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THE EFFECT OF INTERACTIVE BULLETIN BOARDS ON MATHEMATICS
ACHIEVEMENT IN FOURTH GRADE

by
Kathleen M. Charlton

A Thesis

Submitted in partial fulfillment of the requirements of the
Master of Science in Teaching Degree
of
The Graduate School
at
Rowan University
July 1, 2002

Approved by

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Date Approved July 1, 2002

ABSTRACT

Kathleen M. Charlton, The Effect of Interactive Bulletin Boards on Mathematics Achievement in Fourth Grade, 2002, Dr. Randall Robinson, thesis advisor, Rowan University, Master of Science in Teaching

The purpose of this study was to determine what effect the use of interactive bulletin boards when used as manipulative learning tools which reinforce basic arithmetic through repetition on a daily basis, have on the final marking period grades of fourth grade students. It was hypothesized that fourth grade students who experience the daily use of interactive bulletin boards that contain manipulative parts to reinforce basic arithmetic skills as a part of their mathematics instruction will exhibit significantly higher marking period grades in mathematics than students who do not experience such bulletin boards on a daily basis.

The design of the study was quasi-experimental with an experimental group of 23 students and a control group of 23 students. Prior to the treatment, second marking period numerical grades for mathematics were collected from both groups. After four weeks of use of an interactive bulletin board in mathematics lessons in the experimental group, third marking period grades were collected from both groups. A series of t-tests at the .05 alpha level showed no significant difference in achievement between the control and experimental groups.

MINI-ABSTRACT

Kathleen M. Charlton, The Effect of Interactive Bulletin Boards on Mathematics Achievement in Fourth Grade, 2002, Dr. Randall Robinson, thesis advisor, Rowan University, Master of Science in Teaching

Can interactive bulletin boards improve mathematics achievement? Forty-six fourth grade students were used in a quasi-experimental study to determine if using such bulletin boards in mathematics lessons would improve final marking period grades. No significant difference was found between the control and experimental groups to support that using interactive bulletin boards in mathematics improves student achievement.

ACKNOWLEDGEMENTS

The researcher is indebted to the following individuals who played a critical role in the completion of this thesis:

Dr. David Kapel, Director of the Master of Science in Teaching Program and Professor of Education, for affording me the opportunity to pursue my teacher education in this exceptional program. His faith in my abilities and availability for assistance have been unwavering.

Dr. Randall Robinson, Graduate Advisor and Professor, whose patience, wisdom, and flexibility helped me to complete this work with confidence and precision.

Mrs. Dana Stow, Clinical Teacher, Radix Elementary School. Her assistance with this study made my burden lighter and my time in her classroom a true pleasure.

My loving and supportive family, Patricia Fischer, David Fischer, Sean Fischer, Kevin Fischer, Regina Cummings, and Jack Cummings. Their immeasurable faith in me and perpetual love and encouragement have been, and always will be, the most driving force in every one of my endeavors. The accomplishment of this finished product is greatly due to their love and support.

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Chapter I

Scope of the Study

Introduction

It is not uncommon for students to excel in subjects such as social studies and reading but to struggle with concepts in mathematics. Part of the problem may be in the failure of students to develop a solid foundation in basic arithmetic skills. Many problems arise when students attempt to learn mathematical concepts of a greater complexity when they are having difficulty with skills such as addition and subtraction (Mathematically Correct, 2001).

In order to help students to build this much needed foundation, they must be given opportunities that engage them in mathematics experiences and invite problem solving, reasoning, and communication. Interactive bulletin boards that provide students with daily experiences that reinforce basic mathematics skills through manipulation and hands-on activities can greatly enrich a mathematics program (Meagher & Novelli, 1998).

Statement of the Problem

The purpose of this study was to determine what effect the use of interactive bulletin boards, used as manipulative learning tools which reinforce basic arithmetic through repetition on a daily basis, have on the final marking period grades of 4th grade students.

The study attempted to answer the following questions: Is mastery of basic arithmetic operations vital in understanding more complex mathematical concepts? Is a

lack of proficiency in basic arithmetic partially to blame for poor mathematics grades? Will a daily exercise that reinforces basic arithmetic through repetition of performance build these skills? Is an interactive bulletin board, used as both a teaching tool and learning center, an effective medium for building basic arithmetic skills?

Statement of the Hypothesis

Fourth grade students who experience the daily use of interactive bulletin boards that contain manipulative parts to reinforce basic arithmetic skills as a part of their mathematics instruction will exhibit significantly higher marking period grades in mathematics than students who do not experience interactive bulletin boards that reinforce basic arithmetic skills on a daily basis.

Limitations

Several variables may have affected the results of this study. One of these problems may have been the teaching style and/or teaching experience of the teacher in the control group classroom differed from that of the teacher of the class receiving the treatment. A more experienced teacher may have more effective methods of conveying mathematical concepts to students.

