Math Manipulatives to Increase 4th Grade Student Achievement

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Part 1

Abstract:

This research project was completed with twenty-nine fourth grade students from Shawnee Elementary, a school in the Chippewa Valley School District. It began in April 2012 and the data collection was completed by June 2012. The purpose of this project was to see if utilizing math manipulatives in an elementary classroom will increase student achievement. The data tools consist of a parent survey, a teacher survey, a report card analysis, a student Likert scale, a student station questionnaire, a teacher record log, a mastery test, a fraction pre-test and fraction post-test. This project is being conducted to find ways manipulatives may help students improve their understanding of math concepts and improve test scores. The results will be to show what areas of the math curriculum students need the most improvement, how current teachers are already using manipulatives, student responses after exploring with manipulatives, teacher observations and a difference in students' test scores before using manipulatives versus after.

Part 2

Introduction:

I am a 4th grade elementary teacher at Shawnee Elementary, a kindergarten through fifth grade school located in Macomb, Michigan and part of the Chippewa Valley School District. This is my fourth year teaching 4th grade and I am the math representative for my grade level team which consists of six 4th grade teachers. I hold a double major in math and science as well as a Montessori certification. I teach 4th grade math to two different groups of twenty-nine students. My school is positioned in an urban subdivision, and students come from a primarily white middle class community. In my building we currently have 872 students and of those, about 88% are white, 5% are African American, 3% are Asian and the rest include American

Indian, Native Hawaiian and Hispanic. Currently, all students speak English as their primary language, although a few parents speak broken English at home. I have two Indian students and one African American. Since my school is School of Choice, I do have a few students who do not live near the school. Due to the demographics, for a majority of my class, both parents are concerned and part of their child's learning experience. I also have a few students who are labeled gifted and talented based on their IQ scores and are above grade level. These students typically get the lesson objective quicker than the rest of the class so I have alternate activities for these students to push them slightly past their comfort level.

Since I have students coming from all backgrounds, I need to find a way to keep my students focus in math and help them show achievement. I plan on testing my students in all math areas to see what area they are weakest. After reviewing a parent survey as well as my students' scores on their report card, I will determine what area I will focus presenting my students with lessons using math manipulatives. The teacher survey will give me ideas of different manipulatives that I can use as well as how many teachers in my building are currently using manipulatives. Before starting the lessons, I will give my students a pre-test on the specific concept. While teaching the lessons, I will record teacher observations. Students will have the opportunity to complete a Likert scale and questionnaire about their thoughts while using manipulatives. Finally, I will conclude this study by having my students complete a post-test to compare to the pre-test and determine if there was student achievement after using math manipulatives.

Area of Focus:

The purpose of this study is to show how the use of manipulatives will improve learning and student achievement in a 4th grade mathematics classroom.

Research questions:

- What manipulatives are most effective in a 4th grade math classroom and when should they be used?
- How do students benefit from using math manipulatives?
- What areas of math curriculum will improve student achievement while using math manipulatives?

Mayner discusses how a research project should not be general, but instead created for a specific grade (Video: Teachscape, 2007). As a math teacher, I understand there are a variety of manipulatives available for me to use, however, I have never researched their effectiveness. This project will give me the opportunity to learn about manipulatives I currently have and others that would be useful to invest in and how they improve student achievement directly in just a 4th grade classroom instead of having to research the use of manipulatives in all elementary grade levels.

Part 3
Literature Review:

Allen, Crystal. (2007, November). An action based research study on how using manipulatives will increase students' achievement in mathematics. Retrieved from http://www.eric.ed.gov/PDFS/ED499956.pdf

This is an action based research paper that Allen wrote to show how manipulatives help increase student achievement. Allen used a group of twenty-two 5th graders for the study and focused on using manipulatives to teach how to measure interior angles of a regular polygon. She used a control and variable group and her results were that both groups showed improvement from the pre-test to the post-test. The main difference between both groups was the group who used manipulatives showed more interest and enjoyment while learning. Based on her results, Allen recommended allowing students to use manipulatives with traditional instruction in order to give a better understanding of the concepts and to associate enjoyment with learning math.

Battle, Toni. (2007, October). Infusing math manipulatives: The key to an increase in academic achievement in the mathematics classroom. Final Research Proposal. Retrieved from http://www.eric.ed.gov/PDFS/ED499956.pdf

This is a final research proposal about how to increase academic achievement by using math manipulatives. Battle explains in her problem that many math curriculums do not see manipulatives as being high priority so many teachers are reluctant to use them. Her purpose was to see how students could visually see a math concept and if both low and high academic achievers will have a deeper understanding and feel motivated to learn. In the review of the literature, he explains how manipulatives can be the bridge the teacher needs to fill the gap of student's conceptual knowledge. Battle used a 1st grade control and experimental group. Each group was taught a lesson reviewing addition and subtraction. The experimental group used manipulatives throughout the lesson. The results coincide with my initial theory that the group that used manipulatives will show a statistically significant increase in student achievement.

Boggan, M., Harper, S., Whitmire, A. (2010, June). Using math manipulatives to teach elementary mathematics. *Journal of Instructional Pedagogies*. Volume 3. Retrieved from http://www.aabri.com/manuscripts/10451.pdf

This research paper discusses the positive results of several studies that suggest using manipulatives. The authors also explain the history of manipulatives and the correct way to use them in an elementary math classroom. I was surprised to learn the history of manipulatives went back to early civilizations with the use of the first abacus and counting boards. This paper also reinforces my belief that the Montessori way of teaching supports using manipulatives to learn the basic ideas of math. The authors describe the limitless ways manipulatives can be used and how they can also be ways to get parents involved both at school and at home. The study researches the way teachers use manipulatives instead of the outcomes of the students. The results conclude that some teachers in the study did misuse the manipulatives and that further research needs to be done to find ways to give teacher support to make decisions regarding manipulative use.

Donovan, J. (2008, October). Teaching mathematics with virtual manipulatives. Retrieved from http://www.techlearning.com/article/45397

This article focuses on the virtual math manipulatives available to teachers. It discusses what I currently believe that manipulatives helps students learn more effectively. I was surprised to read how research shows virtual manipulatives may be more effective than concrete

manipulatives. Some of the sites this article reviews include Math Playground, Mathematics Lesson that are Fun, Arcytech's Educational Java programs, National Council Teach of Mathematics, National Library of Virtual Manipulatives, the Shodor Educational Foundation, and PBS Teacherline Interactives. Finally, this article also explains how to use manipulatives successfully and the factors to consider when selecting virtual manipulatives over concrete ones.

