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Using Children's Trade Books to Enhance the Mathematics Curriculum in the Elementary School

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USING CHILDREN'S TRADE BOOKS TO ENHANCE THE MATHEMATICS CURRICULUM IN THE ELEMENTARY SCHOOL

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VITA

The author, Dorothy Giroux, entered DePaul University in Chicago in September, 1960 and earned the degree of Bachelor of Science in Business Education in June, 1964. Her first teaching assignment was at St. Ignatius High School in Chicago.

Mrs. Giroux spent the next six years pursuing a career as full time mother to her son and daughter. It was during this period that she was able to observe the impact of reading aloud to children. When her first child entered kindergarten, she continued her education, earning a Master's degree in Reading Education at Loyola University of Chicago in May, 1979.

In October, 1980, she began her work as a reading clinician/tutor in the Loyola University Reading Clinic. Her responsibilities included testing and completing diagnostic evaluations of client's reading strengths and weaknesses and designing and implementing remedial reading programs. In 1982, she became the director of the Professional Tutoring Program in the Reading Clinic, assuming responsibility for the supervision of tutors and the program. From 1987 to 1988, she served as Acting Director of the Reading Clinic. She served as Director of the Reading Clinic from 1988 to 1990.

Mrs. Giroux has taught both graduate and undergraduate courses in reading at Loyola University and was responsible for the direction of the practica experience for M.Ed. candidates in Reading.

With Dr. Mary Jane Gray, she has co-authored Classroom Reading Profiles: A Process Approach (Kendall-Hunt Publishing Company, 1990).

She has also collaborated with Sally Zepeda and other teachers on a handbook for parents "Helping Your Child Succeed in School" (Association of American Publishers, School Division, 1989).

She presented at the International Reading Association convention in Toronto in 1988 and at the Illinois Reading Conference in 1988 and 1991. She has been a frequent workshop presenter at local public and parochial schools.

Mrs. Giroux served as a Project Coordinator for ICARE (Improving Content Area Reading Effectiveness), a grant project funded by the Illinois State Board of Education in 1986. She has also participated in the MCIP (Mathematics Curriculum Improvement Project), a grant project funded by the Illinois Board of Higher Education. Mrs. Giroux and Dr. Diane Schiller received a Phi Delta Kappa award to research "A Project to Develop Parent Awareness of the Importance of Reading to Infants" in 1989.

Currently, Mrs. Giroux is working on a local cable access television program, Countdown, which focuses on the presentation of mathematics concepts to elementary school children. She provides the reading/language arts component using the excellent children's trade books she has discovered through this research.

Mrs. Giroux is a member of the International Reading Association, the Illinois Reading Council, the Association for Supervision and Curriculum Development, Phi Delta Kappa, and the National Council of Teachers of English. She is a charter member of the Pi chapter of Alpha Upsilon Alpha, an honorary society of the International Reading Association and a member of Alpha Sigma Nu, the Jesuit Honor Society.

TABLE OF CONTENTS

LIST OF TABLES

CONTENTS OF APPENDICES

CHAPTER I

NATURE AND SCOPE OF THIS STUDY

Introduction

If an alien being were to enter a third grade mathematics class in the United States today, it might conclude that students are being prepared to live in a society in which rote computation is valued. The alien might see children sitting at their desks watching a teacher at the blackboard perform a multiplication task, or it might see children learning multiplication tables. Children would probably follow their observation of the teacher's model by completing a drill sheet which presents practice in multiplication. If the children were directed to their math textbook, they might find additional practice items or word problems to reinforce the math concept.

Before moving on to another planet, the alien ~~being might~~ stop to consider if this instruction will have any effect on our students. Many who teach mathematics have expressed similar concerns. In Everybody Counts: A Report to the Nation on the Future of Mathematics Education, we learn that "because mathematics is one of the pillars of education, reform of education must include significant change in the way mathematics is taught and learned." (p. 73)

In response to the challenge to revise mathematics instruction, The National Council of Teachers of Mathematics has issued the Curriculum and Evaluation Standards for School Mathematics. This document presents fifty-four standards which cover kindergarten to twelfth grade. The standards present a statement of what the mathematics curriculum should

include as well as activities that will develop the mathematical knowledge students should have.

One area that deserves particular emphasis is Standard 2: Mathematics as Communication. Teachers of children in grades K-4 learn that the study of mathematics should prepare students by providing opportunities in which they can:

* relate physical materials, pictures, and diagrams to mathematical ideas;
* reflect on and clarify their thinking about mathematical ideas and situations;
* relate their everyday language to mathematical language and symbols;
* realize that representing, discussing, reading and writing, and listening to mathematics are a vital part of learning and using mathematics. (p. 26)

Since the verbal communication that occurs among children is a means by which they learn language and express their thinking, it is important for them to be able to talk about mathematics. Reading to children is just one of the teaching strategies which can be used to develop language skills. The educational impact of reading to children has been studied by a number of researchers (Chomsky, 1972; Butler, 1980; Wells, 1986). The Standards suggest that "reading children's literature about mathematics, and eventually text material, also is an important aspect of communication that needs more emphasis in the K-4 curriculum." (p.26)

Standard 2 for grades 5-8 also emphasizes the importance of providing opportunities to communicate so that students can

* model situations using oral, written, concrete, pictorial, graphical and algebraic methods;
* reflect on and clarify their own thinking about mathematical ideas and situations;

* develop common understandings of mathematical ideas, including the role of definitions;
* use the skills of reading, listening, and viewing to interpret and evaluate mathematical ideas;
* discuss mathematical ideas and make conjectures and convincing arguments;
* appreciate the value of mathematical notation and its role in the development of mathematical ideas. (p. 78)

While the Standards do not mention the activity of reading aloud to students at the fifth through eighth grade levels, activities which increase the students' ability to communicate mathematics are mentioned. It is interesting to note that the Standards authors state that developing the ability to communicate mathematically "cannot occur without deliberate and careful acquisition of the language of mathematics." (p. 78)

Are teachers aware of the Standards? In a pilot study this researcher conducted while presenting two workshops on the topic of reading trade books in math class, teachers responded to the following question: "Are you aware of the new (1989) NCTM Standards for School Mathematics? Of the fifty-four teachers who responded to this question, fourteen (26%) indicated that they were aware of the Standards and thirty-eight (70%) reported that they were unfamiliar with the Standards.

There is some indication that teachers will incorporate the use of children's trade books in math class. In her unpublished dissertation, Dwyer (1989) found that teachers who participated in library workshops focusing on math-related materials were enthusiastic about the materials and there was increased use of library materials among the teachers and their students. Among the teacher complaints she observed that teachers expressed frustration with the inadequacy of the library collections with regard to math-related books.

The teachers who participated in Dwyer's research attended workshop sessions where they learned about the many math-related books and reference sources available through local library systems. Are they typical of teachers in Chicago? Since a survey of all teachers in Chicago would be impractical, this researcher decided to consult The Rochelle Lee Fund to Make Reading a Part of Children's Lives to obtain a representative sample of Chicago teachers. The Rochelle Lee Fund provides grant awards for the teachers of District Two. Teachers are invited to submit grant proposals in which they address the need to develop life-long reading habits in elementary school students. In addition to the unique plan submitted in their proposals, teachers agree to provide fifteen minutes a day for reading aloud to their students and twenty minutes a day for sustained silent reading. During the 1990-91 school year there were 1,593 teachers employed in the fifty-six schools in District Two (telephone conversation with David Tate, District Two Representative).

Two hundred fifty-nine proposals were submitted for the 1990-91 school year. Only one grant proposal specifically focused on using math-related trade books to enhance math concept formation and encourage reading for pleasure. One additional grant proposal outlined a program that highlighted specific authors and included the works of Mitsumasa Anno who is recognized as an outstanding author of children's math books. A third grant proposal did not include math trade books, but chose to purchase books that profiled women prominent in history, math and science. The three math-related proposals represent 1% of the total grant proposals received by the Rochelle Lee Fund. Because of the extra effort and initiative involved in writing a grant proposal, we may assume that these

teachers represent some of the best teachers in the area. Since the teachers who submitted grants are typical of teachers in the Chicago area, it appears that an extremely small portion of the teaching population is aware of the possible use of math-related trade books in classroom and independent reading activities.

In workshops presented by this researcher to fifty-four Archdiocese of Chicago elementary school teachers, teachers were asked to indicate whether they read trade books to their students during math class. Eleven of the fifty-four teachers in attendance indicated that they read to their students during math class. Five of these teachers taught at the kindergarten level and three were first grade teachers. Teachers at the beginning stages of instruction tend to devote more class time to reading aloud and these teachers included counting books among the material they chose for read-aloud sessions.

Mathematics Textbook Analysis

Why would teachers use trade books instead of the mathematics textbook to introduce or reinforce the mathematics concepts they wish to teach? The answer appears to be obvious; the mathematics textbooks do not provide an adequate explanation of the mathematical concepts. They provide a limited number of examples and students who are unsure of the topic under study have little information available to them in their textbooks.

Three current mathematics series were examined to determine how the written word is used in math books to teach averages, numeration

systems, large number concepts, and exponents. Only a fraction of the material contained instructional statements.

The textbook series used in this analysis were:

Addison-Wesley Mathematics, 2nd edition. Menlo Park, Ca.: Addison Wesley Publishing Company, 1987.

Mathematics Today. Orlando, Florida: Harcourt, Brace Jovanovich, Inc. 1985.

Invitation to Mathematics. Glenview, Illinois: Scott, Foresman and Company, 1985.

Textbooks at the third, fifth and seventh grade level were examined. Sentences were tallied and categorized as follows:

1. Instructional statements. A statement was considered to be instructional if it provided information about a mathematical concept or a mathematical operation.

2. Directions. If a sentence directed a student to do some act, such as "multiply" or "give the missing number", it was considered to be a direction.

3. Word Problems. Statements which presented a set of conditions and required the student to perform some mathematical operation in order to arrive at an answer that would satisfy the conditions were considered to be word problems.

The first topic to be analyzed was averages. At the third grade level, there are no textbook pages that present, teach or reinforce the study of averages in the textbooks identified for this analysis.

At the fifth and seventh grade level, averages are taught and the following table illustrates how the topic is presented in the textbooks:

Table 1
Mathematics Textbook Analysis: Averages
5th Grade

	AW	HBJ	SF
Total sentences	21	29	16
Instructional	6 (28.6%)	12 (41.4%)	3 (18.7%)
Directions	2 (9.5%)	3 (10.3%)	3 (18.7%)
Word Problems	13 (61.9%)	14 (48.3%)	10 (62.5%)

7th Grade

	AW	HBJ	SF
Total sentences	95	62	82
Instructional	22 (23.2%)	23 (37.1%)	16 (19.5%)
Directions	13 (13.7%)	14 (22.6%)	12(14.6%)
Word Problems	58 (61.1%)	25 (40.3%)	54 (65.9%)
Other	2 (2.0%)	0 (0.0%)	0 (0.0%)

In both the fifth and seventh grade level of these texts, the most frequent use of words is reserved for word problems. While word problems do assist the student to develop and practice the concept, it seems logical that it would be difficult to do so if the student does not have sufficient information about the concept. Such information would be gained from instructional statements, but they represent a small percentage of the words used in the texts.

The mathematics textbooks were analyzed for their treatment of the history of numbers and early numeration systems. It is interesting to note that at the third grade level, there are no pages that present the history of numbers. The Addison-Wesley Mathematics text devotes one page to the study of Roman numerals and the HBJ Mathematics Today text allocates two pages to Roman numerals. The Scott, Foresman text does not include any information on the history of numbers and does not introduce Roman numerals at this grade level.

Table 2
Mathematics Textbook Analysis: History of Numbers
3rd grade

	AW	HBJ	SF
Total sentences	11	16	0
Instructional	3 (27.3%)	14 (87.5%)	0 (0.0%)
Directions	2 (18.2%)	1 (6.3%)	0 (0.0%)
Word Problems	6 (54.5%)	1 (6.3%)	0 (0.0%)

5th grade

	AW	HBJ	SF
Total sentences	29	18	3
Total sentences relevant to topic	17	18	3
Instructional	9 (52.9%)	13 (72.2%)	1 (33.3%)
Directions	3 (17.6%)	5 (27.8%)	2 (66.7%)
Word Problems	5 (29.4%)	0 (0.0%)	0 (0.0%)

7th grade

	AW	HBJ	SF
Total sentences	13	11	0
Instructional	7 (53.8%)	9 (81.8%)	0 (0.0%)
Directions	4 (30.8%)	2 (18.2%)	0 (0.0%)
Word Problems	2 (15.4%)	0 (0.0%)	0 (0.0%)

At the fifth grade level, the authors of the Addison-Wesley Mathematics series include one page on the Egyptian numeration system and two pages about the Roman numerals. In the HBJ Mathematics Today text, one page is devoted to a project in which earlier symbols for numbers are explored and two pages are devoted to Roman numerals. The Scott, Foresman Invitation to Mathematics series devotes one page to a brief explanation of the Roman numeral system.

At the seventh grade level, there are two pages that explain ancient numeration systems in the Addison-Wesley series, one page in the HBJ Mathematics Today text, and the Scott, Foresman Invitation to Mathematics text does not include any pages devoted to the history of numbers or early numeration systems.

Another topic that was included in this analysis of mathematics textbooks was the concept of large numbers. The world in which we live is inundated with large numbers, i.e., the federal budget is reported in trillions of dollars, the war effort required millions and billions of dollars, the prize in the state lottery is a million dollar figure. These are terms that are used so frequently that "it is hard to comprehend the very large numbers that come up in mathematics, the sciences and in the infamous 'real world'" (Stahmer, 1988.)

How do mathematics textbooks treat the concept of large numbers? All of the textbooks considered for this analysis teach place value of large numbers. Students are taught how to read large numbers. Examples and illustrations report the number of babies born, or the attendance at a sport event, or the distance between cities or planets.

At the third grade level, the Addison-Wesley series teaches hundreds and thousands as large numbers and the HBJ series teaches hundreds, thousands and ten thousands. Neither series mentions millions or billions. The Scott, Foresman series teaches hundreds, thousands, ten thousands and hundred thousands, as well as the concept of million. Only one page is devoted to the concept of a million, however the examples used to explain the concept are those that are relevant to a child's experience or could easily be visualized by a child. For example, "Every 40 days, you breathe about 1,000,000 times."

Table 3
Mathematics Textbook Analysis: Large Numbers
3rd grade

	AW	HBJ	SF
Total sentences	19	29	56
Total sentences relevant to topic	14	29	56
Instructional	7 (50.0%)	15 (51.7%)	15 (26.8%)
Directions	6 (42.9%)	14 (48.3%)	17 (30.4%)
Word Problems	1 (7.1%)	0 (0.0%)	24 (42.9%)

5th grade

	AW	HBJ	SF
Total sentences	58	38	11
Total sentences about hundreds, thousands	47	17	
Instructional	24 (51.1%)	7 (41.2%)	
Directions	14 (29.8%)	10 (58.8%)	
Word Problems	9 (19.1%)	0 (0.0%)	
Total sentences about millions, billions	11	21	11
Instructional	2 (18.2%)	6 (28.6%)	2 (18.2%)
Directions	8 (72.7%)	10 (47.6%)	5 (45.5%)
Word Problems	1 (9.1%)	5 (23.8%)	4 (36.4%)

7th grade

	AW	HBJ	SF
Total sentences	18	24	14
Instructional	12 (66.7%)	9 (37.5%)	4 (28.6%)
Directions	6 (33.3%)	10 (41.7%)	6 (42.9%)
Word Problems	0 (0.0%)	5 (20.8%)	4 (28.6%)

When the students reach the fifth grade, they learn about millions and billions in all of the textbooks used in this analysis. At the seventh grade level, all series devote two pages to the reinforcement of the place value concept using millions and billions. The textbooks do not, however, relate the concept of these large numbers to examples the students can use to understand just what constitutes a million.

The mathematics textbooks were further analyzed for their treatment of exponents and powers of 2. At the third grade level, there are no pages devoted to teach, reinforce or practice this topic. The same is true at the fifth grade level; there is no mention of the concept of exponents or powers of 2. The seventh grade level textbooks are analyzed in Table 4.

The Addison-Wesley series and the Scott Foresman series each devote two pages to the concept of exponents. The HBJ series includes six pages on the topic; three pages teach exponents, two pages are devoted to scientific notation and one page is found in the glossary where the term exponent is defined. Each of these series also includes instruction on prime factorization which mentions the use of exponents, but those pages have not been included in this analysis.

Table 4
Mathematics Textbook Analysis: Exponents
7th grade

	AW	HBJ	SF
Total sentences	21	64	25
Instructional	10 (47.6%)	39 (61.0%)	12 (48.0%)
Directions	9 (42.9%)	19 (30.0%)	7 (28.0%)
Word Problems	2 (9.5%)	6 (9.0%)	6 (24.0%)

Visual Aids. In addition to the written text, visual aids in mathematics textbooks were also examined to determine their purpose and how they assist the mathematics learner to understand mathematics concepts. For this analysis, a visual aid was identified as a picture, chart, graph, or table. Visual aids were evaluated as:

a. illustrating a concept explained in instructional statements in the text;

b. illustrating the instructional statements in the text, but the illustration would not be identified with the concept if viewed out of the context of the current text;

c. illustrating a word problem.

Table 5 presents the analysis of visual aids for each concept and each grade level for the three mathematics textbook series used in this study. Those visual aids categorized as "other" generally represent those illustrations which support the instructional statements in the text, but would not be identified with the concept if viewed out of the context of the current text.

