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Twin Texts and Technology: Enhancing Algebra Instruction for Elementary Teachers

Abstract

Introduction: Algebra is often thought of as a course taken in high school, not a part of mathematics instruction in the elementary grades. In reality, algebra is the study of mathematics concerning structure, relations, and quantity and justifying those relationships (Blanton, 2008).

**Twin Texts and Technology:
Enhancing Algebra Instruction for Elementary Teachers**

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Introduction

Algebra is often thought of as a course taken in high school, not a part of mathematics instruction in the elementary grades. In reality, algebra is the study of mathematics concerning structure, relations, and quantity and justifying those relationships (Blanton, 2008). Studying algebra, or the basis for algebraic thinking, in elementary schools aligns with the National Council of Teachers of Mathematics' standards (NCTM, 1989, 1991, 2000). These standards assert algebra begins in pre-kindergarten and continues through high school. NCTM's *Principles and Standards for School Mathematics* (2000) for algebra states

Understand patterns, relations, and functions;

1. Represent and analyze mathematical situations and structures using algebraic symbols;
2. Use mathematical models to represent and understand quantitative relationships; and
3. Analyze change in various contexts. (NCTM, 2000, p. 37)

For elementary students, this is the study of patterns and shapes. This is not a new concept as elementary students have studied patterns and shapes for years. It does, however, require teachers to develop new and innovative curriculum to teach students and develop an understanding of how mathematics taught in elementary school is not distinct from algebra taught in secondary school (Ketterlin-Geller, Jungjohann, Chard, & Baker, 2007).

Integrating literature into mathematics curriculum brings together staples of elementary education—reading and mathematics. *The Standards for the English Language Arts* (International Reading Association/National Council of Teachers of English, 1996) encourage this. They recommend:

Students read a wide range of print and nonprint texts to build an understanding of texts, of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and

nonfiction, classic and contemporary works. (IRA/NCTE, 1996, p. 19)

Twin texts are two books—one fiction, one non-fiction--on the same related topic (Camp, 2000; Opitz, 1998). Pairing fiction with non-fiction books on the same topic can increase students' comprehension and enthusiasm for reading (Deckebach, 2005; Vacca & Vacca, 2008). Another benefit is increasing reading time of non-fiction books in the classroom, as elementary teachers tend to incorporate fiction books into their lessons at a significantly higher rate (Duke, 2000; Gill, 2009/10; Williams, 2009). Whether fiction or non-fiction, literature provides a context for learning about mathematical applications in real-life experiences (Curcio & Artzt, 2008).

Technology, when incorporated into instruction, presents information in new and engaging ways and learning becomes more interesting for students. With technology, students are actively involved in learning (Grabbe & Grabbe, 2007; Tarasiuk, 2010). Technology enhances thinking, analyzing, and problem-solving skills. Students are able to work with simulations, demonstrations, and graphic representations, instead of traditional drill-and-practice (O'Connell, 2005).

The International Society for Technology in Education (2002) recognized this in their profiles for technology-literate students. They recommend students:

- Use a variety of media and technology resources for directed and independent learning activities.
- Use technology resources (e.g., puzzles, logical thinking programs, writing tools, digital cameras, drawing tools) for problem solving, communication, and illustration of thoughts, ideas, and stories. (ISTE, 2002, p. 6)

The NCTM also recognized the effectiveness of technology in their position statement on the use of technology and mathematics (NCTM, 2003). The IRA and NCTE (1996) also support this:

Students use a variety of technological and informational resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. (IRA/NCTE, 1996, p. 28)

With these recommendations and standards from national and international organizations, teachers have the guidance to proceed. The project described below helped provide the content, support, and networking to facilitate teachers' incorporating algebra, literature, and technology into elementary mathematics lessons.

Purpose

Description of the Workshop

This was the third year of a 3-year grant project. Each year consisted of a 2-week summer workshop followed by two follow-up seminar days and one on-site visit from the mathematics coach. The purpose of the project was to enhance teachers' knowledge of mathematics, improve mathematics-teaching strategies, and increase elementary students' performance on the State Mathematics Assessment.

