# Using Manipulatives To Teach Fractions

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# CHAPTER 1: INTRODUCTION

Sixth grade math students tremble in their seats when fraction units are begun. Students often struggle with the concept of fractions as well as any application of fractions. When asked, most students say they "hate" fractions. Middle grade students:

> should see mathematics as an exciting, useful, and creative field of study. As they enter adolescence, students experience physical, emotional, and intellectual changes that mark the middle grades as a significant transition point in their lives. During this time, many students will solidify conceptions about themselves as learners of mathematics—about their competence, their attitude, and their interest and motivation. These conceptions will influence how they approach the study of mathematics in later years, which will in turn influence their life opportunities. (Principles and Standards, 2000, p. 211)

This study focused on using manipulatives while teaching fraction concepts including addition and subtraction, simplifying and equivalent fractions. The students experienced the use of manipulatives while being introduced to fraction concepts and were able to use them while working on problems. Along with the use of manipulatives, students were taught math vocabulary that helped them understand fraction concepts, thereby, helping them work with fractions. Althouse, (as cited in Cain-Caston,1996) stated:

> Teaching mathematics through the use of workbooks, drills, and memorization has proven to be ineffective and outdated. Current

> research shows that children cannot think, or stay on task, when they sit silently. The worksheet must be replaced with an environment that offers the opportunity for children to think as they manipulate objects. (p. 271)

## Statement of the Problem

The purpose of this study was to determine if the use of manipulatives when teaching addition and subtraction of fractions would affect achievement and attitudes of sixth grade math students.

## .Research Questions

1. Does using manipulatives when teaching addition and subtraction of fractions affect student achievement of sixth grade math students?
2. Does the use of manipulatives affect attitudes of students toward fraction concepts?

## Null Hypothesis

1. Following the use of manipulatives when teaching addition and subtraction of fractions, there will be no significant differences in achievement of sixth grade students.
2. Following the use of manipulatives when teaching addition and subtraction of fractions, there will be no significant differences in the attitudes of students toward fraction concepts.

## Definition of Terms

For the purpose of this study, the following terms were defined:

1. *Manipulatives* are objects designed to represent explicitly and concretely mathematical ideas that are abstract. They have both visual and tactile appeal and can be manipulated by learners through hands-on experiences (Moyer,2001).

2. *Equivalent fractions* are fractions that have different denominators but name the same amount.

3. *Fraction bar*s are manipulatives to show fraction quantities and equivalencies.

4. *Fraction circles* are manipulatives to show fraction quantities and equivalencies.

5. *Tangrams* are manipulatives used to compare fraction pieces and show equivalencies.

6. *Pattern blocks* are manipulatives used to compare fraction pieces and show equivalencies.

## Limitations

The following were limitations of this study:

1. The pre/post test for this study was created by the researcher.
2. The researcher taught six classes of mathematics, so students could not be randomly selected for this study.
3. The students communicated between classes about what was going on in the classroom, realizing that some students were using manipulatives while others were not.
4. Attitudes may be difficult to assess in the 3 ½ week length of this study.

## Delimitations

The following were delimitations of this study:

1. For the purpose of this study lessons were implemented in a 3 ½ week period.
2. Each class period was delimited to 42 minutes.

# CHAPTER 2: REVIEW OF RELATED LITERATURE

Many students view math as one of their favorite subjects. They like the idea that they know what to expect each day in their class. They do their homework and know that the first thing the teacher will do is correct the assignment, go over corrections, begin the new lesson and give work time. Consistency for students as well as teachers takes away the pressure of wondering what will happen next in math class. The student is able to determine by their math grades on daily work, quizzes and tests where they are in terms of a grade in that class. However, looking at the above scenario makes this researcher wonder where educators have gone wrong in their instruction. Are the students truly learning and understanding what is taught? Is there a better way to teach mathematics in the classroom? Tsuruda (1998) stated, "a student-centered curriculum focuses on students' needs. Students, particularly at the middle school level, need to be actively engaged in learning" (p. 5). According to the National Council of Teachers of Mathematics standards (1989), students are to be provided experiences to explore and reason, solve non-routine problems, and develop personal self confidence in mathematics. Teachers are key figures in changing the ways in which mathematics is taught and learned in schools. Teachers need to have support and adequate resources to design effective experiences for students using technology and other tools to pursue mathematical investigations. The teachers need to be able to guide students in individual, small-group, and whole-class work.

