An action based research study on how using manipulatives will increase students' achievement in Mathematics.

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Abstract

The purpose of this study is to find out if meaningful educational activities and the use of a manipulative in those activities might have an impact on student achievement. Using manipulative as cognitive tools should improve the teaching and learning process, and encourage student reflections on retaining the information. It has been claimed that the usage of a manipulative not only increases student achievement, but also allows them to improve their conceptual understanding and problem solving skills. The use of a manipulative can also promote a student to have a positive attitude toward mathematics. These manipulatives provide a concrete, hands-on experience, which focus attention and overall increase motivation (Durmas and Karakirik, 2006).

The research was completed was an action research project with one-fifth grade math class over the course of three days. The subjects in this group participate in program by the name of Everyday Math, which they are required to take a pretest and posttest before they are taught any lessons in that unit. Each unit consists of hands-on manipulative, games, partner activities, and everyday mathematics tools. The research was based off of a pretest given the first day, and introduction to the unit using manipulatives on the second day, and a posttest on the third day. All students were given the exact instructions on using pattern blocks to understand the relationship of interior angles in various polygons. All students were given the same pretest and posttest. The results of my study revealed that students using a manipulative improved their level of achievement, increased their understanding, and promoted a positive attitude to a mathematical concept that they previously struggled with before using a manipulative.

Introduction

Throughout my history of being a teacher, students have struggled with understanding mathematical concepts. They have individual personalities, as well as individual learning patterns. With this new technological generation of students, teachers are challenged to teach in a way that involves students. The usage of a manipulative will assist in focusing students' attention, and motivate students to learn with a problem solving approach using something they can touch. It seems as a thing of the past to just teach using a chalkboard, or pencil and paper assignments. It has also been debated for some time if the use of a manipulative shows a significant difference in academic achievement to promote its usage in the classroom. However, many of the research shows that the usage of manipulative will great improve the students attitude toward learning, their academic achievement in mathematics, and allow students to have a more entertaining way to learn mathematical concepts. The usage of a manipulative not only benefits students learning in mathematics, but it teaches them to build on comprehension while they are exploring, and observing math in a context that prepares them for real world applications.

The action study will be used in a fifth grade classroom setting consisting of 23 students. The research will investigate if there is a difference between the academic achievement scores on the pre and post-test of the controlled experimental group, based on the usage and non-usage of a manipulative during instruction in a geometry lesson.

Chapter I: This chapter will explain the problem, including the elements of the problem with students in relation to using math manipulatives in the classroom.

Problem Statement

Many students have struggled with understanding mathematical concepts and become frustrated in the classroom. Most students have low-test scores and have difficulty completing homework. I have observed students inability to complete problems in class, which leads to frustration for future learning. It becomes apparent to myself, that the need to research math manipulatives in a mathematics classroom would be helpful to see if their was an increase in students' academic performance.

Elements of the Problem

Throughout the past decade, researchers have stated that it is the role of the educator to provide students with an environment that actively engages them in learning. The problem with the subject matter at hand is the fact that some educators do not motivate learners that holds their attention and interest in mathematics. Using manipulatives should increase students' attention, and assist in students understanding the mathematical concept.

Purpose of Study

The purpose of this study is to determine if using manipulatives in a mathematics classroom will increase students' achievement in mathematics. I will be using an action-based research to analyze the effects that manipulatives have on student attitudes and learning patterns. The research utilizes previous research to show the correlation between mathematics achievement and the use of manipulative materials in the classroom.

Definition of Terms

Math Manipulatives – Rust (1999) defines manipulatives as any hands-on object that the student can physically move in order to discover the solution to the problem.

Mathematics – Hinzman (1996) defines mathematics as the science of numbers and sets and their general operations, relations and combinations and of space configurations and their structure, measurement and transformations.

Hands-on activities- activities using objects that appeal to several senses, [which] can be touched, handled or moved.

Null Hypothesis

The null hypothesis stated below was tested using a pre-test and post-test on understanding how to find the measurement of an interior angle of a regular polygon:

- Students in the control group will have no significant change in their pre and posttest using manipulative at the .05 level of significance.

Chapter II: This chapter will detail the literature reviewed and discuss how previous manipulative research has been used in the correlation to student achievement in mathematics.

