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Integrating literacy into the math classroom : a staff development for innovative educators

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Abstract

With the collaboration and advice of several mentors and practicing teachers, I found using strategies proven to help students during literacy instruction also had the same effect during mathematics instruction. I took various instructional activities, focused around using reading and writing skills in math, and was able to effectively instruct this group of students. This experience piqued my interest in the connection between literacy and mathematics. As a result, I decided to continue my research into how to effectively integrate these two core subject areas, investigating the efficacy of combining mathematics with literacy instruction.

Integrating Literacy into the Math Classroom:
A Staff Development for Innovative Educators

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Introduction

In the culture of current education, teachers are faced with unique challenges and various pressures. A spectator in a general education classroom can see the pressures clearly, especially in regards to assessment and data. Classroom teachers are increasingly required to provide assessment information that accurately depicts the achievement levels of their students, specifically to ensure their students are meeting set benchmarks (William, Lee, Harrison, & Black, 2004). The No Child Left Behind Act of 2001 states that all students will be proficient in the core subjects of reading and mathematics by 2014. The mandates of this act, combined with the time constraints of a typical classroom and the unexpected daily occurrences, provide a unique obstacle for many teachers (Faulkner & Cook, 2006). To focus on two subjects in a general education classroom may result in feelings of stress and uneasiness, as the teacher will have to adapt curriculum to fit not only students' needs but the established regulations. Furthermore, it has been shown that not many teachers are equally confident in teaching both the core subjects of mathematics and reading (Bursal & Paznokas, 2006; Wood, 1988). Many times, especially in upper elementary and middle school classrooms, schools are departmentalized, so that one teacher is not teaching both reading and mathematics to his or her students. The foundation of this project grew out of the premise that if teachers had a clear plan of how to integrate literacy into the mathematics classroom, it may afford the opportunity to improve student achievement and move away from single-subject focused curriculum.

Rationale

As a pre-service teacher, I was assigned to teach the highest achieving math students in a sixth-grade classroom. With my comfort level secure in literacy, I found myself researching instructional strategies to use with this high performing and challenging group of students. With the collaboration and advice of several mentors and practicing teachers, I found using strategies proven to help students during literacy instruction also had the same effect during mathematics instruction. I took various instructional activities, focused around using reading and writing skills in math, and was able to effectively instruct this group of students. This experience peaked my interest in the connection between literacy and mathematics. As a result, I decided to continue my research into how to effectively integrate these two core subject areas, investigating the efficacy of combining mathematics with literacy instruction.

Purpose

As the initial preview of the literature found that integrating mathematics with literacy instruction was consistently beneficial to learners, the primary goal of this project was to examine the benefits of integrating the core subject areas of literacy and mathematics, and to determine how teachers can incorporate researched literacy instructional strategies into their mathematics curriculum. The proposed staff development, to be conducted over three sessions within a six-month period, was designed to provide teachers with a balanced literacy program to include in their mathematics curriculum. The staff development represented in this project could be adapted to fit classroom teachers ranging from early elementary through middle school classrooms. The outcomes from this staff development are twofold: to help teachers realize the benefit of integrating

mathematics with literacy to improve student performance, and for teachers to recognize the ease in which these two subjects can be integrated.

Research Questions

Three questions guided my research and the development of this project. These questions are the focus of the staff development, with each workshop session focusing on one of the three questions.

1. Why is it beneficial to integrate literacy and mathematics?
2. How can teachers effectively integrate reading and mathematics in the classroom?
3. How can teachers effectively integrate writing and mathematics in the classroom?

Methodology

The purpose of this section is to explain my methodology for locating and selecting sources for my project. I first started with examining literature on how to integrate subjects areas in the classroom and on what the benefits of integration have been found in classroom practice. I primarily used the University of Northern Iowa's library website to research peer-reviewed articles that focused on my three research questions. Computerized bibliographic searches from abstracts and citations were searched and articles were selected. The following index sources were searched to locate articles in both educational literature and social science journals: PsycInfo (which allowed me to limit my search to only peer reviewed journal articles), ERIC, Wilson Web, and Academic Search Premier (EBSCO Host).

As I found resources related to integrated curriculum, I studied how the integration of multiple subjects became a current topic and concern in education due to outside-of-the-school pressures. I then researched the specific student and teacher benefits that are a result of the integration of literacy into the mathematics curriculum. Finally, I researched the specific instructional strategies and activities that teachers could incorporate in their classrooms to address mathematics and literacy. I gathered relevant information from published articles and books developed from research on teaching, learning, and integration of curriculum. I developed a concise literature review. The literature review provided the content in curriculum integration and literacy practice that formed the bases for the professional development project.

Literature Review

"Does tunafish + tunafish= fournafish?" (Moyer, 2000, p. 246). This quote from Moyer is a humorous view of the linear calculation of specific elements adding up to a combined but ludicrous total. This statement can be seen as a metaphor for curricula in the schools, where individual curriculum are isolated through instruction, yet touted as a collective curricular plan for learners. Historically, the focused curriculum in many schools throughout all grade levels has been a single-subject centered curriculum. Unfortunately, this type of structure is thought to disregard the natural form of learning and may leave students with a feeling of impracticality towards schooling. As schools have become more accountable to document school achievement (Helwig, Rozek-Tedesco, Tindal, Heath & Almond, 1999), new challenges arise from sources outside of the classroom. Publications such as, *A Nation at Risk*, published in 1983, and the *No Child Left Behind Act* of 2001, emphasize achievement in core subjects and base levels of achievement in subject-specific standardized tests (Wraga, 2009). As a result, these various pressures encourage teachers to have disconnected subjects and focus more on the specialization of content (Mei, 2009). Overall, "the cumulative message these circumstances send to students is that school's purpose is to study discrete academic subjects, deploy discrete bits of information, and pass tests" (Wraga, 2009, p. 89).

Society functions through an integrated fashion and learning does not occur in a fixed category, so many educators believe that education should follow a similar pattern (Mei, 2009). Therefore, in order to be productive members of society, students need to refer to multiple disciplines and areas of knowledge (Mei). A completely integrated

curriculum is not realistic in the majority of classrooms, especially in upper grade levels; however, correlated curriculums are a possibility (Wraga, 2009). In a correlated curriculum, subjects are separate in some ways, but are integrated in other ways so that students are encouraged to discover connections across their subjects.

Concerns of Integration

Many educators are concerned about the recent results in educational achievement studies. A recent study conducted through Trends in International Mathematics and Science Study (Gonzales, et al., 2009) showed the United States in the eleventh spot internationally for fourth graders in math achievement. Another finding by the National Assessment of Educational Progress, commonly referred to as the nation's report card, showed that many children fail to read at grade level, revealing that 68% of fourth-graders are not reading proficiently (Lee & Herner-Patnode, 2003). Therefore, it is understandable why the United States Department of Education felt the need to take a deeper look at public schools and the curriculum being taught. Government officials supported maintaining reading and mathematics as core subjects, and the regulations of NCLB reiterate this support by requiring specifically for all students to be proficient in reading and mathematics by 2014 (Hess, 2006). The implications for teachers are clear, yet may not be quickly achieved. Teachers may find that integration of subjects is not always the best solution for their particular class, and it has been argued that such integration of content may interfere with learning if the activities within content integration are not purposeful (Morris, 2003). However, research has shown that an integrated curriculum reaps many benefits (Paterson, 2003), including the support for teachers to structure their curriculum to meet district-wide and nation-wide regulations. To meet the specific mandates of NCLB, teachers may find

that the integration of mathematics and literacy in their curriculum will result in higher student achievement and a deeper learning experience.