During the course of the school day several students left their classrooms for various activities such as band, chorus, and the Talented and Gifted (TAG) program. Students leaving the experimental group did not receive consistent treatment on those occasions and possibly missed some vital instruction. Students who left the control group also missed instruction taking place there. All of these student interruptions in classroom instruction during the math period may have affected the results.

Since the mathematics period was not held during the same time of day in each

classroom, there may have been a difference in the performance of students with regard to attention and/or retention of the material. Some students may have learned more effectively in the morning and some may have been more proficient in the afternoon.

Students who were classified as learning disabled or were gifted in mathematics may have affected study results. Their weakness or talent in mathematics may have been reflected in their overall marking period grades. Also, students who had difficulty with learning mathematical skills may not have benefited from the methods implemented in this study. Students gifted in mathematics may have benefited from this reinforcement, however, their grades may have already been significantly higher than others in the groups.

The climate of each classroom, including temperature, lighting, desk arrangements, and visual stimulation of mathematical concepts in each classroom varied. Students who were uncomfortable with the classroom temperature may have been lacking in concentration. Harsh or insufficient lighting may have distracted students from their tasks, which could have affected their academic performance. In one classroom the arrangement of the desks may have been more conducive to learning. Students in both classrooms were seated in groups and pairs. If mathematically slow learning students were seated next to mathematically advanced students, the slow learners may have benefited from the seating arrangement. Since one classroom had more visual stimulation, students could have been overwhelmed and confused with too much information. A lacking of visual stimulation in the less visually stimulating classroom may have taken away from potential learning in the subject area.

Definition of Terms

The following terms were defined by the researcher as:

Achievement - The overall degree of competency shown through cumulative grades in the area of mathematics.

Basic Skills - The ability of students to perform addition, subtraction, and multiplication.

Bulletin Board - A board, mounted on the classroom wall, where items such as students' work or announcements may be posted.

Interactive Bulletin Board - A board, mounted on the classroom wall, which features manipulative items useable for daily mathematics instruction.

Manipulation - The act of moving and using objects as educational tools which give a concrete representation of the ideas being presented.

Marking Period - An approximately ten-week long span of time when academic grades are accumulated, which include grades for homework, quizzes, tests, and class participation, to be totaled for a final report card grade at the end of the ten weeks.

Chapter II

Review of Related Literature

Introduction

Education seems to be plagued by false dichotomies. Until recently, when research and common sense gained the upper hand, the debate over how to teach beginning reading was characterized by many as “phonics vs. meaning.” It turns out that, rather than a dichotomy, there is an inseparable connection between decoding - what one might call the skills part of reading - and comprehension. Fluent decoding, which for most children is best ensured by the direct and systematic teaching of phonics and lots of practice reading, is an indispensable condition of comprehension(Wu, 1999).

“Facts vs. higher order thinking” is another example of a false choice that is often encountered. It is sometimes thought that thinking of any sort - high or low - could exist outside of content knowledge. In mathematics education, this debate takes the form of basic skills or conceptual understanding. This bogus dichotomy would seem to arise from a common misconception of mathematics held by a portion of the public and the education community: that the demand for precision and fluency in the execution of basic skills in school mathematics runs counter to the acquisition of conceptual understanding. Actually, skills and understanding are very much intertwined. In most cases, the precision and fluency in the execution of the skills are the requisite vehicles to convey the conceptual understanding(Wu, 1999).

Advocates of the “new math” have spoken of higher-order thinking, conceptual

understanding and solving problems, but they neglect the systematic mastery of the fundamental building blocks necessary for success in any of these areas. Their focus is on things like calculators, blocks, guesswork, and group activities and they shun things like algorithms and repeated practice. The new programs are shy on fundamentals and they also lack the mathematical depth and rigor that promotes greater achievement (Mathematically Correct, 2002).

This study would determine if there was a significant difference in marking period grades in mathematics between students who do and do not experience the daily use of interactive bulletin boards that contain manipulative parts to reinforce basic arithmetic skills as a part of their mathematics instruction. This chapter focuses on research which has examined the importance of basic skills and the ways in which to build them. Topics include interaction and manipulation, practice, and bulletins boards as a teaching medium in the area of mathematics.

The Importance of Basic Skills in Mathematics

Because conceptual understandings are built on the foundation of technique, sometimes a simple skill is absolutely crucial for the understanding of more sophisticated processes. At other times it is the fluency in executing a basic skill that is essential for further progress in the course of one's mathematics education. The automaticity in putting a skill to use frees up mental energy to focus on the more rigorous demands of a complicated problem(Wu, 1999).