Durmus, S., & Karakirik, E. (2006, January). Virtual manipulatives in mathematics education: A theoretical framework. ***The Turkish Online Journal of Educational Technology, 5*****(1), article 12. Retrieved from http://www.tojet.net/articles/v5i1/5112.pdf**

Durmus and Karakirik discuss the characteristics of virtual manipulatives as well as how to implement and use them in a mathematics classroom. There are suggestions given on the good use of manipulatives such as using them in conjunction with other aids, using the simplest materials, and using them frequently to correlate with math goals. The information in this article parallels with my belief that manipulatives are helpful, but the role of the teacher is important to know when and how to use them. Even though this article supports using virtual manipulatives, the authors explain how they can be more abstract than concrete manipulatives because they do not warrant hands on activities. Finally, in the conclusion, Durmus and Karakirik explain how the use of virtual manipulatives are promising since there are so many projects and web sites being developed that are designing new manipulatives to enhance math standards and curriculum.

Iadipaolo, D. (2010, April). Manipulatives Make Abstract Math Concepts Concrete.

Retrieved from

http://www.lessonplanet.com/directory_articles/math_lesson_plans/15_April_2010/342/manipulatives_make_abstract_math_concepts_concrete

Iadipaolo describes many ways manipulatives can be used in the math classroom in her article. Some suggestions include with estimation techniques, fractions, measurement, ration, probability and properties of whole numbers. She explains how using manipulatives can help increase the retention rate of information. A suggestion in this article is to give students a homework assignment to design a probability simulation using a manipulative instead of assigning problem sets every day. She states the downfalls to using manipulatives include more time to set up, plan and clean up, but the research shows they are engaging and reach to the kinesthetic learners in the classroom. Finally, Iadipaolo gives links to lessons that already incorporate the use of manipulatives.

Kelly, C. (2006). Using manipulatives in mathematical Problem solving: A performance based analysis. ***The Montana Mathematics Enthusiast,*** **3, 184-193. Retrieved from**

http://www.math.umt.edu/tmme/vol3no2/tmmevol3no2_colorado_pp184_193.pdf

Kelly explains what problem solving is in a math classroom and how students can use manipulatives in problem solving while working on math tasks. She uses the word tools in exchange for the word manipulatives since they help student learn math instead of being considered toys. This article discusses how important it is for students to be able to connect math problems to a real world situation and then have the tools to be able to work through the

problem to come to a final answer. The most striking idea in the article is that teachers need to see past a right or wrong answer and instead find a more diversified view of student mathematical understandings. Kelly also gives strategies for teaching and assessing problem solving with manipulatives such as knowing when, why and how to use them by modeling for students and having behavior expectations while using them. Finally, ten ways to effectively introduce and implement manipulatives in performance based tasks is described to prepare students to use manipulatives and set standards in the classroom.

Scheer, J.K. (2008, June). Manipulatives Make Math Meaningful. Retrieved from http://www.beyond-the-book.com/opinions/opinions_061108.html

This article focuses on how math manipulatives are beneficial for students. Scheer explains how using manipulatives make students become active learners and hold discussions with classmates to explain rather than memorize how to figure out problems. This article states how manipulatives can be used to reduce anxiety and understand the abstract idea behind numbers. Scheer discusses how manipulatives are helpful, but they must be grade level appropriate and encourage students to learn a method of problem solving they can use when they forget a rule. I liked how this article showed examples of how to use manipulatives to understand the difference between prime and composite numbers along with positive and negative numbers since both of these concepts are in the 4th grade math curriculum that I teach.

Spear-Swerling, L. (2006, March). The Use of Manipulatives in Mathematics Instruction. Retrieved from http://www.ldonline.org/spearswerling/The_Use_of_Manipulatives_in_Mathematics_Instruction

This article caught my attention because it discusses how The National Council of Teachers of Mathematics (NCTM) strongly advocates the use of manipulatives in the classroom. Spear discusses that research is not clear exactly how much students benefit from manipulative use. She used the term conceptual understanding just as other articles use abstract thinking to relate to how manipulatives change students' ways of approaching math. This article also explains how manipulatives can have negative effects on students if teachers do not present them effectively and can be distracting by causing students to drift off task. Finally, Spear explains how manipulatives can be useful when teaching young students or students with learning disabilities.

Young, D. (2006, April). *Virtual manipulatives in mathematics education*. Retrieved from http://plaza.ufl.edu/youngdj/talks/vms_paper.doc [David Young presents a current review of the literature.]

This article sparked my interest because it discusses the research available and the pros and cons with using virtual manipulatives. Young defines a virtual manipulative and then explains the proposed benefits to using virtual manipulatives. Some of the benefits include how accessible they are, how they give students instant feedback and how they can allow students to perform actions that are impossible with concrete or physical manipulatives. This article contains reviews on five different groups of virtual manipulatives that can currently be used in a classroom. The most beneficial part of this article was when Young explains the existing research on virtual manipulatives along with suggestions for future research.

Part 4

Research Process:

Data Collection Matrix

Research Questions	Data Source 1	Data Source 2	Data Source 3
What manipulatives are most effective in a 4th grade math classroom and when should they be used?	**Parent Survey**	**Teacher Survey**	**Report Card**
How do students benefit from using math manipulatives?	**Student Likert Scale**	**Teacher Log Forms**	**Student Station Questionnaire**
What areas of math curriculum will improve student achievement while using math manipulatives?	**Student Mastery Test**	**Student Pre-Test**	**Student Post-Test**

According to Mills, "It is generally accepted in action research circles that researchers should not rely on any single source of data, interview, observation, or instrument" (Mills, 2007, p. 92). In order to triangulate my data, I created six additional tools including a pre-test, post-test, teacher survey, report card analysis form, student station questionnaire and a teacher log form. I created a pre and post test for fractions. After I give my students the 4th grade mastery test, I can analyze the data and see where my students struggle. In the past the area was fractions, therefore, I created a fraction pre and post test. If after giving the mastery test I find my current students are struggling most in multiplication, I will create a multiplication pre and post test.

Both tests consist of four multiple choice questions with three possible answers pertaining to the Grade Level Content Expectations for fractions. Even though the pre and post test look similar, the numbers and answers are different. I plan on giving the pre-test before working with manipulatives and the post-test to culminate the manipulative lessons to track growth. In order to triangulate my data, the mastery test, pre-test and post-test will be used to help answer my research question, what areas of math curriculum will improve student achievement while using math manipulatives.

