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The effects of small group mathematical instruction

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THE EFFECTS OF SMALL GROUP MATHEMATICAL INSTRUCTION

by
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ABSTRACT

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The purpose of this study was to determine the effects of small group mathematical instruction when compared to whole group mathematical instruction. The participants of the study consisted of 35 first grade students from two intact classes from a suburban school district in New Jersey. The control group included 21 students who received whole group mathematical instruction. The experimental group included 14 students who received small group mathematical instruction. All students were pre-tested, instructed in mathematics, and post tested in their respective groups.

This study hypothesized that first grade students who received small group mathematical instruction would show a higher significant gain when tested compared to first grade students who had not received small group mathematical instruction when pre-test and post test scores were compared.

The results of a *t test* analysis indicated that students who received small group mathematical instruction did not show a higher significant gain. The results indicated no significant differences between the control group and the experimental group when the pre-tests and the post tests were compared.

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My participation in the MST program and the completion of this thesis had at times seemed overwhelming; however, with guidance from my advisor and love from my family and friends the seemingly impossible became possible.

I thank my advisor, Dr. Randall Robinson, for his expertise and patient guidance each step of the way. Learning from his years of experience was a gift that I will carry with me always.

I thank my family and friends for believing in me when I wanted to stop believing. They have shared in my triumphs to produce greater joy and shared in my struggles to lessen the load.

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Tables and Figures

Chapter 1

The Scope of the Study

Introduction

Finding one solution to solve all the mathematical problems of the educational system may be unrealistic. The debate over the most effective way to teach mathematics has been called "math wars" in various articles discussing mathematical instruction. Latterell and Copes (2003) question whether a more traditional or a reformed curriculum will best meet the needs of the students' problem solving abilities. In his article, Marshell (2003) leans towards a reform in curriculum, but views the more important reform to lie in the ability of the teachers themselves. Marshell (2003) expresses concerns that capable "mathematic leaders" are not available to teach students the mathematics that is "their right".

As the debate continues, the principles of guided reading involving small group instruction may be one strategy towards a solution. As defined by Fawson and Reutzel (2000), guided reading is a form of small group reading instruction in which the teacher works with five to eight students at one time. The students are group homogeneously by their individual ability. Fawson and Reutzel (2000) provide an outlined plan to use guided reading principles with basal reading materials. The article provides support for the versatility of the guided reading model. Because the teacher is following the student's reading, she knows when the student is struggling. At this point the teacher can intervene.

Peer Assisted Learning Strategies, similar to small group instruction, researched the effects of peer mediation. Peer Assisted Learning Strategies was implemented as part of the mathematic curriculum in ten kindergarten classrooms. The program involves dividing the classroom students into paired groups based on SESAT standardized pre-test scores. The results of the study showed that "peer mediation represents an effective strategy for promoting learning, even among relatively young children" (Fuchs, Fuchs & Karns, 2001, p. 9).

The use of PALS was also found to be effective for older elementary students. In an earlier study, Fuchs et al. (1995) researched the effects of PALS in nine schools in an urban school district. This study was conducted with 40 general education teachers. The students in the study ranged from grades 2 through 4 and ranged in ability from learning disabled through high achieving. The results of the study show positive effects of peer-assisted learning for average and low ability students as well as learning disabled students.

VanSciver (2005) compares differentiated instruction to coaching a pitcher in baseball. Telling the pitcher to throw a strike is redundant and useless. A good coach teaches the pitcher how to throw a strike based on the pitchers individual abilities. In the same way, differentiated instruction focuses on the individual needs of the student. Sprenger (2002), like VanSciver (2005), recognizes that students may be visual, auditory, or kinesthetic learners. According to Sprenger (2002), a good teacher will prepare lessons to meet the needs of all students and their different individual learning needs.

Statement of the Problem

The "math wars" warn us that students are not receiving mathematic instruction in a way that meets their individual learning needs (Trafton, Reys, & Deanna, 2001).

Guided reading and peer assisted learning are defined by a more individualized learning environment. Small group instruction allows the teacher to differentiate the lessons according to learning style or group students according to ability. The students' individual mathematic learning needs can be better met through small group instruction.

Hypothesis

First grade students who receive small group mathematical instruction will show higher significant gain when tested compared to first grade students who did not received small group mathematical instruction when pre-test and post test scores are compared.

Limitations of the study

There were four limitations to this study:

The first limitation of the study was the familiarity between the instructors and the students. The researcher taught the control group of students for two months prior to the beginning of the study. The homeroom teacher taught one of the experimental groups for eight months prior to the beginning of the study. The researcher taught the other experimental group only during the study. These pre-existing relationships may have affected the students' performance and the outcome of the study.

The second limitation of the study was teaching experience of instructors. The researcher who instructed the control group and one experimental group had less than one year teaching experience. The homeroom teacher who instructed the other experimental group had five years of teaching experience. The homerooms teacher's experience may have enabled her to explain a lesson more clearly. Her ability to better teach a lesson may have affected the post test results.

The third limitation of the study was a lack of resources for all lessons. The design of the lesson plans on weight required the students to compare the weight of various objects within the classroom environment. Due to a limited number of scales, the control group of students was divided in small groups. Those students receiving whole group instruction were exposed to small group instruction which may have affected the post test results.

The fourth limitation of the study was the environmental variable. Any instruction received outside the classroom was beyond the control of the research. Some student may have received additional practice or review from parents. This additional practice or review may have affected the post test results.

Definition of Terms

The terms used in this study are listed below:

Differentiated Instruction – Varying instruction to meet the needs of different learning styles: visual learners, auditory learners, or kinesthetic learners.

Math Wars – The controversy regarding standards-based mathematics curriculum.