The visual aid that most frequently illustrated a mathematical concept was a chart or graph that accompanied instructional statements. Pictures tended to illustrate the instructional statements but would not be identified with the mathematical concept if viewed outside of the context of the textbook. For example, in the 7th grade Addison Wesley Mathematics textbook, the concept of averages is explained by a discussion of the modal age of city workers. The picture shows a teen age boy working in a park. While this may assist students to visualize the situation, it provides little assistance to develop mathematical concepts.

As Table 5 indicates, most visual aids do not illustrate the mathematical concepts presented. Rather, they serve to provide a pleasant, but nonsubstantive illustration to direct the reader's attention.

Table 5
Visual Aids Analysis

	AW	HBJ	SF
Averages: 5th grade			
# of pages	2	3	2
# of visual aids	6	4	3
concept illustrations	1 (16.7%)	0 (0.0%)	1 (33.3%)
word problem visuals	5 (83.3%)	4 (100.0%)	2 (66.7%)
Averages: 7th grade			
# of pages	7	4	4
# of visual aids	16	5	10
concept illustrations	3 (18.6%)	1 (20.0%)	0 (0.0%)
word problem visuals	11 (68.8%)	4 (80.0%)	10 (100.0%)
other**	2 (12.5%)	0 (0.0%)	0 (0.0%)
History of Numbers: 3rd grade			
# of pages	1	2	0
# of visual aids	2	1	0
concept illustrations	1 (50.0%)	1 (100.0%)	0
word problem visual	1 (50.0%)	0 (0.0%)	0
History of Numbers: 5th grade			
# of pages	3	3	1
# of visual aids	3	2	0
concept illustrations	3 (100.0%)	1 (50.0%)	0
word problem visuals	0 (0.0%)	0 (0.0%)	0
other**	0 (0.0%)	1 (50.0%)	0
History of Numbers: 7th grade			
# of pages	2	1	0
# of visual aids	3	2	0
concept illustrations	3 (100.0%)	2 (100.0%)	0
word problem visuals	0 (0.0%)	0 (0.0%)	0
Large Numbers: 3rd grade			
# of pages	4	6	9
# of visual aids	12	13	13
concept illustrations	4 (33.3%)	4 (30.8%)	11 (84.6%)
word problem visuals	8 (66.7%)	9 (69.2%)	2 (15.4%)
Large Numbers: 5th grade			
# of pages	8	4	2
# of visual aids	21	9	2
concept illustrations	12 (57.1%)	3 (33.3%)	1 (50.0%)
word problem visuals	9 (42.9%)	6 (66.7%)	0 (0.0%)
other**	0 (0.0%)	0 (0.0%)	1 (50.0%)
Large Numbers: 7th grade			
# of pages	2	2	2
# of visual aids	2	2	2
concept illustrations	2 (100.0%)	1 (50.0%)	1 (50.0%)
word problem visuals	0 (0.0%)	0 (0.0%)	0 (0.0%)
other**	0 (0.0%)	1 (50.0%)	1 (50.0%)
Exponents: 7th grade			
# of pages	2	6	2
# of visual aids	3	4	1
concept illustrations	2 (66.7%)	1 (25.0%)	0 (0.0%)
word problem visuals	0 (0.0%)	1 (25.0%)	0 (0.0%)
other**	1 (33.3%)	2 (50.0%)	1 (100.0%)

Purpose of Study

The purpose of this study is to determine whether children's trade books can be incorporated into the mathematics curriculum at the second, third, fourth, fifth, sixth, seventh, and eighth grade level. The first research question addressed by this study is:

1. Are classroom teachers who teach at the elementary school level aware of the children's trade books that can be used to introduce and/or reinforce mathematics concepts? It was hypothesized that there are several possible avenues open to teachers who would like to learn about children's trade books. Teachers might consult:

A. Instructor's manual/mathematics textbook
B. Mathematics methods books
C. Content area reading textbooks
D. Language arts methods books
E. Professional journals and publications
F. Professional meetings

Resources to Consult about Trade Books

Instructor's Manual/Mathematics Textbook

The teacher's editions for six elementary mathematics textbook series were examined to determine if the authors provide suggestions for the use of children's trade books in math. The following textbook series were investigated.

Addison-Wesley Mathematics, 2nd edition. Menlo Park, Ca.: Addison Wesley Publishing Company, 1987.

The authors include a "Just for Teachers" section which provides some interesting information about mathematics topics, but there is no mention of the use of children's trade books to enhance the teaching of mathematics. No bibliography of children's trade books is included in this series.

Mathematics Today. Orlando, Florida: Harcourt, Brace Jovanovich, Inc., 1985.

The teacher's editions of this series provide suggestions for integrating math in the content areas, including language arts. The authors also suggest reading strategies which can be taught to aid the reading of word problems. In Levels K-2, the teacher's editions list children's books as teacher support materials. No lists, however, are included in the teacher's editions above grade two.

Heath Mathematics. Lexington, Ma.: D.C. Heath & Company, 1985.

A student bibliography is included in the teacher's edition; however, there are no suggestions for the use of these books in the mathematics class. The books in these bibliographic listings generally were published in the late 1960s and 1970s.

McGraw-Hill Mathematics. New York, New York: Webster Division, McGraw-Hill Book Company, 1987.

An annotated bibliography of two to four children's books is listed at the end of each chapter in the teacher's editions. While no suggestions are made for the use of these books, the short descriptions of the books are helpful for teachers who wish to integrate the books and their math instruction. Often, the same books are listed at the end of several chapters.

Silver Burdett Mathematics. Morristown, N.J.: Silver Burdett Company, 1987.

A bibliography in the teacher's editions lists resource materials for students and teachers. The student bibliographies list approximately 25 books published in the 1970s and 1980s. No suggestions are made for the use of these books, but at least a list is provided for teacher assistance.

Invitation to Mathematics. Glenview, Illinois: Scott, Foresman and Company, 1985.

There is no mention of the use of children's trade books in math class nor is there a bibliography of children's trade books in this math series.

In the 1990 Texas edition of the Scott, Foresman elementary mathematics series, twenty-four children's trade books are listed. This would seem like an excellent source list for teachers, however only seven of the books on this list are currently cataloged in Books in Print. Of the seven listed in Books in Print, two were out of stock with no date available when the researcher called the publisher. Seventeen books on this 1990 list are not in print nor are they available from the publisher; teachers may be able to find them in library collections but this researcher searched the card catalog of the Chicago Public Library and found that some of the books are not in the Chicago system.

There is the possibility that the books are a part of school library collections, but in a personal conversation with Nancy Young, a school librarian in District 203, the researcher learned that school librarians experience the same hurdles in locating books which are not a part of their collection. She stated: "If a book is not in our collection, both the librarian and the teacher are frustrated. Since there is no way to get the book, except to search in used book stores, (and often the search is fruitless) teacher creativity is stifled and they simply stop trying to develop lesson plans using good books."

Mathematics Methods Books

If those who write mathematics methods books wish to encourage the development of a literate math community in which individuals are able to

communicate mathematical ideas, one would expect that the methods books would contain some bibliographic lists or some reference to the use of children's trade books in math class. The researcher examined several mathematics methods books to learn whether they contain any reference to the use of trade books in mathematics class. The following texts were examined.

Bitter, G. G., Hatfield, M. M. and Edwards, N. T. Mathematics Methods for the Elementary and Middle School: A Comprehensive Approach. Needham Heights, MA: Allyn & Bacon, 1989.

At first glance in the index, one would assume that there is no mention of reading trade books in math class in this methods book. None of the common descriptors (reading, literature, stories, language) is listed, however David Schwartz is listed and on Page 159 the authors remark that a book (How Much Is a Million?) is helpful in providing some visual examples of the concept of large numbers.

The authors also suggest a story format to teach integers and an oral language development activity in which the students are asked to write sentences to aid in the understanding of addition.

Cruikshank, D. E. and Sheffield, L. J. Teaching Mathematics to Elementary School Children: A Foundation for the Future. Columbus, Ohio: Merrill Publishing Co., 1988.

A perusal of the index to this mathematics methods book reveals that there is no mention of the use of children's trade books in mathematics class.

Kennedy, L. M. and Tipps, S. Guiding Children's Learning of Mathematics, 5th edition. Belmont, CA: Wadsworth Publishing Co., 1988.

The authors discuss the importance of knowledge of math vocabulary in reading word problems. They suggest a language experience approach for writing word problems in class. The student's oral language development is emphasized. Having students read slowly and carefully in math class is encouraged. There is, however, no mention of reading trade books in math class.

Musser, G. L. and Burger, W. F. Mathematics for Elementary Teachers: A Contemporary Approach. New York, N.Y.: Macmillan Publishing Co., 1988.

There is no mention of the use of trade books in the mathematics class in this methods book.

Post, T. R. Teaching Mathematics in Grades K-8: Research Based Methods. Newton, MA: Allyn & Bacon, 1988.

Chapter 11 of this text is entitled "Developing Relationships among Mathematics and Other Subjects: An Interdisciplinary Approach." It was written by Alan H. Humphreys and Arthur K. Ellis. The authors argue in favor of integrated instructional goals and providing students with lessons in which they learn that subject matter has applications to real-world activities and that various subject matters are interrelated. A model thematic unit is presented, and it includes books and articles to be read by the teacher and students as well as student writing activities.

This textbook does not present any bibliographic lists of appropriate trade books to use in math class but the above chapter at least suggests to pre-service teachers that there may be children's books available to teach integrated lessons.

VanDeWalle, J. A. Elementary School Mathematics: Teaching Developmentally. White Plains, N.Y.: Longman, 1990.

There is no mention of the use of children's trade books in math class in this math methods textbook. The author does, however, emphasize the importance of using language to develop concepts. Pre-service teachers will read in this book that they should encourage students to talk about and express their ideas both orally and in writing. The author believes that children will understand concepts better if the concepts are discussed and connections are made to procedural knowledge. (p. 16)

This researcher found only one mathematics methods book that includes a bibliography of children's literature to use in mathematics class. It is:

Thiessen, D., Wild, M., Paige, Donald D., Baum, D. L. Elementary Mathematical Methods, 3rd edition. New York, N.Y.: Macmillan Publishing Company, 1989.

In the second edition of this mathematics methods book, (published by John Wiley & Sons, in 1982), a bibliography of appropriate children's literature followed every chapter, except chapter 2 and chapter 10. Pre-service teachers were encouraged to use children's literature to teach mathematics. In several of the end-of-chapter questions and activities, pre-service teachers were directed to the bibliography and asked to create appropriate classroom activities. Many of the books listed in the chapter references had publication dates in the 1970s; many of these books are no longer in print.

In the third edition, the authors attempt to include similar bibliographic data after all but five of the fifteen chapters. Continuing the precedent established in the second edition, preservice teachers are encouraged to use children's literature to teach mathematics and end of the

chapter activities and questions refer the student to mathematics trade books to use in creating appropriate classroom activities. The books cited in the chapter references are often the same ones mentioned in the second edition (1982) and as noted above, these books are no longer in print.

Content Area Reading Textbooks

An examination of textbooks used in content area reading courses was completed to determine whether preservice teachers might learn of children's math trade books through this alternative. The following textbooks were included in this analysis.

Vacca, Richard T. and Vacca, JoAnne L. Content Area Reading, 3rd edition. Glenview, Il.: Scott, Foresman and Company, 1989.

Vacca and Vacca suggest applications of three level study guides for word problems in mathematics class. Vignettes about math teachers who use learning logs are presented as well as categorization activities for math vocabulary. There is no mention of the use of children's trade books in mathematics class.

Lapp, Diane, Flood, James and Farnan, Nancy. Content Area Reading and Learning: Instructional Strategies. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1989.

This book contains a chapter entitled "The Role of Reading Instruction in Mathematics" which was written by Joan Curry. In this chapter, teachers are encouraged to use the Directed Reading Activity in mathematics class, as well as an adaptation of SQ3R for math word problems, vocabulary activities and learning logs. There is no mention of the use of children's trade books in mathematics class.

Dupuis, Mary M., Lee, Joyce W., Badiali, Bernard J., Askov, Eunice N. Teaching Reading and Writing in the Content Areas. Glenview, Il.: Scott, Foresman and Company, 1989.

The authors suggest a language experience approach to reading of word problems. This book also suggests that teachers prepare an annotated bibliography of materials to use in teaching a math unit, however, no samples are provided. There is no mention of the use of children's trade books in mathematics class.

Crawley, Sharon J. and Mountain, Lee H. Strategies for Guiding Content Reading. Needham Heights, Ma.: Allyn and Bacon, Inc., 1988.

Crawley and Mountain present teaching strategies to reinforce reading ability in content area materials. Applications of teaching strategies to mathematics are supplied but there is no mention of the use of children's trade books in mathematics class.

Manzo, Anthony V. and Manzo, Ula Casale. Content Area Reading: A Heuristic Approach. Columbus, Ohio: Merrill Publishing Company, 1990.

Manzo and Manzo emphasize the importance of having students "talk, write, react, and become socialized in math terms" (p. 392). They suggest specific strategies (informal textbook inventory, Dahmus method for word problems, semantic feature analysis, R/Q procedure) but do not mention the use of children's trade books in mathematics class.

Richardson, Judy S. and Morgan, Raymond F. Reading to Learn in the Content Areas. Belmont, Ca.: Wadsworth Publishing Company, 1990.

The authors present many teaching strategies and the preservice teacher can find many mathematics applications. An appendix to this book lists geometry trade books for fifth grade by Paula Mitchell. It assumes that

the preservice teacher will use this list as a basis for planning instruction. The authors suggest a teaching approach (PAR) which can be used to incorporate children's trade books in content areas and present an example in science that can easily be adapted to math.

Moore, David W., Moore, Sharon Arthur, Cunningham, Patricia M. and Cunningham, James W. Developing Readers and Writers in the Content Areas. New York, New York: Longman, Inc., 1986.

David W. Moore, et. al. devote an entire chapter in their textbook to a discussion of content area literature. They do not specifically mention books for the mathematics class but they do provide a list of book selection guides, including three sources for mathematics.

Language Arts Methods Books

The researcher has examined several textbooks which focus on the language arts to determine whether these books provide any suggestions for teachers who wish to incorporate children's trade books in mathematics class. The following textbooks were studied:

Rubin, Dorothy. Teaching Elementary Language Arts, 4th edition. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1990.

Chapter 17, entitled "Language Arts in Content Areas", presents some strategies for developing language arts abilities during content area instruction. The author suggests that teachers create a "starter shelf" of interesting children's books about content area topics to stimulate student interest in reading and encourage independent reading. No specific mention is made of any children's trade books for use in mathematics class.

Tompkins, Gail E. and Hoskisson, Kenneth. Language Arts: Content and Teaching Strategies, 2nd edition. New York, New York: Macmillan Publishing Company, 1991.

This language arts methods book employs an integrated or whole language approach to teaching language arts. While the authors provide many examples of thematic unit webs, there are no webs that make use of children's trade books for mathematics class. Only two language activities (learning logs and writing story problems) are mentioned as teaching strategies to implement during math class.

Petty, Walter T., Petty, Dorothy C., Salzer, Richard T. Experiences in Language: Tools and Techniques for Language Arts Methods, 5th edition. Needham Heights, Ma.: Allyn and Bacon, 1989.

Chapter 15, entitled "Literature for Children", suggests that children's literature be integrated within the subject matter areas and that some consideration be given to the ways in which this might be accomplished. No mention is made of specific trade books for use in the mathematics class.

Hillerich, Robert L. Elementary Teacher's Language Arts Handbook. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1988.

The author devotes one chapter to the use of children's trade books to teach reading. There is, however, no mention of children's trade books to teach mathematics.

Temple, Charles and Gillet, Jean Wallace. Language Arts: Learning Processes and Teaching Practices, 2nd edition. Glenview, Il.: Scott, Foresman and Company, 1989.

There is no mention of the use of children's trade books in mathematics class in this language arts methods book. Counting books are mentioned as a medium for language patterning and learning language.

Hennings, Dorothy Grant. Communication in Action: Teaching the Language Arts. Boston, Ma.: Houghton Mifflin Company, 1990.

A chapter is devoted to literature and language arts, but there is no mention of using children's trade books in the mathematics class.

Pappas, Christine C., Kiefer, Barbara Z., Levstik, Linda S. An Integrated Language Perspective in the Elementary School: Theory into Action. New York: New York: Longman, 1990.

The authors present excellent suggestions for integrating children's trade books and language arts activities in all curricular areas, including mathematics. Specific children's trade books which can enhance the teaching of mathematics are presented with suggestions for classroom implementation.

Professional Journals and Publications

Professional journals often provide book reviews that are useful to classroom teachers when they are trying to locate relevant children's books to use in the curriculum. The School Library Journal, the Horn Book, The New Advocate, and Perspectives: Choosing and Using Books for the Classroom are journals which provide reviews of children's books to assist teachers and librarians in choosing appropriate books for classroom use. Another professional resource is The Kobrin Letter, a monthly newsletter, which presents nonfiction books in thematic settings. Recent issues, however, have not focused on mathematics topics.

The American Library Association published Children's Mathematics Books: A Critical Bibliography by Margaret Matthias and Diane Thiessen in 1979. This annotated bibliography lists 200 children's books about math topics. Since the books were listed in the 1975-76 editions of Children's

Books in Print, this resource provides few relevant and available books that teachers might find in libraries and/or bookstores today.

The National Council of Teachers of Mathematics published Mathematics Library: Elementary and Junior High School by Margariete Montague Wheeler in 1986. This publication also contains an annotated bibliography listing 276 childrens's trade books related to math topics. While this book has a more current publication date, only 34 of the children's books listed were published after 1980. This does not mean to imply that no excellent trade books were written before 1980; only that it is almost impossible to find the older books in libraries or bookstores. Thus, approximately 12% of the books listed in this publication might be available for teachers to use.

