

Integrating Mathematics and Reading Fluency Instruction in the Primary Grades

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Abstract

The focus in this article is on integrating instruction in reading fluency with mathematical concept development in the primary grades. Procedures are described herein for having students engage in hands-on mathematics while reading children's literature. In addition, students produce an audio compact disk and engage in performance reading in a readers' theater format with stick puppets. The strategies presented can be adapted in a variety of learning environments.

Educators and psychologists have for many years demonstrated the importance of involving learners physically and emotionally, as well as academically, in their learning. Vygotsky (1978) was a pioneer in demonstrating the importance of socialization as a vital component of learning. Vygotsky proposed that there is a zone of proximal development in which the learner is ready to learn but must receive support in both social and academic contexts. Such support is comprehensively described by Rasinski (2010) as scaffolding wherein the learner is led from dependence on the person in the role of leader/teacher to independence.

Following the lead of Vygotsky, the importance of social acceptance and creating a self-image as a successful learner was strongly advocated by Bandura (1997). The work of Vygotsky, Bandura, and many others of like mind provided the foundation for the constructivist movement in education with its emphasis on "hands-on" learning and developing the whole person in schools in addition to learning information and skills.

Parkay and Stanford (2001), based primarily on the work of Swiss biologist and social scientist Jean Piaget, determined that children learn most effectively and efficiently by engaging in physical, social, and academic activity within their environments. Children need to be physically and mentally active rather than passive learners. Piaget's work also



suggested to these researchers that activity is not only physical manipulation but also fosters mental action that transforms into creating new, exciting, and permanent learning. In this light, Csikszentmihalyi (1997) determined that when a child likes what he or she is doing and is encouraged to do it, "focusing the mind becomes effortless" (p.27). Further, Peterson (2006) determined that positive emotional climates foster "broader attention, greater working memory, enhanced verbal fluency, and increased openness to information" (p.58).

Gardner (2004) powerfully demonstrated the need for involving as many modes of intelligence as can be integrated into the learning environment. Gardner persuasively challenged the long held contention that "intelligence is a single entity and people are born with a certain amount of intelligence" (p.29). Gardner further contended that it is essential that educators/leaders, through engaging positive intervention, actually enhance intelligence. Integrating mathematics and readers' theater, in light of Gardner's theory of multiple intelligences, especially encourages linguistic intelligence, "facility in the use of spoken and written language" (p.31). Spatial intelligence and the personal intelligences, intrapersonal and interpersonal, described by Gardner, are also engagingly facilitated through strategies such as integrating mathematics and readers' theater. In addition, Gardner described "naturalistic intelligence" as intrinsic and intuitive ability

to discern what is in nature, literature, mathematics, and art (p.36). We believe “naturalist intelligence”, is especially encouraged by production of stick puppets and scenery as an integral part of performance reading. Gardner determined that the different intelligences interact and overlap.

Mathematics and Literature

Pat Hutchins’ *The Doorbell Rang* (1986) offers a wonderful context in which to get children thinking about division. In this story, Hutchins presents division through the sharing of a batch of cookies. By choosing twelve cookies, an abundant number (i.e., there are a lot of factors for twelve), the story remains interesting and accessible as the pages turn. The National Council of Teachers of Mathematics [NCTM] stated that children in grades PreK– 2 “understand situations that entail multiplication and division, such as equal groupings of objects and sharing equally” (NCTM, 2000, p.78). This story offers just such an opportunity to introduce division to young children.



Photograph 1: Cookies for manipulation

Two types of division problems are discussed in the professional literature, measurement division and partition division (Van de Wall, Karp, & Bay-Williams, 2010). *The Doorbell Rang* encourages children to explore partition division on their own and measurement division through guidance from the teacher.

Teachers are encouraged to provide children manipulative materials to model the situation as the story unfolds. Teachers can provide students with a set of laminated paper cookies. We photocopy a set of 12 chocolate chip cookies on 110lb. cardstock. Beige, sometimes called buff, cardstock is readily available in office supply stores and makes realistic looking cookies. This is much easier than copying on white cardstock and coloring the cookies. We cover the whole page of cookies with a plastic covering such as clear Con-Tact® and then the children cut out the

cookies. Each child’s set of cookies can be kept in a zipper sealed plastic sandwich bag. We also produce hanging nameplates for the characters in *The Doorbell Rang* for later use in readers’ theater.

Partition Division

As children read the story, they encounter four situations in which the cookies need to be divided. Initially, two children are going to share the 12 cookies. Since the size of the sets is unknown, this is a “partition” problem (Van de Wall et al., 2010, p.155). The remaining three divisions occur in the story, including sharing between four, six, and 12 children. As the children read the story, they are encouraged to physically divide the initial batch of cookies. A frequent strategy is to give each child one cookie at a time since the amount of cookies each child should receive is unknown as the story progresses. As children read this story, they will experience these four situations in which the cookies must be divided (shared) in a realistic context. We use paper plates to make the activity more realistic.