Peer Assisted Learning Strategies (PALS) – A form of peer assisted learning in which two students are paired to work together. PALS is used as reinforcement following the teacher guided whole group lesson. During PALS, each student has the opportunity to be the tutor and the tutee.

Small group instruction – Teacher guided lesson(s) in a given subject to a group of eight or less students.

Whole group instruction – Teacher guided lesson(s) in a given subject to a group of nine or more students.

Chapter 2

Review of Literature

Introduction

Latterell and Copes (2003) are not alone in their search for an effective way to teach mathematics. The indication that students lack problem solving skills is evident in numerous articles. Ironically, the experts and educators are unable to solve the problem of how to teach the students. "These disagreements echo similar discussions in other field…" (Latterell & Copes, 2003, p. 207). Guided reading was not always a practice in education; however, the small group flexibility it provides makes guided reading a valuable part of any reading program (Pinnell, 1999). The discovery of how people learn is also changing how educators should teach. A whole group of learners includes a variety of learning styles (Sprenger, 2002). This study hypothesized that first grade students who receive small group mathematical instruction would show higher significant gain when tested compared to first grade students who did not receive small group mathematical instruction when pre-test and post test scores were compared.

Mathematic Instructional Problems

Mathematics is no longer limited to cashiers counting money and accountants totaling columns. In an ever increasing technical world, the need for mathematics finds its way into many areas of employment. While the literature agrees that mathematical instruction is an important aspect of our education system, there is disagreement on how instruction should be given. The debate is between standard-based mathematics and traditional textbooks as a base for mathematical instruction (Trafton, Reys & Wasman, 2001; Marshall, 2003).

Standard-based mathematics is an effort "to reflect recommendations made by the National Council of Teachers of Mathematics (NCTM) in 1989 in the *Curriculum and Evaluation Standards for School Mathematics*" (Trafton, Reys & Wasman, 2001, p. 259). It is a curriculum supported in part by the National Science Foundation (NSF). The materials incorporated into the standard-based curriculum are: comprehensive, coherent, develop ideas in depth, promote sense-making, engage students, and motivate learning. It is believed that through the use of these materials, students will gain a better understanding of mathematical concepts. It is also believed that a better understanding will transfer to the students' ability to manipulate and use mathematics in real life situations. Students will no longer view mathematics as a variety of individual components; the various parts of mathematics (arithmetic, algebra, geometry) will be viewed as an interrelated whole (Trafton, Reys, & Wasman, 2001).

Traditional mathematic curriculum teaches the basic concepts in isolation before teaching problem solving skills for real world application. In addition, it provides textbooks similar in design to those used in past decades when today's teachers were taught (Latterell & Copes, 2003). Most of today's teachers are more comfortable using traditional mathematic textbooks to teach due to their familiarity with the material. Those who design and sell the textbooks used in traditional mathematic curriculum claim "real life" application meeting the principles and standards as defined by NCTM (Marshell, 2003). As the debate for a curriculum continues, the need for a change as to how mathematics is taught in today's schools can be agreed upon (Latterell & Copes, 2003; Marshall, 2003).

Early home and preschool numeracy exposure impacts student's attitudes and expectations toward mathematics in their later school years. Early numeracy exposure may be during play such as counting "1, 2, 3, ready, set, go", or counting buttons while dressing. This type of numeracy exposure is more in line with real life application. However, preschool aged children may also be exposed to numeracy at home in a more formal setting with one parent acting as the teacher (Aubrey, Bottle & Godfrey, 2003). "[T]here is insufficient evidence however to ascribe a greater effectiveness to one particular style" (Aubrey, Bottle & Godfrey, 2003, p. 102).

While more research is needed to pin-point the development of numeracy and later mathematical attitudes, research has been done on how students learn and remember information. Students may be: (1) Visual learners who want to see the information. "They may not hear what you're saying, but they see what you mean" (Sprenger, 2002, p. 75). (2) Auditory learners who want to talk and listen. "Information isn't real to them until they have had a chance to discuss it" (Sprenger, 2002, p. 76). (3) Kinesthetic learners who want hands-on and movement. "They need a 'pat on the back' rather than an 'A' on a paper" (Sprenger, 2002, p. 77).

Working memory is also an important factor when teaching and learning. There are five types of memory: semantic memory, episodic memory, procedural memory, automatic memory, and emotional memory. When new information is not retained through at least one type of memory, the information is not retrievable at a later time. In order for teaching to be effective, the lesson needs to be presented in such a way that the student is able to retain and retrieve information (Sprenger, 2002).

"Recognizing different mathematical learning styles and adapting differentiated teaching strategies can facilitate student learning" (Strong, Perini, Silver & Thomas, 2004, p. 73). Two different instruction books on how to teach mathematics were compared. The first book, Classroom Instruction That Works, gives a direct approach that outlines what the student will learn by the end of the unit. The second book, How to Differentiate Instruction in Mixed-Ability Classrooms, starts with assessment of the students learning styles (Strong, Perini, Silver & Thomas, 2004).

It was argued that one book was not enough for effective teaching in mathematics. Effective teachers need to differentiate instruction to meet the needs of all their students. Students should be given direct lesson objectives to establish goals while student assessment provides valuable insight for real life application (Strong, Perini, Silver & Thomas, 2004). In spite of the "math wars", many classrooms are not limited to one curriculum. Many teachers will incorporate parts of other curriculum into the existing curriculum (Latterell & Copes, 2003).