The purpose of this study was to determine if the use of manipulatives when teaching addition and subtraction of fractions will affect achievement and attitudes of sixth grade students.

In this review of literature, the researcher found that most of the studies related to the use of manipulatives in all areas of mathematics. For clarity, this researcher will divide the chapter into sections; the role of the teacher, and the effect of using manipulatives on achievement, understanding and motivation.

The Role of the Teacher

The role the teacher plays in any successful lesson is immense. Teachers must plan and facilitate all lessons. Of course, some lessons are more successful than others. Even the most experienced teacher can have a lesson that truly fails. However, the success of a lesson does depends on the teacher. "How mathematics is taught is just as important as what is taught" (Spungin, 1996, p. 2). Lecturing may give the already talented student of math a deeper understanding of the subject. Unfortunately, for many students, these well-organized and enthusiastic lectures fall on many deaf ears (Spungin, 1996).

Mathematics educators around the world have found that mathematics is better learned, and therefore should be taught, by students experiencing it through manipulatives (Tooke, Hyatt, Leigh, Snyder, & Borda,1992). Throughout the research reviewed, it was consistently stated that manipulatives should be used through all grade levels. Why, then, is this not happening? According to Tooke, et al. (1992), the two main reasons for teachers not using manipulatives in their math classrooms were that the teachers were uncertain of how to use the mainipulatives, and that they felt that manipulative instruction was inappropriate for students above the fourth grade. Sherman and Richardson (1995) presented these reasons for teachers not using manipulatives: being unfamiliar and uncomfortable with the materials themselves, concerns about time

constraints, possible discipline problems, availability of manipulatives and their cost. Dorward (2002) noted challenges associated with the use of manipulatives include classroom management, structuring, monitoring, and assessing the use of manipulatives, relating manipulatives to mathematical symbols and procedures, and lack of financial resources and professional development. Likewise, Hatfield (1994) stated: "using a manipulative approach to mathematics instruction requires the knowledge, skills, and experiences necessary to respond to students who are learning mathematics in this environment" (p. 303). In a study done by Winn and Olsen (1998), teachers in a rural district in Illinois were questioned about their use of manipulatives. Again as in other studies, it was found that some of the main reasons teachers don't use manipulatives is that the teachers do not feel that manipulatives benefit the teaching of mathematics and that the teachers need instruction on the effective use of manipulatives.

In order for teachers to be successful with the use of manipulatives, they need extensive training in the use of manipulatives, ample time to try out the manipulatives and plan their lessons around the use, and preparation of the classroom and manipulatives for the activity (Stein & Bovalino, 2001). Simply using manipulatives, however does not guarantee a good mathematics lesson (NCTM, 2000). Moyer (2001) stated:

> Teachers play an important role in creating mathematics environments that provide students with representations that enhance their thinking. Yet even if teachers have learned appropriate strategies for using manipulatives, their beliefs about how students learn mathematics may influence how and why they use manipulatives as they do. (p178)

Good lessons using manipulatives do not just happen. Many teachers plan their lessons in advance after hours of training with manipulatives.

The Effect of Using Manipulatives on Achievement, Attitudes and Motivation

Hinzman (1997) stated that most teachers agree that the use of manipulative materials helps students build a strong understanding of mathematical concepts and enhances students' achievement in mathematics. If this is true, then with all of the anxiety about achievement in mathematics today, educators in this field should be looking at the results of studies which indicate that by using manipulative materials at every level, test scores are dramatically improved.

