Exploring the questions, "What if Sam doubled pumpkins again?" "How would the number of pumpkins change if there was a number other than four to start out with?"; exploring doubling with various other situations or scenarios; exploring triples, quadruples, etc.

Penner, L. R. (2000). *Clean sweep campers*. New York: Kane Press.

Annie writes letters to her mom and dad from camp. She talks about how her cabin worked through dividing up the cleaning chores.

Conceptual learning: Division with remainders, division with grouping, division by halving

Methods for concept development: Multiple examples are used to allow students to generalize and arrive at the meaning of the concept. Each chore the girls in the cabin divvy up represents an example of the concept.

Extensions to story: Making adjustments to the number of campers or cleaning area, extending on the concept of remainders, use the extension of the story in the back matter

Reynolds, A. (2009). *Superhero school*. New York: Bloomsbury.

Leonard is headed to superhero school, where he thinks he will be able to do all sorts of cool superhero stuff, but finds himself stuck in a classroom learning about fractions, multiplication, and division.

Conceptual learning: Problem solving with multiplication, problem solving with division

Methods for concept development: Manipulatives or representations of objects are used in the text to develop understanding of the concept. The super power

techniques the students use to save their teachers are the objects used to develop the concept.

Extensions to story: Creating and solving various scenarios, taking a more in-depth exploration of the math concepts, justifying the problems presented in the story

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

A resource is not widely available that distinguishes picture books that contain a deeper mathematical connection for teacher librarians who do not have training to teach mathematics. Such a resource is needed for those teacher librarians who need assistance when selecting picture books with mathematical connections. The purpose of this project was to construct an annotated bibliography of children's picture books embracing a conceptual approach to mathematics learning for upper elementary students.

Summary

Sixteen children's picture books, which met established selection criteria, underwent analysis which considered the role of multiplication and division concepts and activities to extend these concepts further in the selected titles. From this analysis, 13 titles which met required criteria were compiled to create the annotated bibliography.

While completing the project, adjustments were made to provide a more detailed source of information to its users. Included in these adjustments was the identification of mathematic concepts present in each title. This adjustment provides users with a better understanding of each title included in the annotated bibliography and its possible use in instruction. Along with this identification, a description of the method in which the picture book incorporates or includes mathematics concepts is noted in the annotated bibliography. Users will gain insight into how the concepts are presented in each title prior to obtaining the picture book.

The researcher posed two questions in the research process. The first question considered which of the selected children's picture books would meet the analysis criteria

included in the annotated bibliography. Of the 16 titles analyzed throughout the research, 13 of which included multiplication and three included division, 13 books were included in the annotated bibliography. These selected titles met the established criteria in the analysis stage of the research. The criteria considered how mathematics concepts were presented in the title and possible extension activities that could take place using the picture book in instruction. The three titles not included in the annotated bibliography included mathematics in the story, but were either not developed to aid instruction or presented mathematics for lower elementary students and were not appropriate for the grade levels the annotated bibliography geared toward.

The second question posed by the researcher called for a focus on the authors and publishers of the selected titles in the bibliography and their correlation with one another. Of the 16 titled selected for analysis, two publishers had a recurring presence in the selected picture books. Kane Press published three titles which underwent analysis in the research. The second publisher, Charlesbridge Publishing, published two titles written by the same author, Pam Calvert. A second author also had multiple titles considered, Matthew McElligott.

Conclusions

The annotated bibliography generated in the research serves as a resource for teacher librarians and teachers, alike. The first users of this resource are likely to be teacher librarians, as access will be limited to those participants of a tool whose audience is geared towards teacher librarians in Iowa. The intended use of the annotated bibliography is to assist teacher librarians in collection development for titles incorporating multiplication and division mathematics concepts for students in grades

three through five. Once selected titles are added to the library collection, teachers can refer to the annotated bibliography for selection based on their current instructional needs. Teachers will use this bibliography to identify the math concepts incorporated in each title, as well as the method in which the concept is presented. From this information, teachers will then be able plan their instruction incorporating these titles.