Differential Education

"In differentiated classrooms, teachers begin where students are, not the front of a curriculum guide" (Tomlinson, 1999, p. 2). In today's classrooms, the mix of students range in academic ability while lawmakers demand "No Child Left Behind". The diversity of student abilities and learning styles, and the lawmakers' demands, places the teacher in a challenging situation. When teaching multiplication, some students may understand the relationship between addition and multiplication thereby easily memorizing the multiplication table. Other students may understand multiplication in the relationship of the number of groups to the number within each group (VanSciver, 2005). "Using differentiated instruction high-quality teachers attend to the differing needs of diverse learners in their classrooms" (VanSciver, 2005, p. 535).

Differentiated instruction began with the ideas of Dr. Virgil Ward. His goal was to find a better way to instruct gifted students. Ward did not view additional work as an answer to meet the needs of gifted students. In his view "more of the same" was not enough of a challenge; however, in a classroom with students of varying abilities, some students may need additional instruction to meet the learning objective (Bravmann, 2005).

Ward's ideas can apply to all students. If instruction can be changed to meet the needs of gifted children, then instruction can be changed to meet the needs of struggling learners as well. Carol Ann Tomlinson is one author who took Ward's ideas to the other end of the learning scale. The focus of the "math wars" is the curriculum; the focus of differentiated education is the student's ability (Bravmann, 2005).

Students do not enter school with the same knowledge, understanding and experiences. Once in school, students do not progress at the same rate. For this reason students will gain knowledge when the information is presented at their level. This form of instruction can be presented in a variety of ways where there is a balance between the teacher, the students, and the "stuff". The "stuff" includes the content information and all materials needed to present the lessons (Tomlinson, 1999).

A student needs to understand a mathematical problem before he/she can solve the problem (Garderen & Montague, 2003). And yet, "learning disabilities in mathematics receive far less attention than do learning disabilities in reading…" (Jordan

& Hanich, 2003, p. 213). This may be in part due to the complexity of mathematical concepts (Jordan & Hanich, 2003).

One longitudinal study of second and third grade students investigated students with mathematic deficiencies over a two year period. The students were identified according to the results of the Broad Reading and Broad Mathematics portions of the Woodcock-Johnson Psycho-Educational Battery standardized test. They were then grouped according to mathematic deficiencies, reading deficiencies, and mathematic and reading deficiencies (Jordan & Hanich, 2003).

Those students who were identified with mathematic deficiencies only showed a greater improvement than those students identified with reading deficiencies or mathematic and reading deficiencies. However, students with reading deficiencies and mathematic and reading deficiencies received special education addressing their reading deficiencies. Less attention, in terms of special education, was given to those students with mathematic deficiencies to address their area of weakness. Students with mathematic deficiencies without reading deficiencies had the advantage of language comprehension to better solve story problems (Jordan & Hanich, 2003).

This study further suggests mathematic deficiencies with or without reading deficiencies may be a weakness associated with long-term memory or poorer number sense. In either case the focus should be on the student's progress and development as a means of improving mathematic deficiencies (Jordan & Hanich, 2003).

Another study concluded that pre-service elementary school teachers were in need of additional instruction to gain the content knowledge and positive attitude needed to better present mathematical instruction. The success of mathematical reform depends on the teachers' meaningful mathematical content knowledge and positive attitudes (Quinn, 1997).

The teacher needs an in depth understanding of the content and the students. In this way the content can be presented at the student's level of understanding. One possible way to present the content of the lesson is through whole group instruction followed by varying classroom activities. Again, the activities are designed and assigned to individual students based on the individual student's needs and abilities. In this example equity takes precedence over equality (Tomlinson, 1999).

A second possible way to instruct a lesson in a classroom with students of varying abilities is through small group instruction. This form of instruction allows for a small group of students to work with the teacher while the remainder of the class works independently (Tomlinson, 1999).

Small group instruction needs to be flexible to include all students who are having difficulties with a particular concept or lesson. The students' ability should dictate the grouping; not the grouping dictating the setting in which the student should learn. Both small group instruction and whole class instruction can be used according to student needs. For this reason, student assessment is an ongoing process to ensure student learning and development (Tomlinson, 1999). Flexible grouping is one teaching strategy for effective mathematical instruction (Strong, Perini, Silver & Thomas, 2004).

Types of Small Group Instruction

Guided reading is a form of small group instruction. The students are grouped according to reading ability. The group works with the teacher using the same level reading material. During a guided reading lesson the students may read independently or chorally. In either case, the teacher observes students' behavior and ability as a means of guiding the students. Teachers may also make changes in the grouping as needed based on observation of an individual student's development (Pinnell, 1999).

The flexibility and scaffolding learning style offered through guided reading can be applied with other material. A basal reading program can be changed to a guided reading program. The important elements are identifying the students' ability and content knowledge. The individual student's ability must be identified in order to challenge the student at an appropriate level. The content knowledge of effective reading strategies and grammar are needed to guide the student to become better readers (Fawson & Reutzel, 2000).

Peer group learning, also known as cooperative learning, is another effective alternative to meeting student needs. Students prefer working with a partner or in a small group while using a computer as an educational tool in the classroom or computer lab setting. Students are better able to solve problems and stay on task therefore improving the learning activity when working with other students (Watson, 1995).

Peer assisted learning strategies (PALS) is a form of peer learning whereby one student assumes the role of the tutor while the other student assumes the role of tutee. Two studies examined the use of PALS to improve students' mathematic abilities. The first study focuses on students in second, third and fourth grade with varying learning histories (Fuchs & Fuchs, 1995). The second study focuses on kindergarten students' mathematical development (Fuchs, Fuchs & Karns, 2001). These studies extend from education practices in past history. One room school houses provided the setting for students of varying ages as well as abilities. It was common in such a setting for the teacher to incorporate peer tutoring (Fuchs & Fuchs, 1995).