Traditionally, the teacher has been the leader of the classroom. Working from the front of the classroom, dispensing knowledge on the topic of the day, and assigning the homework were the roles of the teacher. In the ever-changing world of mathematics, however, this role is changing. The teacher is now becoming the observer while the students are actively involved in their own learning. As Cain-Caston stated:

> In most classrooms across the country, math class has changed from the boring pencil and paper chore it used to be, and has become a fun and exciting activity that many children now look forward to. The same concepts are being taught, but somehow it has become a pleasure rather than a chore. What has made the difference? The answer is the use of manipulatives and a hands-on learning technique. (1996, p.3)

Burger, (as cited in Cain-Caston, 1996) stated that teachers have discovered that the introduction of manipulatives into the math lessons have increased interest,

participation and understanding of the students. The use of manipulatives in teaching mathematics has become very prominent in the past decade. Students who use manipulatives in their mathematics classes usually outperform those who do not. The increase in performance is evident in all grade levels, ability levels and topics (Cain-Caston, 1996).

Cain-Caston (1996) also found that the students in the study understood mathematics more and have greater gains in mathematics when manipulatives were used. Dorward (2002) found that mathematics achievement is increased through the long-term use of concrete instructional materials and that students' attitudes toward mathematics are improved when they have instruction with concrete materials provided by teachers knowledgeable about their use. Piaget and Dienes, (as cited in Spungin, 1996) stated:

> Manipulatives have been used for many years to help students understand abstract ideas such as number, numeration, basic arithmetic operations, and spatial relationships. Support for the use of manipulatives in the primary grades dates back many years. (p. 2)

Fuson, Carpenter, and Moser, (as cited in Moch, 2001) stated that it is important to have manipulatives available to children to support their thinking.Stein and Bovalino (2001) have extended this argument by stating:

> Manipulatives can be important tools in helping students to think and reason in more meaningful ways. By giving students concrete ways to compare and operate on quantities, such manipulatives as pattern blocks, tiles, and cubes can contribute to the development of well grounded, interconnected understandings of mathematical ideas.(p. 356)

It was also found by Clements and McMillen (1996) that the use of manipulatives increased scores on retention and problem-solving tests. They also noted that attitudes toward mathematics are improved when students are instructed with concrete materials by teachers knowledgeable about their use. Moch (2001) stated:

> Boys and girls who formerly did not care very much for mathematics were now eager and enthusiastic about participating and learning new ideas in mathematics. The children enjoyed having the opportunity to uncover and think through activities using manipulatives and they looked forward to future opportunities to investigate other concepts. (p. 7)

According to Hinzman (1997) it is as necessary to involve students physically in active learning experiences in an algebra class as it is in a first-grade classroom. The problem with this can be found in the students' attitudes. Students are conditioned to think as they get older, they do not need to use any hands-on activities to learn mathematics. They believe that mathematics always has a rule to follow and want to learn the rule and do the work. Yeatts, (as cited in Hinzman 1997) stated that the use of manipulatives stimulates the senses of students as they are able to touch the manipulative materials, move them about, rearrange them, and or see them in various patterns and groupings. She further stated that the manipulation of these materials assist students in bridging the gap from their own concrete sensory environment to the more abstract levels of mathematics. With that in mind, it reinforces that manipulatives are effective and motivating tools for assisting and enhancing the development of mathematics.

Sowell, (as cited in Ernest, 1994) concluded that mathematics achievement is increased by the long term use of manipulatives and that student attitudes toward

mathematics are improved when they are instructed with manipulatives. In the study done by Ernest in 1994, it was found that students enjoyed using the manipulatives and exhibited confidence in their use.

According to the Curriculum and Evaluation Standards for School Mathematics (NCTM, 1989), teachers need to give increased attention to instructional practices that actively involve the students individually and in groups using a variety of concrete materials. They go on to state that the use of manipulatives for hands-on learning of elementary school mathematics is advocated strongly by the research and reform documents of the last decade.

In a study by Quinn (1998), a group of preservice teachers were asked questions regarding the use of manipulatives. Since many of them did not learn from the use of manipulatives themselves, they tended to shy away from their use. After training and use in their math methods course, many attitudes and beliefs were changed. When asked the same questions again as to whether they would use manipulatives in teaching mathematics, most of the students stated that they saw the benefits now of using manipulatives and would plan to use them in their classrooms. Hatfield (1994) also stated that preservice teachers need to experience mathematics as an active process themselves where they interact with experienced, cooperating teachers who practice and support the teaching with the use of manipulatives. A basic assumption in the Professional Standards for Teaching Mathematics stated, “teachers are influenced by the teaching they see and experience” (NCTM, 1989, p. 124).