The most recent teacher resource was published by Heineman Educational Books in April of 1991. It is entitled Books You Can Count On written by Rachel Griffiths and Margaret Clyne. Suggestions for using thirty-three books and seven poems that reinforce math topics are presented. Teachers who wish to use books to support a thematic unit in math or who simply wish to identify counting books will find this a valuable resource.

An excellent source for nonfiction books is Eyeopeners! written by Beverly Kobrin. This teacher resource lists 500 children's trade books that can be used by classroom teachers to enrich the curriculum. Under the category Math and Counting, nine books are cited.

In Making the Case for Math, a report produced by D. C. Heath and Company, teachers can learn of an annotated bibliography compiled by Kathy McGree and Charles Dorniden of the Minneapolis public schools. This list of 215 children's books is organized by the mathematics topics the

books illustrate. Thus, teachers will find counting books, geometry books, and problem-solving books in this comprehensive list. While this list is available from the authors, this researcher could obtain it only after several calls to D. C. Heath and Company, who then referred the caller to McGree and Dorniden. McGree and Dorniden are considering offers to publish their bibliography.

Professional Meetings

Professional organizations may present workshops related to this topic. At the North Central Regional Conference of the National Council of Teachers of Mathematics held in Madison, Wisconsin on October 11, 1990, the researcher and approximately 100 teachers attended a workshop entitled "Children's Books in Mathematics: To introduce, create interest in, and explore various topics" which was presented by Diane Thiessen of the University of Northern Iowa. During the workshop, Theissen highlighted fifty-five excellent children's books on math topics. The researcher consulted Books in Print and discovered that forty books are currently being published. Many of the books presented by Thiessen were appropriate for pre-school and kindergarten students.

This study will also address the following research questions as it describes teacher and student responses to math-related trade books:

2. Will teachers develop lesson plans to integrate children's trade books in the mathematics curriculum? If teachers become aware of the books that are available, will they then realize the value of using the books as part of their mathematics class?

3. In what manner will children's trade books be incorporated into the mathematics curriculum?

4. Can the use of children's trade books assist children at the elementary school level to enjoy and find value in trade books dealing with topics related to mathematics?

Definition of Terms

1. Children's trade books. Webster's Third New International Dictionary defines a trade book as "not a textbook, not a technical treatise, but the sort of thing that could interest everybody." For purposes of this study, a children's trade book will be defined as any book that is not a textbook which might be of interest to children from ages 8-13. This definition includes both fiction and nonfiction books.

2. Mathematics classroom. That period of time during the school day when mathematics is taught and children are engaged in learning mathematical concepts.

Significance of the Study

Current mathematics textbooks provide little instructional information when presenting mathematics concepts. Textbooks tend to devote most of the printed page to drill and practice exercises and word problems. A thorough explanation of a topic is rarely given in the student edition of the math textbook. This study will contrast the usefulness of math trade books in explaining math concepts in terms that parallel real world experiences to which students can relate. In this manner, math trade books provide a means by which students can understand the concepts. The result of such

knowledge should be students who are able to know how to do a mathematical operation, why to use a mathematical operation in a given set of circumstances and why it will or will not work in other circumstances.

Research for this study indicates that excellent trade books which emphasize math topics are difficult for the consumer (teacher, parent, student) to locate. Publishers have relegated some of the most interesting math trade books to the "never-never land of out of stock, out of print." This study will highlight that there is an audience for these books and that such excellent books should be available for schools, libraries and homes.

Third, this study will focus on the implementation of the NCTM Standards by volunteer teachers who have incorporated a valuable instructional resource into their regular mathematics instruction. Teachers have used trade books in the science and social studies curricula but have not incorporated this approach in math class. This study will provide some initial data for curriculum leaders and teachers to consider as they search for ways to implement the Standards and improve classroom practices.

Limitations

1. The study is limited to thirty-five elementary school teachers who deliver math instruction to children in the second, third, fourth, fifth, sixth, seventh, and eighth grade in schools located within the metropolitan area of Chicago.

2. Participants were identified for this study on the basis of their commitment to improving students' reading and math ability. They may or may not be typical of the general teacher population.

3. The majority of teachers participating in this study were self-selected volunteers and not randomly identified. Nonvolunteers who participated at the request of their principal represented 37% of the population.

4. Trade books that can be used to introduce and reinforce math concepts are not easily available to classroom teachers, parents, or students.

CHAPTER II

REVIEW OF LITERATURE

"A blessed thing happened to me as a child.
I had a teacher who read to me." Bill Martin, Jr.

Introduction

This recollection of an important childhood memory was reported by Bill Martin, Jr. in Children's Literature in the Reading Program, edited by Bernice E. Cullinan (1987). This well-known children's author reflected on his experience and encouraged teachers to read to their students. Linda Leonard Lamme in the same text states "It is amazing how many adults remember a teacher who read aloud to them in elementary school. We have forgotten the worksheets and textbooks, but we remember being read to." Reading aloud is often viewed by teachers as something added to the curriculum. Some teachers, working under the constraints of "completing the textbook" or "preparing students for the assessments" mandated by school districts and states, find little time to read to their students.

Jim Trelease (1985), in the first edition of the Read-Aloud Handbook, responds to those teachers thusly:

> "When you take time to read to your class you are not neglecting the curriculum. Reading is the curriculum. The principal ingredient of all learning and teaching is language. Not only is it the tool with which we communicate the lesson, it is also the product the student hands back to us—whether it is the language of math or science or history."

Research provides strong evidence to support reading aloud to children. Studies which look at the language ability and language development of

children indicate that when children are exposed to good literature, their language development increases. Carol Chomsky's study (1972) of the language acquisition of children aged 5 through 10 found that there was a significant relationship between reading exposure and linguistic stages. Those children who displayed linguistic competencies were those who had been exposed to a great deal of literature.

Gordon Wells (1986) in his longitudinal study of the literacy development of young children found that reading stories to children resulted in a "much richer mental model of the world and a vocabulary with which to talk about it." He concluded that "as the content of the curriculum expands beyond what can be experienced firsthand in the classroom, children who have been read to find themselves at a considerable advantage."

Children who had not previously been read to were the subjects of a study by Dorothy Cohen (1968). The children were students in ten classrooms in New York City; their teachers read aloud on a daily basis for one year. Cohen found that the children who had been read to performed significantly better on reading vocabulary and reading comprehension as compared to control groups. Cullinan, Jaggar and Strickland (1974) replicated Cohen's study with 500 black children in four New York City schools. They concluded that the use of literature expanded the language skills of those children who participated in the study.

While the studies cited tend to focus on language development and reading aloud to young children, Sutherland and Arbuthnot in the 7th edition of Children and Books argue that younger children are not the only ones to whom adults might read. They state that "older children enjoy being read to and often will read books they have heard previously." They further

contend that oral reading creates a group experience which occurs less frequently since older children are more apt to engage in silent reading activities in the classroom.

Huck, Hepler and Hickman (1987) in Children's Literature in the Elementary School (4th edition) observe that the story hour is a common practice in most primary grades, but not in the middle grades. They believe that reading aloud in the middle grades is "just as essential" as it is in the primary grades.

Mary K. Simpson (1986), a junior high language arts teacher, indicates in her article "A teacher's gift: oral reading and the reading response journal" in the Journal of Reading that she was not at all sure of the value of reading aloud to junior high students. Her goal, however, was to create a literate community. She reports that students appeared to learn from this experience and she was enthusiastic about including other books in her program.

At what point should teachers stop reading aloud to students? Judy S. Richardson and Raymond F. Morgan (1990), the authors of Reading to Learn in the Content Area, a textbook designed for use in preservice education, state in the Instructor's Manual to accompany this text that they "believe that reading to college students gives them a powerful message about the value of reading...reading aloud can stimulate interest in the content material." They go on to state that the college students in their classes look forward to the selections they choose to read in class. The authors then include a suggested reading selection to use in the college class at the start of each new chapter of the text.

This researcher has also read to the college students enrolled in her

preservice classes as well as inservice workshops with much the same results as Richardson and Morgan. If college students and teachers can benefit from classes in which they hear their instructors reading, it seems to be logical to assume that students at every level of elementary school from primary levels to the junior high level would also benefit.

Kimmel and Segel (1988) state several reasons which are applicable to teachers as well as parents for continuing to read aloud to students:

1. To stop the read-aloud sessions of the preschool years ends a rich shared experience.
2. Being read to promotes, rather than retards, children's desire to read independently.
3. Being read to fosters improvement of children's independent reading skills.
4. All through their school years, young people can enjoy listening to books that would be too difficult for them to read on their own.
5. Wonderful books that are "hard to get into" are more accessible when read aloud.
6. For the poor student whose inability to read has barred her or him from access to stimulating material in every subject, including literature, there is no substitute for reading aloud.
7. A significant number of children will always grasp material better through their ears than through their eyes.
8. Studies have shown that reading aloud to children significantly broadens their reading interests and tastes.

Reading Trade Books in Content Areas

There is no doubt that reading books during reading class enhances the language development of children and provides motivation for the child to continue reading independently. A reason exists, however, for incorporating children's trade books in other areas of the curriculum. Brozo and

Tomlinson (1986) state that using trade books in other areas of the curriculum can assist the student to obtain important background information about a topic and to recall related information. In other words, the use of the trade books "is compelling also from a schema building perspective."

Cullinan (1989) in Literature and the Child (2nd edition) advocates the use of children's trade books because "Children do read to learn in assigned textbooks, but they read to learn with enthusiasm and excitement in specialized trade books of quality." The children's trade book can more adequately present information on the topic being studied and frequently with more depth than a textbook does. Reading a trade book allows the student to become involved in creating the schema that leads to meaningful learning experiences. The excitement and enthusiasm that is generated by reading trade books extends to additional books on the topic and further knowledge.

In Developing Readers and Writers in the Content Areas, the authors Moore, Moore, Cunningham and Cunningham (1986) present two major advantages for using content area literature:

a. the books are usually better written and more interesting than most textbooks

b. the books offer greater variety than textbooks

Since students will read those books that are interesting, trade book authors must present their topics in such a way that students are encouraged to continue to read. The material must be understandable to the students because it usually is read by children and not adults. Material in trade books is better organized and the authors tend to provide many examples to illustrate the ideas.

Beverly Kobrin (1988) presents the most compelling reason for using trade books in the classroom. She suggests that adults do not make decisions based on isolated bits of information. "Yet that's what we teach them (children) when we hand them one text and one workbook for each subject. A single source of reference conditions children to assume all the 'answers' can be found in one book." Children who are taught to consult a variety of sources will become better learners and critical thinkers. When children are exposed to a number of trade books on a topic, they can verify information, consider different opinions and generally become more active learners.

Current journals in education frequently focus on the need for reform in the curriculum. In The September 1990 ASCD Curriculum Update, a summary of common themes in renewal efforts includes the softening of "rigid boundaries between the disciplines to help students understand the connections among the subjects they learn." While teachers in other subject areas may use trade books to supplement their instruction, it is quite unusual to find teachers using trade books in math class. They are more likely to depend on the mathematics textbook.

Tyson and Woodward (1989) report that textbooks structure from 75 to 90 percent of classroom instruction. They conclude that "textbooks are a pervasive feature of American classrooms."

In Everybody Counts (1989), we learn that "In no other subject do students operate so close to a single prescribed text" as they do in mathematics class. The Commission observed that textbooks dominate the mathematics curriculum and "rarely have any parallel either in the world of work or in the many disciplines that depend on mathematics as a tool."

James R. Flanders (1987) states that "to a great extent the textbook defines the content of the mathematics that is taught in U. S. schools." His research shows that there is very little new material introduced in math textbooks currently in use. He found instead that there is an abundance of review material and the same content being taught in the same way.

Usiskin (1987) states that "Today's mathematics textbooks contain very little reading. Students are forced to learn through the explanations of others, which goes against a primary purpose of schooling, namely to teach students to learn independently." He suggests that changes in mathematics textbooks are necessary if students are to read and learn mathematics independently.

In the preliminary research conducted by this examiner and reported in Chapter 1, it was noted that mathematics textbooks often provide limited explanations of mathematical concepts. Words found in math textbooks most often are used to provide directions for completing drill and practice activities or they are used to present word problems to solve.

Mathematics Research

Since 1969 The National Assessment of Educational Progress (NAEP) has provided information about the performance of students in the United States in the areas of reading, writing, mathematics, science, social studies, and other disciplines. Assessments in the area of mathematics were conducted in 1973, 1978, 1982, and 1988. The results of the assessment in 1988 reveal that "many students appear to be learning mathematical skills at a rote manipulation level without understanding the concepts related to the computation." (Kouba, et. al. 1988)

The Mathematics Report Card: Are We Measuring Up? (1988) reports trends and patterns of math achievement for those students tested at the ages of 9, 13, and 17. Two major trends identified were:

1. There was significant improvement in average proficiency since 1978; black and Hispanic students made appreciable gains, as did students living in the Southeast.

2. While average performance has improved since 1978, the gains have been confined to lower-order skills.

Other findings with important implications for mathematics instruction include the following:

> "Students who enjoy mathematics and perceive its relevance to everyday life tend to have higher proficiency scores than students with more negative perspectives. At the same time, students' enjoyment of and confidence in mathematics appear to wane as they progress through their schooling. Most perceive that the subject is composed mainly of rule memorization, and expect to have little use for mathematical skills in their future work lives."
>
> "Mathematics instruction in 1986, as in previous years, continues to be dominated by teacher explanations, chalkboard presentations, and reliance on textbooks and workbooks. More innovative forms of instruction ... remain disappointingly rare." (Mathematics Report Card)

Willoughby (1990) states, however, that "the teaching of mathematics today is probably not much worse, and not much better, than it has been at any time in the past 50 years." He argues that reform in the teaching of mathematics must take place because the world and the society we live in are changing. The mathematics instruction that was necessary for survival in the past no longer serves the child who will live with the technology of the 21st century. "Simple symbol manipulation can be done effectively by machines, but higher-order thinking skills and the ability to communicate intelligently about mathematical situations are still uniquely human skills."

Mathematics as Communication

The ability to communicate is as important in mathematics as it is in other areas of the curriculum. Willoughby states "The fact that the mathematician knows an answer is of absolutely no interest unless the mathematician can communicate the answer to someone who will use it." For too long the communication that took place in mathematics class consisted of a teacher lecture/demonstration of algorithms, assignment of practice activities, and student response in the form of one word answers which the teacher deemed correct or incorrect. Campbell and Fey (1988) state that such practices "must be replaced by a more active interaction between teachers and students."

A more active interaction simply means that students will no longer passively receive instruction; they will be involved in their learning. Students will be using "manipulatives, discussing the results of their investigations, and writing the results of their experiences." (Dossey, 1989) Discussing and writing the results implies the use of language to aid understanding. "Part of learning mathematics is learning to speak like a mathematician." (Pimm, 1987). Students who are able to use the language to tell their teacher and classmates about their mathematical interests, discoveries, and ideas will be prepared to use mathematics in their everyday lives and in their future careers.

In Standard 2: Mathematics as Communication, the NCTM has challenged teachers to provide "opportunities for communication so that students can realize that representing, discussing, reading, writing, and listening to mathematics are a vital part of learning and using mathematics." Suggestions are made for using listening, reading, and writing activities

during math class and for incorporating small group discussion to help children articulate their thoughts and improve their understanding of mathematics. One suggestion that deserves attention is reading children's literature about mathematics. Using children's trade books to develop mathematical concepts is not an entirely new idea. While this is not an area where there is a great deal of research, a search of the literature reveals that several authors have provided suggestions to classroom teachers for incorporating children's trade books in mathematics class.

Children's Literature in Mathematics Class

In the October, 1969 issue of The Arithmetic Teacher, Strain tells mathematics teachers that children's literature can be used to develop and sustain interest in mathematics topics and provide meaningful experiences during mathematics class. The rationale she presents for using trade books in math class is powerful: "The content of many literary selections, whether obviously or subtly mathematical in nature,..., offers advantages for clarifying, strengthening, and extending children's concepts in mathematics." (Strain, 1969)

She discusses the importance of presenting mathematical ideas simply with terminology that is appropriate to current math instruction. Choices of literature should be influenced by the ability levels of the students as well as specific needs identified in the mathematics class.

Strain stresses that careful planning is necessary to provide the optimum result. The article concludes with a brief bibliography of the books available in 1969.

In an article in the November, 1970 issue of the Instructor, Phillips encourages teachers to use children's trade books in math class as a

supplement to enrich the students' experiences about mathematical topics and as an impetus for developing the students' creativity within the area of mathematics. The author states that using such materials should not be confined to bright children who do well in mathematics; low achieving students can be creative when they are not bound by the "standard school curriculum."

Phillips also suggests that the trade books need not be limited to those that are specifically written to reinforce math topics. Using The 500 Hats of Bartholomew Cubbins, the author presents model math activities. Other suggestions focused on encouraging children to use the trade books to complete a special math project of their choice. Phillips reported that the students presented a variety of activities, including probability experiments, a student-made computer, and many interesting written stories, poems, and essays.

In the October 1980 Ohio Reading Teacher, Swinger reviews seven children's books and provides a number of suggestions for creating math learning stations at which the books could be used to involve students in meaningful activities. Swinger's suggestions encourage students to work and talk together to clarify concepts and to improve ability to discuss ideas and draw conclusions.

In the May 1981 Reading Teacher, Radebaugh listed specific books that would be useful for developing number concepts, geometric shapes, comparison, ordinal numbers, counting, and number operations. The books supplement concrete math experiences and reinforce math concepts.

Smith and Wendelin (1981) present their ideas for using books to teach mathematical concepts in the primary grades. They tell teachers that "books can serve as a supplement to the traditional mathematics materials

and are useful with individuals and with groups." Forty-one books are cited and suggestions are presented for possible activities with some of the books.