Two other additional tools I created are a teacher log form and student station questionnaire. These tools along with the student Likert scale can be used to answer my research question, how do students benefit from using math manipulatives. I will use the teacher log form while observing my students using manipulatives. I kept it simple to use by writing the student name, date, location and comments for what I observe to record many logs. These will be helpful to not forget important observations from the beginning of my study to the time I reach the end. It is not specific so I can record any observations I find may be important for my data. The student station questionnaire is also very simple. Students can fill out a form after spending time at a manipulative station. Students will answer three questions: what manipulatives did they use that day, what concept did the manipulatives help them understand and yes or no, did the manipulative help them understand the concept better?

The last two new tools I created were a teacher survey and a report card analysis form. Along with the parent survey, these three tools will help answer my research question, what manipulatives are most effective in a 4^{th} grade math classroom and when should they be used. I created a teacher survey to send to teachers in my building or in other schools. The survey consists of four multiple choice questions and one open-ended question. I will use this data to

see what manipulatives other teachers have used or are currently using in their classroom and how often they use them. By investigating professional opinions about manipulatives, I can create a list of manipulatives that have worked and when are the opportunities to use them within my own study. I also created a report card analysis form to analyze my students' report cards for math. I can use this data to see when to use manipulatives throughout the year. This tool can also relate to the question, what areas of the math curriculum will show improvement with manipulative use. I have a table with the six sections of math on the report card and I can tally marks to see how many students have 1'2 which is the best, 2's, 3's, and 4's which will be the area I should focus my study.

Part 5

Data Analysis

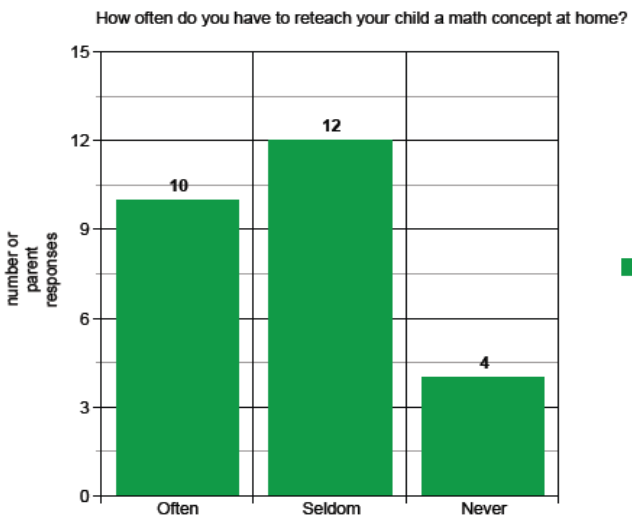
Question 1: What manipulatives are most effective in a 4th grade math classroom and when should they be used?

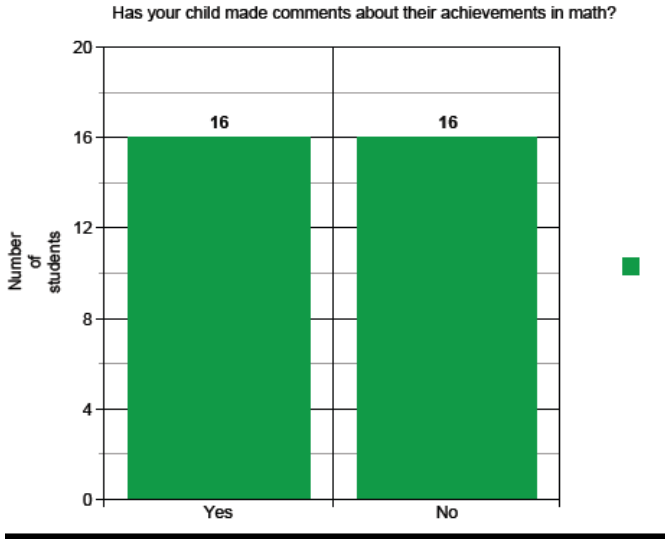
Source 1: Parent Survey

Each of the twenty-nine students in my class took home an anonymous parent survey (See Appendix B) for parents to complete and send back to school. The reason for creating this survey was to see how what I see in the math classroom relates to what is occurring at home. The four, multiple choice question survey was presented to parents as my first tool in this action plan. Twenty-six parents answered this survey based on what happens at home with their child and how they perceive math. Before reviewing the results of this survey, I expected my fourth grade parents to seldom have to assist their children with homework and that most of my students would make positive comments about their achievements in math. The data from this survey showed that ten parents often had to re-teach their child a math concept at home, twelve parents seldom had to re-teach a concept and four parents never had to re-teach a math concept at home. Therefore, 85 percent of my parents were re-teaching math lessons at home. Also, thirteen or 50 percent of my parents said yes, their child has made comments about their achievements in math while the other thirteen or 50 percent responded no, their child has not made comments. (See graphs below)

After reviewing this data, I hoped to use math manipulatives in the classroom to reinforced math concepts so they do not have to be re-taught at home by parents as well as to increase student achievement in math. Finally, the question relating to what area in math that parents thought their child struggled most correlated to my original thoughts. Fourteen, or 54

percent, of the parents stated fractions was the area their child struggled most and lacked confidence. Understanding that there is re-teaching occurring at home and students are not communicating their positive achievements in math, particularly dealing with fractions, helped me answer the research question and know when to use math manipulatives to increase student achievement.





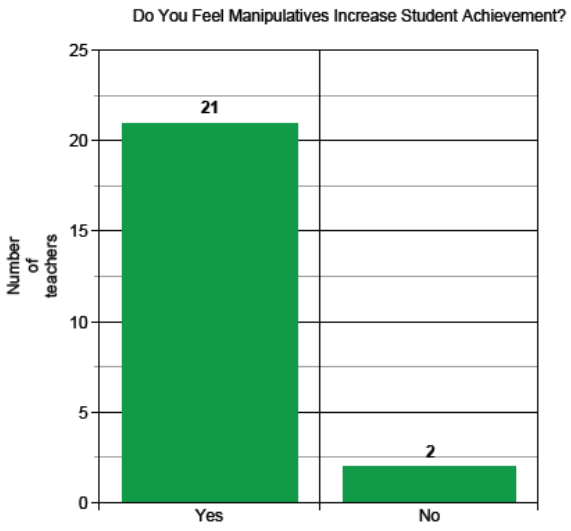
Question 1: What manipulatives are most effective in a 4th grade math classroom and when should they be used?