## Conclusion

In a perfect school, test scores would always be where they are supposed to be, students would be motivated and excited to learn, and teachers would be knowledgeable in all ways to teach their students. There are no perfect schools. Teachers do not always have the know-how for every aspect of teaching. Students are not always motivated to learn. However, educators must do everything they can to work with students.

Moch (2001) stated "teachers must assess their current programs, the amount of time they currently spend re-teaching concepts, and then carefully reflect on how they could properly introduce and use manipulatives in their professional practice" (p. 7).

Heddens and Speer, (as cited in Moch, 2001) stated:

> Manipulatives cannot cure every problem encountered by students, but many problems could be avoided altogether by allowing students to work with concrete models prior to dealing with them on a more abstract level. Developing ideas from concrete to semi-concrete, semi-abstract, and finally abstract levels is a well-documented and known pedagogy for teaching mathematics to elementary school children. (p. 7)

An important change in the teaching of mathematics is that teachers are changing their focus from drill and practice to facilitating learning by getting students to understand by doing. "The use of manipulatives in mathematics classrooms supports this attempt. Incorporating the use of concrete materials with an emphasis on the thought process of students allows teachers better to assess and meet the individual needs of students" (Ross, 1993 p. 257).

Meyer (1997) stated: “the implied challenge to teach new mathematics in a new way is as obvious as its potential to change the way both students and teachers view the learning of mathematics. It won’t be easy, but then change never is. The only easy part is recognizing the need for change” (p. 53.

Teachers must accept the challenge for change and begin teaching mathematics using manipulatives on a day-to-day basis.

# CHAPTER 3: PROCEDURES

## Research Design

The purpose of this study was to determine if the use of manipulatives when teaching addition and subtraction of fractions would affect achievement and attitudes of sixth grade math students. The quasi-experimental study was measured with quantitative and qualitative data. The researcher conducted a short survey at the beginning and end of the unit to help determine attitude changes.

A treatment pre and post test was given to four classes of sixth graders. The experimental group, which was two classes, received lessons using manipulatives throughout the unit.

The control group, which was two classes, had the same lessons using a traditional approach with paper and pencil activities.

## Sample

This was a convenience sample of intact groups, two classes with 46 students, 23 girls and 23 boys, and the other two classes with 42 students, 21 girls and 21 boys. There were mixed ability levels in each class. The students were ages11 and 12 from a class size of 158 students. The students came from four different feeder schools, including one private, one charter and two 4K-5 buildings.

## Instrument

Two instruments were used to collect data for this research study. Scores from researcher-made pre and post tests were collected. These instruments were used to measure achievement through quantitative data. Quantitative data on attitudes and

understanding (Appendix B), were measured through responses to researcher-created survey. The survey was given at the beginning and conclusion of the lessons.

Data Analysis

The first null hypothesis was: following the use of manipulatives when teaching addition and subtraction of fractions, there will be no significant differences in achievement of sixth grade students. A researcher created test was given to both the control and experimental group before and after the unit. A dependent t-test was run to determine if there was a significant difference between the groups at an alpha level of .05.

The second null hypothesis was: following the use of manipulatives when teaching addition and subtraction of fractions, there will be no significant differences in the attitudes of students toward fraction concepts. A researcher written survey was given to the control group and the treatment group before and after the treatment. A dependent t-test was run to determine if there was a significant difference at an alpha level of .05.

Calendar

As with any teaching setting, there were days in between that were not used due to inservices, vacation days, and normal school interruptions.

January 13: Pre survey given to the four classes.

January 14: Pretest given to the four classes.

January 20-24 Introduce fraction concepts and vocabulary.

January 27-31 Continue practice on addition and subtraction of fractions.