Performance in component skills needs to be automatic in order for the learner to concentrate his/her attention on the new task to be learned. If the learner's attention is distracted by the performance of component skills, attention will not be able to be focused

on the new task, and it will not be learned. Automatic retrieval of basic facts is necessary to “free up” the working memory to apply those basic skills to more advanced skills or tasks(Grice, Mabin, &Graham, 1999)

In a study by Grice and colleagues the importance of addressing low mathematical performance with effective teaching methods was examined. In the study three groups of children aged 8 - 10 who scored below the 22nd percentile on the PA Tests were taught basic mathematics skills for 16 hours, each being exposed to varying methods of teaching, all focusing on basic skills. All children changed their percentile ranking significantly the following year by up to 60th percentile ranks(Grice, et al., 1999).

On the other side of proponents of focusing on basic skills in mathematics are those who think that too much time is spent here, and not enough time is spent on problem solving and conceptual understanding. The results of the second national assessment of mathematics reinforced the warnings that professional organizations concerned with mathematics education have been stressing in recent years. An excessive narrowing of the mathematics curricula - in the name of “Back to the Basics” - to the mechanistic learning of computational skills is detrimental to the development of problem solving(Hill, 1990)

Interaction and Manipulation

Over the past decade a growing consensus among educators favors a shift in mathematics instruction from a curriculum in which students learn and practice the standard school algorithms to one in which reasoning, problem solving, and conceptual understanding play a major role. The Curriculum and Evaluation Standards for School Mathematics states that conceptual approaches to computation instruction result in good

achievement, good retention, and a reduction in the amount of time students need to master computational skills(Carroll & Porter, 1997).

Unfortunately, many teachers are not inclined to use manipulatives or interactive bulletin boards in their classrooms. They often hold traditional beliefs concerning the nature of teaching mathematics, and use bulletin boards to decorate their rooms according to the changing seasons. Research has shown that the best way to introduce or reinforce abstract concepts in the primary grades is by using manipulatives and interactive activities.

One way to improve the understanding of numbers and operations is to encourage children to develop computational procedures that are meaningful to them(Carroll & Porter, 1997). Learning about any subject requires students to connect new information with knowledge and skills previously learned, but it must be certain that the connections between old and new knowledge are sound. One effective way of doing this is to incorporate new ideas and techniques into the learning activities of individuals and groups of students working cooperatively with manipulatives(Berk, 1999).

Information gained by a discovery from manipulation is more valuable and meaningful than pencil and paper learning. Hands-on experiences and the ability to manipulate objects increases the retention and understanding of a concept(Quinn, 1998). According to Quinn (1998), manipulatives are objects that appeal to many senses and that can be touched, moved about, rearranged, and otherwise handled by children. Quinn contends that they can be objects from the environment, such as money or measuring instruments, or materials specifically designed to teach mathematical concepts.

When the Association of American Publisher's School Division surveyed 2,000 primary grade teachers about their use of types of instructional materials, they found that

manipulatives ranked second only to textbooks(Berk, 1999). A study of elementary aged children conducted by Dorothy Singer, co-director of the Yale University Family Television Research and Consultation Center, confirms the value of manipulatives as educational tools. They found that manipulatives and interactive activities kept children involved and entertained with a very high level of attention and concentration(Berk, 1999). Children should develop multiple representations of concepts like everyday objects, diagrams, and verbal definitions, and interactive bulletin boards can be used in direct teaching of students as they relate to an ongoing unit of study(Fuys & Liebov, 1997).

The Effects of Practice

It is well documented that practice, or rehearsal, is a necessary condition for skill acquisition. The ways in which students engage in the practice of skills depends on the arrangement of the practices. This approach includes introducing variation in the way tasks are ordered, in the nature and scheduling of feedback, and in the versions of the task to be practiced, and also by providing less frequent feedback. In all cases the authors argue that even though acquisition (i.e. immediate) performance may be decreased, retention and generalization are enhanced owing to additional - and most likely deeper - information processing requirements during practice(Salas & Cannon-Bowers, 2001).

In the 1980's many researchers began studying how people acquire expertise with the main focus being on the role of practice in this development(VanLehn, 1996).

Phenomena that were often associated with motor skills, such as the power-law of practice and the identical elements model of transfer, were found to be important with cognitive skills as well. Most of the recent work has focused on the role of instruction during the

early stages of skill acquisition, in particular on the role of examples. In this literature an example is a problem whose solution is given to the student, along with the solution's derivation. Examples appear to play a central role in the early phases of cognitive skill acquisition (VanLehn, 1996).

Three phases are associated with cognitive skill acquisition: Early phase, intermediate phase, and late phase. It is the beginning of the late phase in where students remove all the flaws in their knowledge and can solve problems without conceptual errors, although they may still make unintended errors. This capability signals the end of the intermediate phase. During the late phase, students continue to improve in speed and accuracy as they practice, even though their understanding of the domain and their basic approach to solving problems does not change. Practice effects and transfer are the main research issues in this phase (VanLehn, 1996).

The intermediate phase is officially concluded when students can produce error-free performances. However, learning does not end at this point. Continued practice causes increases in speed and accuracy. Perhaps the common finding about the late phase of learning is the famous power law of practice. The time needed to do a task decreases in proportion to the number of trials raised to some power (VanLehn, 1996).