More recently, the Mathematics Education Trust published Beyond Numbers: The Mathematics Literature Connection (1987) in which Madison and Seldenstein present activities for seventeen books which introduce, reinforce or broaden mathematics skills. The authors encourage teachers to integrate literature and mathematics, creating interesting opportunities for children to learn math. The activities for each book include questions to elicit mathematical thinking as well as hands-on activities which evolve from the situations developed in the story.

Other educators have provided suggestions for classroom teachers to incorporate children's literature in mathematics at the preschool level (Harsh, 1987 and Tischler, 1988) and the primary grade level (Browning, 1989 and Bohning and Redencich, 1989). Flexer and Topping (1988) offer suggestions to parents to include interesting trade books on math topics in the activities they use at home with their children.

With the current emphasis on using thematic based units throughout the curriculum, Hewitt and Roos (1990) present activities that can be integrated with the subject matter areas of math, science, social studies, language arts, and art. Teachers are encouraged to use the model to create their own activities with other children's books.

Publishers also encourage teachers to make use of children's literature in their periodic teacher bulletins (Mathematical Viewpoint published by Macmillan/McGraw Hill; Making the Case for Math published by D. C. Heath Company).

Borasi, Sheedy, and Siegel (1990) present some excellent arguments

for the use of mathematical stories because stories provide some interesting features which mathematics textbooks do not. In this context, the mathematical stories are ones which were written by students in class, however, the features are appropriate for discussion about children's trade books. The authors cite the genuineness of stories, i.e., they present real problems with no prescribed solution so that readers must reflect and invent some solution to the problem. Second, students have a real reason for solving the problem and since they may define the problem differently, there are alternative solutions to the problem. The authors also feel that students are more involved in directing their own learning when they are free to examine a character's problem from a variety of viewpoints. Using mathematical stories implies that the teacher provides a learning context in which the thinking process is valued over the attainment of the right answer.

Why use mathematical stories at all? Borasi, Sheedy, and Siegel believe that mathematical stories would create mathematics classrooms quite different from current ones. In their view, stories would not be enrichment activities, but an integral part of the teaching and learning of mathematics. They argue, "If mathematical stories are to take their place in the classroom, the notion that mathematics is cold-blooded and stories are warm-blooded must be rethought."

This is a direct challenge to the arguments presented by Jerome Bruner (1986) who states that there are two modes of thought: (1) the logico-scientific, which "attempts to fulfill the idea of a formal, mathematical system of description and explanation"; and (2) the narrative mode, which deals with the human actions and intentions and "leads to good stories, gripping drama, believable (though not necessarily 'true') historical ac-

counts." Borasi, Sheedy and Siegel believe that such distinctions are artificial and that good stories that involve mathematics concepts can include values and emotions and appeal to human beings.

Research on Children's Literature in Mathematics Class

While the articles listed above represent some attempt on the part of educators to encourage teachers to use children's trade books in mathematics class, the only research on this topic appears to be the doctoral dissertation of Diane Thiessen (1978). The purpose of her study was to determine how reading children's trade books in mathematics affected student attitude toward mathematics, problem-solving skills, and attitude toward children's books and book selection. Thiessen administered pretests on attitudes, problem-solving and book selection to experimental and control groups. She then administered a treatment in which she presented four lessons from selected children's mathematics trade books. Trade books remained in the classrooms and children were encouraged to read them in their free time. Following treatment, posttests were administered on attitudes, problem-solving and book selection.

The major findings of this study were:

1. Differences on the posttest scores on attitude, problem solving and book selection of the third graders in this study reflected a change in favor of the control group.

2. There were no differences observed in the posttest scores on attitude, problem-solving and book selection at the fifth grade and seventh grade level.

3. The correlations between the number of books read and the change in pretest and posttest scores on the attitude, problem solving and book selection scores were zero at all three levels.

Thiessen concluded that "this study did not find any significant

positive changes that were attributed to reading children's books during elementary students' free time." A number of factors may have contributed to the results and conclusions drawn by Thiessen. First, this study examined children's attitudes as a consequence of their reading the math-related books during their free reading time. A frequent complaint of the children and teachers was that they often did not have free reading time and most children read less than two books in this study. Thiessen acknowledges that "little change can be expected or measured" when so few books were read.

Second, Thiessen (the researcher) presented the lessons which amounted to a one-shot presentation for each book over a period of four weeks. Perhaps the effect would have been greater had the regular classroom teacher used the material within the regular classroom structure.

Third, students were not allowed to take the books home. Since they were limited in the amount of time they could use the books, students did not develop any strong interest in the books and it was not possible to measure any changes in their attitudes, problem-solving ability, or book selection attitudes.

Thiessen's study reported that the students who read three or more books enjoyed the lessons and would have read more books if they had had more free time to do so. Students who read two or less books appeared to be less enthusiastic about the lessons (one-fourth indicated they didn't like the lessons). One-third of the seventh graders and one-fourth of the third graders reported they were not interested in the books. The students who read fewer books cited the lack of free reading time as the reason why they read less.

Clearly, there is a need for more research in this area. If children's trade books can provide the means to clarify, strengthen, and extend children's concepts in math as Strain suggested in the early 1970s, it would appear that research should provide some additional data to support this intuitive notion.

Change in the Classroom

In the 1990 Yearbook of the National Council of Teachers of Mathematics, Driscoll and Lord (1990) state that mathematics teachers in the 1990s will have the option of assuming roles and responsibilities that are more varied, more challenging, and potentially more satisfying than those defining the profession today. Obviously, it will be necessary for teachers of mathematics to change the way they perceive the field of mathematics and the processes of teaching and learning mathematics. A brief review of the highlights of the professional literature on educational change can assist in understanding how change occurs.

> "Change is neither a geyser bursting from subterranean depths, nor a wandering ooze that becomes a formidable pool." (Simpson, Educational Leadership, May, 1990)

Most educators would agree that change is a process. There are three phases to the process. Phase one, the initiation or adoption phase, includes the processes that result in a decision to adopt or proceed with a change. Phase two, the implementation or initial use stage, includes the initial attempt to put an idea into practice. Phase three, the continuation or institutionalization phase, includes the processes that are used to decide whether a change will be a continuing part of the educational program or whether it will be abandoned or simply left to attrition.

When all is said and done, change must be implemented by the classroom teacher. Fullan (1991) observes that "educational change depends on what teachers do and think—it's as simple and as complex as that." It seems quite logical for those who wish to initiate an educational change to do so by working with teachers to affect what they do and what they think.

Lortie's (1975) study in which he reported what teachers do and think has provided the educational community with an overall view of the teaching profession. His findings include:

1. Teacher training does not equip teachers for the realities of the classroom.

2. Due to the cellular organization of schools, teachers struggle with their problems and anxieties privately, spending time physically apart from colleagues.

3. Teachers do not develop a common technical culture. This is due in part to the physical isolation, and the lack of sharing, observing and discussing each other's work.

4. When teachers do get help, the most effective source tends to be fellow teachers, and secondly administrators and specialists.

5. Teachers use informal, general observations of their students to judge the effectiveness of their teaching.

6. The greatest rewards in teaching were "psychic rewards", i.e., reaching a group of students who have learned.

7. Success stories were a source of pride for teachers but they tended to focus on the occasional student or class.

8. Teachers are not sure whether they have made any difference at all in the learning of their students.

9. Teachers indicated they would choose to spend additional work time in classroom-related activities. Individualistic activities, normally performed alone, were mentioned most frequently by the teachers. Most teachers complained about the lack of time to do all that they wished to do in the classroom.

Into this world of teaching with its uncertainties and relatively few rewards step those who wish to initiate educational change. How do teachers react? Fullan states that "change is a highly personal experience—each and every one of the teachers who will be affected by change must have the opportunity to work through this experience in a way in which the rewards at least equal the cost." As teachers weigh the rewards and the costs and decide to implement an educational change, they may use the following criteria reported by Fullan:

1. Does the change potentially address a need? Will students be interested? Will they learn? Is there evidence that the change works, i.e., that it produces claimed results?
2. How clear is the change in terms of what the teacher will have to do?
3. How will it affect the teacher personally in terms of time, energy, new skill, sense of excitement and competence, and interference with existing priorities?
4. How rewarding will the experience be in terms of interaction with peers or others?

Doyle and Ponder (1977) suggest that teachers employ the "practicality ethic" when considering a change. This simply means that teachers will incorporate into their classroom procedures those new ideas or strategies that they perceive as practical. There are three criteria that teachers apply to determine practicality. They are:

1. Instrumentality. The proposed change must be perceived as something which can be used in the real world of the classroom.

2. Congruence. The proposed change must be congruent with the teachers' perceptions of their own situations. There are three aspects of congruence. First, the teacher must determine whether the change fits into the way the teacher normally conducts class. Second, the teacher considers

the spokesman for the change and the conditions under which the change may have been developed. For example, an inner city school teacher may not consider it practical to implement a change that was successful in a suburban, middle-class school. Third, the teacher will judge the change in terms of how compatible the change is with the teacher's self-image and teaching style and the way the teacher relates to the students.

3. Cost. Cost is defined at the "ratio between amount of return and amount of investment" (Doyle and Ponder, 1977). Monetary matters are but one consideration with regard to cost. Teachers can also be influenced by social factors which might include recognition and student enthusiasm.

Huberman and Miles (1984) examined teachers' motives for adopting an educational innovation and found that teachers offered the following reasons:

A. Administrative pressure, constraints
B. Improves classroom practice
C. Novelty value, challenge
D. Social (usually peer pressure)
E. Opportunity to shape projects
F. Professional growth
G. Gives better working conditions
H. Solves problems
I. Provides extra money

Almost two-thirds of the teachers cited administrative pressure which could be described as "strong encouragement to raw power" as the primary motive for adopting an innovation. The second most frequent response was the teachers' determination that the innovation would somehow improve classroom practice.

Fullan suggests that educational change involves "change in practice." He delineates three components that must be addressed in imple-

menting a new program or policy. They are: (1) the possible use of new or revised materials, (2) the possible use of new teaching approaches, and (3) the possible alteration of beliefs. Fullan believes that all three components are necessary and that these must occur in practice if a change is to have any effect on the outcomes of instruction.

Tyler (1987) states that if a school is to institute any significant change, it is necessary to change teachers' attitudes and practices. "Teachers teach what they understand, what they believe is important, and what they believe they can convey successfully."

If change is to occur, Sarason (1971) observes that teachers must unlearn old ways of thinking and doing and learn new procedures. Learning something new requires both time and effort. It also involves risk-taking and can bring a certain amount of anxiety; change can be very threatening. (Guskey, 1986) Bolster's (1983) research found that even when teachers were presented with evidence of the value of an innovation, they did not easily alter or discard the practices they had developed and refined in the demanding environment of their own classroom.

Time and experimentation are also necessary for teachers to fit new strategies into their classroom practices. Tyler (1987) found that it took six or seven years to get a reform working as intended.

Fullan (1985) summarizes change at the individual level as a process whereby individuals alter their ways of thinking and doing, develop new skills, and find meaning and satisfaction in new ways of doing things.

Some researchers have suggested that teachers will employ a new strategy in the belief that the "extra work and other personal costs of attempting change will result in improved teaching and that as a result their students will benefit" (McLaughlin and Marsh, 1978). Those who view

improved student outcomes as the factor that will influence teachers to change would probably be interested in the model of change developed by Thomas Guskey.

Guskey (1986) proposes a model of the process of teacher change that suggests that "significant change in teachers' beliefs and practices is likely to take place only after changes in student learning outcomes are evidenced." In this model, Guskey suggests the following sequence:

(1) Teachers learn of a new strategy or practice at a staff development session or a professional meeting.

(2) Teachers try the strategy in their classroom practice.

(3) There is evidence of some change or improvement in their students' learning outcomes. This might be evidenced by improved test scores, but may also be observed by increased student attendance, more student involvement in class discussions, greater motivation to learn, or improved student attitudes toward school, or the class. Teachers will judge the effectiveness of the new strategy or practice using whatever means they usually use to evaluate their teaching.

(4) A change in teacher's beliefs and attitudes will result.

Guskey states:

> This model implies that change in teachers' beliefs and attitudes is primarily a result, rather than a cause, of change in the learning outcomes of students. In the absence of evidence of positive change in students' learning, the model suggests that significant change in the beliefs and attitudes of teachers is very unlikely.

Crandall (1983) also observed that teachers are more likely to make a commitment to a new strategy after they have tried the strategy in their classrooms, mastered it, and observed its results with their students. He states that the innovation must be one that really works in the classroom; otherwise, teachers will not see the results and they will not make it a part of their classroom practice. Teachers are more likely to implement the practices of colleagues that they observe as successful and effective.

CHAPTER III

METHODOLOGY

The purpose of this study was to determine whether children's trade books can be incorporated into the mathematics curriculum at the second, third, fourth, fifth, sixth, seventh, and eighth grade level. This chapter describes the sample population, the treatment which occurred in the form of inservice meetings, the questionnaire used to identify the current teaching practices of the participants and the data analysis procedures to be used observing the participants' responses.

Population Sample

Forty-two teachers who teach at the second, third, fourth, fifth, sixth, seventh, and eighth grade level in selected elementary schools in the Chicago area composed the sample population for this study. Teachers are categorized either as a result of their teaching location or interest in this study. Participating in this study were:

A. Fifteen teachers from the faculty of a Chicago public school which was identified as a school which would emphasize the importance of reading throughout the 1990-91 school year. This school received funding for the school-wide reading emphasis from The Rochelle Lee Fund to Make Reading a Part of Children's Lives.

B. Three teachers from a Chicago public school which had not adopted a school-wide reading emphasis for the 1990-91 school year, but the individual teachers had expressed an interest in using trade books with their bilingual students.

C. Nine teachers who participated in the Loyola University Mathematics Curriculum Improvement Project which provided inservice workshops on topics related to the teaching of mathematics and the use of library materials to support the teaching of mathematics.

D. Fifteen teachers from the Archdiocese of Chicago parochial school system who indicated a general interest in improving the reading and mathematics curriculum in their schools. Principals in these schools strongly encouraged the faculty members to participate in this research.

Included in the sample population are the students of the teachers who participated in this study. Students were chosen randomly from each teacher's class list and interviewed to determine their ability to recall the books as well as the mathematical concepts reinforced in the books.

Table 6 presents a breakdown of the teachers by the location of the school in which they teach and Table 7 identifies the teachers by the grade level they teach.

Table 6
Teacher Participants
As Evidenced by Initial and Final Survey Completion

	Initial Survey	Final Survey
Public School Teachers	20	15
Private School Teachers	22	20

Forty-two teachers completed the initial survey. Thirty-five completed the final survey. There were a number of reasons why some teachers did not participate in the final survey, including two who took maternity leave after they had initially expressed an interest in the project. One teacher, who was an MCIP participant, found it difficult to read the books

to her students because she did not feel she had the support of her principal to proceed with the project. The remaining four teachers did not offer any explanations for their nonparticipation.

Table 7 reports the teacher participants who completed both the initial and final surveys and the grade levels at which they teach.

Table 7
Teacher Participants
Grade Level Taught

Grade Level	No. of Teachers
Primary	11
Intermediate	17
Junior High	7

Materials

While the researcher was able to identify some excellent children's trade books that might have been used for this project, several of these books were either out of stock or out of print. Books for this study were chosen using the following criteria:

1. The books presented mathematical concepts in an easy-to-understand format.

2. The books were written for children and presented illustrations of concepts that were within a child's experience.

3. The books were available from the publishers so that copies could be distributed to each teacher who participated in the study.

Children's Mathematics Trade Books

Three books which met the above criteria and which were chosen for this study were:

Birch, David. The King's Chessboard. New York: Dial Books for Young Readers, 1988.

Schwartz, David M. How Much Is a Million? New York: Lothrop, Lee and Shepard, 1985.

Sitomer, M. and Sitomer, H. How Did Numbers Begin? New York: Thomas Y. Crowell Company, 1976.

The King's Chessboard

Each of the books was chosen because it presents a math topic in a manner which can instruct and inform and assist children to understand the math topic. In The King's Chessboard, powers of two are explained through the story of a king who is too proud to admit that he does not know how much rice he would have to give as a reward if he gave one grain for the first square on the chessboard, two for the second square, four for the third square and so on, the grains of rice continuing to double for every square on the chessboard. The reader learns that the King would have to give 549,755,830,887 tons of rice to his subject if he were to keep his promise.

How Much Is a Million?

In How Much Is a Million? students learn to conceptualize large numbers when they are related to simple activities, such as counting to a million (it would take 23 days!), or standing on one another's shoulders (the column of children would extend farther than airplanes could fly!). The book also includes the concepts of billion and trillion. The illustrations in this book assist the reader to visualize large numbers. In an appendix to the book, the author provides the mathematical operations performed in order to present the reader with an illustration which is understandable.

How Did Numbers Begin?

In How Did Numbers Begin? students learn how our number system probably came into existence. Basic concepts, such as matching, naming, ordering and counting, are explained in easily understood terms which provide a foundation for the study of important math concepts. The authors' use of common experiences help the reader to realize the rationale for the number system.

Averages

One additional book was chosen for this study, and the researcher obtained permission from the publisher to photocopy it for this study because it is currently out of print. (See Appendix B.) The book was included in this study because it presents the topic of averages (mean, median, mode) in a manner that is easily understood by children with examples that are relevant to the lives of children. The book is:

Srivastava, Jane Jonas. Averages. New York: Thomas Y. Crowell Company, 1975.

Teachers were given a photocopy of the pages in this book. The copy included an orange paper cover to more closely simulate the actual book cover. It was bound with a spiral binding.