Hesitance towards the Integration of Mathematics and Literacy

As a leading researcher in the connection between mathematics and literacy, Burns (2004) encourages teachers to integrate mathematics and literacy. When working with a group of practicing teachers, she found that many of the elementary teachers were not equally comfortable with both subjects. Her interesting findings led to a deep discussion of the importance of integrating content areas.

One of the largest setbacks to integrating subject areas was the lack of knowledge in the content areas (Burns, 2004). Burns found that many literacy teachers avoided mathematics classes during their teacher education program, and vice versa with mathematics teachers. There was a "general lack of comfort" (p.18) and "fear of the subject matter" (p. 18) towards the content area I n which they were less knowledgeable. These attitudes emphasize the need for teacher preparation programs to include a focus on curriculum integration (Zhbanova, Rule, Montgomery, & Nielsen, 2010). Before teachers can integrate the subjects, they need to feel comfortable with the multiple content areas. Furthermore, it would be beneficial if teachers understood the practicality and benefits of integrating curriculum.

Benefits of an Integrated Curriculum

Several benefits have been acknowledged with integrated curriculums (Zhbanova et al., 2010). A recognized main benefit focuses on the deeper connections to students' everyday lives as well as to previously learned material, creating a feeling of authenticity to learning. The authentic learning that is emphasized with an integrated curriculum is

beneficial for students to connect to real-world situations. Outside of the classroom, students will need to acquire and utilize knowledge from multiple subject areas, so it is believed that this type of learning should be emphasized in schools. Similarly, integrated content areas can develop students' critical thinking skills, develop deep understandings, and help students see the 'big' picture (Czerniak, Weber, Sandmann & Ahern, 1999).

Another benefit of integrated curriculum is associated with the limited amount of time in a school day. When a teacher has connectivity between subjects, he or she is able to address more than one subject area at a time (Zhbanova et al., 2010). Through this structure, teachers also have the ability to acknowledge areas in which students need additional support. Motivation is also a factor that could play a role in students' success in integrated curriculums. Typically in an integrated curriculum, there is more focus on problem-solving skills that include teamwork and collaboration with peers. As a result, it has been found that students in this structure often do better or as well as students in a single-subject focused curriculum (Zhbanova et al., 2010).

Deeper connections. Based in the constructivist theory, deep understanding is achieved when connections between prior knowledge and newly acquired knowledge are made (Czerniak et al, 1999). The natural education and connections that occur during an integrated curriculum is a very beneficial experience for students. For example, when reading a quality piece of literature during mathematics instruction, the literature is helping the students connect abstract ideas to the real world (Hunsader, 2004). Also, there is a connection between cognitive psychology and the schema theory which supports authentic learning experiences, such as integrated curriculums. The schema theory focuses on how a student can connect new information with information previously learned. If a student can

do this, the information will reside inside of an existing schema, and thus be more easily understood and retained (Hunsader, 2004), as well as improves students comprehension by finding a "mental 'home'"(Anderson & Pearson, 1984, p.255) for the text. Teachers are encouraged to find new ways to connect old knowledge with new knowledge, and many believe that by making connections to something familiar to unfamiliar, such as literacy with mathematicsconcepts, may help students in future academic situations (Kang, 1995).

Simultaneous development of skills. According to Draper (2002),

> Mathematics reform has worked to move instruction away from the tradition in which knowledge is viewed as discrete, hierarchical, sequential, and fixed and toward a classroom in which knowledge is viewed as an individual construction created by the learner as he or she interacts with people and things in the environment. (p. 521)

By integrating math and literacy, teachers are encouraging their students to simultaneously develop language and math skills by listening, reading, writing, and talking (Hunsader, 2004). "In the Principles and Standards, mathematical representations are generally recognized as symbolic (algebraic), verbal, graphical, and tabular (numeric)" (Bosse & Faulconer, 2008, p. 9). Research shows that students exposed to multiple representations of concepts have a higher rate of success and retention (Bosse & Faulconer). For example, by having multiple representations of how to solve a mathematical problem, students are able to use stronger critical-thinking skills, which may help with achievement on standardized tests.

In standardized testing the connection to mathematics and reading becomes very clear. The complexity of mathematical questions requires good literacy skills in both reading and writing to enhance a student's understanding of the meaning of mathematical problems.

> Since standardized questions are increasingly open ended, requiring students to read, understand the question, and then compose a response, reading and writing are no longer seen as interesting add-ons to mathematics curricula; rather, they are recognized as instrumental tools to deepen student mathematical understanding. (Bosse & Faulconer, 2008, p.11).

For example, when reading in mathematics class, students may find the mathematical text denser than typical text, as well as the directionality of the text to be different.

Furthermore, teachers have found that students have trouble using mathematical applications in unfamiliar situations. By integrating mathematics, which may be unfamiliar, with something more familiar, like reading or writing, teachers may find that students understand the material better (Brandenburg, 2002). Before integrating literacy and math, teachers should look at reading and writing integrated with math as separate concentrations, and then work to combine all three areas.

Reading and Mathematics

"Unfortunately, teachers assume that students bring (or should bring) reading skills from elementary reading programs to class" (Blanton, 1991, p. 163). The reality that many students are not receiving enough reading instruction is a key reason to integrate literacy and mathematics. Reading is considered a necessary trait to be a life-long learner, and it is common that academic subjects students struggle in with reading can also be focused on during math instruction. If students are expected to think mathematically, it is suggested that they need to learn how to read mathematically (Blanton, 1991). However, the majority of what students' read in math classes limit text exposure to short math biographies or history of mathematics. As a result, this type of mathematical reading is not entirely beneficial because it lacks authenticity (Adams, 2003). Before reading in math class occurs, however, the teacher must understand the various aspects of the reading process,

such as comprehension and fluency, which differ in mathematics instruction as compared to reading instruction.

Comprehension and Fluency

Some educators refer to reading as the basic interaction of two distinctive processes: decoding and comprehension (Helwig et al., 1999). Students who are able to decode words from a text are able to identify the letters as words, and then the words as meaning. Students that comprehend the text are also typically fluent in their reading abilities. The National Reading Panel (NRP) report of effective literacy practices stated that their research was based around three main topics: alphabetic- phonemic awareness and phonemic instruction; fluency; and comprehension-vocabulary instruction, text comprehension instruction, and teacher preparation and comprehension strategies instruction (National Institute of Child and Health Development, 2000). These literacy areas reflect the focus of the literacy curriculum in schools. Reading attributes such as decoding and word identification are heavily focused on in the early grades, and deeper fluency and comprehension in richer texts progresses through grade level progression. Many literacy educators believe that after students are able to focus on what the words mean, they can focus on the content and meaning of the text (Helwig, 1999).

Reading mathematical textbooks or literature about math requires different skills than reading a fiction novel or short story. Students may find reading mathematical text difficult due to the concisely written words and complicated syntax (Kang, 1995). In traditional mathematics classes, students are required to read texts that include words as well as numbers and symbols. The directionality of the text is not always left to right and top to bottom as in other textbooks (Bosse & Faulconer, 2008). Thus, the language of

mathematical text can be difficult for a student's comprehension and fluency development. To fully comprehend the text, the student has to understand the individual concepts within the reading passage as well as the connection between multiple concepts (Adams, 2003). "When the learning task includes deciding whether to calculate sums or products or quotients, when the information is present in words in sentences, students must first comprehend the language of the text before they can employ an appropriate algorithm" (Fuentes, 1998, p. 81). Due to the heavy and condensed load of concepts within mathematical text, the reading of word problems can be difficult for many students.