It has been found that the speed of applying individual components of knowledge increased according to a power law, thus indicating that practice benefits those components rather than the skill as a whole. Accuracy also increases according to a power law, at least on some. The speedup and accuracy are due to two mechanisms: Knowledge is converted from a slow format to a fast format, and the speed of individual pieces of procedural knowledge also increases with practice (VanLehn, 1996).

Some cognitive skills are deterministic calculations, in which case answers to problems are completely and uniquely determined by the inputs of the problem. Mental arithmetic calculations are examples of such deterministic calculations. If subjects are given enough practice with a particular input, then they eventually just retrieve the output from memory rather than mentally calculate it. The change in strategy from calculation to retrieval could be taken as an explanation for the power law increases in speed and accuracy (VanLehn, 1996).

The use of practice is also supported with regard to activation and decay. Activation is assumed to decay spontaneously with the passage of time, so a refreshing process, referred to here as rehearsal, is needed to maintain availability (Nairne, 2002).

Virtually all complex cognitive activities - reading, reasoning, problem-solving - require access to intermediate steps (as in adding or multiplying two-digit numbers in the head) or other situation-specific information. In examining this concept, Nairne (2002) asks, what then are the psychological mechanisms, or systems, that drive and control such short-term maintenance?

The generally accepted view of temporary storage of information includes the idea of a standard model. The model states that short-term storage arises from activation, a mnemonic property that keeps information in an immediately accessible form. Permanent knowledge is activated, as a byproduct of on-line cognitive processing and comes to reside "in" short-term memory. Short-term memory is simply defined as the collective set of this activated information in memory (Nairne, 2002). Activation is assumed to be fragile, however, and it can be quickly lost, through the operation of decay, in the absence or rehearsal. When necessary, rehearsal can counteract decay, refreshing activation, much

like a juggler can temporarily defy the force of gravity by repeatedly tossing plates back up into the air(Nairne, 2002).

Additional evidence comes from studies measuring retention in the absence of rehearsal. Rehearsal can be prevented, or at least disrupted, by requiring subjects to engage in articulatory suppression during the study and recall of a memory list.

Alternatively, one can test young children who lack the ability to rehearse strategically. In the former case, with articulatory suppression, immediate memory performance declines significantly and the work-length effect disappears. In the latter case, young children who fail to rehearse consistently often show little sensitivity to spoken duration in immediate retention, at least when material is presented visually(Nairne, 2002).

Collectively, these data seem to offer strong support for the standard model. Articulation rate, and inferentially the speed of internal rehearsal, varies in a more or less direct way with memory span. In the absence of rehearsal, immediate memory performance declines and no longer shows the clean connection with spoken work duration(Nairne, 2002).

Although much research supports the use of practice in the acquisition of skills, there are questions as to when it is actually taking place. Proponents of the standard model rarely, if ever specify the dynamics of the rehearsal process in any kind of systematic way. The protocol of covert rehearsal is likely to change with a host of variables, such as list length, modality of presentation, presentation rate, lexicality, or interitem similarity. Does rehearsal occur only during stimulus input, or does it also occur during response output? Does it matter whether one rehearses based primarily on sound, or is it necessary to access meaning in order to maintain the activation of permanent

knowledge? The idea of the standard model seems simple enough, but its actual implementation is likely to be quite complex(Nairne, 2002). Additionally, some recent research suggests that practice does not have as dramatic effects as is commonly believed. While it may turn out that some mental operations are automatized in the strongest sense, this may be uncommon(Pashler, Johnston, & Ruthruff, 2001).

A study performed through the Johnson Bible College in Tennessee demonstrates two outcomes following two types of practice administered in different ways. As part of the mathematics curriculum students were provided with activities to refine their basic mathematics skills. The study took place during two weeks in which students practiced the multiplication facts to develop speed and accuracy. The class was divided into two groups with one group receiving paper and pencil practice with worksheets (control group), and the other group using drill and practice software. Both groups were given the same pretest, which was graded based on the number of correct answers completed out of the sixty problems. Each group received thirty minutes of instruction for eight days during a two-week period. At the end of the period the students took the same test to measure improvement in learning the multiplication facts. The mean scores for the posttests of each group were compared. The results indicated that there was a significant increase in the number of problems correctly completed by the treatment group that used the computer software, whereas mean scores for the pencil and paper group did not indicate a significant improvement in the development of their multiplication skills(Williams, 2000).

Bulletin Boards as a Teaching Medium

Many experts say that at least 60% percent of all learning takes place through visual and tactile experiences(Jackson, 1994). Given this, Jackson (1994) claims that

every feature of the classroom, from storage bins to bulletin boards need to work overtime, engaging children's senses, enticing them to explore, and reinforcing their skills and confidence. Small investments and simple innovations can have a big impact on children's approaches to learning(Jackson, 1994).