The first study divided the second, third and fourth grade students into three groups according to leaning disabilities, low-achieving abilities, and average-achieving abilities. The students were tested based on acquisition effects (addition, subtraction, multiplication and division of whole numbers, decimals and fractions) and transfer effects (numeration, concepts, geometry, measurement, charts and graphs, money, word problems) (Fuchs & Fuchs, 1995).

The results of the study showed a growth in students' abilities in both acquisition and transfer for students of all ability levels. The results further indicated the most growth was found in students with learning disabilities and low-achieving students in the area of computation of whole numbers, decimals and fraction (Fuchs & Fuchs, 1995).

The second study, including 20 kindergarten classrooms, divided the students into four groups according to learning disabilities, low-achieving abilities, middle-achieving abilities, and high-achieving abilities based on pre-test scores which determined verbal counting ability and global quantity comparison. These are skills needed in order to form a mental number line which is then used in arithmetic strategies. During this study, "[students] worked constructively and intensively with classmates to support their own and their partners' learning" (Fuchs, Fuchs & Karns, 2001; p. 503).

The results of the study showed that students of all abilities were able to benefit from working with their peers (Fuchs, Fuchs & Karns, 2001).

Chapter 3

Methodology

Introduction

Students are not receiving the mathematical instruction that is needed throughout life. New curriculums are being implemented and old curriculums are being reformed (Marshall, 2003). Small group instruction is an alternative to continues curriculum changing. Small group instruction has found success during math instruction when student work together in pairs (Tomlinson, 1999). Small group instruction is also effective during guided reading (Pinnell, 1999). The success of the small group instruction may be carried over to mathematics as an alternative to ensure the goals and objectives of the mathematic lessons are met (Tomlinson, 1999). This study compared pre-test and post test scores to measure the effects of small group mathematical instruction of first grade students when compared to whole group mathematical instruction of first grade students from a suburban school district in New Jersey.

Description of Subjects

The student participants of the study included 35 of the 124 first grade students from a suburban school district in New Jersey. The students were from two separate intact classrooms. The first class consisted of 21 students with one homeroom teacher who taught the lessons during the school day. The second class consisted of 15 students with one homeroom teacher and one support teacher who co-taught the lessons during the school day. One student in the second class was included when instruction was given but excluded from the study at the parents' request. Prior to the beginning of the study, each class received whole group instruction in mathematics from their respective homeroom teacher.

According to school records, the students were from predominately two parent middle to low income families. The ethnicity of the students were 11 African American, 18 Caucasian, 4 Hispanic and 2 of another race. There were a total of 23 male students and 12 female students participating in this study. The ages of the students at the time of the study were six or seven years of age with one student eight years of age. The students' abilities ranged from needing additional resources to a second grade reading level. None of the students were classified for additional or exceptional mathematic abilities.

Procedure

Prior to beginning the study, a letter was sent home with each student to explain the study and request permission to include the student in the study (see appendix A). Thirty-six letters were sent home; thirty-five were returned granting permission while one letter was returned denying permission.

The control group consisted of 21 students in an intact first grade class. These students received whole group mathematic instruction from the researcher. The experimental group consisted of 14 students from another intact first grade class within the same school. The students in the experimental group were divided into two groups. At the start of the study, the student completed a multiple choice pre-test consisting of 16 questions on measurement (see appendix B). One student who was absent took the pre-test the next school day.

The students were instructed to do their best and guess if necessary. The students were told that the test did not count as a grade but would be used for assessment purposes. Each of the sixteen questions was read aloud along with the four possible answer choices. All test related questions were answered by repeating to the students to try their best. The day after the pre-test, the experimental group was divided into two small groups. On the second day of the study, the experimental group received instruction in two small groups. Both the researcher and the homeroom teacher followed the same mathematic lesson plans on measurement (see appendix C).

Due to scheduling, the control group was administered the pre-test three days after the experimental group was pre-tested. The control group was also tested as a whole group. There were no students absent. The day following the administration of the pre-test the control group began the measurement lessons instructed by the researcher.

The control group and the experimental group were given instruction following the same mathematic lesson plans on measurement. The lessons were taught to the control group and the experimental group at different times depending on the class schedule. The experimental group was taught as two small groups at the same time in the homeroom. The lessons were taught over fifteen school days

The lesson plans followed the district curriculum mathematic textbook by Silver, Burdett and Ginn entitled Mathematics, The Path to Math Success, grade 1; volume 2; chapter 10. The lessons in chapter 10 were on measurement including inches, centimeters, pounds, kilograms, cups, pints, quarts and liters. The students received daily consecutive instruction on lessons 1 through 5 as defined in the textbook. The students then received a review lesson on measurement using inches and centimeters on the sixth day followed by a researcher made test on measurement using inches and centimeters on the seventh day. After the review test, the remaining lessons followed the lessons as outlined in the textbook.

Once the lessons were completed, the post test was administered to the experimental group as a whole class (see appendix D). The students were told that this test counted as a grade; the students were to try their best and all the material had been instructed.

The control group completed the measurement lessons three days after the experimental group. The day following the completion of the last lesson, the control group was given the post test as a whole group. The same procedure was followed.

Description of Instruments

The instruments for the study consisted of a pre-test and a post test.

The pre-test was chapter 10 pre-test, form B, from the textbook by Silver, Burdett and Ginn entitled Mathematics, The Path to Math Success, grade 1, volume 2. The pre-test was a 16 question multiple choice questions on measurement. The questions required knowledge of inches, centimeters, pounds, kilograms, cups, pints, quarts, and liters. The students were asked to choose the correct answer out of four possible choices. The students were not asked to do any measuring with rules, scales or cups; however, they also needed to know which tool was used for each type of measurement.

