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Teaching Mathematics to Elementary School Students Using a Variety of Tools

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This article is based on action research Ms. Bradley did as a student in a master's degree research course. Ms. Bradley is a first-year teacher, teaching third grade at an inner city school.

Abstract

This article is based on a first-year, third-grade teacher's attempt to improve instructional strategies for teaching mathematics in an inner city elementary school. Review of the literature suggested a variety of methods for teaching mathematical concepts to children in grades K-5. The researcher found that carefully-planned units that include group work, intervention groups, parental involvement, entertainment elements, and explicit instruction increase students' curiosity, enjoyment, and success in learning mathematics.

Keywords: Mathematics, Elementary School, Learning activities, Instructional techniques

Mathematics, along with reading and writing, is one of the three main content areas that elementary school students are expected to master during the elementary grades. Many students find mathematics intimidating, difficult to understand, and most difficult to master.

Mathematics is a challenge to teach. Unlike reading and writing, mathematics is a totally different language for children to learn. Symbols represent operations. Operations are performed in different ways for different formulas. Symbols can be interchangeable and require different operations in different situations. Hence, the reading, writing, and interpreting of mathematical symbols can cause confusion for third graders who are struggling to understand new and abstract concepts relating to numbers and operations.

To compound the difficulty of teaching mathematics, accountability pressures teachers to ensure students score well on evaluation instruments. Heavy emphasis is placed on student scores on standardized tests. Teachers are held responsible for their students' mastery of required course objectives. Standardized test-score results are reported and publicized to students, teachers, parents, as well as to the local community, and to state and federal departments of education.

Consequently, the true understanding of mathematics as a natural exploratory endeavor has been overshadowed by teachers' concern with students working problems to get the correct answers. With the pressure to exhibit consistently positive test data, elementary math students tend to rely more on memorization than on reasoning. This gap exposes an inability for many math students to grasp basic operational concepts. In an effort to fill the gap, the researcher has investigated the problem of how to engage the natural curiosity of young learners in the exploration of mathematical concepts. Classroom teachers seldom take the time to survey research addressing instructional strategies for teaching abstract mathematical concepts. However, in the process of pursuing a graduate degree, this researcher, who is also a third-grade mathematics teacher, asked the following question. "What are the most effective ways to teach mathematics to elementary school children?" A review of the literature supplied some answers to this question. The application of these suggested research findings in an Alabama elementary school helped the math teachers improve instruction which resulted in increased students' understanding and appreciation for mathematical operations, and ultimately affected students' performance on chapter tests.

1. Literature Review

Among the many articles reviewed in this study, the researcher focused specifically on articles which suggested a variety of practical instructional strategies for teaching mathematics to children in the elementary grades. Third grade seems to be the most pivotal point in a student's educational career. At this time a student either develops a comfort with mathematics or loses the desire to succeed in the subject. The researcher chose the following articles based on their practical suggestions for mathematical instruction.

Ediger (2001) proposes that teaching mathematics ". . . requires the securing of pupils' attention, having pupils understand what is taught, guiding pupils to perceive reasons for learning that which is stated in the objective, and sequencing learning opportunities in the teaching of mathematics." Wakefield (2001) gives three principles a teacher should consider when teaching mathematics: "Encourage children to think, encourage children to think about thinking, and encourage representations of thinking."

Schorr and Koellner-Clark (2003) believe that while students may be allowed to engage the tactile mode with the use of manipulatives, elementary math students do not necessarily make the intuitive leap allowing them to connect the concrete items with the symbolic meaning of the objective process. These authors propose a multi-tiered program that ". . . encourages teachers to reflect upon their own mathematical concepts and to discuss these with a group of peers before planning a mathematics lesson." This practice allows teachers to engage colleagues, some of whom are master teachers, in exploring different ways of relating the mathematics objectives to the students in their school.

