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Introduction

"You know, you can think of everything as a math problem," says the main character in Jon Scieszka's popular book, *Math curse*. This female character, vexed by a "Math Curse," is told by her teacher that almost anything can be a math problem. Throughout my life, I have always enjoyed seeing math in everyday things and learning about the subject. As an adult, I still continue to have a passion for the subject. Math is indeed everywhere, and in my opinion, it is one of the most important subjects one studies in school. I carry this passion for math with me into my career of teaching a vivacious group of third graders, and I strive to instill a love of math in these learners.

I feel that math should be an enjoyable, not a tedious and boring, experience for students. One way to achieve this in a classroom is to make math meaningful and hands-on. Another useful strategy in teaching math is the use of math-related literature. Knowing that students love being read to, I have utilized storybooks in my math lessons in order to increase motivation and interest. Recognizing the importance of integrating subject matter in order to increase understanding, I set out on an adventure to research the following question: What kinds of mathematical connections can and do students make to literature?

Review of Literature

In today's world, mathematics is different from what it used to be. Rather than teaching skills and concepts in isolation, there is more of a focus on embedding concepts and weaving them together in order to make learning more meaningful and permanent. Mathematics education has evolved into "real mathematics," the mathematics found everywhere. This type of mathematics is not a set of isolated skills; it is reasoning, thinking, problem solving, communicating, and making connections (Hellwig, Monroe, & Jacobs, 2000). Subject integration makes math meaningful for students, assists them in making connections, helps them acquire understanding of math concepts, and improves their attitudes towards mathematics. In addition, integrating subjects helps teachers meet difficult time demands. For these reasons, curricular integration has become increasingly popular.

In a time when teachers feel that curricula are overwhelmingly packed and there never seems enough time to teach all of the concepts required, subject integration has become a solution to help alleviate this problem.
Having students make connections in learning not only helps with curricular and time demands, it allows learners to make meaning of material and enables them to retain information and/or concepts learned. In addition, it helps students with the application of skills and encourages positive attitudes. As a result of integrating math and literature, students learn about both subjects, and they find an increased enjoyment and understanding (Kliman, 1993). The National Council of Teachers of Mathematics (NCTM) also supports this integration, as students who have opportunities for listening, speaking, reading, and writing in math instruction not only learn to communicate mathematically, but they also communicate to learn mathematics (NCTM, 2000).

There have been many articles about curricular integration and its benefits, including studies that examine the impact of integrating math and language arts. These show that when math and reading are integrated, students' mathematical skills, their achievement, and their behavior improve as a result. For example, it has been found that integrating reading engages all types of learners and shows students that math can be found everywhere (Steele, 2001). The use of trade books in math enables students to make meaningful connections between the real world and their experiences within the classroom (Hellwig, et al., 2000). Children's literature guides students to a better understanding of mathematical processes and a discovery of how others utilize mathematics to learn (Roth McDuffie & Young, 2003).

The effects of math and reading integration have also been analyzed in research studies. Mink & Fraser (2000) examined how a program entitled Project SMILE (Science and Math Integrated with Literary Experiences) impacted the attitudes of students toward three core subjects: mathematics, reading, and writing. The project was successful in encouraging positive attitudes toward math, allowing students to learn math concepts from the use of children's literature, and producing positive changes in classroom climate (Mink & Fraser, 2000). Similarly, Knill-Griesser (1999) found that the use of quality literature in math instruction improved students' attitudes towards math.

After learning more about the value of curriculum integration, I designed an action research project to find out not only how my students would make math connections in literature, but if they would make them accurately.

Design of the Study

Description of Participants: Setting:

This action research project took place in my classroom in a public elementary school, located in a suburban town north of Annapolis, Maryland where, in the 2002-2003 school year, there were 637 students enrolled in grades Kindergarten through five. The ethnic backgrounds of the majority of students in this school are Caucasian and African-American. Approximately 10% of the population received free/reduced lunch, and 12% of the students required special education services.

The participants in this study were the 26 third graders in my class, 19 boys and 7 girls. Twenty were of average reading abilities, and six students were identified as being of low ability in reading. Most of my students were of average ability in math as well. The majority of the students in the class (25) were Caucasian; two were African-American.

In my program, part of each reading period consists of a block of time for students to read self-selected literature independently. It was during this time period that my action research project was conducted.

Sub-questions

After pondering my original question of how students make mathematical connections in literature, I realized there were many sub-questions. I wondered, *Do students make mathematical connections in literature?* I also thought, *If they do, what types of connections do they make?* Suddenly, many more of these sub-questions came to mind. *Are those connections accurate? How do the students feel about the integration of math and literature? Are they aware of literature as a tool for learning mathematics? Does the use of literature during math instruction increase their motivation for learning math?* I then designed a study to answer these questions.

Overview of Study

Over a three-week period, I encouraged students to make mathematical connections while engaging in independent reading. Before the study began, I asked the participants to answer a questionnaire to describe their attitudes and perceptions of the use of literature in math and vice versa, and their prior knowledge of types of math connections they might find while reading literature. The students then read books independently to identify math connections in text. At the end of the study, I distributed the same questionnaire in order to assess how their feelings had changed as well as whether their knowledge of types of connections that may be found in literature had increased.