The post test was chapter 10 post test, form B, part 1, from the textbook by Silver, Burdett and Ginn entitled Mathematics, The Path to Math Success, grade 1, volume 2. The design of the post test was the same as the pre-test with 16 multiple choice questions on measurement. The questions required knowledge of inches, centimeters, pounds, kilograms, cups, pints, quarts, and liters. The students were asked to choose the correct answer out of four possible choices. The students were not asked to do any measuring with rules, scales or cups; however, they needed to know which tool was used for each type of measurement.

Chapter 4

Data Analysis

Introduction

This study was conducted to determine the effects of small group mathematical instruction of first grade students' when compared to whole group mathematical instruction of first grade students. Mathematic skills are needed for employment, yet students lack these skills (Marshall, 2003). In an effort to find an effective way to teach mathematic skills to students, small group instruction in reading (Fawson & Reutzel, 2000; Pinnell, 1999) and peer group instruction in mathematics has been researched (Fuchs & Fuchs, 1995; Fuchs, Fuchs & Karns, 2001). Research indicates that students not only range in ability, but also range in preferred learning styles. Some students prefer to hear instructions, other students prefer to see how a problem can be solved, while still other students prefer to work out a problem independently (Sprenger, 2002).

Small group mathematical instruction allows for a more individualized method of teaching in order to meet a student's preferred learning style (Sprenger, 2002). Following the example of guided reading models, small group instruction also allows for flexible grouping based on students' ability (Fawson & Reutzel, 2000).

Description of Data

Table 1 list the scores of the pre-test and post test taken by the 35 first grade students who participated in the study. The test scores indicate the number of correct answers out of a possible 16 questions. The difference indicates the pre-test score subtracted from the post test score for each individual student.

The control group includes 21 students who received whole group mathematical instruction from the researcher. The experimental group includes 14 students who received small group mathematical instruction: 7 students received instruction from the researcher and 7 students received instruction from the homeroom teacher.

table 1
List of test scores

Control Group				Experimental Group			
Case #	Pre-test	Post test	Difference	Case #	Pre-test	Post test	Difference
1	10	15	5	1	10	15	5
2	11	12	1	2	6	12	6
3	13	13	0	3	11	14	3
4	7	12	5	4	8	10	2
5	11	13	2	5	9	14	5
6	11	14	3	6	11	11	0
7	7	11	4	7	11	14	3
8	7	14	7	8	7	12	5
9	14	7	-7	9	8	14	6
10	9	12	3	10	9	9	0
11	10	12	2	11	11	13	2
12	11	14	3	12	8	11	3
13	11	12	1	13	11	11	0
14	11	8	-3	14	10	9	-1
15	10	13	3				
16	9	12	3				
17	10	11	1				
18	12	14	2				
19	10	14	4				
20	15	13	-2				
21	10	12	2				
total	219	258	39	total	130	169	39

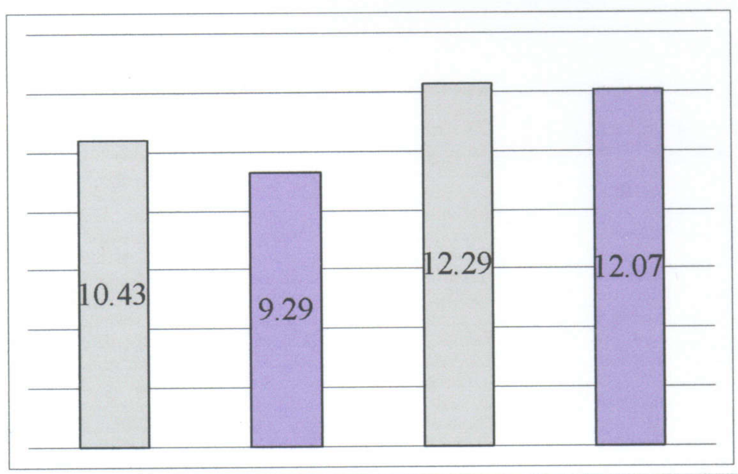
Table 2 lists the students by case number in the experimental group along with their pre-test and post test scores. These students were divided into small groups for mathematic instruction. Group 1 consisted of eight students taught by their homeroom teacher. One student was excluded from the study at the request of the student's parents. Group 2 consisted of seven students taught by the researcher.

table 2
List of experimental group test scores

Group 1 Case #	Pre-test	Post test	Group 2 Case #	Pre-test	Post test
1	10	15	2	6	12
3	11	14	5	9	14
4	8	10	7	11	14
6	11	11	8	7	12
10	9	9	9	8	14
13	11	11	11	11	13
14	10	9	12	8	11

Figure 3 highlights the mean of pre-test and post test scores for the control group and the experimental group. Using two separate *t test for independent samples,* the means of the pre-test scores (10.43 & 9.29) and the means of the post test scores (12.29 & 12.07) were calculated respectively to determine the probability of a significant difference between the control group test scores and the experimental group test scores. The results indicate no significant difference when the two groups test scores were compared. Using two separate *t test for non-independent samples,* the means of the control groups pre-test and post test scores (10.43 & 12.29) and the means of the experimental groups pre-test and post test scores (9.29 & 12.07) were calculated respectively to determine the probability of a significant difference between these test scores. The results indicate a significant difference between the pre-test and post test scores of the control group (t=-2.8015, p<.01) and a highly significant difference between the pre-test and post test scores of the experimental group (t=-4.3582, p<.001). While these results indicate a higher significant for the experimental group all students benefited from mathematical instruction regardless of the group size. Based on the results of the four *t test*, the hypothesis was rejected.

figure 1
Graph of test score means



Mean	Pre-test	Post test
Control Group	10.43	12.29
Experimental Group	9.29	12.07

Chapter 5

Summary, Conclusions & Recommendations

Introduction

The purpose of this study was to determine if small group mathematical instruction was an effective alternative to whole group mathematical instruction. As students continue to enter school with varying levels of ability (Tomlinson, 1999) and preferred styles of learning (Sprenger, 2002), the need for effective mathematical instruction will also continue. Other research articles support the positive effects of small group instruction in reading (Fawson & Reutzel, 2000; Pinnell, 1999) and peer group learning in mathematics (Fuchs & Fuchs, 1995; Fuchs, Fuchs & Karns, 2001) and computers (Watson, 1995). This study combined these teaching strategies.