Recommendations

Annotated bibliographies provide insight into titles, such as the one presented in this research, and can assist educators in preparation of instruction. Creating multiple annotated bibliographies for many concepts across the curriculum and grade levels would be an excellent addition to any curriculum development. The inclusion of literature in instruction provides many excellent learning opportunities for students.

The generated annotated bibliography will be posted on a tool accessible to Iowa teacher librarians, the *Iowa Teacher Librarian Ning* (Steingraber, 2011). The researcher intends to use the generated annotated bibliography to develop the school library collections in which she serves. Also, the researcher will inform teachers of students in grades three through five, in the buildings she serves, to consider implementing the selected titles into their math curriculum.

It is the recommendation of the researcher that schools and districts consider the construction and use of annotated bibliographies as a means of incorporating conceptual learning into the curriculum.

REFERENCES

Bisland, B. M. (2010). Another way of knowing: Visualizing the ancient silk routes. *The Social Studies*, *101*, 80-86. doi:10.1080/00377990903284013

Boulware, B. J., & Crow, M. (2008). Using the concept attainment strategy to enhance reading comprehension. *Reading Teacher*, *61*(6), 491-495.

Burns, M. (2010). As easy as pi. *School Library Journal*, *56*(5), 38-41.

Burns, M. (2002). Q & a with Marilyn Burns. *Scholastic Instructor*, *111*(7), 1-24.

Connor, C. M., Kaya, S., Luck, M., Toste, J. R., Canto, A., Rice, D., Tani, N., & Underwood, P. S. (2010). Content area literacy: Individualizing student instruction in second grade science. *The Reading Teacher*, *63*(6), 474-485. doi:10.1598/RT.63.6.4

Farland, D. (2006). The effect of historical, non-fiction trade books on elementary students' perception of scientists. *Journal of Elementary Science Education. 18*(2), 31-48.

Fraenkel, J. (1994). The evolution of the Taba curriculum development project. *The Social Studies*, *85*, 149-159.

Johnson, N. J., & Giorgis, C. (2001). Interacting with the curriculum. *The Reading Teacher*, *55*(2), 204-213.

Kazemi, E., & Stipek, D. (2001). Promoting conceptual thinking in four upper-elementary mathematics classrooms. *The Elementary School Journal*, *102*(1), 59-80.

Ketterlin-Geller, L. R., Chard, D. J., & Fien, H. (2008). Making connections in mathematics: Conceptual mathematics intervention for low-performing students. *Remedial and Special Education*, *29*(1), 33-45. doi:10.1177/0741932507309711

Krech, B. (2003). Picture-book math. *Instructor*, *112*(7), 42-43.

Marilyn Burns. (2011). *Educational publishing hall of fame*. Retrieved from http://www.aepweb.org/fame/mburns.htm

Marilyn Burns, Founder. (2011). *Math solutions*. Retrieved from http://www.mathsolutions.com

McDonald, S., & Rasch, S. (2004). Picture books + math = fun. *Book Links*, *14*(2), 9-14.

Meagher, S. (2005). All around math. *Teaching PreK-8*, *35*(4), 79-80.

Mink, D. V., & Fraser, B. J. (2005). Evaluation of a k-5 mathematics program which integrates children's literature: Classroom environment and attitudes. *International Journal of Science and Mathematics Education, 3*(1), 59-85.

Moch, P. L. (2001). Manipulatives work!. *Educational Forum, 66*(1), 81-87.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: The National Council of Teachers of Mathematics, Inc.

Orgill M. K., & Bodner G. (2004). What research tells us about using analogies to teach chemistry. *Chemical Education Research and Practice, 5*, 15-32.

Pantaleo, S. (2002). Children's literature across the curriculum: An Ontario survey. *Canadian Journal of Education, 27*(2-3), 211-230.

Rittle-Johnson, B., & Alibali, M. W. (1999). Conceptual and procedural knowledge of mathematics: Does one lead to the other? *Journal of Educational Psychology, 91*(1), 175-189.

Rittle-Johnson, B., & Koedinger, K. (2009). Iterating between lessons on concepts and procedures can improve mathematics knowledge. *British Journal of Educational Psychology, 79*(3), 483-500.