Procedures

Teachers were invited to participate in this study; see Appendix A for the letter of invitation. The researcher conducted information and follow-up sessions in four of the schools where teachers had been identified for this study. The MCIP teachers attended sessions on the Loyola University Lake Shore campus. During the first session, teachers were given information on

the benefits of reading aloud to their students in all curricular areas with a special emphasis on the rationale for reading aloud in mathematics class. Since The Curriculum and Evaluation Standards for School Mathematics encourages teachers to include activities to enhance mathematics as communication, the inservice session provided a means by which teachers could begin to implement the Standards.

The four books chosen for this study were introduced and teachers were encouraged to read them aloud to the students in their mathematics class. Since merely reading aloud to the students would not have been sufficient to help students understand the concepts, the teachers were encouraged to develop some after-reading activities. The researcher requested that the teachers return with at least one lesson plan in which they planned some follow-up activity.

During the first session, teachers completed an initial survey instrument (see Appendix C) developed by the researcher in which they were asked to (1) report their classroom read aloud practices in reading class and in math class; (2) identify sources from which they learned about the books they read in class; (3) rate the teacher's manual which accompanies the mathematics text; (4) indicate their perception of the importance of teaching averages, exponents, numbers greater than a million and numeration systems; (5) indicate their perception of how difficult it is to teach averages, exponents, numbers greater than a million and numeration systems; (6) indicate their personal preference in teaching averages, exponents, numbers greater than a million and numeration systems; and (7) indicate their perception of the importance of following the order of the mathematics book in planning and teaching mathematics.

The second session was held approximately one month later. During this session teachers were invited to share their experiences with the books, their students' reactions to the books, and the follow-up activities they used to reinforce the mathematical concepts. At this time teachers were given a fifth book, Anno's Mysterious Multiplying Jar, in appreciation for their participation in the study.

Teachers also completed a follow-up survey instrument which determined (1) if the teachers personally read the books; (2) if they read the books to their class; (3) if they did any preparation activity before reading the books; (4) if they prepared any follow-up activities; (5) if they read any additional books in math class; and (6) if so, which books were read and (7) how did teachers locate the additional books.

In order to determine if teacher attitudes and practices changed in any way as a result of their experiences with the books in this study, questions from the initial survey instrument were also included in the post-intervention instrument.

Lesson plans submitted by those teachers who were willing to share a lesson plan were examined by the researcher in order to determine how the selected books were actually incorporated into the math curriculum.

Randomly selected students in the math classes of the teachers participating in this study were interviewed to determine if this read-aloud procedure had an impact on their reading interests or their study of math. Students were randomly selected from the class lists of the participating teachers. Questions asked in the interview include:

1. Does your teacher read to your class?
2. Does your teacher read to your class during math?
3. Can you remember the titles of any of the books your teacher read during math class?

4. Did you like the books? What was your favorite part?
5. Have you tried to read any of the books in your free time?
6. How do you think those books can help you with the study of math?

In the spirit of exploratory research, the principal investigator of the Mathematics Curriculum Improvement Project conducted some of the interviews with the children. The enthusiasm of their responses caused her to suggest that the researcher of this study should also conduct some of the interviews. While it may be true that any competent interviewer could report the children's responses, it was thought that it would be difficult to capture the essence of their involvement with the books and mathematical concepts the books reinforce and that it would be important for the researcher to experience first hand the impact the books had made on the children.

Data Analysis

Both subjective and objective data have been gathered in this study and an exploratory/descriptive case study approach was employed. The emphasis in this study was on description and explanation of the behavior of teachers and students as they participated in this strategy. In some ways, this study resembles a "photograph" that reflects how teachers and students react to a change in mathematics instruction. It is a preliminary and somewhat speculative account designed to provide some basic groundwork into an area which is new and different. Perhaps it will lead to further research on the use of non-textbook materials in mathematics class.

Descriptive data was gathered from the teacher survey instruments, the student interviews, as well as the teachers' lesson plans and reports of their classroom interactions.

Chapter IV

ANALYSIS OF DATA

The purpose of this study was to determine whether classroom teachers are aware of the children's trade books that are available to reinforce mathematics concepts. An additional purpose was to observe whether teachers would incorporate identified math-related trade books in their classroom curriculum and what impact the trade books would have on the teachers and their students.

The teachers in this study were categorized by the location of the school in which they taught as well as their interest in this study. Twenty teachers from Chicago public schools and twenty-two teachers from Archdiocese of Chicago parochial schools completed the initial survey instrument. Seven teachers did not complete the post survey. This resulted in a sample population of 35 teachers or 83% of the original population.

Survey Results: Teaching Practices

A profile of this sample population can be determined by examining some of their teaching practices. Table 8 reports on the teachers' commitment to reading aloud to their students:

Table 8
Teacher Practice: Reading Aloud To Students

	During Reading Class	During Math Class
Yes	27 (77.2%)	3 (8.6%)
No	4 (11.4%)	31 (88.6%)
No response	4 (11.4%)	1 (2.8%)

The responses of the sample population indicate that 77.2% of the teachers read aloud to the students in their reading classes, but only 8.6% reported reading aloud during math class. When teachers were asked to identify books they had read in reading class, 54% of the teachers listed two or more books they had read to students and 69% could identify one or more books read to the students. Thirty-one percent of the teachers did not list any titles.

When teachers were asked to identify books they had read in math class, only five teachers (14%) mentioned specific books; some of the teachers listed more than one title. Three teachers mentioned How Much Is a Million? one teacher reported reading puzzle books and logic books to her class, one read magazines and current math articles and one read books chosen by the students. The teachers who did not list any book titles they had read in math class represent 86% of the sample population.

Teachers were also asked to report on the frequency with which they read to their students in both reading class and math class. Table 9 lists the teachers' responses:

Table 9
Frequency of Read-Aloud Sessions

	During Reading Class	During Math Class
Daily	14 (40.0%)	0 (0.0%)
Weekly	6 (17.1%)	0 (0.0%)
Monthly	3 (8.6%)	1 (2.9%)
Occasionally	5 (14.3%)	5 (14.3%)
Never	1 (2.9%)	17 (48.6%)
No response	6 (17.1%)	12 (34.3%)

The responses indicate that 40% of the teachers read aloud daily in reading class and that 65.7% of the teachers read aloud at least once each month in

reading class. The read-aloud practices in math class are a significant contrast; none of the teachers reported a daily read-aloud practice and only 2.9% read aloud at least once a month in math class.

Are teachers aware of the books that can be read in math class? If the self-report regarding read-aloud practices of this sample population are considered, 86% of the teachers did not mention one book title they had read in math class; this is an obvious indication that these teachers are not aware of the books available for use in math class.

Further evidence of teachers' lack of knowledge about appropriate math-related trade books was gathered when in identifying the books to be used for this study, the researcher compiled a bibliography of 65 math-related trade books which were currently listed in the 1991 edition of Books in Print and available from publishers. (See Appendix D.) This bibliographic list included counting books, books on number operations, geometry books, and other math-related topics. The teachers who participated in this study requested and received a copy of this bibliography. While presenting some information about math-related trade books to a group of Rochelle Lee awardees at a content area reading workshop on February 13, 1991, the researcher mentioned the bibliography. Twenty-five teachers in attendance at that workshop requested the bibliography. Mrs. Rochelle Lee reported that there were many additional requests from teachers who had heard about the bibliography from their colleagues and the Rochelle Lee Fund now distributes copies of this bibliography to interested teachers in District Two of the Chicago Public Schools.

On March 15, 1991, the researcher presented the topic of trade books in math class at the Illinois Reading Conference in Springfield, Illinois. To

determine teacher interest in the bibliography, teachers were asked to provide their name and address and a bibliography would be sent to them. Thirty-three teachers from various locations throughout the state of Illinois requested and received a copy of the bibliography.

This lack of awareness of the math-related trade books is not limited to classroom teachers. When this researcher met with a group of Chicago area librarians to discuss content-area library holdings, the librarians also expressed an interest in the bibliography. After receiving a copy of the bibliography, they indicated an interest in ordering books that were not in their branch collections.

How do the teachers in this study find the books they use for read-aloud sessions? Teachers' responses varied and they were encouraged to indicate, where it was appropriate, more than one source for the books they used. The most frequent response given by the teachers in this study (63%) was that they were motivated by other teachers' suggestions. The public library collection and staff were mentioned in 51% of the responses. Reviews in professional journals were mentioned by 40% of the teachers and 37% mentioned school library collections and staff as a source for read-aloud choices. Other sources mentioned include professional workshops, the teacher's private collection and personal experiences with children's books, as well as the children's literature courses taken while they were students. Five teachers (14%) did not respond to this question. The above responses are presented in Table 10 below:

Table 10

Sources Teachers Use to Locate Books for Read-Aloud to Children

	Teacher Responses
Public library collections and staff	18 (51%)
School library collections and staff	13 (37%)
Review in professional journals	14 (40%)
Other teachers' suggestions	22 (63%)
Other	15 (43%)
No response	5 (14%)

Another frequent source of suggestions for teachers to use in mathematics class can be the teacher's manual which accompanies the mathematics textbook. Do the teachers in this study use the teacher's manual? Table 11 reports the responses:

Table 11
Teachers' Use of Manual Accompanying Math Text

	Yes	No
Teacher responses	34 (97.1%)	1 (2.9%)

The teachers' self-report on this question indicates that they are very likely to use the teacher's manual as they teach in math class. The teachers were also given the opportunity to rate their teacher's manuals on the effectiveness of selected features. The teachers' responses are reported in Table 12:

Table 12
Teachers' Ratings of Manual Features

Presentation of Math Concepts			
Effective	Not effective	No opinion	No response
31 (88%)	2 (6%)	0 (0%)	2 (6%)
Teaching Suggestions**			
Effective	Not effective	No opinion	No response
28 (80%)	3 (9%)	1 (3%)	2 (6%)
Supplementary Practice Exercises**			
Effective	Not effective	No opinion	No response
23 (66%	5 (14%)	3 (9%)	3 (9%)

**One teacher indicated that it is her/his opinion that more is needed in the areas of teaching suggestions and supplementary practice exercises.

It appears that the teachers in this study rely on the teacher's manual when they teach mathematics. They rate the presentation of math concepts and teaching suggestions to be effective. Sixty-six percent perceive the supplementary practice exercises to be effective. It seems logical to assume that these teachers use the manual in preparing and delivering mathematics instruction. Since the research in Chapter I indicated that the majority of teacher's manuals present either out of date or no bibliographic information about trade books, it appears that these teachers would have very limited knowledge about this teaching strategy.

The participants were also asked to indicate whether they considered the order of presentation of the mathematics topics in their textbooks as important when making decisions regarding the planning and teaching of mathematics. Table 13 reports the participants' responses:

Table 13
Teachers' Responses
Importance of Mathematics Textbook Order in Teaching Math

Initial Survey			
	Important	Undecided	Not Important
	9 (25.7%)	5 (14.3%)	21 (60.0%)
Post Survey			
	Important	Undecided	Not Important
	9 (25.7%)	5 (14.3%)	21 (60.0%)

There was no change in the responses of the participants in their perception of the importance of the textbook order in planning and implementing mathematics instruction. Sixty percent of the teachers tended to view the textbook order of presentation as not important in teaching mathematics.

The teacher participants all reported that they had personally read the books identified for this study before they read them to their students. All of the teachers reported reading at least one of the four books to their students and the majority of the teachers read all four books.

The teachers were asked to rate the books used in this study using the following key: (1) most interesting, most effective to (4) least interesting, least effective. The participants were told that they might rate all of the books as a (1) if they thought that the books were most interesting or most effective in dealing with the topic the books presented. Teachers interpreted this question in different ways. Twenty-three teachers rated the books using the directions stated above. Table 14 reports the teachers' ratings:

Table 14
Teachers' Ratings of Selected Trade Books

	Rating
How Much Is A Million?	1.32
The King's Chessboard	1.59
Averages	1.79
How Did Numbers Begin?	1.91

It appears that the teachers who rated the books chosen for this study tended to view the books as interesting and effective in presenting the mathematics topics.

Twelve teachers interpreted this question to mean that they were to rank the four books, using a 1, 2, 3, and 4. The researcher assumes that a rank of (1) meant that the book was the most interesting, most effective one of the four used in this study. Likewise, a rank of (4) indicated that a book was judged to be the least interesting, least effective of the four books the teachers were given for this study. Table 15 reports the results of the teachers' rankings of the identified books:

Table 15
Teachers' Rankings of Selected Trade Books

	Ranking
How Much Is a Million?	1.75
The King's Chessboard	2.42
How Did Numbers Begin?	2.66
Averages	3.17

When teachers ranked the four books in the order of most interesting, most effective (1) to least interesting, least effective (4), How Much is a Million? received the highest rank, followed by The King's Chessboard, How Did Numbers Begin? and Averages.

Teachers' Perceptions: Identified Math Topics

For purposes of this study, four mathematical topics were identified and the teacher participants were asked to indicate their perceptions of the importance of the topic and ease in teaching the topic, as well as their personal observation with regard to enjoyment when teaching the topic. Participants responded to these questions on the initial survey and post survey.

Averages

The participants' responses to the topic of averages are reported below:

Table 16
Teachers' Responses
Importance of Teaching Averages

Initial Survey	Important	Undecided	Not Important
	31 (88.6%)	2 (5.7%)	2 (5.7%)
Post Survey	Important	Undecided	Not Important
	33 (94.3%)	1 (2.9%)	1 (2.9%)

More than 88% of the participants in this survey were initially convinced of the importance of teaching the topic of averages in their math classes. Following their exposure to a trade book on the topic of averages, 94.3% viewed the topic of averages as important.

Participants were also asked to report on their perceptions of the ease in teaching the topic of averages. The responses are reported in Table 17:

Table 17
Teachers' Responses
Ease of Teaching Averages

Initial Survey			
Easy	Undecided	Hard	N.R.
17 (48.6%)	8 (22.6%)	9 (25.7%)	1 (2.9%)
Post Survey			
Easy	Undecided	Hard	N.R.
12 (34.3%)	13 (37.1%)	9 (25.7%)	1 (2.9%)

The responses to this question indicate that 48.6% of the teachers initially perceived the teaching of averages to be an easy task. Following the introduction of a trade book about averages, only 34.3% of the teachers perceived the teaching of averages as easy, and 37.1% were undecided. A similar trend was noted in Zito's (1990) study in which she surveyed 47 participants in the MCIP project to determine their ratings on the ease of teaching thirteen math topics: algebra, integers, probability, statistics, coordinate geometry, data collection, whole numbers, ratios/percents, fractions, graphing, math games, computer software, and learning centers. In Zito's (1990) study, participants rated the math topics at the beginning of the MCIP training and one year following the training. The participants included two groups: (1) teachers who had had no previous involvement with MCIP and (2) teachers who had some involvement with MCIP through an inservice workshop. Zito reported that after one year of training in the specialized MCIP program, both first-time MCIP teachers' ratings and veteran MCIP teachers' ratings increased in the undecided and hard or very hard "ease of teaching" categories. (Comparison of Tables 5 and 8 in Zito unpublished dissertation.)

The participants in this study were also asked to rate how much they

liked to teach the topic of averages. The responses are recorded in Table 18:

Table 18
Teachers' Responses
How Much They Like to Teach Averages

Initial Survey			
Like	Undecided	Dislike	N.R.
22 (62.9%)	11 (31.4%)	1 (2.9%)	1 (2.9%)
Post Survey			
Like	Undecided	Dislike	N.R.
24 (68.6%)	9 (25.7%)	1 (2.9%)	0 (0.0%)

The post survey responses reveal that 68.6% of the teacher participants reported that they liked to teach the topic of averages following their use of the trade book which illustrated the concept with examples which were meaningful, understandable and appropriate for elementary school students.

Since the book Averages was out of print, the teachers in this study were given a photocopied version of the text. The photocopied version lacked color illustrations and was a spiral bound copy with a single sheet of colored paper for the title and back page. These differences may have had a subtle effect on teachers' perceptions about the "book" and may in some way account for the relatively small change in teachers' responses recorded as "like" in the post survey.

Exponents

Participants were asked to rate the importance of the math topic of exponents. Their responses are presented in the table below:

Table 19
Teachers' Responses
Importance of Teaching Exponents

Initial Survey			
Important	Undecided	Not Important	N.R.
23 (65.7%)	9 (25.7%)	2 (5.7%)	1 (2.9%)
Post Survey			
Important	Undecided	Not Important	N.R.
26 (74.3%)	7 (20.0%)	0 (0.0%)	2 (5.7%)

Initially, 65.7% of the participants rated exponents as an important topic to be taught in math class. After exposure to a trade book which could be used to reinforce the concept of exponential growth, 74.3% of the participants rated exponents as an important math topic. It is also interesting to note that none of the participants viewed exponents as not important in the post survey.

Participants were also asked to report on their perceptions of the ease in teaching the topic of exponents.

Table 20
Teachers' Responses
Ease of Teaching Exponents

Initial Survey			
Easy	Undecided	Hard	N.R.
14 (40.0%)	12 (34.3%)	7 (20.0%)	2 (5.7%)
Post Survey			
Easy	Undecided	Hard	N.R.
13 (37.1%)	12 (34.3%)	8 (22.9%)	2 (5.7%)

As reported in Table 20, there was very little change in the participants' ratings of the ease of teaching exponents following exposure to a trade book which illustrated exponential growth.

The participants in this study were also asked to rate how much they liked to teach the topic of exponents. The responses are recorded in Table 21:

Table 21
Teachers' Responses
How Much They Like to Teach Exponents

Initial Survey			
Like	Undecided	Dislike	N.R.
16 (45.7%)	16 (45.7%)	1 (2.9%)	2 (5.7%)
Post Survey			
Like	Undecided	Dislike	N.R.
21 (60.0%)	10 (28.6%)	1 (2.9%)	3 (8.6%)

The post survey responses reveal that 60% of the teacher participants reported that they liked to teach the topic of exponents following their use of the trade book which illustrated the topic of exponential growth.