Summary of the Problem

Mathematic computation and problem solving skills are life long tools (Marshall, 2003). As educators, these tools should be provided and enhanced as students' progress through school. Unfortunately, research indicates that students are graduating and leaving school without the necessary mathematical skills (Reys, 2001; Trafton, Reys & Wasman, 2001).

Mathematics is a complex subject that goes far beyond adding and subtracting positive whole numbers. An understanding of negative numbers, decimals, fractions and percentages as well as geometry, measurement, money and word problems is needed at various times in life (Fuchs & Fuchs, 1995). Mathematical instruction needs to be taught to the students' in such a way that it may be applied to real life situations (Trafton, Reys & Wasman, 2001).

Summary of the Hypothesis

This study hypothesized that students who received small group mathematical instruction would show higher significant gain on post test scores then those students who received whole group mathematical instruction.

Summary of the Procedure

Two intact first grade classes from a suburban school district in New Jersey were pre-test, instructed and post tested to determine the effects of small group mathematical instruction. The control group of 21 students from one intact class received mathematic instruction as a whole group. The experimental group of 14 students from one intact class was first divided into two groups. The experimental group received mathematical instruction in two small groups in the same classroom during the same period. The same lesson plans were followed for all instruction.

Summary of the Findings

The findings from this study indicate that no significant difference exists between small group mathematical instruction and whole group mathematical instruction when the pre-test and post test scores of the control group are compared to the pre-test and post test scores of the experimental group respectively. The findings further indicate that a significant difference exist when the pre-test scores of the control group are compared to the post test scores of the control group while a highly significant difference exist when the pre-test scores of the experimental group are compared to the post test scores of the experimental group.

Conclusion

The hypothesis was rejected based on the results of the *t test* which compared the post test scores of both groups. The significant difference and the highly significant difference that existed when pre-test scores are compared to post test scores within each group was expected since mathematical instruction had been given to the students after the pre-test results and prior to the post test result.

This study concluded that small group mathematical instruction does not indicate a significant difference when post test scores are compared; however, there are limitations to consider when accepting or rejecting a hypothesis. Although the hypothesis of this study was rejected, other research supports small group instruction in reading (Fawson & Reutzel, 2000; Pinnell, 1999) and peer group learning in mathematics (Fuchs & Fuchs, 1995; Fuchs, Fuchs & Karns, 2001).

The design of this study was limited to the students in the two intact classrooms. A larger population or an equal number of students in the control group and the experimental group may have shown a significant difference when post test scores were compared. The design of the study was also limited by the lack of resources for all of the lessons. Due to a lack of scales during the three lessons on weight, which included weighing in pounds and kilograms, the students in the control group were exposed to peer group learning during these three lessons. This limitation may have affected the post test results.

Recommendations & Implications

Incorporating small group mathematical instruction requires knowledge of the students' ability and preferred method of learning; this knowledge should develop throughout the school year for all methods of instruction. Incorporating small group mathematical instruction also requires planning time to ensure that all students are engaged in learning while the teacher's focus is on the small group of students with whom he/she is working. Lastly, in order to incorporate small group mathematical instruction, additional material and resources will be needed to implement multiple lesson plans and activities.

Based on the results of this study, small group mathematical instruction does not indicate a significant improvement of test scores. This study does indicates that whole group mathematical instruction is equally beneficial. In spite of the success of guided reading and peer group learning, daily small group mathematical instruction may require time and resources that would be better used elsewhere.

Although there was not a significant difference between the post test scores of the control group and the experimental group to support small group mathematical instruction on a daily basis, it is not a method of instruction that should be completely disregarded. Additional research measuring the effect of small group mathematic instruction is needed. Significant results may be found in a study incorporating older students, a larger population, or sufficient material.

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Appendix A – Letter to parents

Gloucester Township Public Schools

David Hinlicky
Principal

Frederick Johnson
Assistant Principal

James W. Lilley, Jr. Elementary School
1275 Williamstown Road * Erial, NJ 08081
856-875-0991 * FAX 856-728-3028

March 18, 2005

Dear Parents,

For those of you who do not know me, I am in Ms. Conte's first grade class as a student-teacher. I attend Rowan University enrolled in the Maters of Science in Teaching Program. One of my requirements for graduation is to complete an education related research study. My research study will hypothesis the relationship between small group instruction in mathematics and improve test scores.

Provided that I have your consent, Ms. Conte and Mrs. McCarthy have agreed to allow me the use of their classrooms to conduct my research study. This study will be conducted in the normal classroom setting.

In order to determine the effects of small group mathematics instruction, I will administer a pretest to all participating students. I will then teach lessons on measurement to Ms. Conte's class. Ms. Conte's class will then be given the unit test.

I will also teach the identical measurement lessons to Mrs. McCarthy's class; however, her students will be divided into two equal groups who will each receive small group instruction. Upon completion of the lessons, Mrs. McCarthy's class will also be given the unit test. The pretest and unit post test will be compared on an individual basis to determine the amount learned by each student.