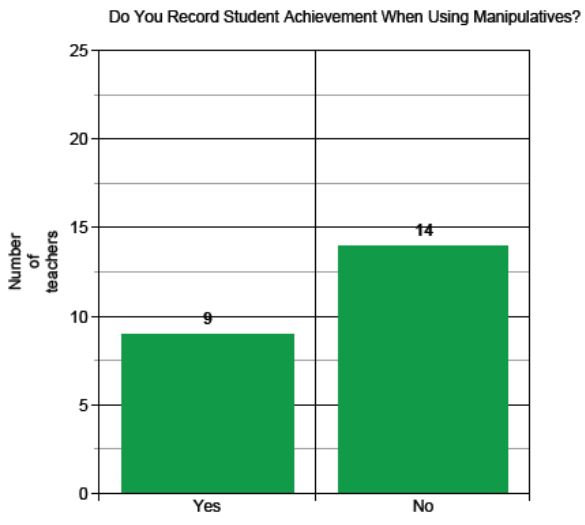
Source 2: Teacher Survey

An online teacher survey (see Appendix C) was sent out to all teachers in my building. The anonymous survey consisted of four multiple choice questions and one free response question. Twenty-three teachers responded to the survey. Of those teachers, eleven teachers, (or 47.8 percent), use manipulatives more than twice a week in their classroom. During the free response question, what manipulatives do you feel are most successful in your classroom, eight teachers responded with Unifix Cubes, five teachers stated base-ten blocks and 4 teachers used fraction strips or bars. Other examples included colored chips, geometric shapes, Tangrams and

clocks. This information gave me ideas of what manipulatives I could try with my students depending on their greatest area of need. The most impressive results of this survey related to manipulatives and student achievement. When asked the question, do you feel manipulatives increase student achievement, twenty-one teachers, (or 91.3 percent) responded yes they do while 2 teachers (or 8.7 percent) stated no manipulatives do not increase student achievement. However, when asked if teachers record student achievement when using manipulatives, nine teachers, (or 39.1 percent) said yes while fourteen teachers, (or 60.9 percent) stated no, they do not record achievement. (see graphs below).

All in all, this survey shows teachers in my building are currently using math manipulatives and believe they increase student achievement. There are a variety of manipulatives being used to teach all areas in math including addition and subtraction, multiplication, division, fractions, and geometry. However, even though this survey answered the research question, what manipulatives are effective, a question of concern is how do teachers know math manipulatives are increasing student achievement if more than a majority are not recording or tracking the achievement?





Question 1: What manipulatives are most effective in a 4th grade math classroom and when should they be used?

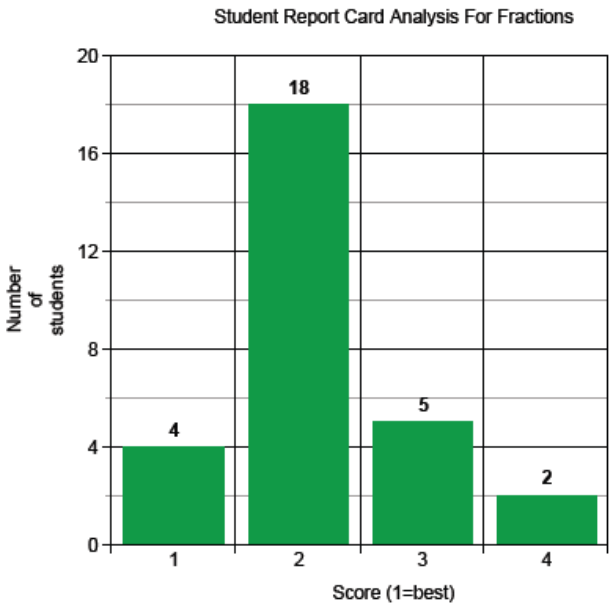
Source 3: Report Card

In order to assess how my entire class is performing in all major concepts in math, I created a report card analysis chart (See Appendix D). Each major math concept that has been taught in fourth grade is listed along with the correlating report card scores one through four. According to my district's report card, a one means a student is consistently and independently demonstrating an understanding of concepts and processes, a two means a student consistently and independently demonstrates an understanding of concepts and processes, a three represents a student sometimes demonstrates an understanding of concepts and processes and may require assistance, while a four means a student seldom demonstrate an understanding of concepts. In our district teachers would like to see all students at a one or a two on their report cards. After analyzing the results of my students' report cards, (see table below) there was only one concept, fractions, where two students (or 6.8 percent of the class) scored a four. Fractions were also the concept where five students (or 17.2 percent of the class) scored a three. Only four students (or 13.8 percent of the class) scored a one in fractions. (See graph below)

After analyzing the math concepts with my class's fourth grade report card, it was evident most of my class was struggling with the concept of fractions. Fractions are where I had seven students, (or 24.1 percent of the class) score below acceptable. After this analysis, I can answer the research question, when should manipulatives be used, since it is apparent my class needs to learn different strategies to understand the concept of fractions in order to show greater achievement.

Report Card Analysis Results

Concept	1	2	3	4
Place Value	10	17	2	0
Add/Sub	9	19	1	0
Multiplication	6	20	3	0
Division	6	20	3	0
Fractions	4	18	5	2



Question 2: How do students benefit from using math manipulatives?
Source 1: Student Likert Scale

In order to see how student's liked using manipulatives, a Student Likert Scale was created. (See Appendix E) Students anonymously responded to five questions after two weeks of using manipulatives to help them have a better understanding of fractions. Students had the option of choosing agree or disagree for all five questions. When asked if math manipulatives make learning more fun, twenty six students (or 89.7 percent of the class) agreed. When asked if math manipulatives helped me understand math concepts, twenty seven (or 93.1 percent of the class) agreed. When asked if using math manipulatives are helpful, twenty seven (or 93.1 percent of the class) agreed as well. These results correlated with my original thoughts that math manipulatives make learning fun and boost student achievement.

After analyzing the results of the scale, it was surprising that only twenty-one students (or 72.4 percent of the class) responded that they agree they understand math better using manipulatives than before using them. The same number of students also agreed math manipulatives are not confusing. A question for further study may be to see if the eight students who disagreed for both questions are the same students, as well as if any of those eight students were already understanding fractions and receiving ones on their report card. The results of this student Likert scale helped answer the research question, how do students benefit from using math manipulatives since a majority of the class thought manipulatives made learning math more fun and helped them understand math better after lessons with manipulatives.