Numbers Greater Than A Million

The importance of teaching large numbers, those greater than a million, was rated by the teacher participants with the following results:

Table 22
Teachers' Responses
Importance of Teaching Numbers Greater Than A Million

Initial Survey			
Important	Undecided	Not Important	N.R.
25 (71.4%)	7 (20.0%)	3 (8.6%)	0 (0.0%)
Post Survey			
Important	Undecided	Not Important	N.R.
30 (85.7%)	4 (11.4%)	1 (2.9%)	0 (0.0%)

It appears from the teachers' ratings on the importance of teaching numbers

greater than a million that, following the use of a trade book on the topic of large numbers, 85.7% of the participants were convinced that large numbers should be a part of the mathematics curriculum.

Teacher participants were also asked to respond to their rating on the ease of teaching large numbers. Their responses are reported in the table below:

Table 23
Teachers' Responses
Ease of Teaching Numbers Greater Than A Million

Initial Survey			
Easy	Undecided	Hard	N.R.
13 (37.1%)	10 (28.6%)	12 (34.3%)	0 (0.0%)
Post Survey			
Easy	Undecided	Hard	N.R.
10 (28.6%)	8 (22.9%)	17 (48.6%)	0 (0.0%)

The above responses reflect a trend observed earlier with the participants' ratings on the ease of teaching averages. Following the classroom use of a trade book to illustrate large number concepts, fewer teachers appear to perceive that instruction in numbers greater than a million is a task that is easy to teach. Large number concepts are not fully developed in current mathematics textbooks (see research reported in Chapter I). Teachers may perceive it as more difficult to teach large numbers when they are exposed to the concepts presented in greater depth in the trade book. Reading this book to a group of children would certainly stir interest in the topic and encourage many questions from the students. If a teacher was uncertain of the answers to the student questions, he/she might perceive this topic as more difficult to teach. It is also possible that children would now view large

numbers as a difficult topic to comprehend and this might influence teachers' perceptions as well.

The participants in this study were also asked to rate how much they liked to teach the topic of numbers greater than a million. The responses are recorded in Table 24:

Table 24
Teachers' Responses
How Much They Like to Teach Numbers Greater Than A Million

Initial Survey			
Like	Undecided	Dislike	N.R.
18 (51.4%)	12 (34.3%)	4 (11.4%)	1 (2.9%)
Post Survey			
Like	Undecided	Dislike	N.R.
25 (71.4%)	8 (22.9%)	2 (5.7%)	0 (0.0%)

The post survey responses reveal that 71.4% of the teacher participants reported that they liked to teach the topic of numbers greater than a million following their use of the trade book which illustrated large numbers with examples which were understandable and appropriate for elementary school students.

Numeration Systems

The importance of teaching numeration systems was rated by the teacher participants with the following results:

Table 25
Teachers' Responses
Importance of Teaching Numeration Systems

Initial Survey			
Important	Undecided	Not Important	N.R.
28 (80.0%)	4 (11.4%)	2 (5.7%)	1 (2.9%)
Post Survey			
Important	Undecided	Not Important	N.R.
30 (85.7%)	4 (11.4%)	1 (2.9%)	0 (0.0%)

Initially, 80.0% of the participants rated numeration systems as an important topic to be taught in math class. After exposure to a trade book which could be used to reinforce the teaching of early numeration systems, 85.7% of the participants rated numeration systems as an important math topic.

Teacher participants were also asked to indicate their rating on the ease of teaching numeration systems. Their responses are reported in the table below:

Table 26
Teachers' Responses
Ease of Teaching Numeration Systems

Initial Survey			
Easy	Undecided	Hard	N.R.
12 (34.3%)	16 (45.7%)	6 (17.1%)	1 (2.9%)
Post Survey			
Easy	Undecided	Hard	N.R.
19 (54.3%	8 (22.9%)	8 (22.9%)	0 (0.0%)

When the teacher participants in this study indicated their perceptions of the ease of teaching numeration systems, 34.3% initially rated this topic as easy to teach. Following their classroom use of a trade book which presents information about early numeration systems not usually found in math-

ematics textbooks, 54.3% of the respondents rated this topic as easy to teach. This is the only mathematics topic identified for this study which was viewed by the teachers as becoming easier to teach after using the trade book.

One reason that may account for this change is that the use of this book increased the teachers' knowledge base. Since there is little in mathematics textbooks about the topic, teachers were probably uncomfortable when the topic was presented on the questionnaire. Following their use of How Did Numbers Begin?, they had more information to share with their students.

The participants in this study were also asked to rate how much they liked to teach the topic of numeration systems. The responses are recorded in Table 27:

Table 27
Teachers' Responses
How Much They Like to Teach Numeration Systems

Initial Survey			
Like	Undecided	Dislike	N.R.
20 (57.1%)	11 (31.4%)	2 (5.7%)	2 (5.7%)
Post Survey			
Like	Undecided	Dislike	N.R.
26 (74.3%)	8 (22.9%)	1 (2.9%)	0 (0.0%)

The post survey responses reveal that 74.3% of the teacher participants reported that they liked to teach the topic of numeration systems following their use of the trade book which presented information about early numeration systems.

Since this information is not usually found in the mathematics

textbooks at the elementary school level, it may be that teachers were more comfortable with teaching the concept when they had more information available to them.

Discussion

To identify some changes in the teacher participants' perceptions regarding the four identified mathematics topics, the table below may be helpful. The table presents a summary of the teacher responses to the topics and their perceptions on the importance and ease of teaching as well as their enjoyment in teaching the targeted topics. Both initial survey and post survey responses are included.

Table 28
Initial Survey and Post Survey Responses Summary

Response: Important	Initial Survey	Post Survey
Average	88.6%	94.3%
Exponents	65.7%	74.3%
Large Numbers	71.4%	85.7%
Numeration Systems	80.0%	85.7%

Response: Easy to Teach	Initial Survey	Post Survey
Averages	48.6%	34.3%
Exponents	40.0%	37.1%
Large Numbers	37.1%	28.6%
Numeration Systems	34.3%	54.3%

Response: Like To Teach	Initial Survey	Post Survey
Averages	62.9%	68.6%
Exponents	45.7%	60.0%
Large Numbers	51.4%	71.4%
Numeration Systems	57.1%	74.3%

There appear to be some changes in the number of teacher participants who now view the topics of averages, exponents, large numbers and numeration systems as important to the mathematics curriculum. It is not

unusual to find that research participants rate the topics of research as more important on a post survey. Attention has been given these items and they naturally gain in importance.

Ease in teaching is an area of particular interest. The participants in this study support the data that indicate it takes time for teachers to become comfortable with a new strategy. Initial reaction appears to indicate that teachers find topics more difficult than they thought. They now have more information to present about a topic and this is a greater challenge to the classroom teacher. It may also be possible that these books open new considerations about teaching a concept in a meaningful way. There is also the possibility that using trade books in math class may be outside the teachers' "comfort zone", an area identified by Lovitt, et. al. (1990) as somewhere outside a teacher's current practice.

The responses to the question regarding whether teachers enjoyed teaching the targeted mathematics topic are most encouraging. The use of a trade book in every trial of this study appeared to increase the teachers' enjoyment in presenting the topic. Further research may be necessary to determine whether it was the teachers' enthusiasm for the trade book reading strategy or the students' enthusiasm that influenced teacher response and enjoyment in presenting the topic.

Teachers' Perceptions: Effectiveness of Trade Books

Since this researcher wished to learn whether teachers would perceive the trade books as effective means of presenting or reinforcing mathematics topics, the teacher participants were asked to indicate whether they were convinced of the effectiveness of the trade books. Table 29 reports their responses:

Table 29
Teachers' Responses
Effectiveness of Trade Books in Mathematics Class
Total Group

Totally Convinced	45.7%
Somewhat Convinced	51.4%
Not Convinced	0.0%
No opinion	2.9%

Although this study took place over approximately one month of the school year, participants reported that they were convinced of the effectiveness of trade books and only one participant indicated that he/she had not formed an opinion on their use. The above table shows that 45.7% were totally convinced and 51.4% were somewhat convinced. Since the teachers were identified in different ways for this study, it may be important to examine their responses to the perception of the effectiveness of this instructional strategy by considering their group membership. Group A and Group B consisted of non-volunteers from two Archdiocesan schools who were committed to improving reading and mathematics instruction in the classroom. The principals of both schools were very interested in the project and volunteered their teachers for participation in this research. Group C were volunteer teachers from a school committed to improving reading school-wide. Group D were volunteer teachers who had participated in the Mathematics Curriculum Improvement Project and who expressed an interest in this project. Group E were volunteer teachers who expressed an interest in using trade books with their bilingual students. The table below indicates how each group viewed the effectiveness of the trade books:

Table 30
Teachers' Responses
Effectiveness of Trade Books in Mathematics Class
School/Group Membership

	A	B	C	D	E
Totally Convinced	25.0%	20.0%	45.5%	87.5%	33.3%
Somewhat Convinced	75.0%	60.0%	54.5%	12.5%	66.7%
Not Convinced	0.0%	0.0%	0.0%	0.0%	0.0%
No opinion		20.0%			

In examining this data, the highest percentage of commitment was observed in Group D which consisted of volunteer teachers who had been part of the MCIP training. One might have predicted that this group would exhibit the greatest interest in this project and might perceive it as effective because (1) they have an interest in improving the teaching of mathematics and (2) they were volunteers for this project.

Group C had the second highest percentage of teachers who were totally convinced of the effectiveness of this project. Group C teachers were also volunteers. Since their school had identified the improvement of reading as one of the school year's major objectives, they were initially committed to the use of books in their classrooms. Perhaps the leap to mathematics trade books was easier because of those two factors.

Group E consisted of teachers who were volunteers for this project and were concerned about improving mathematics instruction. Since there were only three teachers involved in the study at this school, the small number does not permit further analysis.

Group A and Group B recorded much lower percentages of those teachers totally convinced about the effectiveness of the math trade books. In both groups, teachers were participants because their principals wished to be part of the project; teachers were not volunteers.

The responses seem to indicate that staff development issues may be related to the perceptions the teachers expressed about the effectiveness of the trade books. Teachers who feel forced to participate in an innovative instructional strategy pilot program may perceive their involvement as an imposition on their valuable teaching time and their professional skills. When they are asked to evaluate the pilot program, they may choose to view the experience as negative and ineffective.

The final survey question asked "Have you read any additional books in math class? If yes, please specify." Four teachers responded that they had read additional books in math class; this represents 11.4% of the sample population. While this might seem low, there are several factors that might account for only four teachers reporting that they read additional books. First, this study was conducted over a period of only one month. Since this was such a short period of time, teachers would not have had the time to read additional books in their math class. Second, finding appropriate books to include in the math curriculum is not easy. This researcher found it difficult to locate good books that were available from publishers. Library sources did not always have the books requested and bookstores did not carry the titles. In some cases, an ordered book took several weeks to arrive. Teachers would have to be persistent in their efforts to find additional titles. Perhaps teacher attitude can best be summarized by the response added to the final survey sheet by one teacher. She indicated that she had not read any additional books in math class "but I'm planning to after the holidays."

It is interesting to note which additional books were chosen by the teachers to be read to their classes. The books were:

Millions of Cats (Wanda Gag)
Millions of People
Animalia (Graeme Base)
The Eleventh Hour (Graeme Base)
The Tree on your Street
Anno's Mysterious Multiplying Jar (Anno)

The authors (in parenthesis in above list) were cited by the teachers in only four of the books. Although the researcher is unfamiliar with some of the titles, the teachers appeared to find these additional titles useful for reinforcing the math concepts they were teaching.

Analysis of Lesson Plans

Twenty-one teachers submitted lesson plans that included the trade books identified in this research. Some teachers submitted more than one lesson plan and a total of twenty-six lesson plans were studied to determine how the teachers used the books in their classrooms. The table below lists the books for which lesson plans were developed:

Table 31
Lesson Plan Focus: Books

	Frequency
Averages	7
How Did Numbers Begin	4
How Much Is a Million	8
The King's Chessboard	6

*One lesson plan mentioned only the generic term books.

It appears that How Much Is a Million? was the most frequently chosen book. Averages and The King's Chessboard also appeared to be used more frequently by the teachers in this research. Since the topics in these books may not have been in the teachers' plans or within the mathematics textbook sequence, the teachers would have had to make a conscious decision to teach the concept during the time designated for this research.

Presentation Mode

The lesson plans indicate that twenty-one teachers decided to read the books orally to their students. In five lesson plans, the researcher found it difficult to determine whether the books were read by the teacher or the students. The books were, however, mentioned in the lesson plans and it was assumed that they were read by either the teacher or the students.

Pre-reading Activities

Fifteen teachers did not mention any pre-reading activities. One can assume that these teachers viewed the reading of the book as the means by which they created the anticipatory set for the math concepts they planned to teach.

Seven teachers used discussion questions to interest their students in the book they were about to read. Predictions and questions which encouraged students to discuss their ideas about the math concepts were most frequent. One teacher chose to begin the lesson in a traditional way by defining the vocabulary (mean, median, mode).

Some of the creative pre-reading activities involved the use of the newspaper to develop an awareness of how numbers are used in every aspect of daily life. One teacher brought in a chessboard, discussed the number of squares and how the game of chess is played before reading The King's Chessboard. Perhaps the most interesting pre-reading activity was devised before reading How Much Is a Million? This teacher had her students gather 1,000 leaves and then explained how many more bags they would need to fill in order to have one million leaves.

After-reading Activities

Teachers planned two types of activities following the reading of the

books. The students were engaged in either (1) math activities only, or (2) math/language arts activities.

The students who performed math activities only tended to perform mathematical calculations, sometimes using calculators. Discussion about the math concepts and how to perform the mathematics operations were listed in seven lesson plans. A typical example of the type of activity a teacher might plan is a worksheet that was used in one classroom. The students were asked to fill in the blank to the following statements:

I could hide a million _____ under a bed.

A million _____ could fit in the school yard.

I could put a million _____ in the Sears Tower.

Students in one classroom wished to verify the statement in How Much Is A Million? regarding how long it would take to count to a million. They began to count and the teacher reported that it took the class 28 minutes to count to 1,000! In another interesting project, the students created a visual of 1,000,000 units made from graph paper. The teacher reported that the students wanted to continue to 1 billion units!

Lesson plans which included math/language arts activities for the students provided a variety of creative applications to reinforce math concepts. Some students were asked to write paragraphs to explain what they had learned. Some students drew pictures or created short dramatizations from the books. One class created a "Big Book" of the math concepts they had learned to share with a first grade class. Another class in another school developed books about the math concepts to share with primary grade children who could read them during free reading time. One teacher provided a chart with a numerical value for each letter of the alphabet;

students were encouraged to find a "million dollar word." Students in an eighth grade class were encouraged to devise their own math and alphabet symbols after reading How Did Numbers Begin?

Only one lesson plan contained no after-reading activities.

Follow-up Session Summary

In addition to the written lesson plans submitted by teachers, the researcher had the opportunity to discuss teacher implementation plans and reactions at the follow-up meeting. Teachers who did not submit lesson plans shared their ideas at the sessions. The general tone of these sessions was positive; teachers appeared to enjoy using the books and reported that the students reacted favorably to the books.

One teacher reported a prereading activity in which he showed students a book containing 125 pages of computer printout which contained 8,000 dollar signs ($) per page to illustrate the concept of a million.

Teachers also indicated that postreading activities included having students draw pictures to illustrate math concepts. Pictures were then displayed outside the classroom. Teachers also had students become involved in real-life mathematics activities. For example, one teacher had students stand shoulder-to-shoulder around the room and then calculated the number of students that would completely fill the room.

Two teachers reported that they shared the trade books with other teachers. One teacher encouraged her sister who is also a teacher at another school to use the books and the other teacher shared her books with a teacher in her school building.

Teachers were very enthusiastic in their responses about the books. Many commented that the students really enjoyed the books and the math

activities they created to reinforce the math concepts. One teacher stated, "This is the way I would like to teach math."

One teacher was so enthusiastic about the use of trade books that she wrote a proposal for a mini-grant to purchase additional math trade books. The grant was funded by her school district and she was able to purchase books for the Parent Resource Center in the school library.

This teacher also presented the math trade books at a Family Math Night for the parents of second and third graders at her school. Math games and activities were also presented at the parent meeting and parents were asked to react to the information they had learned. Two questions were relevant to the math trade books. The questions and their responses as reported by the teacher are listed below:

Question #4 The Math Trade Books were of interest to our family.

Strongly agree	35.5%
Agree	51.0%
Neutral	12.0%
Disagree	1.5%

Question #5 We would recommend Math Trade Books to another family.

Strongly agree	35.0%
Agree	45.5%
Neutral	16.5%
Disagree	1.5%

While these responses are quite favorable, the teacher was quick to point out that the results reflect two nights when she presented the material. The first night's presentation was very brief—no more than three minutes. The second night's presentation was longer, approximately 15 minutes, and she actually read a book. She felt that since the figures were averaged, the

first night's responses may have been influenced by the very short presentation. Regardless of the results, it appears that there is some interest on the part of parents to read math trade books to their children at home.