Roberts, S. K. (2010). The conceptual chicken and the procedural egg. *Mathematics Teaching in the Middle School, 16*(4), 196-198.

Sarama, J., & Clements, D. H. (2006). Books that build math skills. *Scholastic Early Childhood Today, 21*(3), 20.

Sarama, J., Clements, D. H., & Swaminathan, S. (2003). Development of mathematical concepts of two-dimensional space in grid environments: An exploratory study. *Cognition and Instruction, 21*(3), 285-324.

Schneider, M., & Stern, E. (2010). The developmental relations between conceptual and procedural knowledge: A multimethod approach. *Developmental Psychology, 46*(1), 178-192. doi:10.1037/a0016701

Star, J. R. (2005). Reconceptualizing procedural knowledge. *Journal for Research in Mathematics Education, 36*(5), 404-411.

Steingraber, K. (2011). *IATeacherLibrarians.* Retrieved from www.iateacherlibrarians.ning.com

Williams, J. P., Nubla-Kung, A. M., Pollini, S., Stafford, K. B., Garcia, A., & Snyder, A. E. (2007). Teaching cause-effect text structure through social studies content to at-risk second graders. *Journal of Learning Disabilities*, *40*(2), p. 111-120.

Williams, J. P., Stafford, K. B., Lauer, K. D., Hall, K. M., & Pollini, S. (2009). Embedding reading comprehension training in content-area instruction. *Journal of Educational Psychology*, *101*(1), 1-20. doi:10.1037/a0013152

Wysocki, B. (2004). A thousand words: The picture-perfect link to the curriculum. *School Library Journal*, *50*(4), 8-12.

APPENDIX A

STUDIED PICTURE BOOKS

Brenner, M. (2000). *Stacks of trouble*. New York: Kane Press.

Bruce, S. (2001). *Everybody wins!*. New York: Kane Press.

Buckless, A. (2000). *Too many cooks!*. New York: Scholastic.

Calvert, P. (2006). *Multiplying menace: The revenge of Rumpelstiltskin*. Watertown, MA: Charlesbridge.

Calvert, P. (2011). *Multiplying menace divides!: A math adventure*. Watertown, MA: Charlesbridge.

Dodds, D. A. (2004). *Minnie's Diner: A multiplying menu*. Cambridge, MA: Candlewick Press.

Esham, B. (2008). *Last to finish: A story about the smartest boy in the math class*. Ocean City, MD: Mainstream Connections.

Glass, J. (2000). *Counting sheep*. New York: Random House.

McElligott, M. (2009). *The lion's share*. New York: Walker.

McElligott, M. (2007). *Bean thirteen*. New York: G. P. Putnam's Sons.

Napoli, D. J., & Tchen, R. (2008). *Corkscrew counts: A story about multiplication*. New York: Henry Holt & Co.

Ochiltree, D. (2004). *Sixteen runaway pumpkins*. New York: Margaret K. McElderry Books.

Penner, L. R. (2000). *Clean sweep campers*. New York: Kane Press.

Perez, M. (2006). *Curious George: The donut delivery*. Boston: Houghton Mifflin.

Reynolds, A. (2009). *Superhero school*. New York: Bloomsbury.

Suen, A. (2008). *Times tables cheat*. Edina, MN: Magic Wagon.

APPENDIX B

ANALYSIS TOOL

Title of Book: _____

Author(s): _____

Date of Publication: _____ Publisher: _____

Summary: _____

_____

Does the book present content that is mathematically sound and appropriate for grade span?

YES / NO

Examples of this content include: _____

_____

Does the book provide opportunities to introduce or reinforce mathematical symbolism?

YES / NO

Examples of these opportunities include: _____

_____

Does the book portray a conceptualized approach to mathematics?

YES / NO

Examples of this content include: _____

_____

Does the book provide opportunities to extend mathematical concepts beyond the book?

YES / NO

Examples of these opportunities include: _____

_____

Include in annotated bibliography? YES / NO

Reference to checklist in Marilyn Burns' (2010) "As Easy as Pi" article was made while creating this analysis tool.