Question 2: How do students benefit from using math manipulatives?
Source 2: Teacher Log Forms

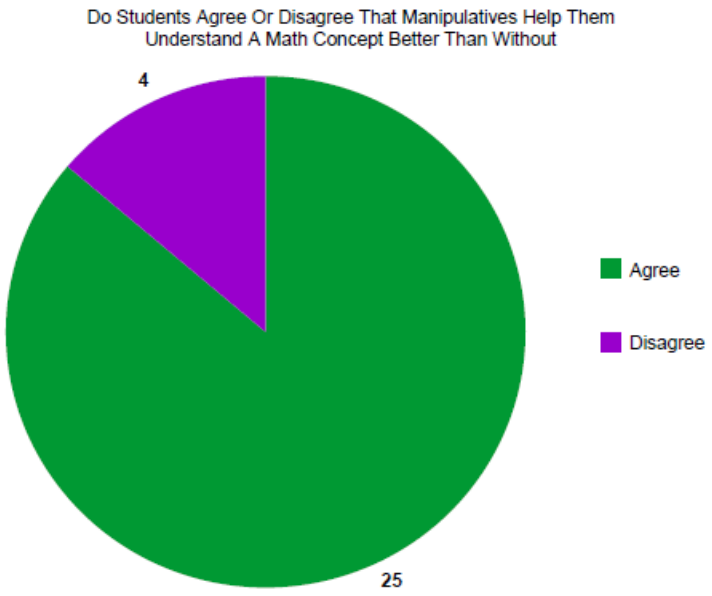
In order to keep track of what I observed while my students used math manipulatives, I created a Teacher Log Form. (See Appendix F) This form was created so it was simple and quick for me to document important sightings. I recorded the student or students' names who I observed, the date, location and comments. I filled out eighteen logs. Of those eighteen, fifteen included comments pertaining to students appearing to be enjoying themselves while using manipulatives. Two logs mentioned students appeared distracted while using manipulatives do to the fact they were not on task and did not complete the required work. One log discussed how a group of advanced students took it upon themselves to finish the task at hand and use the manipulatives to come up with their own problems for each other to figure out. During that group, I also recorded how students were asking each other questions using manipulatives that required higher order thinking and more than just figuring out an answer by completing a math process.

The comments from the Teacher Log Forms showed math manipulatives kept the attention of most of my students. Since there are records that manipulatives caused my advanced learners to probe each other past their assignment helped answer the question, how do students benefit from using math manipulatives. For further study, I could have mini lessons with those students who seemed distracted by the manipulatives to see what was causing them to lose focus. It may be a simple matter of how they did not understand instructions.

Question 2: How do students benefit from using math manipulatives?
Source 3: Student Station Questionnaire

To help with direct student feedback, I created a Student Station Questionnaire. (See Appendix G). After a lesson was taught using math manipulatives for fractions, students had multiple opportunities to use the manipulatives while working on homework and class work. Throughout the two weeks, each student was asked to fill out one student station questionnaire. On the questionnaire, students listed the manipulatives they used that day and the math concept the manipulatives were supposed to help them understand. There was one yes or no question at the end. For the question, twenty-five students (or 86.2 percent of the class) responded yes, they agreed manipulatives helped them understand the math concept better. (See graph below) Only four students (or 13.8 percent of the class) recorded no, they disagreed the manipulatives did not help them understand the math concept better.

Therefore, these results answer the research question, how do students benefit from using math manipulatives. This questionnaire tool reinforced my idea that math manipulatives increase student achievement by helping a majority of students understand math concepts at a deeper level. Further study may include investigating how students feel manipulatives helped them understand math better.

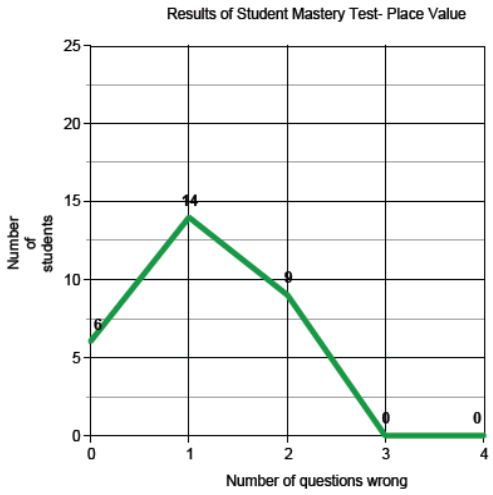


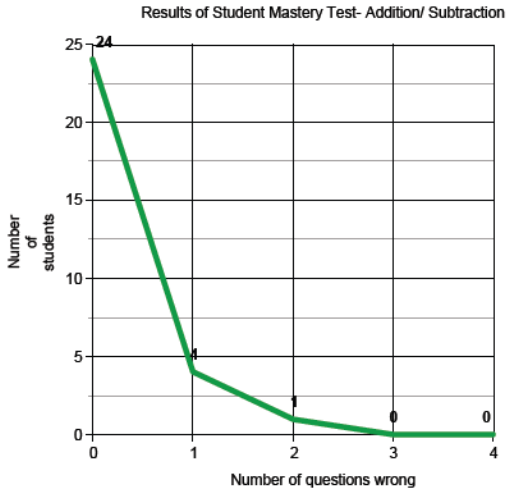
Question 3: What areas of math curriculum will improve student achievement while using math manipulatives?

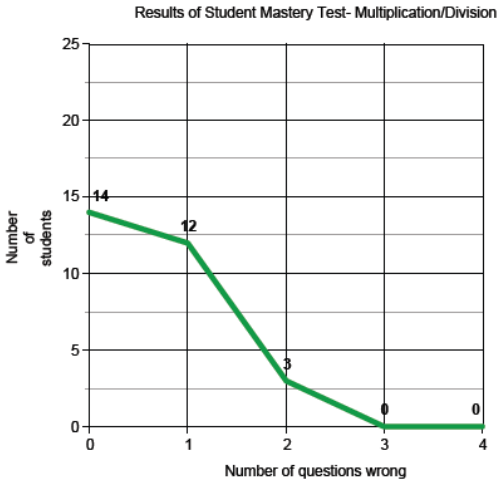
Source 1: Student Mastery Test

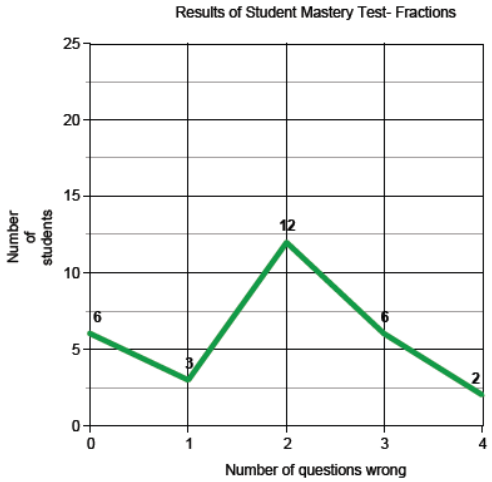
The first tool given to my student was a Math Mastery Test. (See Appendix H) This test consisted of sixteen multiple choice math questions. There were four questions for each of the following math concepts: place value, addition and subtraction, multiplication and division and fractions. The questions were created to correlate to the fourth grade math curriculum. After analyzing each of the four sections on the test, my students overall scored worst in fractions. Six students (or 20.7 percent of the class) scored 100 percent in the fraction section. Three students (or 10.3 percent of the class) missed one fraction question. Twelve students (or 41.4 percent of the class) missed two questions. Six students (or 20.7 percent of the class) missed three questions, while two students (or 6.9 percent of the class) missed all four fraction questions. When comparing the performance of my students on the other three concepts on the test, no student missed three or four questions. (See graphs below)