Bulletin boards are used in most classrooms to display holiday themes and students' academic and creative efforts. They can also become effective learning centers if they are used as "teaching walls." The teaching wall approach focuses on a major stimulus, has supportive visuals, matches the interests, needs, and capabilities of the learners, provides immediate feedback, proceeds from simple to more complex tasks, and is fun for the learners(Cummins & Lombardi, 1989). Cummins and Lombardi (1989) tell of students with learning disabilities in their resource room and their difficulty with learning spelling skills. To facilitate knowledge of letter-sound relationships, visual imagery through a bulletin board learning center was used. Because an interest inventory administered at the beginning of the school year had indicated that each of these students enjoyed fishing, the bulletin board learning center was organized around the theme "Expert Fishing Makes a Good Speller." The board was colorfully decorated and creatively designed. Learning packets, which progressed in difficulty, were fastened to the board display and were to be completed by each student during each session at the board.

The results of using this board indicated progress with this approach to learning. The students were not familiar with the words until they finished several of the packets and had mastered all of the words upon completing the sixth and final packet(Cummins & Lombardi, 1989).

In the article, "Organizing for instruction in Mathematics," featured in the Journal

of Instructional Psychology, the author states that bulletin board displays which illustrate selected facts, concepts, and generalizations in mathematics can assist pupils to obtain needed background information on their very own and that the bulletin board display may also be used in direct teaching of pupils as they relate to an ongoing lesson or unit of study(Ediger, 1999). Ediger(1999) describes one of the best stimulating bulletin boards he observed when supervising student teachers and cooperating teachers in the public schools. It emphasized a history of measurement. Many pupils were fascinated with the display by noticing how the centimeter, meter, and kilometer had their beginning or origin. The bulletin board display here helped pupils to learn more about measurement. Many pupils spent much time viewing and discussing the bulletin board display. This author also states that it is important for a bulletin board to be taken down when it has served its purpose and replaced with a new one which encourages pupil learning(Ediger, 1999).

Chapter III

Procedure and Design of Study

Introduction

It is possible that the practice of reinforcing basic arithmetic skills of elementary school-aged children on a repetitive daily basis could alleviate the difficulty that some students have with grasping more complex mathematical concepts in later grades. A daily exercise that involves teachers engaging students in interactive arithmetic activities, which feature drill and repetition, is one way to reinforce their basic skills. Classroom bulletin boards are a possible medium for such an activity (Meagher & Novelli, 1998).

This study was conducted to determine if interactive bulletin boards that reinforce basic arithmetic skills on a daily basis would improve the total marking period mathematics grades in fourth grade students. The researcher took into consideration possible variables in classroom conditions which may have affected results.

Population and Sample

The study was conducted in an elementary school in a suburban town with a population of approximately 12,000 . Eighty six percent of the population was Caucasian, 10.4% African American, 2.9% Hispanic, and 1% Asian. It was a socio-economically divers community. The median household income for the county at the time of the study was \$49,000(U.S. Census Bureau, 2000).

The school encompassed grades pre-K through 5, with 2 pre-K classes, 4 kindergartens, 6 first grades, 5 second grades, 7 third grades, 8 fourth grades, and 7 fifth

grades. There were two floors in the school building. Pre-K and kindergarten classes were held in a separate, yet connected wing of the school.

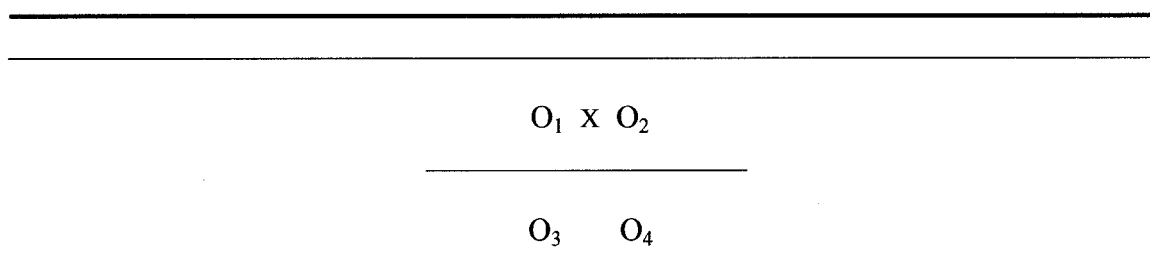
The total sample for the study was 46 students. The experimental group contained twenty-three students with twelve males and eleven females. The control group contained twenty-three students with 14 males and 9 females. In the experimental group four students were involved in the Talented and Gifted (TAG) program. Two students received basic skills instruction for both language arts and mathematics, and one student received basic skills instruction for language arts only. In the control group one student was in the TAG program, and three students received basic skills instruction.

Experimental Design

The design of the study was one-tailed, quasi experimental with independent samples. A pure experimental design with random samples was impossible, because the experimental and control groups were already intact at the beginning of study (see Figure 3.1).

