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When Instruction Doesn't Add Up: A Practical Action Research Study Identifying Strategies for Helping 6th Grade Learners with Special Needs Overcome Barriers in Math

by

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Thesis Abstract

The purpose of this study was to identify strategies for helping sixth grade learners with special needs achieve in math. The research design was practical action research, which focused on discovering effective strategies to improve the math skills of students who had a known history of struggling in this curricular area.

The five students in this study participated in a before-school math intervention program supported by Title I funding. In this class, they received instruction about strategies to help them succeed in their general education math classes. These strategies included color coding, highlighting, and learning how to spatially organize their math work. The *Getting Ready for Algebra Program* was used to measure students' achievement prior to and following the application of the strategies and instruction. Data from the 2005 and 2006 *California Standards Test* of Mathematics (*CST*) were also used.

The results of the pre- and post-tests from *Getting Ready for Algebra: Unit One*, and the 2005 and 2006 *CST* scores were analyzed to determine whether the strategies used affected student achievement. Four study participants (students with learning disabilities who struggled in math) improved, although not significantly. The study findings may have been limited by the brevity of the data collection period. Also, students attended this support class on a voluntary basis, which may also have affected the outcomes.

Key words: dyscalculia, direct instruction, instructional strategies, learning disabilities, learning center

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CHAPTER ONE

Introduction

The rigor and challenges of learning mathematics at the secondary level has become increasingly difficult for students with learning disabilities. Garnett (2005) discusses that the manifestation of specific math disabilities are not quite validated or widely accepted in relationship to other learning disabilities. However, dyscalculia is an identified math disability. Students with dyscalculia often have difficulty with the visualizing of numbers and patterns as well as sequencing difficulties. These difficulties can cause number reversals and other errors that may be referred to as stupid mistakes (Newman, 2005, para. 1). Newman also describes tasks such as name/face recognition, time management, and remembering number concepts as other areas of complication for individuals with dyscalculia.

There is a need to provide differentiated instruction and useful strategies for students with special needs when trying to learn, retain, and understand mathematical concepts due to the variety and number of topics in most math curriculums. The multiplicity in the current curriculum at the investigator's school site makes it difficult to provide adequate and in-depth instruction that students with learning disabilities need in order to be successful. Consequently, the challenge of learning mathematics, particularly developing automatic recall of basic number facts and concepts, becomes frustrating for these students. When assessed, they often display low achievement levels in these areas.

Swerling (2005) identifies math elements typically taught at the secondary level. These are: development of concepts and reasoning, automatic recall of number facts, computational algorithms, functional math, and verbal problem-solving are components that should be included in the secondary mathematics curriculum. Many of these areas are discussed in the literature related to improving instruction at the secondary level for students who struggle with math achievement (Bottage, 2002; Jones, 1997; Swerling 2005). The investigator examined literature regarding strategies for improving math instruction. Bottage (2002) suggests that teaching basic number sense skills like adding and comparing fractions to students using direct instruction, and using these skills in a meaningful application, is a balanced approach to effective math instruction. The National Council of Teachers of Mathematics (NCTM) also proposes in their newest standards that all students have opportunities for solving meaningful and complex math problems.

From her experience, the investigator has discovered that instructional strategies provided in the curriculum materials at the investigator's site to support the effective development of secondary math skills for students with learning disabilities are deficient in terms of providing understanding for maximum achievement. For example, the investigator's special education pre-service programs did not include specific instruction in strategies to remediate or support math skill development for students with special learning needs. Although Jones (1997) discusses such strategies as direct instruction, principles for designing practice activities, and options for presenting and responding to math problems, he does not disclose how an instructor could implement these identified practices to help improve math instruction for students with learning disabilities.

Background

In January 2002, Congress passed a federal law called the No Child Left Behind Act (NCLB). This law requires districts to adopt grade-level standards. NCLB also requires the use of the most effective instructional strategies for teaching all students, and annually assess each student's progress toward meeting those standards. Schools that do not make Adequate Yearly Progress (AYP) in this federal system for two consecutive years must be identified as *program improvement schools* by the California Department of Education (Noonan 2005). This federal law also has provisions that give parents the option regarding school choice for their children when a school becomes a program improvement school.

In 2004-2005, the investigator's school was described as a large middle school within an urban fringe of a large city (California Department of Education 2005). The investigator's middle school in San Diego County met 28 out of the 29 criteria on the AYP (School Wise Press 2005). The subgroup specified as *missing the target* was *students with disabilities*. The target area that the students in the special education program missed was math. Unfortunately for the district, this group of students narrowly missed their target for two years in a row; as a result, the school was placed on the program improvement list. The school-wide goal at this middle school is to improve mathematics instruction for all learners in an inclusive educational program with a primary focus on students involved in the Resource Specialist Program (RSP).

As a Resource Specialist, the investigator is responsible for coordinating the implementation of students' Individualized Educational Plans (IEPs). Assessing students' present levels of performance in a variety of academic areas is an integral part of the IEP process. Based on the results of their assessments, the Resource Specialist provides ongoing support to help students develop important life skills, including math.