This mastery test coincided with the results from the Report Card Analysis that fractions is the area in math my student struggle the most. I needed to figure out what concept in math my students can show the greatest increase in achievement so I knew where to begin my manipulative lessons. The results of this test helped answer the research question that areas of math curriculum will improve student achievement while using math manipulatives since fractions will be the focus area for my manipulative lessons during the rest of this action plan.







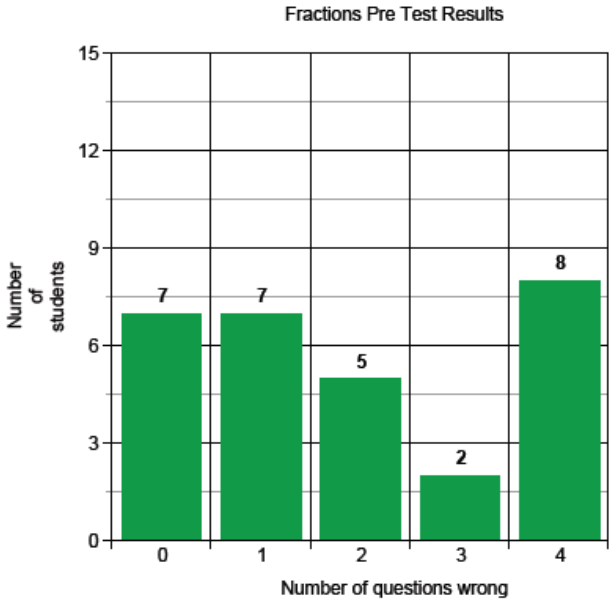


Question 3: What areas of math curriculum will improve student achievement while using math manipulatives?

Source 2: Student Pre-Test

In order to see what areas related to fractions my students needed to show achievement, I created a Fraction Pre-Test. (See Appendix I) This assessment consisted of four, multiple choice questions that aligned with my district's fourth grade math curriculum. The class was given the Pre-Test after the results of the Mastery Test showed students struggled most with the concept of fractions. After analyzing the results (see graph below), seven students (or 24.1 percent of the class) scored 100 percent and did not miss any questions. Seven students (or 24.1 percent of the class) missed one question. Five students (or 17.2 percent of the class) answered two out of the four questions wrong. Two students (or 6.9 percent of the class) missed three questions while eight students (or 27.6 percent of the class) missed all four fraction questions.

I knew from the Math Mastery Test my students would not do well on a fraction test; therefore, I was not surprised to see the results of the Fraction Pre-Test. This test helped answer the question, what areas of math curriculum will improve student achievement while using math manipulatives since the analysis showed fifteen students (or 51.7 percent of the class) scored a 50 percent or lower. These results will help me design fraction lessons using math manipulatives to see if using them help students succeed.

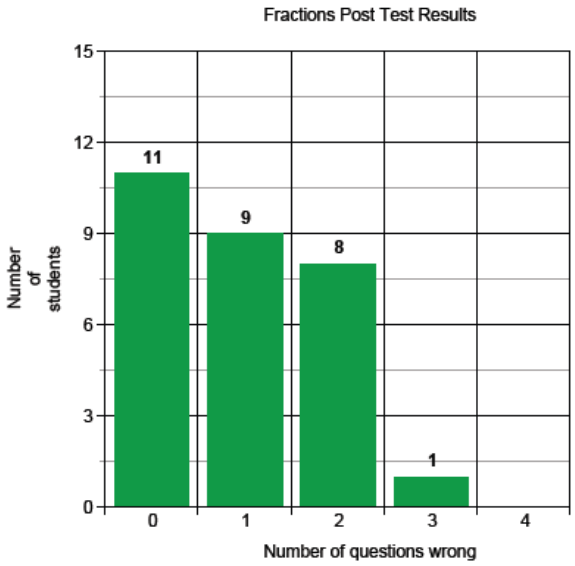


Question 3: What areas of math curriculum will improve student achievement while using math manipulatives?

Source 3: Student Post-Test

In order to see if there was student achievement after teaching fraction lessons using math manipulatives, I created a Fraction Post-Test. (See Appendix J) This assessment consisted of four, multiple choice questions that aligned with my district's fourth grade math curriculum. The questions were similar to the Fraction Pre-Test, just different numbers. The class was given the Pre-Test after all manipulative lessons were completed along with the Student Questionnaire. After analyzing the results (see graph below), eleven students (or 37.9 percent of the class) scored 100 percent and did not miss any questions. Nine students (or 31.0 percent of the class) missed one question. Eight students (or 27.6 percent of the class) answered two out of the four questions wrong. One student (or 3.4 percent of the class) missed three questions while no students missed all four questions on the test.

This Fraction Post-Test helped answer the question, what areas of math curriculum will improve student achievement while using math manipulatives. These results can now be compared to the results of the Fraction Pre-Test in order to analyze if there was student growth. Further studies on math manipulatives might include what fraction concepts show the biggest growth in student achievement when using manipulatives.