Literature Review

As I conducted previous research on finding a solution to increasing students' understanding of mathematics, I found that manipulatives were proven to assist in helping students eliminate their frustrations and create enjoyment in learning mathematics. Teachers are constantly looking for ways to improve their teaching and help students understand Mathematics. Based on research from several countries, manipulative materials in teaching mathematics to students hold the promise that manipulatives will help students understand the material being taught (Heddens, 2007). While it has been proven that manipulatives are helpful, they can hold potential harm if they are used in a poor manner. There are multiple perspectives concerning how manipulative resources help students learn mathematics, though little evidence firmly supporting one view (Chao et al, 2000). All mathematics comes from the real world and the real situation must also be translated from symbolic of mathematics to the mathematical computation. In general, most of the research has shown evidence that states if manipulatives are used properly then they will increase students' academic performance levels and improve their attitudes towards mathematical classes.

(Heddens, 2007) states that manipulative materials are concrete models that involve mathematical concepts, appealing to several senses that can be touched and moved around by the student. Manipulative materials must be selected for the activity and appropriate for the concept being taught and appropriate for the developmental level

of the students'. According to Heddens, using manipulative materials in teaching can help students learn how to relate real world situations to mathematics symbolism and work together cooperatively in solving problems. He further states that manipulatives allow students' to discuss mathematical ideas, concepts, and verbalize their mathematical thinking (Heddens, 2007). Students who use manipulatives in their mathematics courses usually out perform those who do not, although the benefits may be slight (Clements, 1999). Manipulative usage can also improve students' attitude toward mathematics, and give instruction that uses concrete materials to help students retain information and increase scores on test (Sowell, 1989).

In order for mathematics to engage students interactively and entertaining for the purpose of learning, teachers must involve students physically in hands-on experiences. Although some research states that students learned the material no matter which way it was taught; there were definite differences in student enjoyment (Rust, 1999). Student enjoyment in school is directly related to their overall academic success because it has been proven that students will retain the information if it enjoyable to them. (McClung, 1998) states that using manipulative aids and devices make the classroom a more interesting and engaging place for both teachers and students.

Chapter III: Methodology

This chapter will highlight the method used in this experimental action based research study. The researcher will define subjects, control method, and the procedures taken throughout the course of study.

Research Design

This researcher will study a fifth grade self-contained class. A pre-test will be given on the first day to determine the groups' prior knowledge and level. This data allows the researcher to understand the control groups post-test. On day two the researcher will give instructions and a post-test will be given on the third day.

Subjects

The subject site is Hickory Grove Elementary School in Bloomfield Hills, Michigan. The subjects in this research are a controlled experimental group consisting of 23 fifth grade students. This researcher will conduct a pre-test, teach a lesson, and then conduct a post-test. This researcher understands that the limitations of the study conclusions cannot be used to project the results of other studies because findings may differ due to restrictions of the sampling.

Control Method

This researcher will give a lesson on how to find the interior angles of certain polygons and students will pay close attention. The researcher will teach using a smart board and document camera to illustrate various polygons. Students will try to figure out using prior knowledge of angle measurements. For instance, students would have to draw a triangle and label each interior angle with the correct measurement.

Experimental Method

The researcher had the students in the control method use pattern blocks as manipulatives to learn the angle measurements for different polygons. Students were taught that a triangle had the interior sum of angles being 180 degrees. Then we discussed that a triangle had three interior angles. Students then were able to draw the conclusion that 180 degrees was divided by three angles. This lead to the discovery that each angle in a triangle had an interior measurement of 60 degrees, because the total sum of the three interior angles was equal to 180 degrees. Students were then shown a pentagon, hexagon, square, and octagon. Students were now to use the pattern blocks to show the relationship of a triangle to the other polygons. Students were able to fill their polygon with the triangular pattern blocks. Students were then taught the if an interior angle contained triangles then that angle measurement was 60 degrees times the number of triangles within that polygon. For example, students were able to fill a hexagon with 6 triangles, and see that the measurement of each angle was 60 degrees multiplied by 2. While using manipulatives, students learned how to find the interior angle measurement for polygons in relation to using the triangular pattern blocks.