Measurement Division

As a follow-up, we ask, “How many children could be at the table if each child were to receive exactly 4 cookies?” This is one situation that was not presented in *The Doorbell Rang* where a factor of 12 could be used. This question presents a “measurement” division situation, where the number of children is unknown (Van de Wall et al., 2010, p.155). Since the students know that exactly four cookies should be given to each child, the students can subtract four cookies at a time. This process will allow for three children at the table. This method of division is called measurement, or subtractive, division because the students know exactly how many to subtract, in this case, $12 - 4 - 4 - 4$. Having subtracted four a total of three times leaves no more cookies, so, consequently, there are enough cookies for three children.

These two types of division problems, partition and measurement, are important for all of us as teachers to know; however, students need not identify problems as being one or the other. Partition and measurement division are important concepts for us to know as teachers so that we do not only use one form in the problems and exercises we have our students work out. For example, *The Doorbell Rang* presents opportunities for partition division but not for measurement division. Consequently, upon recognizing this limitation, we will present additional questions and story-based situations that require measurement division. Measurement division involves slightly different, but essential, problem solving strategies.

The Doorbell Rang offers an opportunity in which

mathematics is presented in such a way that young children can access the operation of division. Older students often have their first memories of division as the long-division problems they encountered in the upper elementary grades. However, the NCTM Standards state that, "Teachers play an important role in the development of students' problem-solving dispositions by creating and maintaining classroom environments" (NCTM, 2000, p. 53). By using enjoyable stories to involve students in solving a problem, students begin to view mathematics as natural and viable even in the primary grades.

In this light, an extensive review of research led Cartwright (2009) to determine that going beyond domain specific study strategies (i.e. mathematical computation) by integrating other learning domains (i.e. literary experiences) encourages "cognitive flexibility" leading to more powerful learning experiences (p.130). In addition, Cartwright concluded that study across texts fosters development of the "ability to conceptualize a task or situation in multiple ways" leading to greater comprehension and flexibility relative to new reading (p.118).

CD Production

In addition, we invite the students to produce a CD based on the text of *The Doorbell Rang* (Hutchins, 1985). The text is put into a play format with a narrator and parts for each of the characters. The students practice their parts and when they and their reading coach determine they are ready, they record the script. The reading coach can be an older student, teacher, instructional assistant, or parent volunteer. A digital recorder such as the Olympus WS-311M works very well. We make a professional looking label with the name of the actors in a text box. Label making programs such as the one produced by Memorex are easy to use and inexpensive.



Photograph 2. Students practice reading *The Doorbell Rang*.

In this age of high stakes testing much school time is devoted to test preparation and focus on skills oriented activities that are often dull and tedious (International Reading Association, 1999). On the other hand, we have found reading competencies can be greatly fostered through exciting activities such as recording CDs. As described earlier, this is an issue that goes beyond pedagogy to basic human desires to do interesting and meaningful things. In addition to producing a CD students also engage in performance reading for an audience.

Performance Reading: The Puppet Play and Readers' Theatre Production of Stick Puppets

Characters for puppets can be photocopied from the text, *The Doorbell Rang*, or drawn by students. The size of photocopied characters can be easily adjusted using the zoom feature on a copier. Crayons tend to work much better than markers for coloring the figures unless the figure is very small or specific detail is necessary. General production guidelines are presented below and are not limited to working with *The Doorbell Rang*:

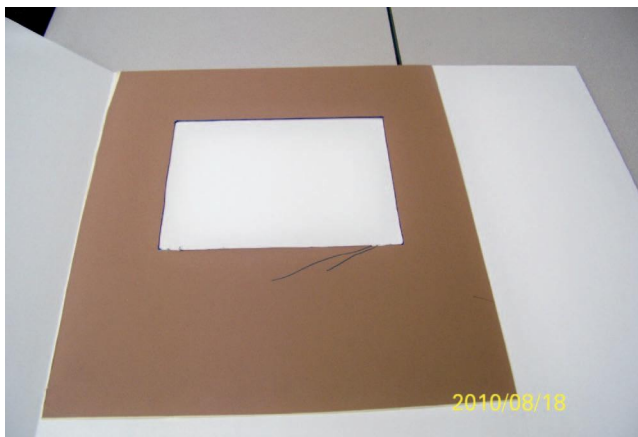
- Use white 110 lb. cover weight paper to photocopy the puppet outlines. Regular copy weight paper is too flimsy. You can get by with 67 lb. paper but it is not as durable. If students are drawing their own puppets, we suggest using regular white drawing or copy paper and then transfer the drawing for the puppet using a glue stick to the 110 lb. paper. This is advisable because students tend to make several attempts before settling on a drawing with which they are satisfied.
- Invite the students to color the figures that will become the puppets. We are perfectly content with multi-colored animals whose colors do not resemble those in the wild. Crayons work much better than markers.
- Cover the figures with clear plastic adhesive such as Con-Tact®. This is not essential but contributes substantially to durability and keeping the puppets clean. Covering the puppets is especially important if we are producing a set of puppets for extensive classroom use.
- Cut out the puppets. Some students leave space around the edges. For example, it might be difficult to cut around the hands on a character. Leaving spaces does not detract from the overall quality of the stick puppets. A light color can be added around the white space to provide texture to the setting.
- Using a glue stick, attach the figure to a large craft stick (6" x .75"). The smaller popsicle size sticks are usually inadequate for holding the puppets unless the puppets are very small. Reinforce the placement of the craft stick by placing a piece of tape over the stick and onto the puppet base. Even though there might be several stick puppets for a

short production, we make it possible for each child to eventually have a copy of the story and all the puppets. Having one set to share does not work well since just about all of the children want the full set of puppets that go with a story. The students frequently report retelling and/or rereading the story at home with the puppets for their parents, siblings, and friends. This rereading is great practice and can be especially helpful for encouraging younger children in the home to appreciate the joys of reading. For example, a parent told us that his daughter made a stage at home using bunk beds and performed many variations of plays using the stick puppets prepared in class. His daughter involved her younger brother and sister in producing the plays. She even made “tickets” for family members and friends to attend performances!

Production of the Puppet Stage

All great puppets must have an excellent puppet stage! A durable, convenient, and easily stored puppet stage can be made out of a tri-fold display board. These multi-purpose display boards are typically used for science fair presentations. A good size for placing on a table is 40 inches x 28 inches overall. Boards this size will usually have a 20 inch x 28 inch front panel. Production guidelines are presented below:

- On the center section of the display board, measure a centered square about 12 inches x 9 inches. The square can be larger or smaller depending on the size of the display board. We use a template made out of mat board to facilitate designating the area to cut out the window of each puppet stage.



Photograph 3: Template for window for the puppet stage placed on the display board.

- A knife with a retractable blade works well for cutting the square out of the display board and makes smooth cut lines. A knife with a serrated edge or sturdy scissors will also do the job. Do not be concerned about making precise cuts because you

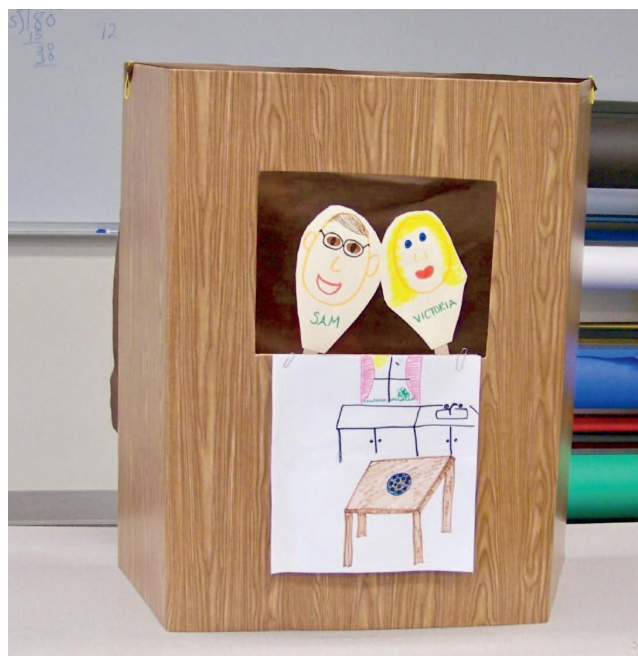
can cover the edges and make them smooth. Be sure to place a piece of scrap mat board under the display board to keep from damaging the surface below the display board.