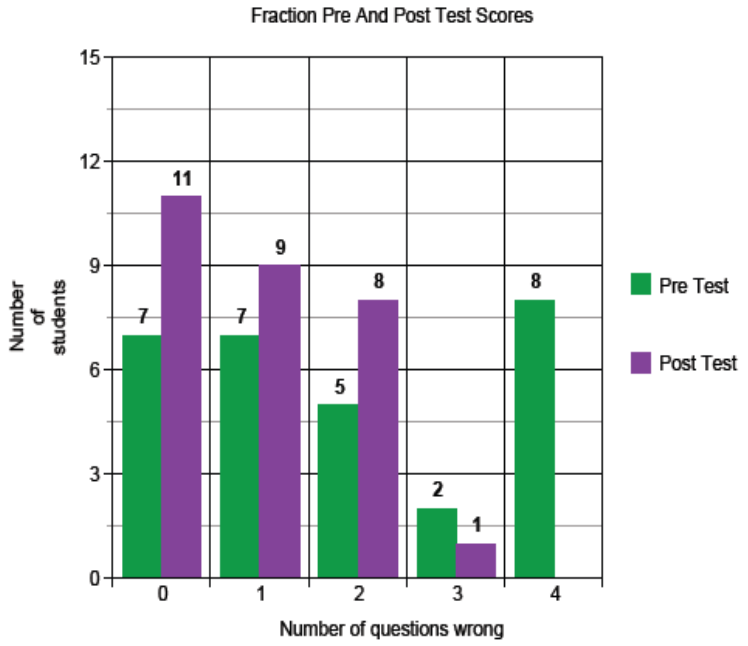
Part 6

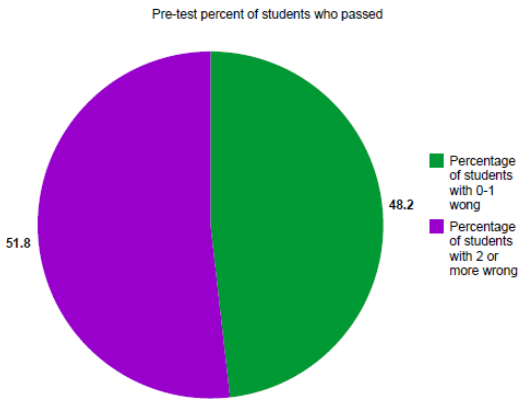
Action Plan:

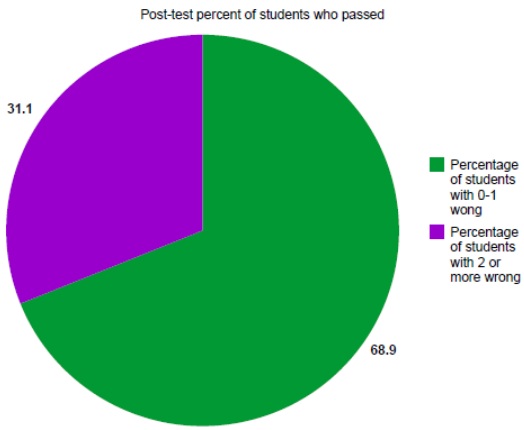
After completing this data analysis, it is apparent using math manipulatives do increase student achievement. The results of the teacher survey concluded 91.3 percent of teachers thought math manipulatives increase student achievement. With the student likert scale, 91.3 percent of students thought math manipulatives were helpful in assisting them learn math concepts with a deeper understanding. With the scale, 89.7 percent of students thought using math manipulatives made learning math more fun. The most concrete evidence that math manipulatives help increase student achievement are the scores of the fraction pre-test versus the fraction post-test. (see graphs below) 48.2 percent of the class passed the pre-test while 68.9 percent of the class passed the post-test after two weeks of math lessons utilizing manipulatives. That is a 20.7 percent of the class increase within two weeks.

The results of this project confirmed my original thought that math manipulatives will help increase student achievement. Teaching math with manipulatives make learning more fun for students and reach at different learning styles students may have. Manipulatives cause students to explore math with concrete objects instead of relying on the teacher to lecture a concept. Manipulatives allow students to construct deeper meanings of math concepts and learn math is more that memorizing a process. Manipulatives help struggling students visually see a math process while allowing advanced learners to question themselves and dig deeper into a concept they have mastered.

After reviewing the outcomes of this project, I feel empowered to continue to use math manipulatives in all areas of math instead of just fractions. I will keep track of the manipulatives I try and document their effectiveness. I hope to teach my teaching partners how to use math manipulatives so they can help their students feel successful. It would be beneficial to hold a staff meeting to present my findings to all the teachers in my building. After they review the results, those teachers who are currently using manipulatives may feel what they are doing is beneficial and worth the work while those teachers who are not familiar with math manipulatives may take the time to seek out ways they can start introducing them into their lessons.







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Appendix A:

Data Collection Matrix

Research Questions	Data Source 1	Data Source 2	Data Source 3
What manipulatives are most effective in a 4th grade math classroom and when should they be used?	**Parent Survey**	**Teacher Survey**	**Report Card**
How do students benefit from using math manipulatives?	**Student Likert Scale**	**Teacher Log Forms**	**Student Station Questionnaire**
What areas of math curriculum will improve student achievement while using math manipulatives?	**Student Mastery Test**	**Student Pre-Test**	**Student Post-Test**

According to Mills, "It is generally accepted in action research circles that researchers should not rely on any single source of data, interview, observation, or instrument" (Mills, 2007, p. 92). In order to triangulate my data, I created six additional tools including a pre-test, post-

test, teacher survey, report card analysis form, student station questionnaire and a teacher log form. I created a pre and post test for fractions. After I give my students the 4th grade mastery test, I can analyze the data and see where my students struggle. In the past the area was fractions, therefore, I created a fraction pre and post test. If after giving the mastery test I find my current students are struggling most in multiplication, I will create a multiplication pre and post test. Both tests consist of four multiple choice questions with three possible answers pertaining to the Grade Level Content Expectations for fractions. Even though the pre and post test look similar, the numbers and answers are different. I plan on giving the pre-test before working with manipulatives and the post-test to culminate the manipulative lessons to track growth. In order to triangulate my data, the mastery test, pre-test and post-test will be used to help answer my research question, what areas of math curriculum will improve student achievement while using math manipulatives.

Two other additional tools I created are a teacher log form and student station questionnaire. These tools along with the student Likert scale can be used to answer my research question, how do students benefit from using math manipulatives. I will use the teacher log form while observing my students using manipulatives. I kept it simple to use by writing the student name, date, location and comments for what I observe to record many logs. These will be helpful to not forget important observations from the beginning of my study to the time I reach the end. It is not specific so I can record any observations I find may be important for my data. The student station questionnaire is also very simple. Students can fill out a form after spending time at a manipulative station. Students will answer three questions: what manipulatives did they use that day, what concept did the manipulatives help them understand and yes or no, did the manipulative help them understand the concept better?

The last two new tools I created were a teacher survey and a report card analysis form. Along with the parent survey, these three tools will help answer my research question, what manipulatives are most effective in a 4th grade math classroom and when should they be used. I created a teacher survey to send to teachers in my building or in other schools. The survey consists of four multiple choice questions and one open-ended question. I will use this data to see what manipulatives other teachers have used or are currently using in their classroom and how often they use them. By investigating professional opinions about manipulatives, I can create a list of manipulatives that have worked and when are the opportunities to use them within my own study. I also created a report card analysis form to analyze my students' report cards for math. I can use this data to see when to use manipulatives throughout the year. This tool can also relate to the question, what areas of the math curriculum will show improvement with manipulative use. I have a table with the six sections of math on the report card and I can tally marks to see how many students have 1'2 which is the best, 2's, 3's, and 4's which will be the area I should focus my study.