Student Reactions

The students of the teachers who participated in this survey were the audience for this instructional strategy. Since it was important to learn how they reacted to it, informal interviews were conducted with random groups of students in each school setting. Students were asked to verify that the books had been read in their classroom by naming book titles or identifying the book jackets. Students did so without any hesitation. They easily remembered book titles or book jackets. They could recall the story without any encouragement from the interviewer. The students were spontaneous in their responses to the books and it appeared that they genuinely enjoyed the experience. In addition to the enthusiastic enjoyment of the books, students appeared to be able to recall the mathematics concepts the books reinforced and their explanations appeared to indicate that they were more knowledgeable about the concepts. Some of the comments made by the students are listed below:

"helped me think about numbers in a fun way"

"made averaging seem easy"

"learned how large a million is"

"would rather read stories about math, instead of doing math in the usual way"

"enjoy learning new information and new words"

"would like to suggest that other kids read these books"

"wish there was a (trade) book for decimals and place value"

"if we didn't understand the way teacher was teaching, we could look at these books to help us understand"

"math could be fun with books"

"class was learning multiplication and this book was really helpful"

"math is boring; reading books about math isn't"

"it (reading the books) rewinds your brain"

"would like to read books about math, just as long as they are not Addison Wesley (the publisher of the student's current mathematics textbook)

The students' comments clearly demonstrate that the trade books were perceived as a pleasant change from the usual instruction in math class. At each school, the children were positive in their comments about the trade books; they tended to describe their mathematics textbooks as boring and dull. The enthusiasm and enjoyment generated for math topics by the students who were exposed to these books are testimony to the value of this instructional strategy.

CHAPTER V

DISCUSSION

Summary of Study

In preliminary research for this study, three mathematics textbook series were examined to determine how the written word is used to teach the concepts of averages, numeration systems, large numbers, and exponents. Sentences were categorized as instructional statements if information about a mathematical concept or a mathematical operation was provided. If a sentence directed a student to do some act, it was considered to be a direction. Word problems were identified as those statements which presented a set of conditions and required the student to perform some mathematical operation in order to arrive at an answer. In almost every example, the majority of sentences were word problems and directional statements. (See Chapter I, Tables 1-4.) Instructional statements were infrequent and contained relatively few examples. If a student was having some difficulty with a concept, there was little in the math textbook that he could read that would assist him to understand. Under such circumstances the student would have the choice of searching for other instructional information or simply ignoring the topic which might lead to feelings of frustration, incompetence, and a dislike for the study of mathematics.

The purpose of this study was to determine whether elementary school teachers were aware of the children's trade books that can be used to introduce and/or reinforce mathematics concepts. Several possible sources that teachers might consult to learn about the trade books were identified by the researcher:

A. Instructor's Manual/Mathematics Textbook
B. Mathematics Methods Books
C. Textbooks for content area reading courses
D. Language arts Methods Books
E. Professional journals and publications
F. Professional meetings

Six instructor's manuals from current mathematics textbooks were examined. Two provided no bibliographies of available trade books; two provided bibliographies of books which were published in the 1960s and 1970s; one series provided bibliographies in the K-2 levels, but not in the grades beyond the primary level; and one series did list two to four children's books at the end of each chapter in the teacher's manual. The same books were often listed at the end of several chapters.

Seven mathematics methods books for preservice and inservice teachers were examined. Only one series, authored by Theissen, Wild, Paige, and Baum (1989) provided bibliographies of children's trade books at the end of each chapter. The lists, however, contained many books that were published in the 1970s. It is the experience of this researcher that such books are difficult to locate.

Seven textbooks used in content area reading courses for preservice and inservice teachers were also examined. Although there is much discussion about integrating reading across the curriculum, six textbooks made no mention of trade books to use in mathematics class. Richardson and Morgan's (1990) text included an appendix in which geometry trade books for fifth grade students were listed.

There is no mention of mathematics trade books in six of the seven language arts methods books identified by the researcher. Pappas, Kiefer, and Levstik (1990) present excellent suggestions for the use of children's

trade books and specific children's books which can enhance the teaching of mathematics are presented.

Teachers can learn of new and interesting trade books for children if they read professional journals. The journals generally provide reviews of new publications and teachers who focus on mathematics topics may occasionally learn of excellent resources in this manner.

Professional meetings are frequently a source of information for teachers. In Chapter I, the researcher reported on a North Central Regional Conference of the NCTM at which 100 teachers attended a workshop entitled "Children's Books in Mathematics." Teachers who may be interested in this topic may wish to peruse the program schedule for the October 1991 NCTM Central Regional Conference. There are four sessions that include children's literature and math in their titles.

The first research question in this study asked whether teachers who teach at the elementary school level are aware of the children's trade books that can be used to introduce and/or reinforce mathematics concepts. In the self-report regarding read-aloud practices of the sample population, 86% of the teachers did not mention one title they had read in math class. This is an obvious indication that they did not read aloud to their students in math class and were unaware of the books that could be used.

The researcher presented three workshops within the Chicago area on the topic of children's trade books in math class within the last year. At each workshop, the teachers expressed a great deal of interest in the books; they frequently stated that they had no idea such books were available. Librarians also appeared to be unfamiliar with the books as evidenced by the meeting reported in Chapter 4.

This study also attempted to determine what impact the children's trade books might have on teachers' perceptions of the importance of the math topics identified for this research. As a result of this study, more teachers viewed the mathematical concepts of averages, exponents, large numbers, and numeration systems as important to teach. It is not unusual to find that research participants rate the topics of research as more important following their involvement in the study.

Teachers' perceptions on the ease of teaching the identified math topics indicate that following the use of the trade books the teachers found the topics more difficult to teach than they originally thought. This is an interesting response. The expectation was that teachers would find that the trade books made the topics easier to teach. The trade books, however, seemed to open new considerations about teaching the topics. It may be that teachers now have more knowledge to convey about a topic and they perceive a greater challenge to impart that information. There is also the possibility that using trade books to teach in math class may be outside the teachers' "comfort zone", an area identified by Lovitt, et. al. (1990).

Teachers were also asked whether they liked or disliked teaching the identified topics. The use of trade books in every trial of this study appeared to increase the teachers' enjoyment in presenting the topic. Logically, if a teacher enjoys teaching a topic, she/he will convey her/his enthusiasm to the students. It is also possible that a teacher will spend more time presenting a topic that he/she enjoys. It also appears logical to assume that students will have a better understanding of the topic.

When teachers were asked their opinion of the effectiveness of using trade books to introduce and/or reinforce mathematics concepts, 45.7%

indicated that they were totally convinced of the strategy's effectiveness. Those who were somewhat convinced represented 51.4% of the population. Only one individual indicated that he/she had not formed an opinion.

Why were teachers so positive in their assessment of this strategy? Perhaps they consciously or unconsciously applied the criteria reported by Fullan (1991) (see Chapter 2). The criteria and a response that may shed light on teacher reactions follows:

1. Does the change potentially address a need? Mathematics textbooks do not provide adequate explanations for the mathematics topics presented. Students who do not understand a concept will find little in the mathematics book to help them understand. Teachers perceive this need and find it necessary to provide additional instruction to their students.

Will students be interested? Teachers may not be able to easily determine this before trying a new strategy, but they were able to observe student interest and enthusiasm following the use of the trade books.

Will they learn? Is there evidence that the change works, i.e., that it produces claimed results? Since this study did not attempt to correlate student achievement with reading trade books, there is no formal evidence that it "works." Teachers do have their informal observations and student artifacts, such as scores on worksheets, visuals created by students, and books written by students to illustrate the concepts as some indication of the effectiveness of the strategy. There is some evidence in this study to indicate that the students remembered the books and could recall the math concepts when they were interviewed by the researcher.

2. How clear is the change in terms of what the teacher will have to do? The teachers were given a great deal of freedom to use the trade books

in whatever manner they chose. The researcher relied on their professional skills and judgment to determine the best possible method of presentation. Teachers were most likely pleased with this aspect of the research since they could be as creative as they wished to be. They could "try out" a new role relationship with their math students, thus creating an innovation open to continuous development and redefinition as described by Fullan and Pomfret (1977).

3. How will it affect the teacher personally in terms of time, energy, new skill, sense of excitement and competence, and interference with existing priorities? It appears that teachers did not seem to count the costs of using this strategy as too high in terms of time and energy. Since teachers generally read to students in other classes, they did not have to learn new skills. Following the implementation of this strategy, the researcher observed a sense of excitement in the teachers. Since the math subject matter was covered, this approach did not seem to interfere with existing priorities, but in some cases the teachers reported that they planned to use some of the books later in the year when their textbook introduced the topic.

4. How rewarding will the experience be in terms of interaction with peers or others? Teachers had the opportunity to meet in one follow-up session to discuss their implementation strategies. In a conversation with the researcher, one teacher requested that she be kept informed of other research projects such as this one. "I would like to be involved in any research you might do in the future," stated teacher Lori Konicek. Those teachers who shared books with colleagues not involved in this research also stand as testimony to the rewarding aspect of this research.

The criteria above appear to indicate that teachers found this strategy

to be one that addressed a need to present mathematics topics in a manner that was different but understandable to students. Students were likely to be interested in the topics. Implementation was sufficiently clear to them and since the strategy did not extract too much in terms of cost, the teachers were more likely to describe the strategy as effective in their classrooms. Teachers also appeared to find their participation in this study to be personally rewarding. They also observed that their students were enthusiastic and that they enjoyed the math activities that teachers created to accompany the reading of the trade books.

Another research question addressed in this study attempted to determine how the children's trade books would be incorporated into the mathematics curriculum. Lesson plans were examined and it was learned that 81% of the teachers read the books orally to their students. Fifteen teachers did not mention any prereading activities and it was assumed that reading the book provided the anticipatory set for the mathematics lesson. With the exception of one teacher, all planned some after-reading activities. These activities could be categorized as math only or as math/language arts activities. Students performed mathematical operations, created "Big Books" or "buddy books", devised their own math and alphabet symbols, or created visuals to illustrate the math concepts.

Teachers also reported that they shared the books with colleagues. Since 63% of the teachers in this study indicated that they learned of good books to read to children from other teachers' suggestions, it is encouraging to see the teachers in this study sharing their new-found mathematics trade books with other teachers.

This study also attempted to determine whether the use of children's

trade books at the elementary level might assist students to enjoy and find value in trade books related to mathematics. Interviews with the children who were the audience for this instructional strategy provided the strongest support. The students remembered the books and the topics presented. They could give examples to illustrate their understanding of the concepts. They were spontaneous in their responses and seemed to thoroughly enjoy the experience. They expressed a desire to read other books that might provide information about other math topics and hoped that other students might have the opportunity to read the identified books.

Unexpected Outcomes

This study has resulted in some unexpected and interesting outcomes. First, the Rochelle Lee Fund purchased all of the books listed in the math bibliography compiled by the researcher and has made them available to fund awardees in the Teacher Resource Center created in August, 1991. Teachers will now have the opportunity to preview these math-related books and judge how they might be incorporated in their school curriculum.

Second, the math bibliography will be published in the Spring of 1992 by St. Martin's Press as an appendix to a mathematics strategies book, Mathematics Across the Curriculum .

Third, the reading of mathematics trade books has become a regular feature on a local cable access television program entitled Countdown. This children's television show teaches, reinforces, and encourages elementary school students to enjoy the study of mathematics. Permission was obtained to read ten children's trade books on selected mathematics topics. The researcher has also been involved in the creation of nine original stories

to teach math concepts. Through the medium of television, children are learning that there are excellent books to help them understand math. Children are also challenged to create their own stories to illustrate math concepts. The seeds of an excellent strategy have been planted during the first year of Countdown and there are plans to continue to read books on the second year of this educational program.

Fourth, school librarians and the librarians in local branches of the Chicago Public Library have expressed an interest in the math bibliography. Working together with teachers who are aware of this strategy will allow them to strengthen the resources that students can utilize as they study mathematics.

Fifth, one teacher who participated in this research was successful in writing a grant proposal to purchase selected math trade books for use in the Parent Resource Center in the school library. Parents seemed interested in reading math-related trade books to their children as a result of hearing her presentation at a parents' meeting. If Ms. Szuch's success is any indication of the possible impact of this strategy, it is possible that parents would be another audience for the math-related trade books. Since the book publishing industry is very much motivated by the possibility of book sales, teachers and parents will have to make their interests known. If publishers were to realize that there is a market for math related trade books, more good books would be published or perhaps some of the more interesting older editions (such as Averages) might be reissued.

Sixth, the strategy of reading children's trade books in mathematics class to introduce and reinforce math concepts will be incorporated into the teacher education curriculum at Loyola University. Preservice teachers will

learn that this strategy is another effective means of delivering math instruction at the elementary school level.

Conclusions

This research has shown that there is a need for math-related trade books which can introduce and reinforce mathematics concepts. Teachers appear to be convinced of the value of including the books in their mathematics lesson plans. Elementary school students were enthusiastic in their appraisal of the math trade books identified for this study. In the preliminary research with parents, it appears that parents might be interested in reading the math trade books to their children.

There is a need for publishers to provide such excellent math-related trade books to the public. The researcher was frustrated in the early stages of this research because many excellent trade books were unavailable. They were either out of stock or out of print. Finding books that could be purchased from a book store or a publisher was usually a cause for rejoicing. As the researcher delved more deeply into this area, additional books were identified. The bibliography that was developed as a result of that effort contains books that are currently available from publishers. Given the past history of these trade books, it is unrealistic to expect that these books will be available for any length of time. One book store manager told the researcher that one cannot assume that all the books listed in the current Books in Print will be available from the publishers. Teachers and parents who wish to purchase good books for children must make their choices known. In this way, the excellent children's trade books will make their way into classrooms and homes where they will provide the information and pleasure they were intended to give to future generations.

Summary

"Readin', writin', and 'rithmetic" have been the mainstays of curriculum since colonial times in the United States. In the past, they have been viewed as separate subject matter areas. More recently, educators have begun to discover that there are ways to integrate subject matter across the curriculum. The strategy of reading trade books in mathematics class is but one step in the process of reform. Where else, but in a trade book, could a student learn the value of numbers, as when he/she reads:

> "Don't you know anything at all about numbers?
>
> "Well, I don't think they're very important," snapped Milo, too embarrassed to admit the truth.
>
> "NOT IMPORTANT!" roared the Dodecahedron, turning red with fury. "Could you have tea for two without the two—or three blind mice without the three? Would there be four corners of the earth if there weren't a four? And how could you sail the seven seas without a seven?"
>
> "If you had high hopes, how would you know how high they were? And did you know that narrow escapes come in all different widths? ...And how could you do anything at long last," he concluded, waving his arms over his head, "without knowing how long the last was? Why, numbers are the most beautiful and valuable things in the world. Just follow me and I'll show you."
>
> (The Phantom Tollbooth, p. 177)

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APPENDIX A

LOYOLA
UNIVERSITY
CHICAGO

Water Tower Campus
820 North Michigan Avenue
Chicago, Illinois 60611
Telephone: (312) 915 6046

Department of Curriculum and Human Resource Development

October 12, 1990

Dear Colleague,

We would like to invite you to participate in a unique project which will examine the use of trade books in mathematics class. You may wonder what sort of commitment is necessary for this project. We will ask you to read 4 books to your students in mathematics class before November 14, 1990. The books you will receive for your classroom are:

AVERAGES	by	Jane Jonas Sristava
THE KING'S CHESSBOARD	by	David Birch
HOW DID NUMBERS BEGIN	by	Mindel and Harry Sitomer
HOW MUCH IS A MILLION?	by	David M. Schwartz

Each of these books is written at a very simple level, illustrating important mathematical concepts in situations which your students will understand. While the initial reading is unlikely to take more than 10 minutes, we are sure you will find interesting discussions and/or activities that may extend the exercise to 30 minutes.

At the initial meeting, we will ask you to complete a short questionnaire. We will disseminate the books and discuss some activities that you may wish to try with your class. This meeting is scheduled for TUESDAY, OCTOBER 16, 1990 from 8:30 to 9:00 a.m. in your SCHOOL LIBRARY.

At a follow-up meeting on TUESDAY, NOVEMBER 20, 1990 from 8:30 to 9:00 a.m. in your SCHOOL LIBRARY, we will ask you to complete a post questionnaire and to share your reactions and your students' reactions to this novel way of delivering mathematics instruction. We would also like at least one outline or brief lesson plan showing how you used one of the books.

In addition to your 4 books, the Rochelle Lee Foundation will supply a fifth surprise book which will be distributed at the follow-up meeting. This mathematics trade book has been selected by Rochelle herself as a token of her gratitude for your efforts to try to include reading in your mathematics class.

Small random groups of students will also be selected for short interviews. Some of your students may be selected. The interview will require no more than 10 minutes and will be scheduled at your convenience in order to minimize loss of instructional time.

We hope you will consider participating in this project. If you have any questions about this project, please call Dorothy Giroux at 915-7388. We look forward to an exciting collaboration.

Sincerely,

Diane Schiller
Mathematics Curriculum Improvement Project

Dorothy Giroux
Director, Loyola University Reading Clinic

APPENDIX B

Children's Books
10 East 53rd Street
New York, New York
10022-5299
Telephone 212 207 7000
Telex 12420
Fax 212 207 7222

HarperCollins*Publishers*

Dorothy Giroux
5219 South Nottingham Ave.
Chicago, IL 60638

January 16, 1991

RE: AVERAGES by J.J. Srivastava

Dear Ms. Giroux:

This letter will serve as our formal agreement granting to you non-exclusive permission free of charge to reproduce the above mentioned copyrighted material. This permission is granted on the condition that no changes be made to our work unless indicated as a post script to this letter and that complete and proper credit be given to our material including the following: title, author, illustrator, copyright line (must appear exactly as the copyright line in the book, usually found on the back of the title page) and HarperCollins Publishers, as publisher of the work.

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Sincerely,

Stephanie A Miller
Children's Books Permissions

APPENDIX C

This questionnaire is part of a study to determine current practices in reading and mathematics education. You as a classroom teacher are the most important component in the delivery of effective instruction. Would you please respond to the following questions about your classroom practices?