While the lessons and testing are a part of your child's normal school day, the test score results will be part of my research study. Although it is within your parental right to deny me the use of your child's test scores, the reliability of my results increase with each additional set of test scores.

Those who will have knowledge of the study and it's results other than I will be my Rowan University advisors, the classroom teachers involved, and the principal and vice principal of J.W. Lilley School. Please be assured that neither your child's identity nor the school's identity will be published in the research study.

Please indicate on the bottom of this letter your consent. If you have any questions, please give me or your child's classroom teacher a call at 856-875-0991. Thank you in advance for your assistance in my endeavors.

Sincerely,
Theresa Storms

_____ I give consent for my child's test scores to be added to the above mentioned research study.

_____ I do not give consent for my child's test scores to be added to the above mentioned research study.

Child's name ______________________________ Parent's signature ____________________________

cc: D. Hinlicky / Principal
D. Conte / cooperating teacher
M. McCarthy / teacher

Appendix B – Sample Pre-test

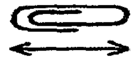
Name ______________________________

Fill in the ○ for the correct answer.

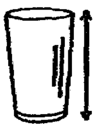
About how long or tall is each real object?

1. 

Ⓐ 3 in. Ⓑ 1 in.
Ⓒ 10 in. Ⓓ 18 in.

2. 

Ⓐ 20 cm Ⓑ 10 cm
Ⓒ 3 cm Ⓓ 12 cm

3. 

Ⓐ 25 in. Ⓑ 1 in.
Ⓒ 12 in. Ⓓ 6 in.

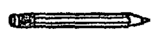
4. 

Ⓐ 2 cm Ⓑ 8 cm
Ⓒ 16 cm Ⓓ 1 cm

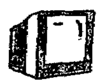
5. Which weighs more than 1 kilogram?

Ⓐ  Ⓑ  Ⓒ  Ⓓ 

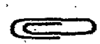
6. Which weighs more than 1 pound?

Ⓐ  Ⓑ  Ⓒ  Ⓓ 

7. Which weighs less than 1 pound?

Ⓐ  Ⓑ  Ⓒ  Ⓓ 

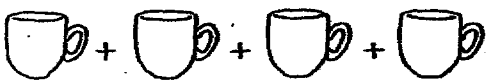
8. Which weighs less than 1 kilogram?

Ⓐ  Ⓑ  Ⓒ  Ⓓ 

Name____

Fill in the ◯ for the correct answer.

9. How many pints in all?

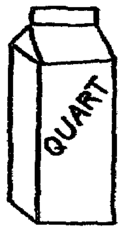


Ⓐ 1
Ⓑ 2
Ⓒ 4
Ⓓ 8

10. How many cups in all?

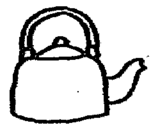
Ⓐ 2
Ⓑ 3
Ⓒ 4
Ⓓ 5

11. How many cups can you fill?



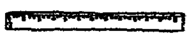
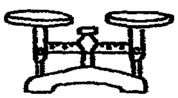
Ⓐ 1
Ⓑ 2
Ⓒ 3
Ⓓ 4

12. Which holds more than 1 liter?

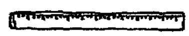
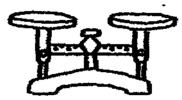
Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

Which tool should you use to measure?

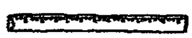
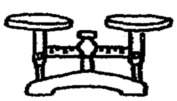
13. How long.

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

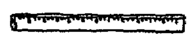
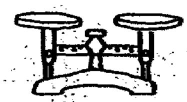
14. How heavy.

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

15. How much it holds.

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ not given

16. How high.

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

Appendix C – Lesson Plans

Mathematics
Measurement Lessons

	Objective	Procedure	Evaluation	Materials
1	Complete a pretest on measurement.	Explain to students that they will take a pretest on measurement. Instruct the students to do the best they can. Read any part of the test for the students without hinting to an answer.	Grade pretest	Copies of pretest
2	Compare the lengths and heights of objects.	Explain the vocabulary (shorter, taller, longer), choose two students, ask the remaining students to pick which student is taller, explain that height measures up and down, choose two objects (pencil and paperclip), lay the items flat, have student choose which is longer, explain that length measures side to side, complete student pages 281 & 282, choose an item in the classroom, ask several students to choose another item to tell if their item is shorter, taller, or longer, further ask the student if he/she is measuring height or length.	Teacher observation	Textbook, pencil, paperclip
3	Estimate and measure length and height by using nonstandard units.	Give students a group of paperclips, demonstrate how to measure a pencil with paperclips, ask each student to measure his/her pencil using paperclips, ask the students how many paperclips were needed, compare a paperclip to a toothpick, ask the students which is longer, ask the students to guess/estimate how many toothpicks are needed to equal the pencil, explain that a paperclip can be one unit of measure while a toothpick can be another unit of measure, complete student pages 283 & 284, ask the student guess and measure their paper with the paperclips and toothpicks.	Teacher observation	Textbook, paperclips, toothpicks
4	Measure length and height by using inches.	Explain vocabulary (inch, foot, ruler), explain that Americans use inches and feet to measure length and height, explain that an inch and a foot are also units of measure, show students an inch on a ruler, ask student to look around the room and guess something that is an inch long, show students a foot is twelve inches, complete student pages 285 & 286	Teacher observation	Textbook, inch ruler
5	Measure length and height by	Explain vocabulary (centimeter, decimeter, metric system), explain that the	Teacher observation	Textbook, centimeter