Figure 3.1

Experimental Design



Procedure

Before beginning the study verbal permission was sought and granted from the

classroom teacher and school principal. Parent permission slips were sent home, signed by parents, and returned by students in the experimental group (see appendix A) and control group (see appendix B).

Second marking period mathematics grades for both groups were obtained from both classroom teachers before the treatment was implemented. Treatment for the experimental group began on the fourth Monday of the 3rd marking period and was continued for 4 weeks.

For each day of the treatment period students in the experimental group were given a series of 15 arithmetic problems to solve as part of their morning work. The problems appeared in 3 columns on a bulletin board in the classroom. The problems consisted of 5 involving adding a combination of three numerals ($5 + 6 + 1$), 5 involving multiplying and adding or subtracting a combination of 3 numerals ($2 \times 3 + 6$ or $2 \times 3 - 6$), and 5 involving multiplying a combination of 3 numerals ($5 \times 3 \times 6$) (see appendix C). Numerals in all problems were changed each morning prior to students arrival. Students wrote and solved all problems on individual daily charts previously distributed. Each mathematics period, starting at 11:15 a.m., began with a review of the answers. Students checked and corrected their work. In addition to the daily morning exercise two students per day were selected to use the bulletin board as a mathematics game for approximately 20 minutes during a free period in the day. During the game numerals for the problems were obtained by students rolling a set of three number cubes simultaneously. The numbers rolled on the three cubes became the 3 numerals for a problem. For example, if in one roll of the cubes, the numerals 2, 4, and 6 were facing up, one of the problems would read $2 + 4 + 6$. The three cubes were rolled for all 15 problems, adding numerals

to the board with each roll of the cubes. Once all numerals were in place, the two students worked together to solve, using supplied numeral cards to display answers (see appendix D).

Final marking period grades for mathematics were obtained from both the experimental and control groups after four weeks, which ended the third marking period. To analyze data, five separate t- tests at the .05 level of significance were performed by the researcher. The first compared the pre-treatment scores of the experimental and control groups. The second compared the post-treatment scores of experimental and control groups. The third compared the change scores of the experimental and control groups. The fourth compared pre and post-treatment scores of the experimental group. The fifth compared the pre and post-treatment scores of the control group.

Chapter IV

Analysis of the Findings

Introduction

In order to help students to build this much needed foundation, they must be given opportunities that engage them in mathematics experiences and invite problem solving, reasoning, and communication. Interactive bulletin boards that provide students with daily experiences that reinforce basic mathematics skills through manipulation and hands-on activities can greatly enrich a mathematics program(Meagher & Novelli, 1998). It was hypothesized that fourth grade students who experience the daily use of interactive bulletin boards that contain manipulative parts to reinforce basic arithmetic skills as a part of their mathematics instruction will exhibit significantly higher marking period grades in mathematics than students who do not experience interactive bulletin boards that reinforce basic arithmetic skills on a daily basis.

Results

Pre and post-treatment numeric grades for mathematics were collected for the experimental group. The means and standard deviations for each were calculated. The mean for pre-treatment numeric grades was 92.83 with a standard deviation of 3.73. The mean for post-treatment numeric grades was 91.91 with a standard deviation of 3.82. (see table 1).

table 1

Means and Standard Deviations of Numeric Grades
Experimental Group

Second Marking Period (Pre-treatment)	Mean	Standard Deviation
	92.83	3.73
Third Marking Period (Post-treatment)	91.91	3.82

Pre and post-treatment numeric grades were collected for the control group. The means and standard deviations for each were calculated. The mean for pre-treatment numeric grades was 88.00 with a standard deviation of 7.92. The mean for post-treatment numeric grades was 84.39 with a standard deviation of 15.21. (see table 2).

table 2

Means and Standard Deviations of Numeric Grades
Control Group

Second Marking Period (Pre-treatment)	Mean	Standard Deviation
	88.00	7.92
Third Marking Period (Post-treatment)	84.39	15.21

A t-test was calculated at the .05 alpha level on the pre-treatment numeric grades

of the experimental group and control group. A t-score of 2.63 with 44 degrees of freedom was calculated. This was significant at the .05 alpha level showing inequality in the two groups at the pre-treatment point.

A t-test was calculated at the .05 alpha level on the post-treatment numeric grades of the experimental group and control group. A t-score of 2.30 with 44 degrees of freedom was calculated. This was significant at the .05 alpha level. However, because of the significant difference between the pre-treatment scores of the experimental and control groups, pre-treatment numeric grades were subtracted from post-treatment grades of both groups. Forty points were added to each difference to bring both groups to the same starting level. A third t-test was calculated at the .05 alpha level on these change scores in order to determine any true significant difference in post-treatment numeric grades. A t-score of 1.10 with 44 degrees of freedom was calculated. This was not significant at the .05 alpha level.