Ufuktepe and Ozel (2002) take Schorr and Koellner-Clark one step further. They suggest the integration of music and drama with concrete manipulatives. Employment of music and drama with traditional mathematical instruction not only reduced math anxiety but also improved student performance on unit tests.

Building mathematical concepts by making connections of abstract symbols to concrete materials with the use of manipulatives, music, and drama are vital ways to engage tactile, auditory, and kinesthetic activity in learning. Engaging as many of the five senses as possible helps make the abstract more concrete for the learner. But it is still difficult for young math students ". . . to make connections between conceptual and procedural knowledge" (Yetkin, 2003). The language of mathematics is different from the verbal language of every day communication. Yetkin (2003) points out that the written symbols of mathematics create confusion for many students. He suggests using number lines in addition to manipulatives, in an effort to more concretely visualize the abstract symbol.

Furthermore, Yetkin emphasizes the importance of tapping into prior knowledge as a necessary building block for the attainment of new knowledge. Mathematical processes are intricately linked; each new concept builds on a former concept. Just as learning to read depends on a scaffolding process, so does the learning of the mathematical processes. The learner hikes up each new step in the ladder by launching off from the firm footing of the wrung below. The fledgling math student clings to concrete supports until those supports may be gradually relinquished as mastery takes hold.

Baker, Gersten, and Lee (2003) offer suggestions for supportive activities. They recommend scaffolding components which include ". . . providing teachers and students with data on student performance, using peers as tutors or instructional guides, providing clear, specific feedback to parents on their children's mathematics success, and using principles of explicit instruction in teaching math concepts and procedures."

Carey (1998) advocates consistent parent-teacher relationship as a key factor in achieving any educational objective. Parents can reinforce mathematical concepts in many ways. From the spending of a weekly allowance to figuring the tip at a restaurant, parents can engage their children in practical applications of mathematical concepts. Students are more highly motivated and more personally excited about learning when their parents actively participate in the learning process with them.

Although a variety of methods are essential to effectively reach all students, from at-risk to gifted, the teacher is the primary decision maker in planning the specific combination of instructional strategies to accommodate the needs of every learner (Little, 2003). The teacher holds the ultimate responsibility for planning an instructional program that blends a variety of methods into the most appropriate mix for his/her classroom of diverse learners.

2. Summary of Literature Review

A summary of the review of the literature suggesting proven instructional techniques for teaching mathematics in the elementary school includes the following.

Reflect on practice.

Consult with colleagues.

Sequence learning opportunities.

Model logical thinking processes and get students to think about their thinking.

Engage students in the use of manipulatives.

Integrate music and drama.

Help students visualize with the use of number lines.

Tap prior knowledge.

Offer scaffolding.

Set up peer tutoring.

Provide step-by-step explicit instruction.

Share student assessment results with all stakeholders.

Involve parents.

Take responsibility, as the ultimate decision maker in planning classroom instruction.

In an effort to apply the research findings into elementary classrooms, the researcher engaged in a mini-action-research project. The school involved in the project was a K-5 school, with two classes of each grade level. Children in these classrooms shared similar socioeconomic backgrounds with 97% on partial or free lunch. The population of the school is 98% African American.

The action research was conducted in an Alabama elementary school which was under a state-mandated school improvement program. This school fell below the margin of acceptability in benchmark scores required by the Alabama Reading and Math Test (ARMT) and the Scholastic Achievement Test (SAT).

3. Methods

The design of the study included three major components. First, all ten teachers in the school were asked to respond to a questionnaire. Teachers were asked about instructional methods they employ for teaching math, and they were asked about the difficulties they encountered while trying to achieve the Alabama Course of Study Objectives for their respective grade levels, K-5. Figure 1 shows the results of the Teacher Methods Survey and Figure 2 shows the results of the Problems in Teaching Mathematics. (See Figure 1)