Purpose of the Study: Rationale

In October 2005, the investigator's school offered her an opportunity to instruct a before-school class to help sixth grade students in math. Originally the site administrator's plan was for this class was to be a pre-teaching class for math students identified as needing support. The investigator was to introduce students to the vocabulary and major concepts that they would be seeing in their math classes later in the school day. After six weeks of conducting this class, and because the class was not successful in accomplishing its original objectives, the investigator and her colleagues became frustrated; some colleagues resigned from this assignment. The five teachers who were left scheduled a meeting with the principal to brainstorm ideas for helping the students in these support classes.

Research Question and Hypothesis

The investigator's question for this thesis was: What are effective instructional strategies for helping sixth grade learners with special needs overcome barriers in math? The sub-questions that helped identify these strategies were: What are the challenges that students with disabilities face in mathematics? The investigator also asked: How does student performance on math assessments relate to their actual learning needs?

The purpose of this study is to identify strategies for helping sixth grade learners with special needs achieve in math. Early in the 2005-2006 academic year, the investigator attended a workshop, *Getting Ready for Algebra*. This workshop introduced an intervention program of the same name. This program was developed by the San Diego County Office of Education Achievement Gap Task Force. The investigator used this program to help structure the support class she conducted for the remainder of the 2005-2006 academic year.

Students were introduced to *circuit instruction*, wherein three groups of students circulated through three learning centers in three twenty-minute cycles. One center was led by the teacher, who used direct instruction; another center offered computer practice opportunities; and the last center was an area in the room available for independent practice of the concepts and skills introduced in the lesson. These three centers were designed to implement the components of a comprehensive and well-rounded math instructional program.

A further purpose of this study was to provide a support curriculum of effective remedial strategies to colleagues. Further, the investigator hoped to convince colleagues and administrators to integrate math support in math classes held during the school day to help more students achieve in math.

The investigator's hypothesis is when students are provided additional mathematical instruction with multiple strategies, then their performance on assessments will improve. The antithesis would be that students' achievement results would stay the same or decrease.

Definition of Terms

The following list of terms will be referred to throughout this paper and are key to understanding the material being presented.

Centers: interactive areas within a classroom that are designed around subjects, topics, themes, modes of learning, etc.

Circuit instruction: multiple, simultaneous, and varied instructional activities that occur in *centers* within a classroom.

Cornell note-taking: a method for taking notes where a two to three inch margin is drawn and questions, problems, and vocabulary are written on the left side and the responses are written on the right, and the bottom two inches of paper is the area where a summary can be written of what the notes were about.

Direct instruction: teaching to the whole group/class in a step by step, methodical manner.

Dyscalculia: "a specific learning difficulty affecting a person's ability to understand and/or manipulate numbers. Dyscalculia can be caused by a visual perceptual deficit" (Wikipedia, 2005, para. 1).

Instructional strategies: teaching practices that enable others to learn about a given subject or skill

Learning center: a classroom area in which 4-5 students are arranged in a small group working on the same activity.

Learning disability: a neurological disorder in which a person's brain works or is structured differently. These differences interfere with a person's ability to think and remember.

Multiple disabilities: the concurrence of two or more disabilities in the same person, with one identifying disability being mental retardation.

Conclusion

The current educational system has integrated a check and balance system in which student achievement is measured by academic assessments. When students' scores are low on these assessments, something is presumed to be wrong. Common conjecture among the general public suggests various reasons for these low scores. Hypotheses range from lack of student motivation and engagement to under-prepared teachers.

In the next chapter the author reviewed the literature to determine the challenges that students with disabilities face in mathematics. The author also investigated how student performance relates to student needs. Lastly, the author hoped to uncover specific strategies to help students ascertain the power that comes with the knowledge of math, as well as the ability to demonstrate this knowledge.

CHAPTER TWO

Literature Review

The California Department of Education (2005) reports that 71% of the total student population (1,752) at the author's school passed the California Standards Test (CST) with a *basic* or *above* (basic) score. This means on a scaled score of one to five, 71% of the students scored *three* or higher. The special education student enrollment at the time of testing was 184 students. If the passing percentage for the total student population was applied, then 131 students receiving special education services received a score of *three* or higher. However, this was not the case. The number of students in special education who passed the CST with a basic or above (basic) score was 28 (California Department of Education 2005). This number reflects a 15.2% passing rate. Why are students in the resource specialist program having such trouble in math?

A Word from the Experts

There are particular details that all researchers must consider when conducting an investigation. In other words, they must examine the knowledge of the experts in the area of study. The National Council of Teachers of Mathematics (NCTM) and the Trends in International Mathematics and Science Studies (TIMSS) are the most well-known organizations of experts in the field of mathematical instruction. Their collective analyses of research data on student performance in math is highly regarded by teachers and mathematicians in K-12 education.