	using centimeters.	metric system is used by other parts of the world, explain that a centimeter is another unit of measurement, show students a centimeter on a ruler, show students a decimeter is 10 centimeters, complete student pages 287 & 288		ruler
6	Measure inches and centimeters.	Complete worksheets (row after row, supersize sunflowers) as a class, Complete measurement worksheet (pipe cleaner, index card, toothpick, cup, large paperclip, stick)	Teacher observation	Inch and centimeter rulers
7	Complete inches and centimeter test	Review inches and centimeters as two different units of measure, distribute test,	Grade test	Copy of inches and centimeter test
8	Compare the weight of objects.	Math minutes choosing several students to name something in the room he/she can lift and can not lift, explain vocabulary (heavier, lighter), give students a cotton ball and marble to hold in each hand, explain that the marble is heavier and weighs more and the cotton ball is lighter and weighs less, complete student pages 289 & 290	Teacher observation	Textbook, cotton balls, marbles
9	Measure weight in pounds.	Explain vocabulary (pound), display a 1 lb. bag of rice, allow each student to hold, compare the weight of several items with the pound of rice (paperclip, pen, book), complete student pages 291 & 292	Teacher observation	Textbook, bag of rice
10	Measure weight in kilograms.	Explain vocabulary (kilogram), identify the kilogram with the metric system used in other countries, display a 1 kilogram bag of marbles, allow each student to hold, compare the weight of several items with the kilogram of marbles, compare the kilogram of marbles to the pound of rice, complete student pages 293 & 294	Teacher observation	Textbook, bag of marbles, bag of rice
11	Explore capacity.	Display different size cups; ask students which cup would hold the most water, sand, etc.; complete student pages 295 & 296	Teacher observation	Textbook, small, medium, and large cup
12	Estimate and measure capacity by using cups, pints, and quarts.	Explain vocabulary (cup, pint, quart); display cup, pint, and quart containers; teach students Quart Song; complete student pages 297 & 298	Teacher observation	Textbook, cup, pint, and quart container,

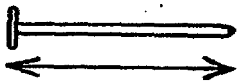
				copy of Quart Song
13	Estimate and measure capacity by using liters.	Explain vocabulary (liter); display a liter bottle; ask the student if the liter bottle will hold more or less than a cup, the trash can, a bucket in the classroom, etc.; complete student pages 299 & 300	Teacher observation	Textbook, liter bottle
14	Choose appropriate tools to measure length, weight, and capacity.	Review measuring lengths and heights, weights, and volume (how much can it hold); discuss the tools of measurement; complete student pages 301 & 302	Teacher observation	Textbook, ruler, scale, measuring cup
15	Complete a post test on measurement	Review the different forms of measurement, distribute test, read and answer questions as needed	Grade post test	Copies of post test

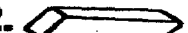
Appendix D – Post test

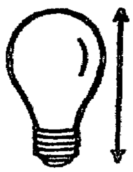
Name ____________________

Fill in the ◯ for the correct answer.

About how long or tall is each real object?

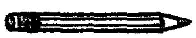
1. 
   - Ⓐ 12 inches
   - Ⓑ 2 inches
   - Ⓒ 20 inches
   - Ⓓ 10 inches

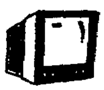
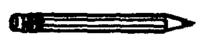
2. 
   - Ⓐ 15 centimeters
   - Ⓑ 12 centimeters
   - Ⓒ 10 centimeters
   - Ⓓ 5 centimeters

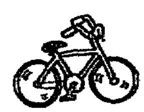
3. 
   - Ⓐ 4 inches
   - Ⓑ 1 inch
   - Ⓒ 2 inches
   - Ⓓ 12 inches

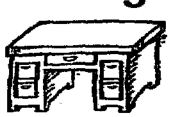
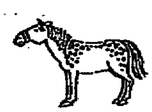
4. 

   - Ⓐ 20 centimeters
   - Ⓑ 25 centimeters
   - Ⓒ 10 centimeters
   - Ⓓ 1 centimeter

5. Which weighs more than 1 kilogram?
   - Ⓐ 
   - Ⓑ 
   - Ⓒ 
   - Ⓓ 

6. Which weighs more than 1 pound?
   - Ⓐ 
   - Ⓑ 
   - Ⓒ 
   - Ⓓ 

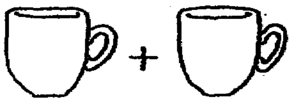
7. Which weighs less than 1 pound?
   - Ⓐ 
   - Ⓑ 
   - Ⓒ 
   - Ⓓ 

8. Which weighs less than 1 kilogram?
   - Ⓐ 
   - Ⓑ 
   - Ⓒ 
   - Ⓓ 

Name ______________________________

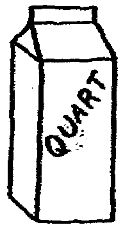
Fill in the ◯ for the correct answer.

9. How many pints in all?



Ⓐ 1
Ⓑ 2
Ⓒ 4
Ⓓ 8

10. How many cups in all?



Ⓐ 2
Ⓑ 3
Ⓒ 4
Ⓓ 5

11. How many cups can you fill?

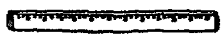
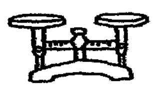
Ⓐ 1
Ⓑ 2
Ⓒ 3
Ⓓ 4

12. Which holds less than 1 liter?

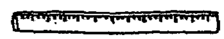
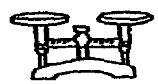
Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

Which tool should you use to measure?

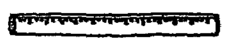
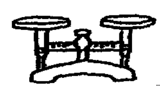
13. How heavy.

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

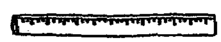
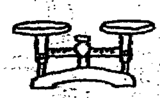
14. How high.

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

15. How long.

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

16. How much it holds.

Ⓐ 
Ⓑ 
Ⓒ 
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