- Cover the outside of the display board with plastic adhesive such as Con-Tact®. We have found that it is much easier for two people to cover the board with the adhesive than for one person to attempt to do it. Cut two full pieces of Con-Tact® 31 inches long and one piece 31 inches by 9 inches. This will be enough to cover the board. The 9-inch wide piece is half the width of the Con-Tact® roll and, consequently, can be used for part of the covering for another stage. Completely cover the board with Con-Tact® leaving about one inch over the edges. Turn over the board with the Con-Tact® face down. Draw a line from the upper right corner of the window to the lower left corner and from the upper left corner to the lower right corner. This makes lines in the form of an X with four triangles. Cut along the lines and then fold over the triangles onto the edges of the window. This will make a very neat and secure window.
- Fold over the Con-Tact® on the outside edges. Before folding, it is helpful to trim the corners to avoid excessive overlap of Con-Tact® on the corners.
- There is a variety of eye-appealing patterns typically found in the shelf liner section of stores. On the other hand, some teachers simply get a plain colored display board, cut out an opening, and are ready to go on with the show.
- Cut a plain piece of cloth to use as a backdrop so that the puppeteer(s) is not visible. The cloth can be clipped onto the edges of the stage with large paper clips or clothespins. It is very helpful if the cloth is translucent so the puppeteer can make out the outline of the opening but not be visible to the audience.
- Open the sides to stand up the puppet stage. You might need to place objects such as tape dispensers at the lower inside edges to keep the ends from folding in toward the center. The stage is now ready for your puppet performance!

Performance Reading and Puppet Manipulation

Students are invited to read the scripts with partners. We sometimes have the students, especially struggling readers, retell the story without the script (Kroskinen, Gambrell, & Kapinus, 1993). The partner(s) might be a fellow classmate, a lead reader such as the teacher, the whole class as in choral reading, or with an older more competent reader (Leland & Fitzpatrick, 1994). For example, fourth graders might read and make puppets with second graders. Sometimes we use all of the strategies mentioned above with a group of children. The students then make the puppets as

described above. The puppet production, as one can easily imagine, is a delightful undertaking for the students. Backdrops can be drawn by students to complement the story. The students can clip the background drawings to the front of the puppet stage under the window. Background drawings can be attached to the curtain with paper clips but this can interfere with the puppeteers view and cause the puppets to be more difficult to see.



Photograph 4: Puppet stage.

Once the puppets have been completed, the students are invited to work in teams: one student manipulates the puppets while the other read the story in a readers' theater format. The puppeteer has enough to do without a speaking part and, in addition, it is difficult to hear the puppeteer from behind the stage. We like to practice during the week and have more formal puppet presentations on Friday afternoons. Guests such as the principal, the school librarian, parents, school nurse, and whoever else might be in the area are invited to the presentations. Students enjoy taking their show on the road by visiting other classrooms. This is an advantage in having an easily portable puppet stage. Students switch places so everyone gets to be a reader and a puppeteer. The earlier practice encourages reading fluency. In addition, the students are very motivated to "sound good" when reading the script to their classmates. It is not a drawback that the class hears the same story several times. The activity of the puppeteer and the engaging voice of the readers hold the attention of the audience.

We especially enjoy seeing highly talented students enjoying the opportunity to shine. For example, capable

students can turn a story into a readers' theater script and perform for an audience. In addition, they might write their own version of a story for presentation in a six-o'clock evening news format. They usually would have an anchor, reporter in the field, and characters to interview. The flexibility of readers' theater formats provides opportunities for the weakest of readers but also for the strongest of readers. Provisions for gifted students have been greatly curtailed in many school districts primarily due to economic conditions. Readers' theater, as described herein, provides an opportunity to compensate for special programs for talented students that have been curtailed.

Although we concentrated on division in this article, there are countless opportunities for using *The Doorbell Rang* in reading and mathematics activities. For example, children might determine the measurements in a recipe for making the cookies. On the other hand, characters and stories do not necessarily have to have any mathematical orientation to be useful for integrating mathematics and literature. In this light, the wonderful story *The Paper Bag Princess* (Munsch, 1980) can lend itself to mathematical activities. For example, Princess Elizabeth might have to walk six miles to save Prince Ronald. She stops for a rest after walking two miles. How many more miles does she have to walk to save Prince Ronald? The children could draw a map with a castle and forest and mile designations and, most fun of all, the dragon.

Conclusions

We feel strongly that the mathematics activities and readers' theater activities described herein present learners with highly positive opportunities for both affective and academic experiences in enhancing both mathematical and literacy competencies. We have completed these activities with hundreds of students. We have observed what Csikszentmihalyi (1998) described as flow, wherein intrinsic motivation is fostered through a state of harmony within the learning environment. Mathematics and artistic activities can be, as Fields, Groth, and Spangler (2004) proposed, authentically related to enhancing reading comprehension and fluency. In addition, students have a product they have played a major part in producing. Tangible products and active engagement are especially important in this, the digital age. In this light, Jackson (2008) determined that there is less and less permanence in the lives of individuals in this, the digital era. We propose that use of manipulative materials in mathematics, the building of puppet stages, creation of puppets and scenery for puppet shows, and readers' theater performances, described herein, provide a sense of anchoring and community within the classroom.

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