TIMSS 2003 is the third comparison of mathematics and science achievement carried out since 1995. This study was completed by the International Association for the Evaluation of Educational Achievement (IEA). The IEA is an international organization of national research institutions and governmental research agencies. In 2003, 46 countries participated in TIMSS, at either the fourth or eighth-grade level, or both. The most recent report conducted by TIMSS (2003) concluded that U.S. fourth-graders outperformed their peers in 13 of the other 24 participating countries in mathematics. U.S. eighth-graders outperformed their peers in 25 countries in mathematics. However, the overall trends between the data collected from 1995 to 2003, shows that the performance of U.S. fourth-graders in mathematics was lower in 2003, than in 1995. This drop is in relation to the 14 other countries that participated in the study. The reverse was true for eighth grade students from the same time period.

In 1981, then Secretary of Education, T. H. Bell, examined the effectiveness of the United States educational system. The results of this investigation determined that the United States was "A Nation at Risk." The 1983 report from the National Commission on Excellence in Education.,, *A Nation at Risk*, found that the decline of our nation's educational performance was lacking due to content, expectations, time, and teaching (National Commission on Excellence in Education, 1983). These four areas may give insight into the difficulties students face when it comes to learning mathematics.

Math Learning Difficulties

Most of the students in a special education resource specialist program (RSP) are there due to some form of disability (IDEA, rev. 2004). Garnett (2005) advised that there is little acknowledged or validated research to support specific and varying levels of math disabilities. However, math disabilities are most frequently related to specific learning disabilities (SLD).

The California content standards for mathematics include:

i) number sense,

ii) algebra and functions,

iii) measurement and geometry, and

iv) statistics, data analysis, and probability.

These four areas are annually assessed in grades two through seven. The total number of *number sense* items assessed through the years decreases from 58% for grade two, to 34% for grade seven. Results indicate that students with disabilities do not fully understand basic elementary concepts, and their acquisition of higher order thinking skills becomes more difficult as they reach higher grades.

The primary math learning difficulty for students with learning disabilities is computational skills (Bley & Thornton, 2001; Garnett, 2005; Lock, 2005; Rienick, 2005; Sherman, et al. 2005; Swerling, 2005). These skills include basic fact calculations, and recalling step-by-step procedures used in computation, called algorithms. Some hypotheses noted for this deficit include inconsistent awareness to the changing of computational signs, a simple calculation error, or forgetting and not understanding what the problem was asking in the first place (Garnett, 2005 2 ¶ 4).

Another area that troubles students with learning disabilities, making mathematical achievement difficult to obtain, is language (Bottage, Heinrich, Mehta, and Ya-Hui, 2002; P.E Whitin and D.J. Whitin, 1997). There is an immense mathematic vocabulary to learn, but for students with learning disabilities, this may be a cognitive overload. The language of math is multifaceted and vital to achievement of arithmetic. Following directions, meaningful application, and possessing the verbal skills to explain the process are essential to monitoring the steps of complex calculations. Students with learning disabilities are often troubled by one or more of these essential skills.

According to some researchers, there is a more difficult attribute to consider when students are struggling in math. Visual-spatial relationships in math are the pictorial representations, shapes, signs, and other handwriting components that also make the acquisition of math difficult for learners with disabilities (Garnett 2005; SDCOE 2005). Students are promoted from one grade to the next and the curriculum becomes more challenging. The complexity math presents make the use of visual-spatial cues important to help students understand new terminology and concepts.

The research also reveals that all students, especially those with learning disabilities, need repeated exposure and various opportunities with concrete materials. This exposure helps improve their understanding of symbolic representation, in relation to the hands-on materials that are provided for those mathematical experiences.

The absence of number sense understanding and mathematical comprehension is compared to phonemic awareness and reading comprehension (Gersten, 2005). Meaning, if you don't know and understand the sounds letters make how can you read fluently and comprehend what you read. Mathematically, number sense is defined as, "an emerging construct that refers to a child's fluidity and flexibility with numbers, the sense of what numbers mean and an ability to perform mental mathematics and to look at the world and make comparisons" (p.3).

Math consists of making comparisons by understanding numbers and manipulating them in various situations. Today's math instruction is so vast in material and standards that the performance of students on standardized tests is driving mathematics instruction.

Students Performance and Needs

The National Council of Teachers of Mathematics (NCTM 2005) displays 10 different math standards and expectations for students beyond the five areas that are recognized by the state of California Department of Education. The additional five standards are categorized as processing standards by NCTM. These standards include; problem solving, reasoning and proof, communication, connections, and representations. Now, some of these additional standards may be recognized by the state as what should be embedded in the instruction of the areas that are annually assessed, but the processing standards don't have a specific strand that is dedicated solely to communication or connections like that of number sense and measurement.

Jones (2005), discussed data-based investigations of procedures that have evaluated the effectiveness of mathematics instruction of secondary students with learning disabilities. The factors that affected their instruction were:

(a) students' prior achievement,

(b) students' perceptions of self efficacy,

(c) the content of instruction,

(d) management of instruction,

(e) educators' efforts to evaluate and improve instruction, and

(f) educators' beliefs about the nature of effective instruction.