1. Do you read children's trade books and/or literature to your students during reading class?

( ) Yes ( ) No

1a. If yes, how often do you read to your students during reading class?

Daily	Weekly	Monthly	Occasionally	Never
1	2	3	4	5

1b. Please list any books you have read aloud in reading class.

_____

_____

_____

_____

2. Do you read children's trade books and/or literature to your students during math class?

( ) Yes ( ) No

2a. If yes, how often do you read to your students during math class?

Daily	Weekly	Monthly	Occasionally	Never
1	2	3	4	5

2b. Please list any books you have read aloud in math class.

_____

_____

_____

_____

3. How did you learn about the books you chose to read to your students? (check all that apply)

( ) public library collections and staff
( ) school library collections and staff
( ) reviews in professional journals
( ) suggestions from other teachers
( ) other: _____
(please specify)

4. Do you use the teacher's manual which accompanies your students' mathematics text?

( ) Yes ( ) No

5. How would you rate the teacher's manual on the following features?

presentation of math concepts

effective	not effective	no opinion
1	2	3

teaching suggestions

effective	not effective	no opinion
1	2	3

supplementary practice exercises

effective	not effective	no opinion
1	2	3

6. How important is it to teach AVERAGES (mean, median, mode)?

very important	important	undecided	not important	not at all important
1	2	3	4	5

How difficult is it to teach AVERAGES (mean, median, mode)?

very easy	easy	undecided	hard	very hard
1	2	3	4	5

How much do you like teaching AVERAGES (mean, median, mode)?

like a lot	like	undecided	dislike	dislike a lot
1	2	3	4	5

7. How important is it to teach EXPONENTS?

very important	important	undecided	not important	not at all important
1	2	3	4	5

How difficult is it to teach EXPONENTS?

very easy	easy	undecided	hard	very hard
1	2	3	4	5

How much do you like teaching EXPONENTS?

like a lot	like	undecided	dislike	dislike a lot
1	2	3	4	5

8. How important is it to teach NUMBERS GREATER THAN A MILLION?

very important	important	undecided	not important	not at all important
1	2	3	4	5

How difficult is it to teach NUMBERS GREATER THAN A MILLION?

very easy	easy	undecided	hard	very hard
1	2	3	4	5

How much do you like teaching NUMBERS GREATER THAN A MILLION?

like a lot	like	undecided	dislike	dislike a lot
1	2	3	4	5

9. How important is it to teach NUMERATION SYSTEMS?

very important	important	undecided	not important	not at all important
1	2	3	4	5

How difficult is it to teach NUMERATION SYSTEMS?

very easy	easy	undecided	hard	very hard
1	2	3	4	5

How much do you like teaching NUMERATION SYSTEMS?

like a lot	like	undecided	dislike	dislike a lot
1	2	3	4	5

10. How important is it to follow the order of the mathematics textbook in planning and teaching mathematics?

very important	important	undecided	not important	not at all important
1	2	3	4	5

THANK YOU FOR YOUR PARTICIPATION IN THIS SURVEY.

Name _____

School in which you teach: _____

Grade level at which you teach: _____

POST-READING QUESTIONNAIRE FOR TEACHERS

PARTICIPATING IN STUDY

1. Did you personally read the books selected and given to you for this study?

( ) Yes ( ) No

2. Did you read the books to your class?

( ) Yes ( ) No

Please list the books you have read to your class

_____

_____

_____

_____

3. If you were to recommend these books to other teachers, at what grade level would you suggest it would be most appropriate to read

	Grade Level
THE KING'S CHESSBOARD	_____
HOW MUCH IS A MILLION?	_____
HOW NUMBERS BEGAN	_____
AVERAGES	_____

4. BEFORE READING the selected books to your class, did you do any preparation for:

THE KING'S CHESSBOARD	( ) Yes	( ) No
HOW MUCH IS A MILLION?	( ) Yes	( ) No
HOW NUMBERS BEGAN	( ) Yes	( ) No
AVERAGES	( ) Yes	( ) No

5. AFTER READING the selected books to your class, did you prepare any follow-up activities for your students?

THE KING'S CHESSBOARD	( ) Yes	( ) No
HOW MUCH IS A MILLION?	( ) Yes	( ) No
HOW NUMBERS BEGAN	( ) Yes	( ) No
AVERAGES	( ) Yes	( ) No

6. Would you be willing to share the lesson plans and activities you created for use with these books?

( ) Yes ( ) No

7. Using the numerals 1 to 4, please rate the books used for this study using the following key: (1) most interesting, most effective to (4) least interesting, least effective.

THE KING'S CHESSBOARD _____
HOW MUCH IS A MILLION? _____
HOW NUMBER BEGAN _____
AVERAGES _____

8. Have you read any additional books in math class?

( ) Yes ( ) No

If yes, please specify_____

_____

_____

9. How important is it to teach AVERAGES (mean, median, mode)?

very important	important	undecided	not important	not at all important
1	2	3	4	5

How difficult is it to teach AVERAGES (mean, median, mode)?

very easy	easy	undecided	hard	very hard
1	2	3	4	5

How much do you like teaching AVERAGES (mean, median, mode)?

like a lot	like	undecided	dislike	dislike a lot
1	2	3	4	5

10. How important is it to teach EXPONENTS?

very important	important	undecided	not important	not at all important
1	2	3	4	5

How difficult is it to teach EXPONENTS?

very easy	easy	undecided	hard	very hard
1	2	3	4	5

How much do you like teaching EXPONENTS?

like a lot	like	undecided	dislike	dislike a lot
1	2	3	4	5

11. How important is it to teach NUMBERS GREATER THAN A MILLION?

very important	important	undecided	not important	not at all important
1	2	3	4	5

How difficult is it to teach NUMBERS GREATER THAN A MILLION?

very easy	easy	undecided	hard	very hard
1	2	3	4	5

How much do you like teaching NUMBERS GREATER THAN A MILLION?

like a lot	like	undecided	dislike	dislike a lot
1	2	3	4	5

12. How important is it to teach NUMERATION SYSTEMS?

very important	important	undecided	not important	not at all important
1	2	3	4	5

How difficult is it to teach NUMERATION SYSTEMS?

very easy	easy	undecided	hard	very hard
1	2	3	4	5

How much do you like teaching NUMERATION SYSTEMS?

like a lot	like	undecided	dislike	dislike a lot
1	2	3	4	5

13. How important is it to follow the order of the mathematics textbook in planning and teaching mathematics?

very important	important	undecided	not important	not at all important
1	2	3	4	5

14. Has this experience (reading books during math class) had any effect on your opinion of the effectiveness of using trade books to introduce or reinforce math concepts?

_____ I am totally convinced of the effectiveness of reading trade books in math class.

_____ I am somewhat convinced of the effectiveness of reading trade books in math class

_____ I haven't an opinion on the effectiveness of reading trade books in math class.

_____ I am not convinced of the effectiveness of reading trade books in math class.

THANK YOU FOR YOUR PARTICIPATION IN THIS SURVEY.

Name _____

School in which you teach: _____

Grade level at which you teach: _____

APPENDIX D

CHILDREN'S TRADE BOOKS IN MATH
A Selected Bibliography of Available Books to Teach and Reinforce Math Concepts

Compiled by Dorothy Giroux

COUNTING AND NUMBER BOOKS

Anno, Mitsumasa. Anno's Counting Book. New York: Thomas Y. Crowell, (Harper/Collins Pub.) 1975. (ISBN 0-690-01288-8) $13.99

Aylesworth, Jim. One Crow A Counting Rhyme. New York: J. B. Lippincott, 1988. (ISBN 0-397-32175-9) $12.89

Bang, Molly. Ten, Nine, Eight. New York: Greenwillow Publishers (ISBN 0-688-09906-9) $13.95 Also available in paperback.

Carter, David A. How Many Bugs in a Box? New York: Simon and Schuster, 1988. (ISBN 0-671-64965-5) $11.95

Carter, David A. More Bugs in a Box. New York: Simon and Schuster, 1990. (ISBN 0-671-69577-0)

Demi. Demi's Count the Animals 1-2-3. New York: Grossett & Dunlap, 1986. (ISBN 0-448-18980-1) $9.95

Haskins, Jim. Count Your Way Through Africa. Minneapolis: Carolrhoda Books, 1989. (ISBN 0-87614-347-8) $11.95

Haskins, Jim. Count Your Way Through Canada. Minneapolis: Carolrhoda Books, 1989. (ISBN 0-87614-350-8) $11.95

Hellen, Nancy. The Bus Stop. Shapleigh, ME: Orchard Books, 1988. (ISBN 0-531-05765-8) $11.95

Hoban, Tana. Count and See. New York: Macmillan, 1974. (ISBN 0-02-744800-2) $12.95

Kitamura, Satoshi. When Sheep Cannot Sleep: The Counting Book. Farrar, Strauss, Giroux, 1986. $3.95

Maestro, Betsy. Harriet Goes to the Circus: A Number Concept Book. New York: Crown, 1977. (ISBN 0-517-55303-1) $2.50

McMillan, Bruce. Counting Wildflowers. New York: Lothrop, Lee & Shepard, 1986. (ISBN 0-688-02859-4) $12.95

Moerbeek, Kees and Carla Dijs. Six Brave Explorers. Los Angeles: Price Stern Sloan, 1988. (ISBN 0-8431-2253-6) $9.95

Pluckrose, Henry. Numbers. New York: Franklin Watts, 1988. (ISBN-0531-10453-2) $10.90

Trinca, Rod and Kerry Argent. One Wolly Wombat. New York: Kane/Miller Book Publishers, 1985. (ISBN 0-916291-00-6) $11.95

NUMBER OPERATIONS

Anno, Mitsumasa. Anno's Counting House. New York: Philomel Books, 1982. (ISBN 0-399-20896-8) Putnam, $12.95

Anno, Mitsumasa. Anno's Mysterious Multiplying Jar. New York: Philomel, 1983. (ISBN 0-399-20951-4) Putnam, $14.95 (introduces factorials)

Dee, Ruby. Two Ways to Count to Ten. New York: Henry Holt and Co., 1988. (ISBN 0-8050-1314-8) $5.95

Ehlert, Lois. Fish Eyes: A Book You Can Count On. Orlando, FL: Harcourt Brace Jovanovich, Inc., 1990. (ISBN 0-15-228050-2) $14.95 (reinforces addition)

Gerstein, Mordicai. Roll Over! New York: Crown, 1984. (ISBN 0-517-55209-4) $8.95 (reinforces subtraction)

Hawkins, Colin and Jacqui Hawkins. How Many Are in This Old Car?: A Counting Book. New York: G.C. Putnam Sons, 1988. (ISBN 0-399-21565-4) $11.95

Hutchins, Pat. The Doorbell Rang. New York: Greenwillow Publishers, 1986. (ISBN 0-688-05251-7) $13.95 (reinforces division)

Mathews, Louise. Bunches and Bunches of Bunnies. New York: Scholastic, 1978. (ISBN 0-590-41880-7) $2.50 (reinforces multiplication)

Owen, Annie. Annie's One to Ten. New York: Alfred A. Knopf, 1988. (ISBN 0-394-82791-0) $8.95

Zaslavsky, Claudia. Zero: Is It Something? Is It Nothing? New York: Franklin Watts, 1989. (ISBN 0-531-10693-4) $12.90

GEOMETRY

Emberley, Ed. The Wing of a Flea: A Book About Shapes. Boston: Little Brown and Company, 1988. (ISBN 0-316-23600-4) $14.95

Forman, Robert. Angles Are As Easy As Pie. New York: Thomas Y. Crowell, 1975. (ISBN 0-690-00916-X) Harper, $12.95.

Hoban, Tana. Circles, Triangles and Squares. New York: Macmillan, 1974. (ISBN 0-02744830-4) $12.95

Hoban, Tana. Is It Larger? Is It Smaller? New York: Greenwillow Books, 1985. (ISBN 0-688-04028-4) $12.88

Hoban, Tana. Shapes, Shapes, Shapes. New York: Greenwillow Books, 1986. (ISBN 0-688-05833-7) $11.88

Pluckrose, Henry. Capacity. New York: Franklin Watts, 1988. (ISBN 0-531-10547-4) $10.40

Pluckrose, Henry. Big & Little. New York: Franklin Watts, 1987. (ISBN 0-531-10373-0) $7.99

Pluckrose, Henry. Length. New York: Franklin Watts, 1988. (ISBN 0-531-10618-7) $10.90

Pluckrose, Henry. Pattern. New York: Franklin Watts, 1988. (ISBN 0-531-10619-5) $10.40

Pluckrose, Henry. Sorting. New York: Franklin Watts, 1988. (ISBN 0-531-10548-2) $10.40

Pluckrose, Henry. Weight. New York: Franklin Watts, 1988. (ISBN 0-531-10525-3) $10.90

Walter, Marion. Look at Annette. M. Evans & Company, 1977. (ISBN 0-87131-071-6) $5.95

Walter, Marion. Make a Bigger Puddle, Make a Smaller Worm. M. Evans and Company, 1971. (ISBN 0-87131-073-2) $5.95

Walter, Marion. The Mirror Puzzle Book. Parkwest Publications, 1985 (ISBN 0-906212-39-1) $5.95

MONEY

Hoban, Tana. Twenty-Six Letters and Ninety-Nine Cents. New York: Greenwillow Books, 1987. (ISBN 0-688-06362-4) $14.88

Schwartz, David. If You Made A Million. New York: Lothrop, Lee & Shepard, 1989. (ISBN 0-688-07017-5) $14.95

Viorst, Judith. Alexander Who Used to Be Rich Last Sunday. New York: MacMillan, 1980. (ISBN 0-689-71199-9) $3.95

LARGE NUMBERS

Myers, Bernice. The Millionth Egg. New York: Lothrop, Lee & Shepard Books, 1991. (ISBN 0-688-09886-X) $13.95

Schwartz, David. How Much Is A Million? New York: Lothrop, Lee & Shepard, 1985. (ISBN 0-688-04049-7) $14.95. Also available in paperback from Scholastic (ISBN 0-590-33966-4) $2.95

MISCELLANEOUS MATH TOPICS

Abbott, Edwin A. Flatland: A Romance of Many Dimensions. Dover Publishers (ISBN 0-486-20001-9) $2.25

Adler, David A. Roman Numerals. New York: Thomas Y. Crowell Books/ Harper/Collins Publishers, 1977. (ISBN 0-690-01302-7) $12.89

Anno, Mitsumasa. Anno's Math Games. New York: Philomel Books, 1987. (ISBN 0-399-21151-9) Putnam, $18.95

Anno, Mitsumasa. Anno's Math Games II. New York: Philomel Books, 1989. (ISBN 0-399-21615-4) Putnam, $19.95

Birch, David. The King's Chessboard. New York: Dial Books for Young Readers, 1988. (ISBN 0-8037-0365-1) $10.95

Burns, Marilyn. The I Hate Mathematics Book. Little, Brown & Company, 1975. (ISBN 0-316-11741-1) $8.95

Burns, Marilyn. Math for Smarty Pants. Little, Brown & Company, 1982. (ISBN 0-316-11739-0) $7.95

Dennis, J. Richard. Fractions Are Parts of Things. New York: Thomas Y. Crowell Books/Harper/Collins Publishers, 1971. (ISBN 0-690-31521-X) $12.95

Gamow, George. One, Two, Three . . . Infinity: Facts and Speculations of Science. Dover Publishers, 1988. (ISBN 0-486-25664-2) $6.95

Greene, Carol. The Thirteen Days of Halloween. Chicago: Children's Press, 1983. (ISBN 0-516-48231-9) $3.95

Jonas, Ann. Round Trip. New York: Scholastic Inc., 1983. (ISBN 0-590-40956-5) $3.95.

Juster, Norton. The Dot and The Line: A Romance in Lower Mathematics. New York: Random House, 1977. (ISBN 0-394-73352-5) $10.95

Juster, Norton. The Phantom Tollbooth. New York: Random House, 1972. (ISBN 0-394-82199-8) $3.95

Munsch, Robert. Moira's Birthday. Annick, 1987. (ISBN 0-920303-85-4) $12.95 (reinforces estimation)

Nesbit, E. Melisande. Orlando, Florida: Harcourt, Brace Jovanovich, 1989. (ISBN 0-15-253164-5) $13.95 (exponents and measurement)

Nozaki, Akihiro and Anno, Mitsumasa. Anno's Hat Tricks. New York: Philomel Books (Putnam Publishing Co.) 1985. (ISBN 0-399-21212-4) $13.95

Phillips, Louis. 263 Brain Busters: Just How Smart Are You Anyway? Viking, 1985. (ISBN 0-670-80412-6) $10.95

Pittman, Helen Clare. A Grain of Rice. Mamaroneck, New York: Hastings House Publishers, 1986. (ISBN 0-8038-2728-8) $12.95

Sachar, Louis. Sideways Arithmetic from Wayside School. New York: Scholastic, 1989. (ISBN 0-590-42416-5) $2.50

Sitomer, Mindel and Sitomer, Harry. How Did Numbers Begin? New York: Thomas Y. Crowell, 1976. (ISBN 0-690-00794-9) Harper/Collins $12.95

Tompert, Ann. Grandfather Tang's Story. New York: Crown, 1990. (ISBN 0-517-57272-9) $13.95

Watson, Clyde. Binary Numbers. New York: Thomas Y. Crowell/Harper/Collins Publishers, 1977. (ISBN 0-690-00993-3) $12.98

White, Laurence B. and Broekel, Ray. Math-A-Magic: Number Tricks for Magicians. Niles, Illinois: Albert Whitman & Company, 1990. (ISBN 0-8075-4994-0) $10.95

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

10/3/91 Diane Schiller

Date Director's Signature