Figure 1 indicates that the K-5 teachers surveyed were already using a variety of instructional strategies. Whole group instruction and use of the textbook were used by all teachers in this elementary school. Intervention techniques were used by all teachers except for one fifth-grade teacher. Manipulatives were more often employed with the children in grades 1-3; whereas parental involvement was specifically used by third-and-fourth-grade teachers in this school. The two fifth-grade classes were the only ones using computer software for math instruction. Computer software was used the least, possibly due to the minimum amount of computer hardware and availability at the school. (See Figure 2)

Figure 2 indicates that the children in the lower grades had difficulty visualizing math concepts and they put forth little effort in trying to learn it. Neglecting to do assignments, lack of discipline on the part of the students, and lack of involvement by the parents appeared to be a trend in almost every grade.

The second component of the research design was that parents were asked to sign a permission slip allowing their children to be part of the study where math teachers experimented with instructional strategies. They were also invited to be part of the action research by personal involvement with their child's math progress.

The third and major part of the study was the implementation of a variety of instructional strategies during the daily math period. Math teachers in the study employed a variety of techniques to include (1) modeling logical thinking in the use of intervention activities, (2) using manipulatives and number lines during whole-group instruction, (3) focusing on explicit instruction with small-groups, (4) engaging students in partner learning and peer tutoring, (5) integrating music,

videocassettes and computer software, (6) working problems from the textbook, and (7) involving the parents by sending home the results of daily math quizzes and by requesting that the parent or guardian oversee math homework assignments.

4. Findings

The K-5 teachers participating in this study report that the concentrated use of the varied instructional strategies affected the atmosphere of the classroom during math period. The students were more involved in math activities, especially during partner learning and peer tutoring. The students enjoyed the music as well as the entertaining videocassette with the mathematics objective as the subject of a story. Perhaps as a result of the audio, visual, and kinesthetic modes of instruction, students actually appeared more attentive during direct instruction. Teachers reported that students whose parents supervised their homework assignments performed better on daily quizzes. Carrying through with manipulatives and number lines with the fourth-and-fifth graders helped them to grasp abstract concepts and become more accurate in solving problems in the math textbook.

Figure 3 (below) shows the difference between the pre-and-posttest based on textbook chapter tests. (See Figure 3)

Figure 3 shows pretest score results based on three chapter tests taken before the action research study. The post test scores are the result of three chapter tests taken at the end of the three-week study. During this short study, a 27-point increase was achieved between the pre-and posttest.

Conclusion

The results of this isolated action-research study tends to support the use of a variety of instructional strategies and tools for teaching mathematics in grades K-5. Carefully-planned units that include manipulatives, explicit instruction, music, narratives, small group, partner learning, peer tutoring, and parental involvement, from kindergarten through fifth grade, definitely influence student interest, enjoyment, and ultimately, test scores.

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Teacher Methods Survey Results by Teacher and Grade