While these factors may impede on all learners and not just the learners with learning disabilities it is ideal to use a data-based investigation technique within the specific factors mentioned to try and understand how to improve the instruction of mathematics for all learners in an inclusive educational setting.

Accommodations/Modifications for Student Success

The investigation conducted by the author helped determine what strategies would be helpful to students in an inclusive setting. Also, investigated were the specific strategies that would be implemented in this study.

Adapting and modifying instruction for students with learning disabilities, in a general education classroom, will help student's confidence. With this reinforcement, students will be more likely to take risks in problem-solving, which strengthens student understanding of the concept (Lock, 1996).

By the time students reach the secondary level of mathematics, it is presumed that

their knowledge and understanding of basic computation is mastered. However, this is not always the case of students with learning disabilities. Therefore, it is necessary to provide specific instruction, practice, and review of concepts. This system will help students with learning disabilities begin to master the essentials in developing their math skills.

Lock (1996, table 1) suggests these specific tips for modifying mathematical computational assignments:

1. reduce number of problems on worksheets for independent practice,
2. increase the amount of time students have time to complete the assignments,
3. provide adequate space for students to write out solutions,
4. follow a standard format for developing worksheets,
5. cut worksheets in halves or fourths requiring students to complete one section at a time,
6. assign only odd or even problems,
7. highlight the operation to be performed, and

8. move gradually to increasing the number of problems (not more than 20) and decreasing the amount of time to complete the assignment.

Problem solving strategies varied, in the number of steps, throughout the literature reviewed for this study. Students with learning disabilities often demonstrate weaknesses in higher order thinking skills, which are necessary for problem solving. Students with disabilities often have difficulty with retaining information in both their short-term and long-term memory. Providing students with a specific process to follow and practice using this process will help improve problem solving skills (Garnett, 2005; Jones, 1997; Lock, 1996; and Spear-Swerling, 2005). An example of a problem solving process that reflects the collective wisdom of these researchers might include these four basic steps:

a) read and understand the problem,
b) plan what procedures to use,
c) carry out appropriate calculations, and
d) check your answer for reasonableness.

Conclusion

A recurring message presented in the literature reviewed for this study included techniques for effective instruction. Gersten (1999) suggests that instructional time be longer and varied than what is most common in schools today. Students at the investigator's school have one fifty-minute class in sixth grade math, covering a vast array of topics with little time for exploration. This lack of exploration time makes it difficult for students with learning disabilities to effectively grasp new concepts and practice using them. There is a math support class offered for a small population of sixth graders that is not aligned with any particular curriculum. Lock (1996) suggests that there should be multiple math classes for all students to address multiple needs. A suggested class schedule would incorporate and introduction, direct instruction, and a period of review for one day of mathematics instruction. Lock also suggests another class to consider might be an intervention-type class that would develop the essential skills students may not have fully grasped in elementary math instruction.

In the following chapter the investigator discusses the practical action research study of implementing the aforementioned suggestions in a before-school math class.

CHAPTER THREE

Methodology

Design

Practical action research was used to help identify strategies for helping sixth grade learners with special needs overcome barriers in math. Airasin, P. Gay, L.R. & Mills, G.E. describe practical action research in education as, "Any systematic inquiry conducted to gather information about the ways in which a school operates, the teacher teaches, and the students learn," (2006, p. 501). Researchers have the decision-making authority to make the research as meaningful and in-depth as they see fit. The four basic steps in conducting practical action research are; identifying an area of focus, data collection, data analysis and interpretation, and action planning. This design was chosen because it most closely represents the everyday classroom practices that the investigator employs when developing and executing lessons.

Setting

The school in this study is a large middle school (1,819 students; grades 6-8) located in North San Diego County, California. The homes in the surrounding neighborhood of the school are fairly new, and the neighborhood continues to develop into more family homes and some commercial buildings, as well. A senior community is adjacent to the school. The school is the epicenter between a neighboring elementary school and a high school within the same district (less than one mile in each direction). The school calendar is 180-182 teaching days and operates on a semester schedule with three six-week grading periods per semester.

There are six 55-minute academic periods within a day. The exception is the first period, which lasts 57 minutes due to morning announcements.

Of the 1,819 total student population, 184 students were enrolled in the special education program at the time of study (California Department of Education). The racial/ethnic groups, at the time of study, are shown in Figure 1.

Race/Ethnicity	*Percentage of Students Enrolled 2004-2005, Taking CST's*
Hispanic	46.3%
White	27.2%
African American	13.5%
Filipino	5.9%
Pacific Islanders	4.4%
Asian	2.0%
American Indian/Alaskan Native	0.6%

Figure 1: Racial/ethnic percentages of students enrolled 2004-2005, taking the California Standards Test of Mathematics

Participants

The participants in this study were five middle school students. Four of these students were identified as having specific learning disabilities. The students' ages ranged from 11-13 years. Three were male and two were female. One male student had a medical diagnosis of attention deficit disorder, and was on medication. The racial makeup of the students in the study group was one African American, and four Hispanic. Two of the Hispanic students (males) were also English language learners.