A t-test was calculated at the .05 alpha level on the pre and post-treatment numeric grades of the experimental group. A t-score of -0.92 with 22 degrees of freedom was calculated. This result has shown a decline in grades, however the absolute value, 0.92, was not significant at the .05 alpha level.

A final t-test was calculated at the .05 alpha level on the pre and post-treatment numeric grades of the control group. A t-score of -1.75 with 22 degrees of freedom was calculated. This result has also shown a decline in grades. Although the absolute value of 1.75 was not significant at the .05 alpha level, it was approaching significance. (see table 3).

table 3
Summary of t-Tests

Group	t	d.f.	p level
1. Pre-Test Experimental vs. Control	2.63	44	<.05
2. Post-Test Experimental vs. Control	2.30	44	<.05
3. Change Scores Experimental vs. Control	1.10	44	n.s.
4. Change Scores Experimental Only	-0.92	22	n.s.
5. Change Scores Control Only	-1.75	22	n.s.

Discussion

Initial t-test calculations on mean marking period numeric grades after the implementation of treatment showed a significant difference. However, the experimental group and control group were not equal at the pre-treatment point, as the first t-test showed. After accommodation for this inequality it became clear that there was no significant difference in post-treatment numeric marking period grades between the two

groups. It was hypothesized that fourth grade students who experience the daily use of interactive bulletin boards that contain manipulative parts to reinforce basic arithmetic skills as a part of their mathematics instruction will exhibit significantly higher marking period grades in mathematics than students who do not experience interactive bulletin boards that reinforce basic arithmetic skills on a daily basis. T-test scores did not support this hypothesis. T-test scores did show a negative change in numeric marking period grades for both groups after treatment. Both were determined not significant, however, the difference between pre and post-treatment numeric grades for the control group were approaching significance.

Chapter V

Summary, Conclusions, and Recommendations

Introduction

A strong foundation in basic arithmetic skills is crucial for the comprehension and acquisition of more complicated mathematical concepts. This research has examined the effectiveness of building these skills through the use of interactive bulletin boards. It was hypothesized that students who experienced the use of interactive bulletin boards in their mathematics lessons on a daily basis would show significantly higher achievement in final marking period grades in mathematics than students who did not receive this treatment. Literature related to this study supported the importance of strength in basic skills and suggested varying ways in which to acquire it. Among them was the use of interactive bulletin boards as a medium for reinforcing these skills through stimulation, enjoyment, and practice.

Summary of the Problem

This study attempted to answer the following questions with regard to the reinforcement of basic arithmetic skills through the daily use of an interactive bulletin board and its effect on final marking period grades of fourth grade students: Is mastery of basic arithmetic operations vital in understanding more complex mathematical concepts? Is a lack of proficiency in basic arithmetic partially to blame for poor mathematics grades? Will a daily exercise that reinforces basic arithmetic through repetition of performance

build these skills? Is an interactive bulletin board, used as both a teaching tool and learning center, an effective medium for building basic arithmetic skills?

Summary of the Hypotheses

It was hypothesized that fourth grade students who experience the daily use of interactive bulletin boards that contain manipulative parts to reinforce basic arithmetic skills as a part of their mathematics instruction will exhibit significantly higher marking period grades in mathematics than students who do not experience interactive bulletin boards that reinforce basic arithmetic skills on a daily basis.

Summary of the Procedure

Before beginning the study verbal permission was sought and granted from the classroom teachers and school principal. Parent permission slips were sent home, signed by parents, and returned by students in the experimental group (see appendix A) and control group (see appendix B).

Second marking period mathematics grades for both groups were obtained from both classroom teachers before the treatment was implemented. Treatment for the experimental group began on the fourth Monday of the 3rd marking period and was continued for 4 weeks. Treatment consisted of the implementation of an interactive bulletin board which required students to complete a series of 15 arithmetic problems as part of their daily morning work. The board was also used as a learning center during free periods in the day (see appendix C).

At the end of the treatment period third marking period grades for mathematics were collected from both classroom teachers. Five separate t-tests were calculated to determine the effect of the treatment.

Summary of the Findings

A t-test calculated on the post-treatment mean numerical grades of the experimental and control groups did show a significant difference in achievement. However, the experimental and control groups were not equal in their marking period grades prior to administering the treatment. This, in effect, caused there to show a significant difference in the post-treatment grades of the two groups. After accommodating for the inequality, it was found that the means of the two groups after treatment did not show any significant difference. Change scores for pre and post-treatment of the experimental group showed a decrease in achievement as well as for the control group. Neither change was significant, however the decrease in the control group pre and post-treatment grades was approaching significance.