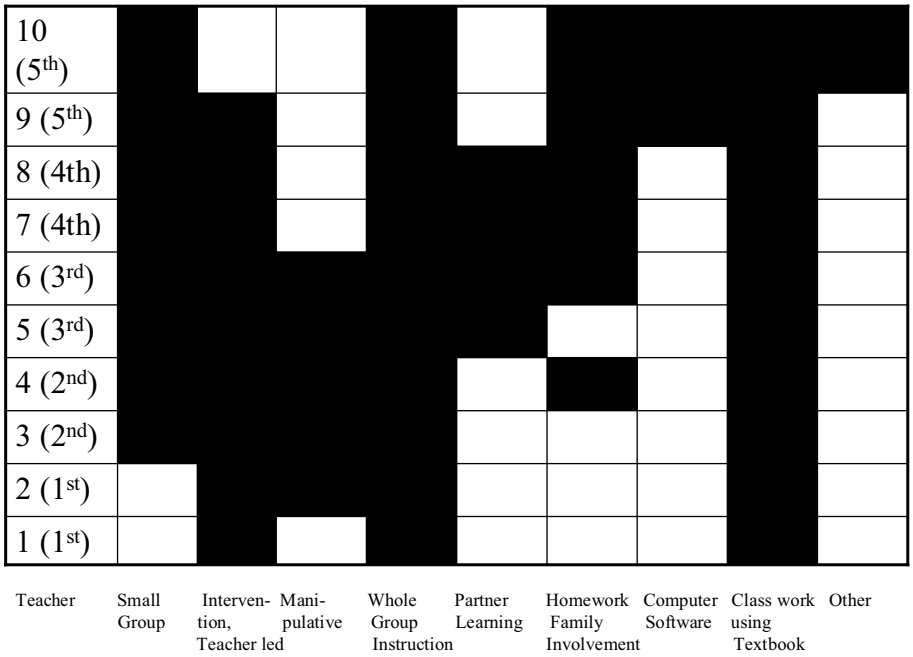

Figure 1.

Problems of Teaching Mathematics in Elementary School

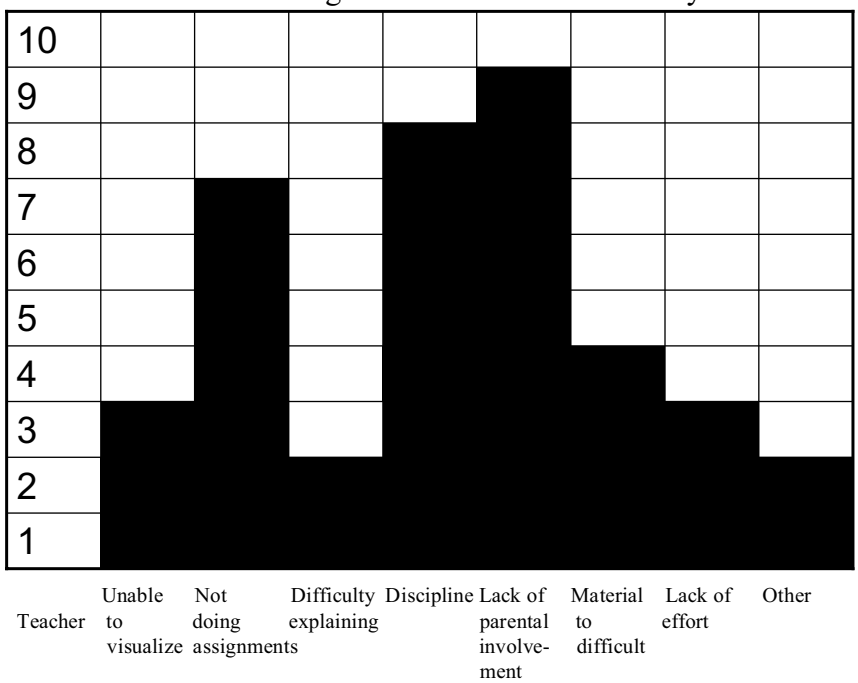

Figure 2.

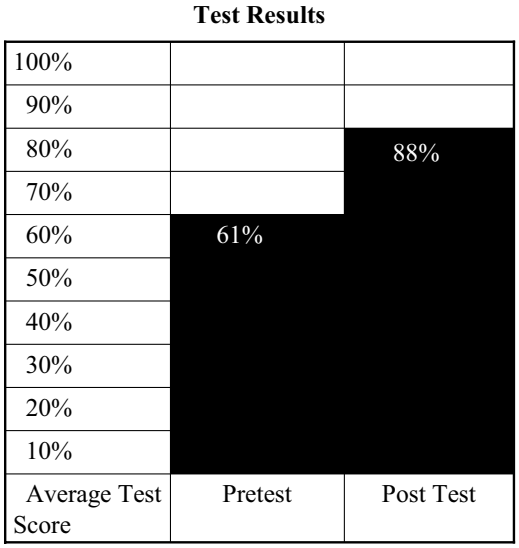
Test Results
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
61%
88%
Average Test Score
Pretest
Post Test

Figure 3.