February 10-14 Addition and subtraction with mixed numbers.

February 17-20 More practice and review with post test and post survey given on February 20.

A total of 21 days was used for this study.

## Budget

There was no cost to this research study. The researcher had access to all of the manipulatives in the classroom.

# CHAPTER 4: RESULTS

## Introduction

The purpose of this study was to determine if the use of manipulatives when teaching addition and subtraction of fractions would affect student achievement and attitudes of sixth grade math students. The quasi-experimental study was measured with quantitative and qualitative data. Data were collected from two groups of students who were both taught by the researcher. Students in both groups were given a pre and post test (Appendix A) to determine if their achievement with fractions changed with the use of manipulatives. Students in both groups were given a pre and post survey (Appendix B) to determine if their attitudes were changed by the use of manipulatives. Both groups were given the same assignments and were taught for the same amount of time during the study. The experimental group was given the opportunity to try various manipulatives during each lesson, while the control group was taught the lesson using the conventional lecture, model and practice method. The daily assignments were the same for both groups; however, the experimental group had the opportunity to use manipluatives to help them solve the problems.

## Research Findings

During the course of the study, two students moved from the district, both from the experimental group, thus changing the numbers from 46 to 44. There were no changes in the control group.

Research question one states: Does using manipulatives when teaching addition and subtraction of fractions affect student achievement of sixth grade math students?

The null hypothesis one states: Following the use of manipulatives when teaching addition and subtraction of fractions, there will be no significant differences in achievement of sixth grade students.

The researcher created pre test (Appendix A) was given to the students in both the experimental and control groups. A t-test for nonindependent samples was run on the pre test for the experimental and control group to determine that there was no significant difference at the start of the study. With the degrees of freedom being 43, a critical *t* of 2.021 was needed to show significant difference at the .05 level. The t-value of 0.57 indicates that there was no significant difference at the start of the study.

The researcher created post test (Appendix A) was given to the students in both the experimental and control groups at the end of the unit. A t-test for nonindependent samples was run on the post test for the experimental and control group to determine if there was a significant difference at the end of the study. With the degrees of freedom being 43, a critical *t* of 2.021 was needed to show significance at the .05 level. The t-value of 0.62 indicates there was no significant difference at the end of the study.

The researcher failed to reject the null hypothesis due to the results of the t-test. There was no significant difference found in achievement between sixth grade students who used manipulatives and those who did not when working with addition and subtraction of fractions.

Research question two states: Does the use of manipulatives affect attitudes of students toward fraction concepts?

The null hypothesis two states: Following the use of manipulatives when teaching additions and subtraction of fractions, there will be no significant differences in the attitudes of students toward fraction concepts.

The researcher-created pre survey (Appendix B) was given to both the control group and the experimental group prior to the beginning of the unit. A t-test for nonindependent samples was run on the pre survey for the experimental and control group to determine that there was no significant difference in attitudes at the start of the study. With the degrees of freedom being 43, a critical *t* of 2.021 was needed to show significant difference at the .05 level. The t-value of 0.44 indicates that there was not significant difference in attitudes at the start of the study.

The researcher created post survey (Appendix B) was given to both the control group and the experimental group at the conclusion of the unit. A t-test for nonindependent samples was run on the post survey for the experimental and control group to determine if there was a significant difference in attitudes at the end of the study. With the degrees of freedom being 43, a critical *t* of 2.021 was needed to show significance at the .05 level. The t-value of 2.61 indicates there was a significant difference in attitudes after the study.

Therefore, the researcher rejected the null hypothesis and concluded that the change in attitudes was due to the treatment of using manipulatives.