These students were invited to participate in this before-school intervention math support as a result of their California Standards Test scores in mathematics, which were *below basic* to *basic.*

The California Standards Test is apart of the Standardized Testing and Reporting (STAR) Program. The purpose of the STAR Program is to measure how well students are learning the knowledge and skills identified in the California content standards. Overall scores are reported on a scale ranging from 150 to 600. The CST results for each subject area tested also are reported by performance levels: advanced (600-450), proficient (449-350), basic (349-300), below basic (299-250) or far below basic (249-0). Teacher and parent recommendations were also part of the invitation process. The school-based resource teacher (SBRT) sent all intervention math support class instructors a template of the invitations to be sent to the group of students who would be part of the math support classes (Appendixes A and B). These invitations included the time and reasons for having these support classes, and a signature area for parents to decide whether their student would participate.

Materials

During this study the investigator used the *Getting Ready for Algebra* program to guide instruction for the math support class. This program was selected to evaluate whether these materials would be appropriate and useful at the investigator's school site for the intervention math support classes. At the time of the study the investigator's school had no uniformed curriculum materials for the math support classes.

The students in this study used spiral notebooks to record and practice the skills and concepts presented to them throughout the study period. These notebooks were used to maximize organization for the students and the investigator.

The students also used computers to access the Harcourt website (http://www.harcourtschool.com/menus/math2002/ca/menu_ca.html) to help reinforce some of their basic math facts (i.e., adding, subtracting, multiplying, and dividing positive whole numbers), as well as other math games. This website was used because it supports the current text being used in the students' math classes.

Procedure

The focus for the study was to complete the *Getting Ready for Algebra: Unit One* which suggests a six to eight week time period for full completion. The support classes were held twice a week, Tuesdays and Thursdays, from seven to eight o'clock in the morning. The students were given a spiral notebook, which was kept in class. These spirals were used for students to participate and practice the skills being reviewed in the direct instruction portion of the class. These notebooks were also used to document the students' progress with the computer activities they practiced.

The investigator began by welcoming the students at the front of the school, because the class is held before school hours and the gates are locked. The students would enter the classroom and take their notebooks and turn to the page instructed by the investigator. Many of the materials provided by the Getting Ready for Algebra Program were copied and pasted into the student's spiral notebooks prior to their arrival so that maximum instructional time could be used. This set up was also used to utilize the suggested strategies discussed in chapter two specifically, increasing the amount of time students have to complete assignments, following a standard format, and cutting worksheets into manageable amounts with ample workspace for students to complete assignments.

The first day of instruction the investigator reviewed the purpose of the before school math class and explained the classroom procedures and overview of the *Getting Ready for Algebra Pacing Guide* which was the pasted on the very first page in the students spiral notebook. Then the investigator administered the practice test to the students. The results of the practice test would determine which lesson would be instructed the following session.

Students would complete a five to ten minute warm up reinforcing prior skills and concepts already covered and/or known. During this warm up students would also assess their prior knowledge of the new concept(s) being introduced for that class session. All warm up materials, overheads, suggested activities such as "multiplication tic tac toe" board were provided by the *Getting Ready for Algebra* program in the teacher materials notebook. Next, the investigator introduced the lesson using direct instruction. This instruction technique would last for 20 minutes. The strategies used during this instruction included the use of a highlighter to identify important vocabulary and/or operation(s) to be performed. If notes were taken in the direct instruction time then the Cornell note-taking format was implemented. Student would then take their spirals and turn the page to their recording sheets, glued on the page following their practice test, for computer practice and spend 20 minutes on the computers. See Figure 2.

After the computer practice time expired the students spent the last 10 minutes doing an independent practice of the concept(s) taught for the day. This process was repeated each session until unit one was completed.

That's a Fact Recording Sheet

Date: ____________ Fact practice: +/- x/÷
Time: 3 minutes Number Correct: ____ Number Incorrect:
____

Date: ____________ Fact practice: +/- x/÷
Time: 3 minutes Number Correct: ____ Number Incorrect:
____

Date: ____________ Fact practice: +/- x/÷
Time: 3 minutes Number Correct: ____ Number Incorrect:
____

Equivalent Fractions Recording Sheet

Directions: Match the equivalent fractions and decimals in the least number of moves.

Date: ______________ # of moves to complete picture: _______

Date: ______________ # of moves to complete picture: _______

Date: ______________ # of moves to complete picture: _______

Figure 2: Partial copy of computer recording sheet

Analysis

The first step of integrating the Getting Ready for Algebra program was for the students to take the unit one practice-test. This practice-test had at least one problem from each lesson in unit one that was covered in this study. The investigator graded each item of every student's pretest either correct or incorrect according to their responses. Their responses would help determine what specific lessons the group needed to review. The investigator would not review any lesson where 100% of the participants answered a test item correct. The Getting Ready for Algebra program was designed to assess student's mastery of the skills and concepts presented every two to three lessons. The investigator would not continue to the next lesson in the unit until every student received at least 80% on their assessment.