Appendix B:

Parent Math Questionnaire

Date:_____

Parents, please answer these questions as it pertains to math in Ms. Couture's classroom.

1. How often do you have to re-teach your child a math concept at home?
    a. Often
    b. Seldom
    c. Never

2. What area or concept in math this year has your child struggled most in math?
    a. Addition and subtraction
    b. Multiplication
    c. Fractions
    d. none

3. What area or concept in math this year has your child felt the most confident?
    a. Addition and subtraction
    b. Multiplication
    c. Fractions
    d. none

4. Has your child made comments about their achievements in math?

    a. Yes
    b. No

Thanks for your time and comments!

Appendix C:

Teacher Math Manipulative Survey

Date:_____

Grade Level:_____

Please answer these questions.

5. How often do you use math manipulatives in your classroom?
    a. Less than once a week
    b. Once a week
    c. Twice a week
    d. More than twice a week

6. What area or concept in math do you use manipulatives the most often?
    a. Addition and subtraction
    b. Multiplication
    c. Division
    d. Fractions
    e. Geometry

7. Do you record student achievement when using manipulatives?
    a. Yes
    b. No

8. Do you feel manipulatives increase student achievement?
    a. Yes
    b. No

9. What manipulatives do you feel are the most successful in your math classroom?

_____
_____
_____
_____
_____

Thanks for your time and comments!

Appendix D:

Report Card Analysis

Date:_____

Grade:_____

Concept	1	2	3	4
Place Value				
Add/Sub				
Multiplication				
Division				
Fractions				

Appendix E:

Date:_____

Students,

Please respond to the following items by drawing a circle around the response that most closely reflects your opinion:

1. **Math manipulatives make learning math more fun.**

   Agree **Disagree**

2. **Math manipulatives help me understand math concepts.**

   Agree **Disagree**

3. **I understand math better using manipulatives than before using them.**

   Agree **Disagree**

4. **Math manipulatives are not confusing.**

   Agree **Disagree**

5. **Using math manipulatives are helpful.**

   Agree **Disagree**

Appendix F:

Teacher Log Record Form

Name:_____

Grade:_____

Date:_____ Location:_____

Comments:_____

_____

_____

_____

_____

_____

Name:_____

Grade:_____

Date:_____ Location:_____

Comments:_____

_____

_____

_____

_____

_____

Appendix G:

Name:_____Date:_____

Student Station Questionnaire

What manipulative(s) did you use today?

_____

_____

What math concept was the manipulative(s) supposed to help you understand?

_____

Did the manipulative(s) help you understand the concept better?

a. **Yes**
b. **No**

Appendix H:

Name:_____Date:_____

Math Mastery Test 4th Grade

Directions: circle the correct answer

Place value, factors and multiples

1. Which of these numbers is prime?
   a. 15
   b. 21
   c. 29
   d. 27

2. Which of these is a multiple of 3?
   a. 23
   b. 41
   c. 62
   d. 81

3. What is the value if 4 in 5,142
   a. 4
   b. 40
   c. 499
   d. 4,000

4. Which number has a 7 in the hundreds place?
   a. 1,297
   b. 5,688
   c. 5,753
   d. 7,548

Addition and Subtraction

5. What is 4,968+3,975?
   a. 8,922
   b. 8,943
   c. 9,523
   d. 8,832

6. What is the sum of 567 and 35?
   a. 592
   b. 602
   c. 567
   d. 56,735

7. What is the difference of 657 and 1
   a. 548
   b. 552
   c. 558
   d. 638

8. What is 5,632- 4,005?
   a. 2,625
   b. 1,624
   c. 1,627
   d. 995

Multiplication

9. What is 500 x 70?
    a. 35
    b. 350
    c. 3500
    d. 3,500

10. What is 12 x 15?
    a. 18
    b. 180
    c. 200
    d. 188

11. What is 348 x 26?
    a. 9,448
    b. 9,523
    c. 9,048
    d. 8,128

Division

12. What is the quotient of 15 and 3?
    a. 45
    b. 3
    c. 5
    d. 18

13. What is 400 divided by 2?
    a. 2
    b. 20
    c. 200
    d. 80

14. What is 364 divided by 6?
    a. 60 R 1
    b. 66 R 4
    c. 6 R 4
    d. 60 R 4

Fractions

15. Which fraction is greater than ½?
    a. 3/6
    b. 1/6
    c. 1/3
    d. 2/3

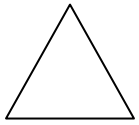
16. Which mixed number is equal to 20/6?
    a. 3 1/3
    b. 3 1/6
    c. 6 1/3
    d. 6 ½

17. What is ¼ + ½?
    a. ¼
    b. ½
    c. 1/6
    d. ¾

18. What is 2/3 – 1/6?
    a. 1/3
    b. ½
    c. 1/6
    d. 2/6

Geometry

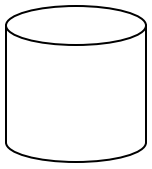
19. What kind of triangle is this?



    a. Right
    b. Scalene
    c. Obtuse
    d. Acute

20. How many faces does a cube have?
    a. 2
    b. 4
    c. 6
    d. 5

21. What is this shape called?



    a. Cone
    b. Cube
    c. Cylinder
    d. Prism

22. How many vertices does a cone have?
    a. 1
    b. 2
    c. 3
    d. 4

Appendix I:

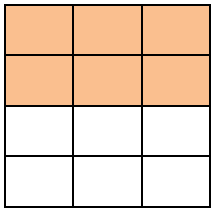
Fraction Pre-Test

1. Which fraction is equal to ½?
    a. 4/5
    b. 7/7
    c. 5/10

2. What is 5/3 as a mixed number?
    a. 1 1/3
    b. 1 2/3
    c. 2 2/3

3. What is 3/7 + 2/14?
    a. 5/14
    b. 5/7
    c. 8/14

4. What fraction of the shape is shaded?
    a. 3/6
    b. ½
    c. 6/11



Appendix J:

Name:_____Date:_____

Fraction Post-Test

1. Which fraction is equal to 2/3?
    a. 4/8
    b. 6/9
    c. 6/12

2. What is 7/3 as a mixed number?
    a. 1 2/3
    b. 1 3/3
    c. 2 1/3

3. What is 3/7 + 2/14?
    a. 5/14
    b. 5/7
    c. 8/14

4. What fraction of the shape is shaded?
    a. 3/4
    b. 9/10
    c. 9/11