Summary

The researcher found that there was no significant difference in achievement between the experimental and the control group after using manipulatives while teaching addition and subtraction of fractions. However, the researcher found a significant

difference between the experimental and control group as far as the attitudes of students toward fraction concepts. As Cain-Caston stated:

> In most classrooms across the country, math class has changed from the boring pencil and paper chore it used to be, and has become a fun and exciting activity that many children now look forward to. The same concepts are being taught, but somehow it has become a pleasure rather than a chore. What has made the difference? The answer is the use of manipulatives and a hands-on learning technique. (1996, p.3)

Moch (2001) stated:

> Boys and girls who formerly did not care very much for mathematics were now eager and enthusiastic about participating and learning new ideas in mathematics. The children enjoyed having the opportunity to uncover and think through activities using manipulatives and they looked forward to future opportunities to investigate other concepts. (p. 7)

In comparison with the findings of other studies and with this study, the researcher concluded that when students were allowed to manipulate objects to help them learn, they became more enthusiastic toward the mathematic concepts being taught.

# CHAPTER 5: CONCLUSIONS

## Introduction

The purpose of this study was to determine if the use of manipulatives when teaching addition and subtraction of fractions will affect student achievement and attitudes of sixth grade math students. This was a quasi-experimental study measured with quantitative and qualitative data.

## Interpretation of the Findings

This study was done with a convenience sample of intact groups, two classes with 46 students, 23 girls and 23 boys for the experimental group, and two classes with 42 students, 21 girls and 21 boys in the control group. There were two students who moved out of the district from the experimental group and no changes in the control group.

During this study, both groups were taught the same material for the same amount of time. The experimental group was given manipulatives such as fraction bars, tangrams, fraction circles and the use of slates to work on their fractions. The control group was taught by the teacher with lecture, model, and practice lessons.

The first null hypothesis states: following the use of manipulatives when teaching addition and subtraction of fractions, there will be no significant differences in achievement of sixth grade students. Each group was given a pre test. A *t*-test was run after the pre test and there was no significant difference shown. The researcher was not surprised because the students had not seen or done fractions since the middle of their fifth grade year. Also many of the students, depending on which school they came from, did not get as far in the fraction units. The scores on the pre test indicated for both groups that much of the fraction work had been forgotten.

Therefore, the researcher concluded that the two groups were very close in their ability to work with fractions at this point in the study.

After the 21 days of lessons were taught, a post test was given and a t-test was run again, and it was found that there was no significant difference in the achievement of sixth grade students after the use of manipulatives. The findings of this study did not match the findings of other studies regarding the achievement of students when manipulatives were used. There were some factors that the researcher felt may have affected the results of this study. The researcher found that the use of manipulatives took much more class time than originally thought. It seemed that the experimental group was just getting into the manipulatives and working with them when it was time to give the assignment and finish the class. The experimental group did not get much class time to work on the assignment and therefore, did not have access to the teacher or the manipulatives for any help needed. The control group, however, always seemed to have more class time to work on the assignment with access to the teacher when help was needed. Another point the researcher discovered was that it took a lot of time to teach the manipulative use properly. The students were unfamiliar with some of the manipulatives and needed to learn how to use them as well as understand them. Teacher preparation time and class time was a constraint that could have affected the outcome of this study. According to Sherman and Richardson (1995) being unfamiliar and uncomfortable with the materials themselves and concerns about time constraints were reasons for teachers not to use manipulatives. The researcher understood this as time constraints were the largest problem of this study. Simply using manipulatives, however, does not guarantee a good mathematics lesson (NCTM, 2000). The researcher also found that the students

were talking between classes as to what was done in math class. This made it difficult for the control group to understand why their class was taught differently than the morning classes. The students had been very accustomed to discussing what happened in math class that day and what they were to expect. It was hard for them to understand why they were taught differently. It was also hard for the researcher not to use manipulatives when it was apparent that the other students were enjoying it.

The second null hypothesis states: following the use of manipulatives when teaching addition and subtraction of fractions, there will be no significant differences in the attitudes of students toward fraction concepts. Each group was given a pre survey. A t-test was run after the pre survey, and there was no significant difference shown. The students at this time were not familiar with many of the manipulatives and what they were used for. The scores on the pre survey indicated that the attitudes of most sixth grade students were much the same concerning fraction concepts and math in general.