The ultimate analysis for this study was the comparison between the practice-test and the unit one assessment. The number of items answered correctly and incorrectly was compared for each individual student, and the group average performance was compared, as well. With this analysis, the individual items that were answered correctly were compared to those answered incorrectly. The strategies used with each concept covered in the *Getting Ready for Algebra: Unit One* were identified to determine which strategies are most helpful. The students' correct answers would be the criteria used to determine the strategy to be helpful. The investigator also incorporated the Spring 2005 and Spring 2006 California Standards Test scores of the students participating in this study, as those scores represented the basis upon which the decision to include the students in the intervention support math class was made.

Limitations

Due to administrative decision, the study group for this research was limited to fifteen students. There was also no guarantee that the computers would be functioning during all class sessions of the study. The *Getting Ready for Algebra* program required time beyond the data collection time of this study. The study findings may have been more useful if a longer data collection period had been available. Students attended this support class on a voluntary basis, which may have affected the outcomes

CHAPTER FOUR

Results

Getting Ready for Algebra: *Unit One* contains nine instructional lessons, two quizzes, one practice test, and an assessment that is provided in two different forms. Three of the five participants in this study completed Unit One in its entirety. One student completed everything except the final assessment. One other student joined the group when lesson five was underway; however, the practice test was still administered to this student. Therefore, the findings included here represent the various levels of the students participating in this study. The following outcomes of this study include a comparison of student responses/scores on the practice test, unit one assessment, and the California Standards Tests results from 2005, and 2006.

The practice test used in *Getting Ready for Algebra*: *Unit One* had 13 questions. However, certain questions had multiple components that were scored independently. For example, Question #4 asks students to name the digit located in the given place value (a. 4*1*5; tens). Within Question #4 there are six opportunities for students to identify digits in varying place values. In Question #1, students were asked to graph points on a number line. Their responses were scored as correct or incorrect. If any part of the question was incorrect, then the entire question was marked wrong. This scoring method made the total number of points possible in the practice test 55. Of the four students completing the practice test, the average number of points for correct responses was 30.8. The average number of points for incorrect responses was 24.2. The average of the percent correct was 56 %. See Figure 3.

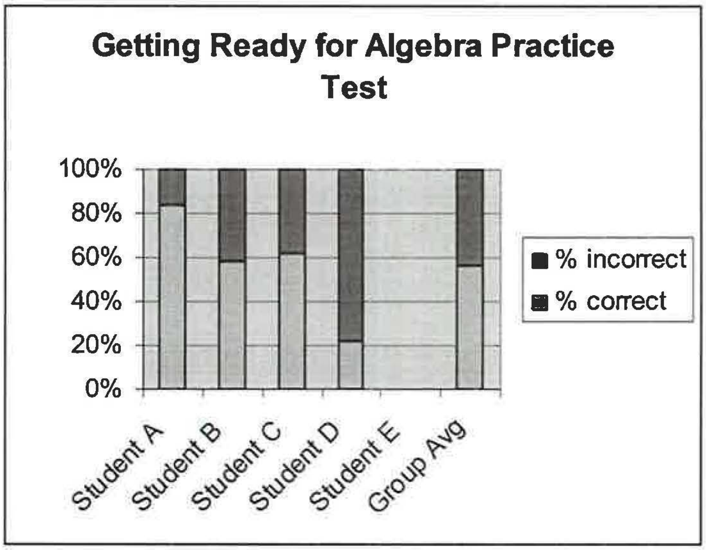

Figure 3. Comparison of student performance on the *Getting Ready for Algebra: Unit One* practice test.

The assessment in *Getting Ready for Algebra: Unit One* contained 20 questions. The total number of points possible was 31. As shown in Figure 4, the average number of points for correct responses was 24.75. The average number of points for incorrect responses was 6.25. The average of the percent correct was 80 %. The questions that students missed most frequently, as determined by two or more students missing the question, were numbers 7, 8, 9, 11, and 19. These questions covered concepts dealing with rounding (7, 8), graphing points on a number line (9), writing positive and negative integers in order from least to greatest (11), and using mathematical reasoning to justify integer comparison and place value (19).

The final comparison, as shown in figure 5, is the students' performance on their California Standards Test (CST). Every student, except one, increased their raw scores on the CST from 2005 to 2006. The difference in points from 2005 to 2006, ranged from -6 to 71 points.

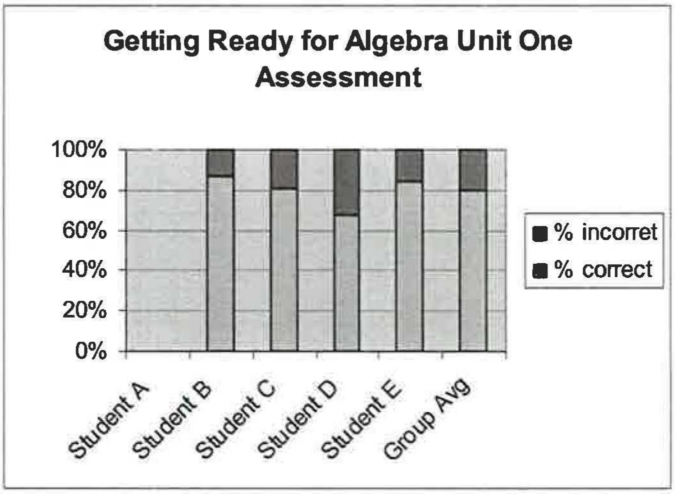

Figure 4. Comparison of student performance on the *Getting Ready for Algebra*: *Unit One* assessment.