Word problems. Word problems in math classes are typically presented as a story or as a real-life situation (Adams, 2003). Students that have trouble with reading comprehension typically struggle with word problems in math class (Helwig et al., 1999), and students who have experienced success in reading courses may also find that they struggle with understanding the text within word problems. One way to tackle the complexity of concepts within word problems is through the use of a graphic organizer. Students who are able to comprehend a word problem, but struggle with the organization of the text, find the use of graphic organizers helpful in improving their understanding of text order and text organization (Zollman, 2009).

Polya (2003)is considered by some to be a leading educator in working with and in improving problem solving. Polya has identified four steps for working through word problems: read the problem without giving any attention to terminology; question what the problem is asking, and if there are terms that are confusing, refer back to the first step to re-read the problem; go through the actual mathematical procedure to solve the problem; then, re-read and use the text to confirm the solution to the problem. These four steps provide a

process for thinking about the concepts within a word problem, and for engaging with and reflecting upon the problem and the possible solution. After going through these sequential steps, a student who still has trouble comprehending the problem may be struggling with the specific language within the word problem.

Language specific to reading in mathematics. It is important that teachers and students understand the mathematical language and vocabulary that that will appear in the content-specific texts. While reading, it is beneficial if students are aware of unknown terms they will encounter in the text. Suggestions to overcome unknown terms include student awareness of word to symbol correspondence, words that indicate mathematical operations, as well as words that are specific to mathematics (Kang, 1995). The importance of understanding vocabulary leads to the importance of effective communication in instruction and learning. However, there is not one defined best practice or strategy to teach vocabulary, but rather the frequent and multiple exposures to new or difficult vocabulary are necessary for learning gains (Bratina & Lipkin, 2003).

There are several social conventions that are associated with understanding vocabulary, indicating that the source of knowledge lies within the learner (Burns, 2004). The majority of students come to school with a large variety of language and vocabulary exposure. Therefore, it is encouraged that teachers give students many opportunities to communicate and encourage the link between mathematics and language (Cook & Buccholz, 2005). One strategy to help students connect to the vocabulary and retain the definitions or meaning is to include some type of visual in the room, possibly a word wall or class chart (Cook & Buccholz, 2005). By transferring the new terms to a word wall, the students have constant access to the vocabulary and are able to demonstrate their

understanding of specific words through class discussions and classroom writing activities (Bratina & Lipkin, 2003).

The use of vocabulary in math class requires that students are able to correctly define the terms they are using. Many times, teachers allow students to use informal definitions as an introduction to formal definitions; however, it is important that students continually develop these definitions to address the concept they are discussing (Adams, 2003). Students may encounter multiple meanings, informal definitions, and the combination of symbols and text when reading these types of texts. When multiple meanings are encountered, it is important that teachers recognize the additional meaning and confirm if it is correct (Adams, 2003).

Similar to multiple meanings, homophones and similar-sounding words are also addressed in comprehension and fluency when reading mathematics. Homophones are defined as words with identical pronunciations, but possible different meanings. "Vocabulary in the mathematics classroom not only includes specialized terms such as quotient, multiplication, divisor, denominator, minuend, and subtraction but also everyday terms that take on new meaning when used in mathematical context" (Adams, 2003, p. 788). Once again, including visuals such as a homonym bulletin board or encouraging students to keep a journal of similar-sounding words would be beneficial. Overall, teachers are encouraged to have students incorporate the mathematical vocabulary in written assignments on a regular basis (Burns, 2004).

Choosing Appropriate Literature

In addition to addressing the specific skills related to reading and mathematics, teachers also need to decide what materials to include in the instruction. There are many

varieties of literature available to educators, but not all may be suitable for inclusion in a reading into math class. Furthermore, reading about mathematics and reading in mathematics are two different concepts (Bosse & Faulconer, 2008). The teacher needs to take on a detective role and critically search through literature and trade books to ensure the work is challenging and appropriate for each student.

> By selecting quality children's literature and using it to find natural mathematical connections, teachers can create an environment for learning that is supported by both the National Council of Teachers of English (NCTE) and the National Council of Teachers of Mathematics (NCTM)." (Hunsader, 2004, p. 618)

The subject of mathematics revolves around thinking and reasoning, and many teachers are shifting away from traditional text books and incorporating more high quality trade books in their instruction (Ducolon, 2000).

An informational trade book is a type of book that is a non-fiction piece written for a public audience, not necessarily always for education purposes (Wallace, 2008). Some educators believe that there is a lack of quality literacy instruction in the majority of mathematic trade books (Hunsader, 2004). The teacher who wants to use a trade book must ensure that the quality and material is appropriate for the goals of the class (Hunsader). Once the teacher finds a useful trade book, s/he is able to make connections more effectively between math and literacy, literally making math come alive and occur in a more natural educational setting (Hellwig, Monroe & Jacobs, 2000). Trade books can be grouped into four categories: counting books, number books, miscellaneous storybooks, and concept books (Hellwig et al, 2000). It is important to note that a good trade book is meant to supplement and enhance instruction, not replace traditional mathematical texts.

Specific criteria should be used when evaluating trade books (Von Drasek, 2006). Von Drasek suggests five key criteria for the evaluation of trade texts: accuracy, visual and

verbal appeal, connections, audience, and the "wow" factor. If a trade book meets these five criteria, it is considered acceptable to use in mathematics instruction as it's content is accurate and it's appeal to students will encourage their engagement and foster their connections between the reading world and the world of math (Hellwig et al., 2000).

Picture books. Literature for children, specifically picture books, gives teachers a useful extension from reading into math (Kay & Charles, 1995). Many educators believe that using children's literature increases motivation for children to read and learn about mathematics (Von Drasek, 2006). For example, high-quality picture books, such as *Caps for sale: A tale of a peddler, some monkeys, and their monkey business* (Slobodkina, 1968), could be used in preschool or kindergarten classrooms to introduce critical thinking and problem solving. Lessons with this story include children trying to understand and explain a procedure and how mathematical rules are apparent in the story (Ducolon, 2000). By providing unknown mathematical concepts into known language terms, such as in picture books, students would be able to identify connections more easily (Moyer, 2000). "It is through this interaction between both written and oral language that students have opportunities to build their reading and mathematical abilities in meaningful ways" (Moyer, 2000, p 246). Picture books are a text that could be used in any classroom with all ranges of reading abilities.

Writing and Mathematics

Current reform in education emphasizes student's active participation in their own understanding of mathematics (Johanning, 2000). One recommendation of the NCTM is to increase attention on students' abilities to communicate math orally and in writing. The increased amount of writing in math class can encourage students to discuss their ideas,

build arguments, and analyze concepts. When writing, students are able to reflect on their own understanding and pull together a cohesive understanding of a particular topic. Through writing, students develop a capacity to communicate ideas and use the language of mathematics smoothly (Johanning, 2000). For teachers, writing in math is beneficial because multiple examples of students learning and thought processes will be available (Dougherty, 1996).