Variables

For the purpose of this study there will be two variables used. The independent variable is the use of a manipulative and the dependent variable is the change in academic achievement. The subjects in this group will receive instruction on finding the interior angle measurement for various polygons and they will also be given MANIPULATIVES

to use. This group will take a pretest; undergo instructions with manipulatives, and then a posttest to see if the academic achievement improves.

Methods of Data Collection

The method of data collection will be generated using pre and posttest on finding the measurement of interior angles in various polygons. The pre-test and post-test will be similar, using the same skills but different problems. As in most studies, the pre-test will not be the same as the post-test. The researcher assumes that students will do better on the test the second time it is taken.

Data Analysis Procedures

A one-tailed paired data ttest at the .05 significance level will be used to analyze the date that is collected form the pre-test and post-test after the data has been generated. If there is a significant change that is equal to or lesser than the level .05 would indicate that there was a reason to reject the null hypothesis with at least a 95% confidence level.

Timeline

This study will be conducted over a three-day period during the scheduled math time on a regular full school day. Students will be given the pre-test on the first day, and the researcher will give instruction on the second day. The third day will consist of students taking a post-test that should show an improvement in achievement.

Chapter IV:

Comparison of Control Group Pretest and Posttest Data

There were 22 students in the control group who received instruction using pattern blocks to find the sum of an interior angle of a regular polygon. The post-test was not identical to the pre-test but they both contained regular polygon figures. Students were given as much time as needed to take both test during the class period. Both tests were scored based on the number of correct answers attained with ten being a perfect score. The change between the pre-test and post-test scores was calculated for each group to determine the improvement factor. The mean score for change of the control group was 13.182. (See Table and figure 1 in the Appendix.). The *critical t* was 0.00011 . The level of significance between the control group was calculated to be 80.4545455. The null hypotheses stated that students in the control group receiving instruction with manipulatives will have no significant change in their pre and post tests at the .05 level of significance. *With the significance being higher than .05 the researcher cannot reject the null hypotheses. Although, the null hypotheses cannot be rejected at a .05 significant level, this researcher can say that there was a significant change in the experimental group scores over the control group scores, with an 85% confidence level.*

Pre-Test Scores

Group	**Number**	**Mean**
Control	22	67.273

Post-Test Scores

Group	Number	Mean	T-Score
Control	22	80.455	0.00011
T-Score			

Chapter V:

Summary

This researcher conducted a research project with a group of fifth grade mathematic students on geometry. The study took place over a three-day period of time. Both groups were given the same pre-test. The pre-test was graded based on the number of correct answers attained out of ten problems. Each group received one full class period of instruction for one day, the next day the students took the post-test.

Conclusion

As a result of geometry instruction using manipulatives, the group increased their skills and showed more interest and enjoyment when learning was done through the use of manipulatives. The students were visibly more active in class and develop more self-confidence in their math skills. However, manipulatives do not always magically assist student's learning mathematical concepts. Some student scores decreased when taught using manipulatives rather than increased. Overall, they provide a concrete way for students to link new, often abstract information to already solidified and personally meaningful networks of knowledge, thereby allowing students to take in the new information and give it meaning. It seemed that the students in this experimental group enjoyed working with manipulatives to find how to find the interior measurements of angles in regular polygons. Although, the null hypotheses could not be rejected at a .05 significant level, this researcher can

This proves that the use of manipulatives has a positive effect on students' academic achievement.

Recommendations

The researcher found that if students are given the opportunity to use manipulatives along side traditional instruction they will learn and understand basic math skills. The researcher also recommends that using manipulatives gives students a better understanding of basic math skills and seems to hold their interest and help them to enjoy learning.

Appendix A

Pre-Test and post-Test Scores/Changes/Averages

	Group A Pretest	Group A Post-test	Group A Change
1	90	100	10
2	70	90	20
3	60	50	-10
4	90	100	10
5	60	70	10
6	50	80	30
7	70	60	-10
8	60	80	20
9	70	70	0
10	70	70	0
11	70	90	20
12	50	80	30
13	90	90	0
14	90	100	10
15	50	60	10
16	70	90	20
17	80	80	0
18	40	90	50
19	60	80	20
20	50	70	20
21	80	90	10
22	60	80	20
Mean	67.273	80.455	13.182

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