The most significant changes in scores came from Students D and E who changed their level of proficiency from far below basic to below basic and below basic to basic, respectively. The investigator will discuss the findings from the practice test, unit one assessment, and the CST scores as well as the next steps for further investigation in the following chapter.

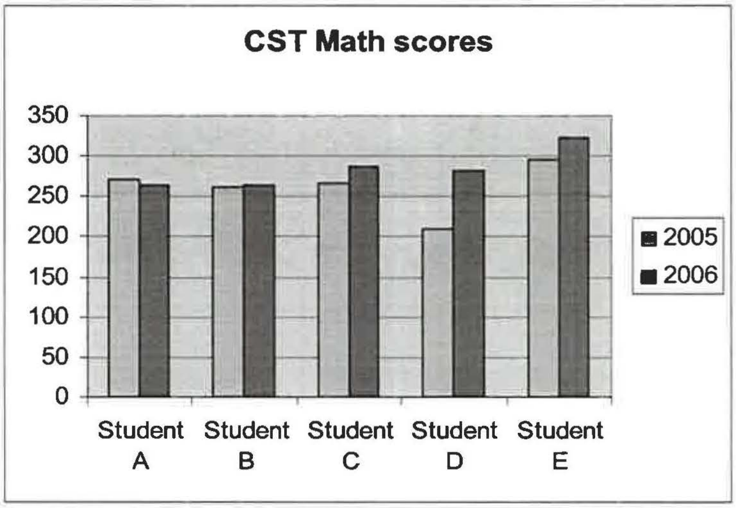

Figure 5. Student performance data from the 2005 and 2006 California Standards Tests for Mathematics.

CHAPTER FIVE

Conclusions and Recommendations

Introduction

The *Getting Ready for Algebra* program was used, for this study, to help identify strategies for helping sixth grade learners with special needs achieve in math. The *Getting Ready for Algebra Practice test*, *Getting Ready for Algebra: Unit One Test,* and the *California Standards Test of Mathematics* were used to compare student performance before and after applied strategies and instruction occurred.

There were twenty, sixth grade students invited to participate in the before-school math support class and five of those students who accepted the invitation were included in this study. The other fifteen students did not consistently attend the before-school math intervention class, did not attend at all, or did not return their parent permission slip to participate in this study. Four of the students who did participate were identified as having learning disabilities. Findings from this study showed that four out of the five students participating in the before-school intervention math class increased their scores on the *California Standards Test of Mathematics* from 2005, to 2006. Another result indicated from this study showed that the percentage of errors decreased from the *Getting Ready for Algebra Practice Test* to the *Getting Ready for Algebra: Unit One Test.*

Synthesis of Research and Discussion of Study

A synthesis of the findings of this research study and the research reviewed in *chapter two* was done to determine the effective instructional strategies for helping sixth grade learners with special needs overcome barriers in math. From this research review the investigator chose to use direction instruction, computational facts practice, via computer, and accommodating/modifying strategies to promote student understanding (Bley & Thornton, 2001; Garnett, 2005; Lock, 2005; Rienick, 2005; Sherman, et al. 2005; Swerling, 2005).

Specific Modifications

One of the dominant accommodating strategies applied in all instruction was the use of color. Colored overhead transparencies, highlighters used in notes and other mathematical computational assignments, as well as highlighting tape to provide feed back to both student and investigator. The use of color as an adaptation for modifying math instruction coincides with the research of Lock (1996), in which he discussed that using such modifications will help student's confidence and encourage them to take risks in problem-solving, which will strengthen student understanding of concepts.

Students with learning disabilities are neurologically structured in a way that makes it difficult for them to process, think, and remember information. The California content standards for mathematics is so vast and the language is so cumbersome (Bottage, Heinrich, Mehta, and Ya-Hui, 2002; P.E. Whitin and D. J. Whitin, 1997), that students with learning disabilities would benefit from supplemental instruction, according to this study. Other strategies applied that were observed to be helpful included:

a) using maximum instructional time (time limit with direct instruction)

b) increasing amount of time students have to complete assignments

c) following a standard format

d) cutting worksheets into manageable amounts (dependent on student need) with ample workspace

With the application of the aforementioned strategies, used in this study, three of the five students who completed both the practice test and unit one tests increased the percentage of questions answered correctly with an average increase of 31.3%. The other two students did not take both practice and unit one tests and therefore were not included in this average. However, the performance of all five students on the California State Standards test of mathematics were compared and four out of the five students increased their raw scores (0-600) with an average increase of 22.8 points. The highest increase of points of a student's raw score was 71 and the lowest -6. Two students changed their proficiency level from far below basic to below basic and from below basic to basic. Although notable increases were made the investigator does not consider the results to be statistically significant. The study findings may have been limited by the number of students participating in the study and the brevity of the data collection period. Also, students attended this support class on a voluntary basis, which may have affected the outcomes.