Conclusions

It was hypothesized that fourth grade students who experience the daily use of interactive bulletin boards that contain manipulative parts to reinforce basic arithmetic skills as a part of their mathematics instruction will exhibit significantly higher marking period grades in mathematics than students who do not experience interactive bulletin boards that reinforce basic arithmetic skills on a daily basis. T-tests calculated on the collected data did not show any significant difference between the experimental and control groups after the implementation of the interactive bulletin board. It can be concluded that the use of an interactive bulletin board used in mathematics lessons did not have a significant effect on the fourth grade students in this study.

Implications and Recommendations

Although this study did not reveal a statistically significant difference in student achievement in mathematics after exposure to an interactive bulletin board, the researcher feels that the board did help to maintain the experimental group's level of competency in basic arithmetic skills. This seems apparent due to the almost significant decrease in the post-treatment performance of the control group. Without exposure to the bulletin board, this group decreased in achievement more than the experimental group.

The researcher also suggests that further research on this topic have a longer treatment period and use random samples. Longer exposure to an interactive bulletin board that reinforces basic arithmetic skills may have a stronger effect on student achievement. Additionally, this study had a number of variables that may have affected outcomes. Many which may be eliminated in a pure experimental design.

Because of the apparent maintenance of skills and the enjoyment that students received from using the bulletin board, the researcher would suggest its use in elementary classrooms. Its appealing appearance and game-like activities proved to be very attractive to these fourth grade subjects. Variations of this type of bulletin board may also be used in higher grades and in other disciplines, as the literature has suggested. In addition to drill and practice, such boards can provide students with opportunities to apply new information in meaningful ways and engage them in experiences that invite problem solving, reasoning, and communication.

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Appendix A

Parent Permission Slip for Experimental Group

February 19, 2002

Dear Parent:

I am a student from Rowan University, seeking my Masters Degree in Elementary Education. From now until May, I will be a student teacher in your child's classroom.

As part of my graduate studies, I will be conducting an experimental study on the effects of the use of interactive bulletin boards in mathematics lessons. The study will be taking place in your child's classroom.

I feel that this technique will be very beneficial to your child in the area of maintaining basic skills in math, however, I need your permission to include your child in my study. I will also be using students' test scores to determine the effectiveness of the bulletin boards.

I assure you that this study is strictly confidential in the respect that I will not be using the name of _____ School, _____, or the names of any children.

If you are in agreement to me including your child in my study, please sign this letter and return the signed portion to school with your child. Please feel free to call me in _____ classroom with any questions or concerns that you may have. Thank you in advance for your cooperation.

Sincerely,

My child's name _____

____ I give my permission for my child to be included in your study.

Signature

____ I do not give my permission for my child to be included in your study.

Signature

Appendix B

Parent Permission Slip for Control Group

February 19, 2002

Dear Parent:

I am a student from Rowan University, seeking my Masters Degree in Elementary Education. From now until May, I will be a student teacher in _____ classroom.

As part of my graduate studies, I will be conducting an experimental study on the effects of the use of interactive bulletin boards in mathematics lessons. The study will be taking place in _____ classroom.

As part of my study, I will be comparing the math test scores of the students in _____ class to the math test scores of the students in your child's class. This is to determine if my technique is beneficial enough to be implemented into other classrooms.

I assure you that this study is strictly confidential in the respect that I **will not** be using the name of _____ school, _____, your child's teacher, or the names of **any** children.

If you are in agreement to me including your child in my study, please sign this letter and return the signed portion to school with your child. Please feel free to call me in _____ classroom with any questions or concerns that you may have. Thank you in advance for your cooperation.

Sincerely,

My child's name _____

___ I give my permission for my child to be included in your study.

Signature

___ I do not give my permission for my child to be included in your study.

Signature

Appendix C

Photograph of Interactive Bulletin Board



Appendix D

Lesson Plan

Lesson: Mathematics
Topic: Daily basic skills exercise
Grade: 4
NJ CCCS#: 4.1, 4.2, 4.4, 4.5

Objective

At the end of the lesson, the students will be able to complete a daily series of arithmetic problems after inserting different numerals into the problems each day, with 100% accuracy.

Materials

Operation Station bulletin board, Operation Station daily logs for students, numeral hang tags, blank hang tags, number cubes.

Teaching Activities

Introduction/Anticipatory Set

1. Teacher provides each student with an Operation Station daily log.
2. Teacher creates new problems each day by changing the numeral hang tags in each arithmetic problem on the bulletin board.

Body/Development

1. Morning work
 - a. Students copy each problem from the bulletin board into daily logs.
 - b. Students solve all problems in daily log.
2. Math period
 - a. A student "station operator" reads each problem from the bulletin board aloud to the class.
 - b. Students respond by calling out answers to problems.
 - c. Station operator writes answers on blank hang tags on board.
3. Operation Station bulletin board as a game board (used during down time after recess)
 - a. Two students roll a set of three number cubes to obtain numerals to insert into problems. Repeated until all problems have numerals inserted.
 - b. Students race to complete problems.

Assessment

Teacher checks answers to morning's problems and game board players' problems.

VITA

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