Student Questionnaire

The questionnaire was designed to enable me to recognize the students' desire to use math in literature and their knowledge of math concepts that may be included in storybooks. In addition, the purpose of the post-questionnaire was to allow me to analyze the students' growth in their knowledge of how math can be integrated in literature, as well as changes in their attitudes and perceptions of reading about math.

In the event, however, the questionnaires weren't very useful to my research. Reactions to a statement such as "I like to read about math," to which students answered "never, sometimes, often, or always" simply weren't helpful. I felt that most students wrote responses that they thought I wanted to hear (i.e. *"always"*). On the other hand, I felt that the connections made during the study, my observations, and their conversations with each other and with me were more indicative of how they felt about the integration of math and literature and of the types of connections they made.

Other Sources of Evidence

List of Concepts

The students brainstormed a brief list of math topics to look for in their reading. Some concepts included were time, money, measurement, and number operations. Next, I guided them in extending this list to include some additional concepts such as fractions and geometry. Afterwards, a small number of concepts were added to the class list when they appeared in their literature.

This list remained posted to assist students in recording their concepts on the Post-It Notes. It guided them in determining the proper connections and the spelling of those connections.

Modeling with Post-It Notes

To model how to find connections, I read to them *Math Curse* by Jon Scieszka. I selected this book for its many math connections and for its interesting way of showing children how math is all around us. I wanted the students to learn how to find the math ideas that are buried in literature, and to experience how reading about math is enjoyable. I also began other lessons by modeling how to make connections in text through read-alouds, such as *Counting Sheep* by Dr. Julie Glass and *Pigs in the Pantry* by Amy Axelrod. In all of my modeled lessons, I demonstrated how to make math connections and how to identify these connections with the use of Post-It notes.

Journal Entries

After modeling, I instructed the students to read silently and to note connections and to mark them accordingly. I also had them write a journal entry to record the books read and connections found. The journal entries enabled the students to reflect on their math connections and to communicate them in writing. They also allowed me to compare them to the connections marked with Post-It Notes and were helpful in keeping track of the books read by each student.

Collection of Data

Upon students' completion of the lessons, I collected the books and recorded the types of connections on a data chart by coding them. I also noted incorrect connections made by the students so that I could identify their misunderstandings.

On the first day of the project, I was pleased that they were very involved in identifying connections and noted that some students made great connections in the text. For example, Susan recognized that when determining a very large number, estimation is used to predict a close guess for the number. Although she needed assistance with the word "estimation" and we added this to the list, she recognized the concept independently. This surprised me, because she is a student who was recently referred for Special Education testing. At the end of this lesson, Sarah, who frequently misbehaves in my class, said, "This was fun! Can we do this again?"

Despite the enthusiasm and motivation, I did observe initially that, while students found many connections in the text, they were not all accurate. The connections in the next two lessons, however, appeared to be made more carefully. The students made fewer connections, but with more accuracy. I believe this was a result of my instructing them to focus on finding math connections and reminding them that it is better to make a few connections accurately than to make many inaccurately. Analyzing the results from these two lessons created a feeling of confidence in me that the students were indeed making connections in the text. I also noted that they were enjoying this, due to the excitement and smiles in the room throughout the lesson. Two days after the second lesson, one boy in my classroom, Stephen, a student of average ability, made a math connection while he was reading *The Indian and the Paintbrush*, a book chosen for self-selected reading. Excitedly, he explained to me that he found math in his book and showed me the word "multiplied" in reference to the growing plants in the text. During the third day's lesson, I observed more motivation and interest in reading the books and observed students as they made more math connections. They dutifully wrote on their "sticky notes," marked connections made, and wrote in their journals. I also found that they were making connections across texts. For example, Allison, a low-average math student, referred to the book I modeled in the day's lesson and compared it to her book. She said, "Just like you read about counting by numbers, I had counting by fours in my book." I was impressed that she made accurate connections and even made connections between different texts. Once again, I found great pleasure in analyzing the data at the end of the day. The students were indeed finding math connections, and with more accuracy than before. I felt that this initial research project was concluded and that I had support for my original idea: students are indeed capable of finding math connections in text.

A Change of Course

I felt a sense of completion with this project for a short time, but soon realized there was more to come. Andy approached me during his self-selected reading time and said, "Remember how we found math in reading? I have a book of poetry from the library and it has math in it." He proceeded to show me a poem from *There's a Bug in Teacher's Coffee* and pointed out an accurate math connection in the text. That evening, while sitting in my graduate school class, I thought about this incident and wondered, *Would other students do this without prompting from me? Would they recognize math connections without specific directions for finding them? Would they even read these types of books willingly?* These questions prompted me to take this project one step further. The next day, I decided to distribute a variety of books for self-selected reading, half of which were books used in the math connection lessons. I presented the books to the students and made no mention of finding math connections, but just allowed each child to select one book to read for self-selected reading. I was surprised by the results that followed.