Recently, there has been an emphasis on writing as a beneficial means of learning in math class, but little attention has been given to learning how to write mathematically (Burton & Morgan, 2000). Writing in mathematics class and writing to learn mathematics are two very different concentrations (Johanning, 2000). Some researchers have found that students have not been practicing writing skills during math or have had very little instruction in this area. The little writing that has occurred has been in small increments and primarily textbook based (Bosse & Faulconer, 2008). To encourage teachers to incorporate writing in math, Bosse and Faulconer provided four ways to easily foster writing, activities which help to demonstrate the value of writing in a mathematics class but which also require the teacher to rethink the role of writing in mathematics: require writing to be done often; provide opportunities that include a variety of writing assignment; incorporate writing in place of typical class work; and give positive feedback. Burton and Morgan (2000) have found that by teaching writing in mathematics class, teachers are making participation in math more accessible to all students. Part of the success of incorporating more writing into math classes is the comfort level teachers have with the math content itself and with their own teaching of mathematics (and writing).

By engaging in expository or creative writing, students are expanding their connections of mathematics and literacy (Quinn & Wilson, 1997). However, mathematics requires different and additional skills than typical writing assignments. Teachers need to understand the specific skills needed for each concept, and then relate those concepts into an authentic writing assignment. Specific instruction related to the expectations and requirements while writing in mathematics class needs to be addressed prior to the assignment (Bosse & Faulconer, 2008).

Journal Writing

Journal writing is one of the most common forms of writing found in math classrooms and one of the easiest ways to engage students in writing on a daily basis (Bosse & Faulconer, 2008). The use of journals in the classroom helps construct a deeper understanding "through a language-based approach to mathematics" (Dougherty, 1996, p. 557). There are a variety of ways to use journal-writing to integrate writing and mathematics.

To start journal writing, opportunities should be given informally so that students are eased into the process of writing in mathematics (Kay & Charles, 1995). One example of informal journal writing could include a nightly, reflective assignment. Students would have the opportunity to reflect on feelings from the previous class on a short, regular basis (Dougherty, 1996). Another option for a journal assignment is to structure the journal writing as an autobiography, or "mathography" (Kay & Charles, 1995, p. 22). In this form of writing, teachers encourage students to discuss feelings about prior experiences with math or recent feelings with a concept (Vacca, 2011). Using this strategy would also help teachers have a clearer understanding of prior knowledge, gaps in learning, or

misconceptions students may have. Another suggestion for journal writing encourages students to explain a newly learning concept in their own terms. The information from the informal journal writing can help teachers plan for instruction and address any student misconceptions on a daily basis (Janzen, 2005).

Mathematical researcher and teacher, Dougherty (1996) uses a structured framework for the journal writing in her algebra class, which includes three types of prompts: mathematical content, process, and affective attitudinal. The content portion allows students to discuss certain topics for deeper understanding. For example, the student could explain "the difference between undefined slope and zero slope is..." (p. 558). This prompt encourages students to connect their experiences and interactions with a specific math topic in a unique way. The second type of prompt, the process prompt, allows students to reflect on particular methods or strategies. This type of prompt could have students reflecting on how they solve a problem. For example, the student can think "when I have math textbook and see a word I don't know, I..." (p. 558). In this particular prompt, the student is also working on reflecting on decoding skills, or how the student identifies letters and words in a text. From process prompts, Dougherty (1996) states that students realize there are multiple solutions and methods to problems. In the final section, affective/ attitudinal prompts, students display creativity in their thinking by viewing themselves as a mathematician or problem solver. Overall, this journal structure is a beneficial starting point for teachers wanting to incorporate journal writing into math instruction.

An adaption to a conventional journal is to incorporate a double-entry journal into the classroom. A double-entry journal is beneficial in math class because "the students are able to use a two-column format to relate ideas" (Vacca, 2010, p. 301). One way to use a

double-entry journal in math class is to have students explain a particular concept in their own words, and then connect that concept to a real-world situation. Overall, by incorporating formal and informal journal writing into the classroom, students are able to engage in meaningful writing practice as well as work on mathematical concepts.

Writing and Poetry

An additional instructional activity to integrate mathematics and writing is to incorporate poetry into math class. By incorporating poetry into math, students are able to be involved in a creative process that allows students to apply their understandings of a concept in a unique form (Jenzin, 2005). One area of research focuses on the parallels between poetry and mathematics, specifically stating that the language rhythm and rhyme found in poetry can help students understand and remember mathematical terms and concepts (Danielson & LaBonty, 2004). As an example, children who have taken music lessons, studying the rhythm of music notes, have been thought to have a higher achievement in solving mazes, copying patterns, and drawing geometric figures (Danielson & LaBonty, 2004).

It has been found that writing poetry about math incorporates an additional way for students to speak, read, and write in order to develop an understanding of concepts and relationships (Danielson & LaBonty, 2004). Furthermore, writing poetry helps students understand specific literacy concepts, such as metaphors, similes, symbolism, and diction in a unique way. By having interesting and creative activities such as creating poetry with math, students are gaining an additional way to explain their understanding of concepts as well as learning additional ways to organize their thoughts.

Alphabet pyramids, terquains, cinquains, definition poems, haiku, and diamentes are examples of poems that can be used in a math curriculum (Danielson & LaBonty, 2004). An alphabet pyramid poem is shaped like a triangle: the first line must have a noun, the second line must have an adjective and noun, the third line must have an adjective, noun and verb, and the fourth line must have an adjective, noun, verb and adverb. A terquain is a simple three-lined poem about any subject. Each line states something about the subject. There are no rhymes or syllable patterns. Cinquain poetry utilizes an increasing syllable count in the first four lines, namely two in the first, four in the second, six in the third, and eight in the fourth, before returning to two syllables on the last line. A definition poem takes a word or a concept and attempts to define it, provide perspective, redefine it, or create a definitive example of it. Haiku poetry in English is usually written as a three line poem containing 17 syllables with five syllables on the first and last line and seven syllables on the second line. Diamentes poetry is written in the shape of a diamond using specific types of words on each line (such as adjectives, ing- words, etc.). An example of a simple poetry assignment can be focused on students creating haiku poems for geometry concepts. The following poem is a haiku adapted from Danielsons and LaBonty's (2004) examples:

Triangular Prism

Five faces, all flat

Your straight edges count to nine

Triangles- a must!

Writing a short poem could be easily incorporated into the beginning or ending of a lesson as another option for students to gain deeper understanding with a particular idea, as well as to introduce various formats of poetry writing.

Word Problems and Writing

As previously stated, writing to learn mathematics can be very beneficial for students. In regard to word problems, many students struggle how to understand the main question or concept in a word problem. This could be addressed as a reading issue, but it could also be worked through with writing assistance. One way to help students understand a word problem is to have the student explain the problem in their own terms (Johanning, 2000). Before discussing a word problem, it is beneficial to have students explore through writing their own thinking process.

By explaining word problems through writing, students are expected to explain their reasoning for choosing specific strategies or solutions (Johanning, 2000). This process encourages reflection as well as practice with sequential and organizational writing skills. By having students document the process they took to solve a problem, they are also practicing how to write in an organized manner. By writing, students are also able to see their reasoning in particular steps, which could lead to the recognition of an error (Johanning, 2000).

Conclusion

"Students who have opportunities, encouragement, and support for purposeful writing and reading in mathematics classes will have a more concrete grasp of concepts and be able to apply learning to alternate situation" (Bosse & Faulconer, 2008, p. 11). It is clear

from the literature that through the use of reading and writing in the teaching of math, students benefit academically. In addition, teachers benefit by being able to meet various standards and benchmarks in the curriculum.