Recommendations

Most classrooms are impacted by the number of students in a classroom and although this study was implemented with a small group the investigator intended to identify strategies that would be most applicable to a large, 20-35, group of students.

The set period of time of no more than 20 minutes of using direct instruction appeared to be another effective strategy used in this study. This structured time provided students with opportunities to practice the concept(s) presented in the direct instruction as well as allowed the investigator to monitor student progress and understanding. There should be a maximum of two new concepts presented in one lesson so that student mastery can be observable and achievable. Students should also have access time to practice their basic facts, whether it is as a class center or a component of an additional intervention class. Instructors should use more color in their instruction to promote awareness of algorithms, computational signs, and other important math concepts.

Future studies may want to focus on identifying strategies to help students understanding of math vocabulary and how that affects their level of achievement on assessments. Other investigations could look at student readiness for various math levels as students are presented algebra concept as early as third grade. Another study could concentrate on student perceptions of learning math including their motivation and engagement in math activities and how this may affect their achievement. Lastly, implementing the suggestions from this study with a larger group of students in a general education classroom including a cluster of students with learning disabilities would be a very practical next step for a future study.

Summary

This study intended to help identify strategies to help sixth grade learners with learning disabilities overcome barriers in math. However, findings from this study could be identified as strategies that instructors of math could utilize in supporting mathematical understanding of students with special needs. The challenges that these particular learners face from recalling basic number facts to a comprehensive curriculum supported the need for this research. These challenges are also apparent in student performance on math assessments. Using consistent strategies such as direct instruction (no more than 20 minutes), following a standard format, and accommodating/modifying instruments such as color, as well as those mentioned in the beginning of this chapter, are helpful in improving students' confidence and understanding of mathematical concepts.

The 'work in progress' goal of the investigator has always been with the best intentions of helping students achieve and feel successful no matter what their perceived abilities may be and this study was a launching pad in reaching this goal.

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APPENDIX A

Math Support Program Invitation

February 2006

Dear Parents of ____,

Your child has been designated to receive additional support through our federally funded Title I program. These support services are provided for students who are considered to be achieving below grade level and are targeted to receive services based on district and site criteria. The measures used at King to target students include the California Standards Tests, grades, and teacher evaluation of student performance. As a part of our Title I program we are offering a before school support program in math for grades 6-8.

This program will begin on February 23 and continue through April 20, 2006. It is being offered on Tuesdays and Thursdays, from 7:00 to 8:00 A.M. All students enrolled in the Title I program will be expected to participate two times a week for the entire 10 weeks. Attendance will be taken daily and students with excessive absences (more than 2) may be dropped from the program. We appreciate your support in this endeavor.

Please complete the bottom portion of the form and return it to Ms. Sanders by Wednesday

February 15, 2006.

Sincerely,

Xye Sanders
Sixth Grade Resource Specialist

Student Name (please print): ____
Math Teacher: ________________________________ Grade: _____
Please check the item below that applies and return as soon as possible:

____Yes, my child WILL PARTICIPATE in the before school math program.

____No, my child WILL NOT PARTICIPATE in the before school math program.

APPENDIX B

Math Support Program Invitation

Febrero 2006

Estimados Padres de________________________________,

Su nino ha sido designado a recibir apoyo adicional por nuestro financio federalmente el Titulo que programo. Estos sostienen los servicios se proprcionan para estudiantes que son considerados para estar logrando debajo del nivel del grado y es concentrados en recibir los servicios basados en criterios de distrito y sitio. Las medidas utilizaron en Rey para concentrar en a estudiantes incluyen las Pruebas Estandares de California, la evaluacion de grados y maestro del desempeno de estudiante. Cuando una parte de nuestro Titulo que programo ofrecemos un despues del programa de apoyo de escuela en matematicas para grados 6-8.

Este programa empezara el 23 de Febrero y continuara por el 20 del Abril de 2006. Se ofrece los Martes y los Jueves, de 7:00 a 8:00 de la manana. Todos estudiantes se matricularon en it Titulo que programo se esperara participar dos veces una semana para las enteras 10 semanas. La asistencia sera tomada diaria y los estuiantes con ausencias excesivas (mas de 2) puede ser dejado caer del programa. Apreciamos su apoyo en esta tentativa. Complete por favor la porcion inferiora de la forma y lo vuelve a Senorita Lijadoras por el miercoles, el 15 de febrero de 2006.

Sinceramente,

Senorita Sanders
Maestra de Especialista de Recurso

Nombre del Alumno (letra de molde): ________________________________
Maestro/a de matematicas: ______________________________ Grado: _____
Favor de marcar abajo y regresar lo mas pronto possible:

____Si, mi hijo/a PARTICIPARA en el programa de matematicas

____No, mi hijo/a NO PARTICIPARA en el program de matematicas