Math and Literature Explosions

Like never before, the students were eager to choose the math books to read. Twenty out of twenty-three students present selected math books. In fact, so many students wanted to read the math books that I had to create a system of "picking a number" to obtain order and fairness in this activity. There were even quite a few books that were desired by five and six children! I noted the enthusiasm among the class over these math books. In addition, students were

recommending them to each other. This showed me that they really enjoyed the books and were showing much eagerness to read them. I found great pleasure in the fact that there were practically fireworks in the room about reading and math!

In addition to this overwhelming enthusiasm, I overheard some fantastic conversations among the students. Not only were they switching books and recommending them to others, they were talking about math during self-selected reading! Timmy, a student of low-average ability (one who appeared very frustrated in previous lessons and expressed an inability to find math connections) came to me and asked me for a "sticky-note." I asked innocently, "What for?" and he replied in his grumpy manner, "I want to find some math." I happily gave him a small stack of "sticky-notes" and proceeded to observe him as he accurately located six math connections in his book! For instance, he noted that dogs jumping off a raft and gradually decreasing in number in *A Dozen Dogs* was an example of subtraction. He also noted a pattern in the pages, as the dogs decreased one by one. Next, he asked an average student, Jonathan, to join him, and the two boys enthusiastically read four books and accurately labeled them with math connections! Another student, Mitchell, said to a friend, "Let's go ask Mrs. Pasko for some sticky-notes." I don't believe he was aware of Timmy and Jonathan's engagement in finding math connections. I was thrilled that my students were thinking about math during language arts. Cara, another student of low-average ability, had a revelation during this activity. She not only made a connection in a book that was not selected as a "math book," but she connected the text with a previous math lesson! When she saw an Egyptian pyramid in the book, she showed it to me and said, "Look--this is kind of like the pyramids we made with the marshmallows and toothpicks (in math)!" I was ecstatic that the students found pleasure in reading these books and found math connections in the texts!

Conclusion

Throughout the course of my research, I found much data addressing and answering my list of sub-questions, and I also was enlightened by my students' ability to connect math and literature and to enjoy reading about math. Not only can the students connect math with literature, but they also enjoyed doing so. I have always subscribed to a teaching philosophy in which learning should be enjoyable and meaningful for the students. When learning is fun for them, it seems that more learning takes place and their desire to learn more and to refine their knowledge is increased. The energy of the students in my classroom throughout these lessons has increased each day and can be compared to fireworks, each explosion becoming louder, brighter, and more powerful than the previous one.

In spite of this, though, the most important result was within my soul as a result of this project. This is a time when many of us feel that the job of teaching is overwhelming and even impossible. Sometimes it feels that we spend so much time assessing and so little time teaching. We feel that we just aren't good enough and don't "teach to the tests" enough. We feel that if we aren't teaching "by the book" and sticking to the scheduled minutes, we aren't doing a good job. Well, I took a risk by teaching outside of the curriculum and interrupting the precious "language arts block" to complete an action research project. At the end of it all, I learned something so valuable: sometimes it is OK to take risks and to follow our hearts. Our students will learn amazing things, and teachers will be reminded of what teaching is all about: the magic and

excitement of seeing students learn. When I try to put my feelings in words as I write this conclusion, my eyes well up with tears and the emotions in my heart are stirred. Teaching is indeed a special profession, with "paychecks" made out of such joyful moments instead of money. I suppose that is what keeps us coming back year after year, even with rigorous demands and often unappreciative students and parents.

Further Steps

Action research often creates new questions and directions in a teacher's desire to learn and to teach his or her students well. After conducting this project, I feel inspired to continue examining how students can benefit from curricular integration. At the end of *Math Curse*, the character repeats a quote from her teacher and says, "You know, you can think of almost anything as a Science Experiment." Recognizing the importance of subject integration, I am curious to see how students can use literature to increase their knowledge of science material, and I'd now like to know more about the integration of science and literature.

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The books used in this action research project are listed below, arranged alphabetically by title

- *26 Letters and 99 Cents*
- *100th Day Worries*
- *Alexander, Who Used to be Rich Last Sunday*
- *Bunny Money*

- *Counting Cows*
- *Counting Sheep*
- *Dozen Dogs, A*
- *Dragon's Scales*
- *Each Orange Had 8 Slices*
- *Eating Fractions*
- *Fraction Fun*
- *Get Up and Go!*
- *Great Book of Optical Illusions, The*
- *Icky Bug Counting Book*
- *Inch by Inch*
- *Math Curse*
- *Math Riddles*
- *Miss Bindergarten Celebrates the 100th Day of Kindergarten*
- *Monster Math*
- *Mother Goose Math*
- *On Beyond a Million*
- *One Guinea Pig is Not Enough*
- *One Potato*
- *Pigs go to Market*
- *Pigs in the Pantry*
- *Remainder of One*
- *Spaghetti and Meatballs for All!*
- *Too Many Things for Kangaroo to Do!*
- *Twenty is Too Many*
- *Very Hungry Caterpillar, The*