The successful integration of literacy practices within math instruction positively impacts how students think about math and how students are able to successfully engage with math. For students to be successful, though, the curriculum and the instruction need to be effectively integrated. This successful integration of literacy strategies in math classes requires teachers to be familiar with math concepts, to be effective in using appropriate literacy strategies, and to be prepared to reorganize their instructional planning to make integration possible. Such demands on teachers and their instructional lives requires professional support that will address both the academic content and the instructional planning and implementation of curriculum integration.

The Project

The project I have created is shaped in the form of a staff development that would expand over the course of one school semester, typically twenty-five weeks. The staff development will be divided into three workshops, each workshop building upon the previous. Teachers will be engaged in each workshop through meaningful discussions with fellow colleagues, interactive examples, and technology-based learning activities.

Project Timeline

The following timeline provides the projected overview of the staff development implementation:

1. Session I:
    a. Introduction-
        i. What is the workshop; why this is important; practical applications
        ii. Hesitance towards integrating the core subjects
        iii. What research shows
    b. Writing and Math-
        i. Teachers experience with using writing in math class- how has it worked? What have you done?
        ii. Poetry and math- rhythm and rhyme
        iii. Use of journals in math class
    c. Homework for the first session
        i. Personal journal
        ii. Math and Poetry
        iii. Students' samples

2. Session II:
    a. Debrief: Have teachers share their journals, observations, and comments.
    b. Reading and Math:
        i. Discuss research and benefits of using reading and literature to teach mathematics
        ii. Marilyn Burns comments and connectivity
        iii. Divide teachers into groups and hand out a picture book to each group of teachers. Teachers will discuss picture books in terms of reading and math benefits.
        iv. Handout Marilyn Burns' list of recommended picture books divided by grade level and topic
    c. Homework for the next session
        i. Journal
        ii. Picture books
3. Session III:
    a. Debrief: How did the integration work? What books did you and your students find most engaging? Have teachers share their journals, books they found to use, and overall comments.
    b. Since this is the last session, ask teachers to continue to use their math journals to reflect on how they can continue to integrate the two core subjects. Hand out an evaluative form to teachers, which will assess their understanding of the benefits of integration and how their experiences in their classrooms. The evaluative form will also be available online, through a Google Document

Website, along with the websites, documents, and references used during the sessions.

c. Share the Google Documents with teachers. Teachers will also have the opportunity to upload any student work (made anonymous by teacher), suggested activities, or share any comments about the topic on the website.

Outline Description

At the first session, teachers will have the opportunity to learn the importance of integrating literacy and mathematics (See Appendix A for specific details). The workshop will focus on connecting the integration of the curriculums to current education policies and reforms. Furthermore, the first session will address the benefits and possibilities of integrating mathematics and writing. Teachers will be asked to examine their own practice in writing, and to envision implementing writing in their own classroom.

Writing practices will focus on journal writing (including double entry journal writing) and poetry. Specific focus will be given to connecting writing with mathematics concepts, and the use of poetry in encouraging students to write about their math understandings. Homework for the next session (Session II): Each person will receive their own journal at the beginning of the session. Teachers will be asked to be prepared next session to show how they were able to use writing in math time. They will be asked to bring examples of student work and progress, and to share what they found that worked in their classroom as well as to share what did not work. Also, they will be asked to be prepared to talk about the use of poetry and math, responding to the prompt, Were your

students able to write their own poems? Teachers will be asked to bring their journals to the next session in order to share their thoughts and experiences more fully.

During the second session, teachers will be able to d iscuss their learning process and their student experiences with writing during math class. After the discussion, teachers will receive information regarding integrating reading and mathematics through the forms of picture books, trade books, and specific tips to help students read mathematically (See Appendix B for specific details). Homework for Session II: Teachers will be asked to reflect in your journals on how their students responded to using literature in math class. Teachers will also be asked to check their school library for trade books that would be useful in connecting reading with math concepts. Teachers will be encouraged in this homework assignment to include at least four of the recommended math picture books from Marilyn Burns in their class library and in their planning for integrated instruction in their math curriculum.

The final session will conclude the workshops with teachers sharing their experiences with integrating texts in the math instruction and in researching the books available to them through their school library. Teachers will be provided an opportunity to share information about the trade books that seemed work well in the math instruction over the past few weeks. Following the sharing of their trade book use in the classroom, teachers will be provided access to the internet to explore an interactive website designed specifically for their professional development in integrating curriculum. Teachers will be work in partners and small teams to explore the internet and to discuss possible application of the ideas in their classroom math instruction. The session will close with final comments from the teachers and myself regarding the implementation of literacy in math instruction,

and to encourage them to ncontinue the integration of the two core subject areas (See Appendix C and D for specific details). Teachers will be encouraged to continue their partnerships with colleagues by networking face to face on online to continue their ongoing wok and to further their integration of curriculum in their teaching.

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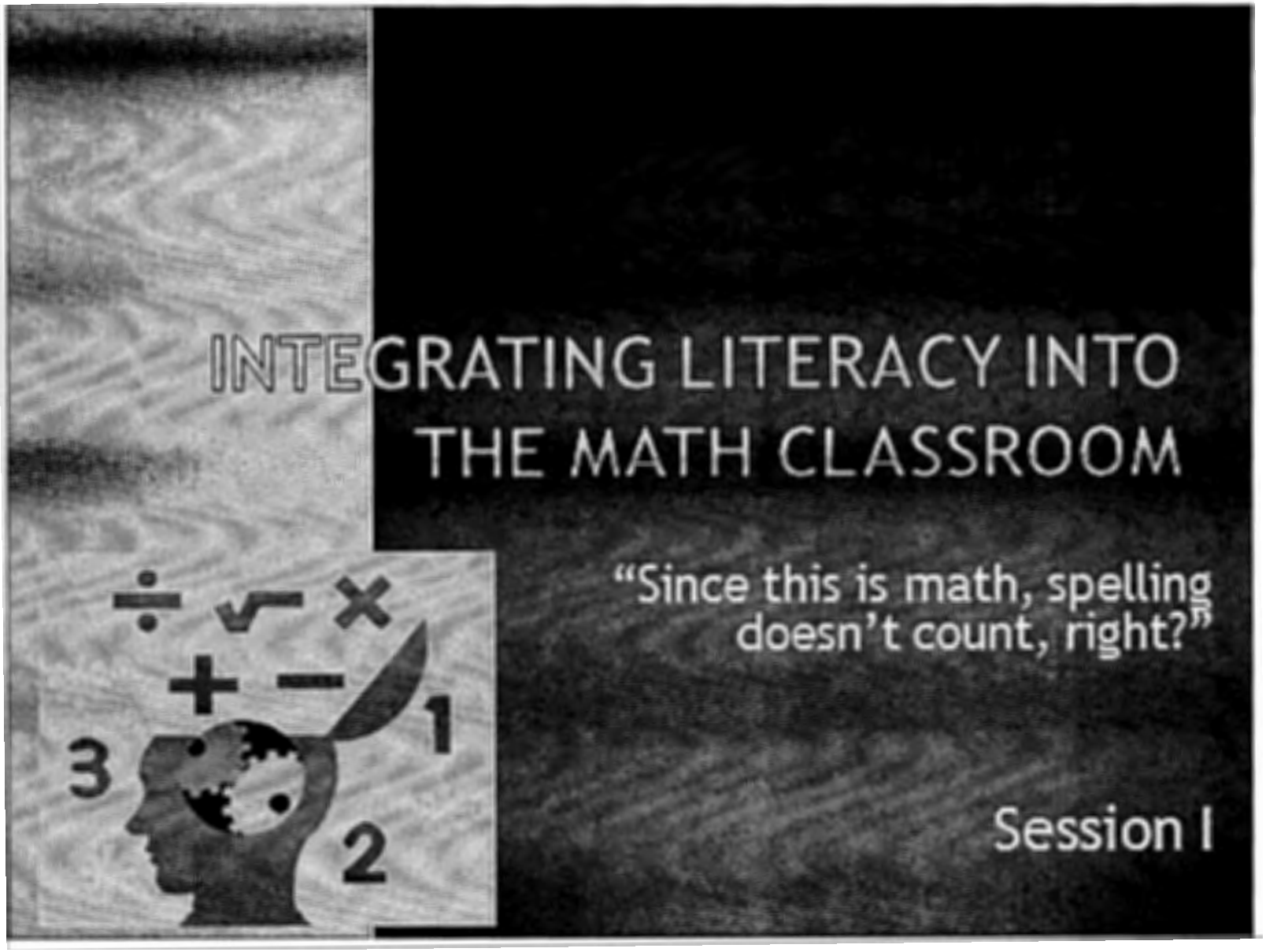
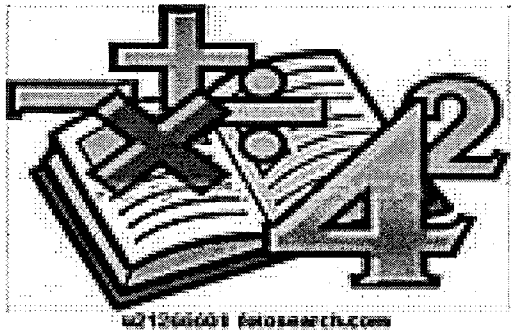
Appendix A:

Session I PowerPoint


INTEGRATING LITERACY INTO
THE MATH CLASSROOM
"Since this is math, spelling doesn't count, right?"
Session I



- According to the NCTM, students who have opportunities, encouragement, and support for speaking, writing, reading, and listening in mathematics classes reap dual benefits

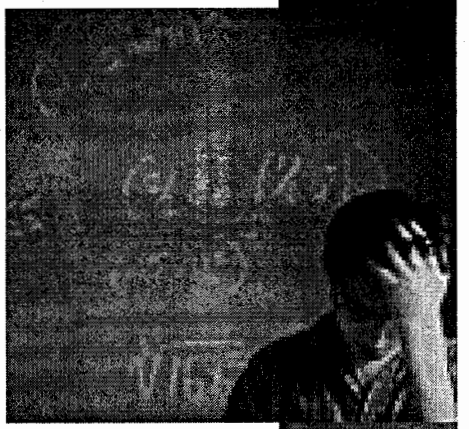
PRESSURE

- In a recent study by Trends in International Mathematics and Science showed that the United States ranks 11th in math achievement when comparing 4th grade students internationally.
  - The countries that rank above the U.S. include: Singapore, Kazakhstan, Russia, and the Netherlands.

- NCLB: In 2014 students will be proficient in reading and in math.

RESEARCH

- A large setback in integrating mathematics and literacy is the lack of confidence towards a content area.



- Benefits of integration:
  - Deeper connections
  - Authentic learning
  - Development of critical thinking skills
  - Improvement on standardized tests

- Writing through journals, using poetry, and picture books

WRITING

WRITING

- One recommendation of the National Council of Teachers of Mathematics is to increase attention to student's ability to communicate math orally and through their writing.

- Writing in math requires different skills
  - Numbers and symbols
  - Directionality
  - Organization

BENEFITS OF INCORPORATING WRITING

- **Organization skills:**
  - Students can work on organizing their thoughts related to the math topic
  - Helps clarify thinking

- **Teacher benefits:**
  - Evaluation
  - Identify misconceptions
  - Close learning gaps

GUIDELINES TO ASSIGN WRITING

1. Model

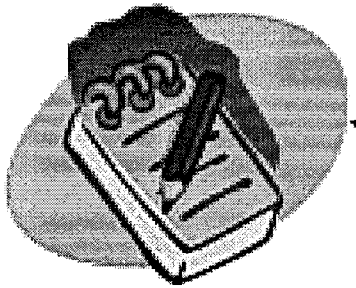
2. Time frame

3. Make expectations clear

   "Since this is math, spelling doesn't count, right?"

IDEAS FOR WRITING

- **Poetry**
  - Students are able to be more creative in their application of math concepts
  - The rhyme and language rhythm found in poetry can help students understand and remember mathematical terms and concepts



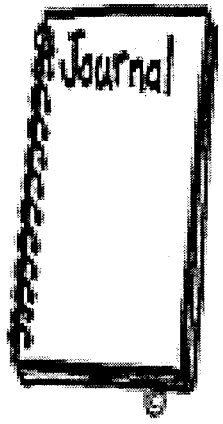
Triangle Prism

Five faces, all flat
Your straight edges count to nine
Triangles- a must!

http://www.tooter4kids.com/classroom/math_poems.htm

JOURNAL WRITING

- Quick
- Efficient
- Easy to incorporate



- Start informally:
  - How did you feel about the new topic we learned yesterday in class?
  - Explain everything you know about---
  - Write about a time you had trouble in math class.
  - How would you explain this formula/concept/idea to a friend?
  - What didn't you understand about this problem?

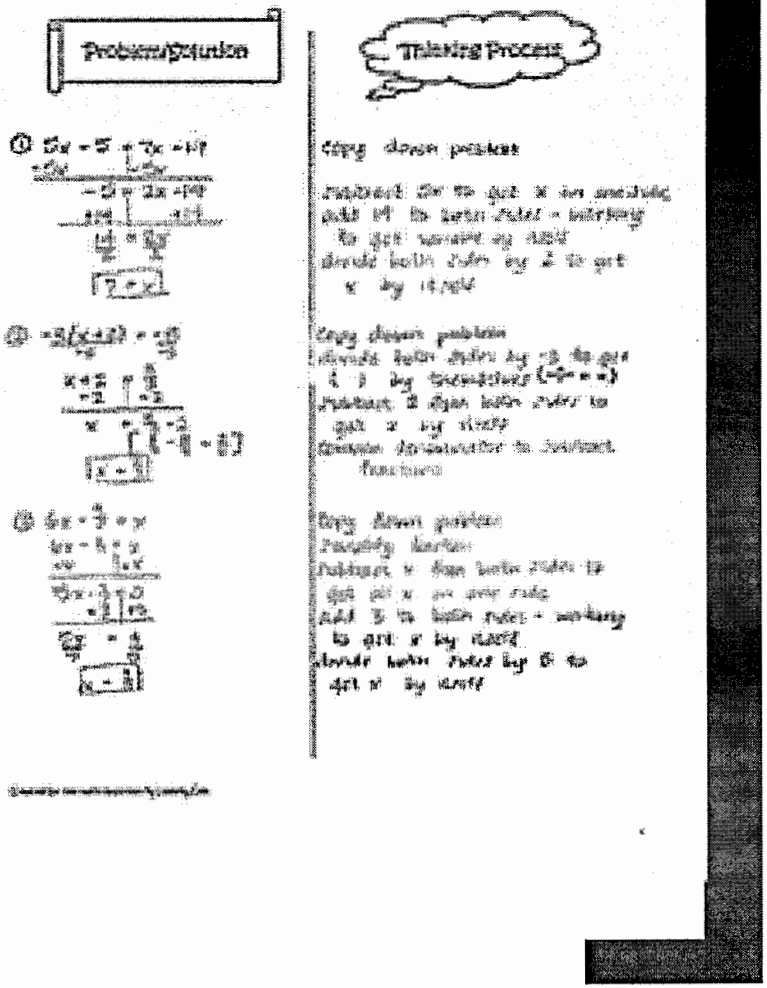
A more structured framework:

- 3 types of prompts: mathematical content, process, and affective attitudinal

1. Mathematical content
   - "The difference between undefined slope and zero slope is..."
2. Process
   - "When I see a problem that I don't know, I first...then I...and finally I..."
3. Affective attitudinal
   - "Describe this problem in your own words"
   - "Create your own word problem using..."