Each year, the project had a different mathematics theme. The first year was geometry, the second year was data and probability, and the third year was algebra. Technology was integrated in all three years but, only in the third year, was literature incorporated into the instruction.

Participants

Seventeen teachers from nine school districts participated in the workshop. The teachers brought together a wide background of experiences. Their years of teaching ranged from beginning teachers to over 20 years experience. They taught kindergarten through fourth-grade. Although certified to teach elementary students, none had a mathematics endorsement.

The Lesson

Algebra content. One-half of each 2-week summer workshop days was devoted to algebra content. The teachers' knowledge of algebra was assessed by a 27-question pretest. The questions were taken from the State Mathematics Assessment for fifth-grade students. At the end of the summer, the teachers took the same test. Results were calculated using a t-Test, Paired Two Sample for Means (see Table 1).

The teachers participated in many hands-on activities to increase their knowledge of algebra and teaching algebra, and as seen in Table 1, the teachers increased their knowledge of algebra. Activities were driven by the state standard, "The student uses algebraic concepts and procedures in a variety of situations." Within this standard, four benchmarks applied:

- Benchmark 1: Patterns
- Benchmark 2: Variables, Equations, and Inequalities
- Benchmark 3: Functions – Benchmark
- Benchmark 4: Models

Twin texts. The other half-day consisted of technology, literature, and pedagogy. The lesson on twin texts and technology used castles as its theme. *Rapunzel* by Paul O. Zelinsky was read aloud to the teachers. Not only does this story take place in a castle, it is a Caldecott Medal winner. Other fiction books on different reading levels were available for the teachers to read, as well as several non-fiction books on castles (see Table 2 for a list of titles).

After listening to *Rapunzel*, the teachers drew a picture of a castle. They were given a sheet of white bond paper, crayons, rulers, and three piece of construction paper. Using the ruler and one piece of colored construction paper, the teachers drew a square, which became the main geometric figure for their castle. They then traced the square on the second piece of colored construction paper and drew a diagonal line to create two triangle patterns. They again used the square to double it to form the rectangle pattern. These three patterns (square, triangle, rectangle) were used to trace and draw their castle.

Once they completed that part of the activity, they were free to color and decorate their castle and its landscape as they saw fit (see Figures 1 and 2 for examples). As an extension activity, the teachers counted the number of squares, rectangles, and triangles in their castle. This activity was adapted from the performance assessments developed by the Center for Performance Assessment (1998).

Technology

The teachers were then introduced to the National Library of Virtual Manipulatives website where they could select the program Pattern Blocks. Once in Pattern Blocks, they created a castle using the square, triangle, and rectangle provided by the program (see Figures 3 and 4 for examples).

Using a commercial blog website, a blog was created for teachers. The teachers were also introduced to other websites based on the four benchmarks (patterns; variables, equations, and inequalities; functions; models). After reviewing those websites, they used the blog to post their comments and questions. They also shared sites and resources they discovered as they searched the internet. As a follow-up, they were asked to continue blogging monthly during the school year to share their experiences using twin texts and technology in their classrooms.

Summary

Overall, the teachers found this approach to teaching algebra in their elementary classroom fresh and novel. Teachers' comments in the blog included:

- "I really like the idea of using twin texts meets technology in my classroom. I think that this will provide students with several different ways to connect to a concept that is being taught."
- "I love all of the lists of books that help teach the different math concepts. I am always looking for ways to make math easier for students to understand and to make it more fun. Adding a story helps grab their attention."
- "I like the idea of linking literature to the math concept being taught and then linking both the literature and math concept to technology. ... I will be sure to share all of the new things that I have learned with the other teachers in my district."

Developing curriculum incorporating twin texts and technology integrates reading, technology, and mathematics standards concurrently. Participating teachers learned how to integrate content and save themselves time as many standards are met at once. Knowledge gained from workshops like this is enjoyable for the teachers, which translates to enjoyable lessons for their students. The teachers also established collegial friendships and electronic networking for when they returned to their classrooms.

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