After the 21 days of lessons were taught, a post survey was given and a t-test was run again. It was found that there was a significant difference in attitudes of sixth grade students toward fraction concepts between the experimental group and the control group. The researcher was pleased to find these results. As Cain-Caston stated:

> In most classrooms across the country, math class has changed from the boring pencil and paper core it used to be, and has become a fun and exciting activity that many children now look forward to. The same concepts are being taught, but somehow it has become a pleasure rather than a chore…. (1996, p. 3)

Some of the reasons the researcher felt contributed to these results were: students like to be actively involved in their learning, they were able to play (in their words) in math, they were able to see what they were doing and in turn made more sense of it, the students could communicate during class to other students and to the teacher when they discovered something from the manipulatives, group work added to the enjoyment of the class, and the overall ability to have some control over what they were doing in math class. As Tsuruda (1998) stated, "a student-centered curriculum focuses on student's needs. Students, particularly at the middle school level, need to be actively engaged in learning" (p.5). According to Spungin (1996), how mathematics is taught is just as important as what is taught.

The researcher learned through this study that if a teacher gets students interested and excited about learning, gains will be seen. This researcher believed that if the time constraints could be overcome, not only would the attitudes of the students towards fractions improve, so would achievement.

Conclusions

Based on the results of this study, the following conclusions were made:

1. The researcher concluded that there was no significant difference in achievement of sixth grade students after the use of manipulatives when teaching addition and subtraction of fractions.

2. The researcher concluded that there was a significant difference in the attitudes of sixth grade students after the use of manipulatives when teaching addition and subtraction of fractions.

Summary and Future Implications

If the researcher were to do this study over again, some suggested changes would be:

1. The researcher would better familiarize herself with the use of certain manipulatives.
2. The researcher would give the students more access to the manipulatives.
3. The researcher would increase the lesson length to two class periods so that the students could familiarize themselves with the manipulatives first and then use them for the lesson, also having time to get assistance from the teacher.

The main objectives the researcher had in mind at the start of this study were to see if the students could learn fraction concepts more effectively with the use of manipulatives, and see if the researcher could get the students to see that fraction concepts weren't the worst thing they were ever going to have to encounter. The researcher felt that the objectives have been met, however without getting all of the results that were expected. What was unexpected by the researcher was the satisfaction and sense of accomplishment that was felt after the completion of the study. The results of the study did not show there was a significant difference in achievement between the two groups, however the researcher knows from the results that each group learned whether they were taught with manipulatives or not. There was a satisfaction in knowing that the students changed their attitudes toward fractions and felt more comfortable with fractions after the unit was completed. All children learn differently, and the researcher felt that the study was successful in finding alternative ways to teach students so all can learn and can enjoy it in the process.

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# APPENDIX A

Pre/Post Test

Hour_____ Name_____ Date_____

Pre/Post Test

Directions: Write these fractions in simplest form (lowest terms). Show work.

1. 4/12

2. 2/8

3. 8/16

4. 8/20

Directions: Find an equivalent fractions for the following fractions. Show work.

5. 3/5

6. 1/2

7. 50/75

8. 3/4

Directions: Add or Subtract these fractions. Put the answers in simplest form (lowest terms). Show work.

9. ¾ - ¼

10. 4/9 + 1/3

11. 2/3 + 2/3

12. 9/10 – 3/5

13. 2 3/7 + 1 4/7

14. 3 5/6 – 2 1/6

15. 3 – 1 ¼

16. 2 7/8 + 1 ¼

17. 2 ½ + 1 ¼

18. 4 1/3 – 1 2/3

# APPENDIX B

Survey

Survey

Please circle yes or no to the following statements.

| | | |
|---|---|---|
| 1. I like math. | Yes | No |
| 2. I think math is easy to understand.. | Yes | No |
| 3. I think it's important for students to study math. | Yes | No |
| 4. I like working in cooperative groups. | Yes | No |
| 5. I feel more confident when working with a partner. | Yes | No |
| 6. I like to do hands-on work. | Yes | No |
| 7. I understand fraction concepts. | Yes | No |
| 8. Working with manipulatives helps me understand fractions better. | Yes | No |
| 9. Fractions are easier when I can see what I am doing. | Yes | No |
| 10. Math is more fun when I use manipulatives. | Yes | No |