DOUBLE ENTRY JOURNALS

- Students are able to use a two column format to relate ideas, concepts, etc.
  - Compare two concepts
  - Connect a problem to real-world
  - Give formal definition of term, then explain in own words



DISCUSSION AND CONCLUSION

- **Can you see these strategies working in your classroom?**
- **For next session:**
  - Journal assignment- How did it work? What would you change for next time? Student reactions? Was the poetry writing effective?
  - Examples of student work would be helpful!

Appendix B:

Session II PowerPoint

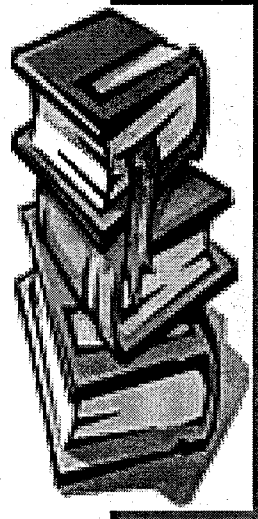
INTEGRATING LITERACY INTO THE MATH CLASSROOM

"Success in one area reinforces success in another" - Douglas Clements

Session II

READING

- If students are expected to think mathematically, they need to learn how to read mathematically.



- **Difficulties with reading mathematical text:**
  - Fluency
  - Numbers and words
  - Directionality of the text
  - Comprehension
  - Language

- *Marilyn Burns Video:*
  http://teacher.scholastic.com/reading/bestpractices/math.htm

COMPREHENSION

Reading Comprehension	Math Comprehension
•Students predict what will come next in the story • Writing is not identical between students or different subjects •Reading combines whole-class, small-group and individualized instruction	•Students make estimations before solving problems •Students are encouraged to use different methods to solve problems •Math combines same types of instruction

Adapted from :
http://www.mathsolutions.com/index.cfm?page=nl_wp1&crid=160&contentid=529

- Math can be like another language to students. It is important that students understand the vocabulary

- Use authentic instructional strategies- ones that students are able to connect to real-life situations.

- Use books that incorporate vocabulary in ways that students will be able to understand.

INCORPORATING BOOKS

Reading about mathematics and reading in mathematics are two different things

- **Literature for children provides a useful extension from reading into math**

- **Benefits for students**
  - Creativity
  - Motivation
  - Engagement
  - Deeper connections
  - Reiterate concepts

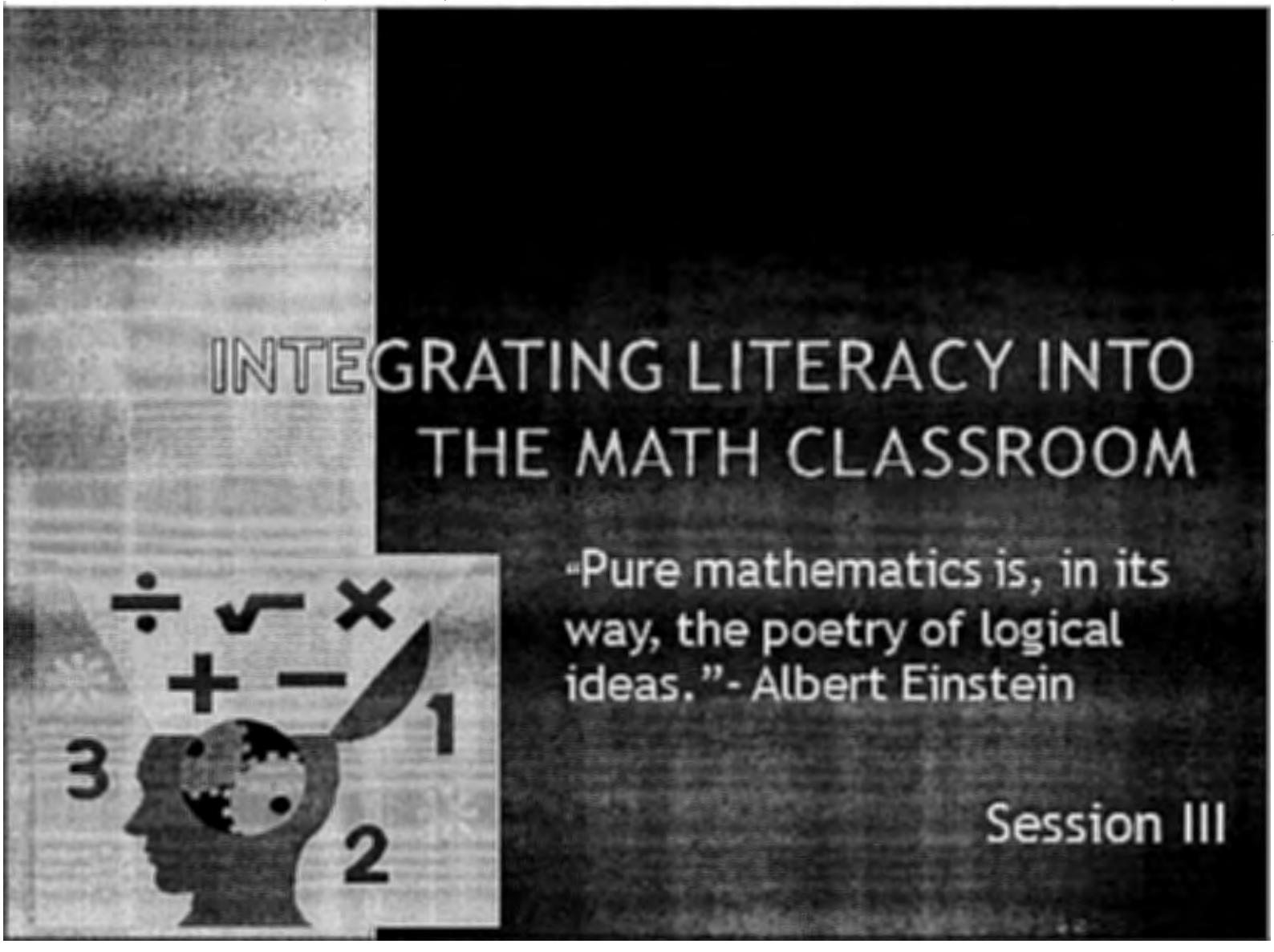
http://teacher.scholastic.com/reading/bestpractices/math.htm

EXAMPLE BOOKS TO HAVE IN YOUR CLASSROOM LIBRARY

- **Example books used**
- Adler, D. (1996). *Fraction fun*. New York, NY: Holiday House.
- Aker, S. (1990). *What comes in 2's, 3's & 4's*. New York, NY: Simon and Schuster Books for Young Readers.
- Anno, M. (1975). *Anno's counting book*. Mexico: HarperCollins Publishers.
- Burns, M. (1994). *The greedy triangle*. New York, NY: Scholastic Inc.
- Fromental, J.L, & Jolivet, J. (2006). *365 penguins*. New York, NY: Harry N. Abrams
- Geisert, A. (1992). *Pigs from 1 to 10*. New York, NY: Houghton Mifflin Company
- Hutchins, P. (2000). *Ten red apples*. Singapore: Tien Wah Press
- Leedy, L. (1997). *Measuring Penny*. New York, NY: Scholastic Inc
- Lewis, J.P. (2002). *Arithme-tickle*. New York, NY: Harcourt Inc.
- Wood, A. (1984). *The napping house*. Singapore: Tien Wah Press
- http://teacher.scholastic.com/reading/bestpractices/pdfs/mbmath_TitleList.pdf

Appendix C:

Session III PowerPoint


INTEGRATING LITERACY INTO THE MATH CLASSROOM
"Pure mathematics is, in its way, the poetry of logical ideas."- Albert Einstein
Session III
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DEBRIEF AND DISCUSSION

- Share journals:
  - How did the integration work?
  - What books did you find you and your students most engaging and effective?
  - Comments, share student work, and discussion

FINAL COMMENTS

- Continue to use your math journal to reflect on how you can integrate the two core subjects.

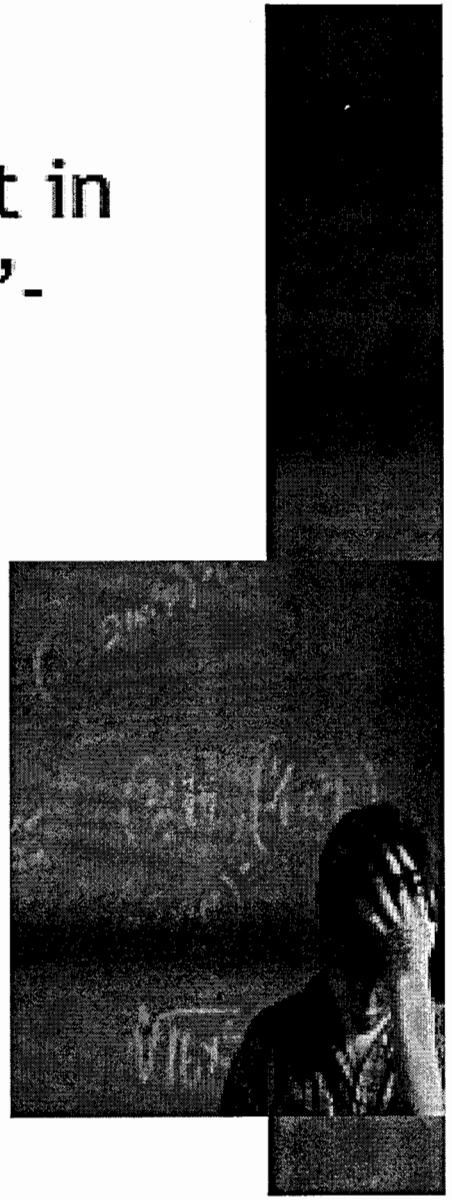
- Handouts from Marilyn Burns collection

- Evaluative form

"All children will be proficient in reading and math by 2014"-

No Child Left Behind 2001

Will your students be?



Appendix D:

Google Documents

Google Documents Website

INTEGRATING LITERACY IN THE MATH CLASSROOM

Home

Welcome!

This site was created as a part of a staff development for practicing teachers in the general education elementary classroom.

Teachers participating in the workshop are able to use this website to:

- Search websites relevant to the project
- Watch videos used in the workshop from Scholastic.com
- View handouts from workshop
- Complete evaluative form of workshop
- Upload anonymous student work relevant to the topic
- Participate in a continuous blog discussion

Thank you for visiting the website! Any questions can be Directed to katiepollina@gmail.com

Subpages (5): Evaluative Form Handouts References Student Work Websites

Add comment

Handouts

The following attachments can be found underneath the Attachments tab:

Marilyn Burns compiled a list of books, separated by concepts and grad level, that she believed to be effective in student development. Under attachments, you will find the PDF list of these books. The list can also be found at http://teacher.scholastic.com/reading/bestpractices/pdfs/mbmath_TitleList.p

- PowerPoints from three sessions
- Double entry journal
- Structured journal

Attachments (6)

Handout-Double entry journal.docx - on Jul 19, 2011 11:57 AM by Katie Pollina (version 1)
29k View Download
Handout-Structured journal.docx - on Jul 19, 2011 11:57 AM by Katie Pollina (version 1)
15k View Download
MarilynBurnsMathLibraries.pdf - on Jul 18, 2011 7:33 PM by Katie Pollina (version 1)
20k View Download
Session III Powerpoint.pptx - on Jul 19, 2011 11:54 AM by Katie Pollina (version 1)
238k View Download
Session II Powerpoint.pptx - on Jul 18, 2011 7:35 PM by Katie Pollina (version 1)
918k View Download
Session I Powerpoint.pptx - on Jul 19, 2011 11:55 AM by Katie Pollina (version 1)

Home >

Websites

Listed below are the websites I found to be helpful while designing this staff development:

- Marilyn Burns on integrating literacy and math:
  - *http://www.mathsolutions.com/index.cfm?page=nl_wp1&crid=160&contentid=529*
  - *http://teacher.scholastic.com/reading/bestpractices/math.htm*
- National Council of Teachers of Mathematics and National Council of Teachers of English
  - *http://www.nctm.org*
  - *http://www.ncte.org*
- Poetry in math class
  - *http://www.tooter4kids.com/classroom/math_poems.htm*

Home >

Student Work

This page is for teachers to upload **anonymous** student work relevant to the workshop. It would be helpful to have a short description of the work and the student's reaction.

To upload a document, simply click on the (+) icon below next to Attachments.

To leave a comment, click on the (+) icon next to Comments.

Appendix E:

Workshop Materials

Workshop Materials and Equipment

Overhead projector

Computer with PowerPoint software and internet access

Teacher packets

Evaluative form

Name card

Writing utensils

Journal for each teacher

Picture books:

- Adler, D. (1996). *Fraction fun.* New York, NY: Holiday House.
- Aker, S. (1990). *What comes in 2's, 3's & 4's.* New York, NY: Simon and Schuster Books for Young Readers.
- Anno, M. (1975). *Anno's counting book.* Mexico: HarperCollins Publishers.
- Burns, M. (1994). *The greedy triangle.* New York, NY: Scholastic Inc.
- Fromental, J.L, & Jolivet, J. (2006). *365 penguins.* New York, NY: Harry N. Abrams
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- Hutchins, P. (2000). *Ten red apples.* Singapore: Tien Wah Press
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- Lewis, J.P. (2002). *Arithme-tickle.* New York, NY: Harcourt Inc.
- Wood, A. (1984). *The napping house.* Singapore: Tien Wah Press

Double Entry Journal

Solve the problem	Explain the problem and the steps I took to solve the problem.

Mathematical Content	Ex: The difference between ____ and _____ is…	
Process	Ex: When I see a problem I don't know, I first…	
Affective attitudinal	Ex: Describe ____ in your own words.	