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Research Article

Manipulative Approach in Teaching Fractions

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ABSTRACT

This study aimed to determine the effects of using manipulatives in teaching fractions. Quasi- experimental method of research was used in this study. It was conducted during the first quarter of S.Y. 2019-2020 among the respondents were randomly selected. Two sections of Arayat National High School were the respondents of the study. The control group was the 7-Rosal while the 7-Sampaguita was the experimental group. Both groups were given a pretest prior to the discussion about fractions and a posttest after instruction using the traditional method (control group) and the use of manipulatives (experimental group). The results were then evaluated, analysed through SPSS, and interpreted. Mean, t-test and ANCOVA were utilized to analyze and interpret the data.

This study found out that the post-test scores of the respondents from the two groups improved in comparison to their pre-test scores. The mean pretest and mean posttest scores of both groups showed significant difference. The results showed that the use of virtual manipulatives in converting fractions to decimals had significant difference compared the use of the traditional method. On the contrary, teaching fractions on a number line did not have significant difference. Out of the four operations on fractions, three showed that the use of concrete manipulatives was highly effective.

This study recommends that teachers must test the prior knowledge of their students before discussing about fractions to determine the students' strengths and weaknesses. Although both traditional method and the manipulative approach showed improvement on the post-test results in teaching fractions, still, teachers are encouraged to use manipulatives in teaching fractions to improve students' performance. It is important for teachers to provide their students opportunities for hands-on manipulation of objects in order to grasp the concepts of fractions more easily. Lastly, teachers must develop the use of concrete and virtual manipulatives in teaching fractions to promote active learning that can enhance students' mathematics performance and can help them to realize that mathematics is an enjoyable subject.

Keywords: Manipulatives, Teaching fractions, Virtual

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Introduction

Mathematics teachers find most of their students to have low achievement level in mathematics, especially with their topic on fractions.

Fractions are widely used in the world of mathematics; however, students find them very difficult to understand. This may be because fractions are one of the most chronically troublesome areas in mathematics for children and adults alike. Students find them difficult to learn, while teachers find them difficult to teach. Before students go deeper in solving fractions, it is a must to already know how to perform the basic fundamental operations.

Teachers should discover a solution to deal with these issues in order to positively influence students' mathematics achievement and also their attitude in dealing with fractions. Integrating manipulatives into classroom discussions may address these problems and may help students deepen their understanding about the different mathematical concepts and improve mathematical skills.

(Smith, 2009) argued that manipulatives can come in a variety of forms and these are often defined as "physical objects that are used as teaching tools to engage students in the hands-on learning of mathematics". Using mathematical manipulatives and models provides many benefits (Shaw, 2002). Just as a picture can be worth a thousand words, manipulatives can provide visual representations of ideas, give support to students in knowing and understanding mathematics, enhance reasoning and communicating skills of students at all levels. Working with manipulatives deepens understanding of concepts and relationships and makes skills practice meaningful.

For this reason, it is perceived that using manipulatives could help improve the mathematics performance of the students and their attitudes toward the subject. This may also provide possibilities to determine a solution in solving some of the issues in dealing with fractions. Knowing that fractions pose problems/difficulty,incorporating manipulatives in classroom discussion may help the students to be more engaged or actively involved in the discussion. This will give them the opportunity to enjoy learning fractions through hands-on activities.

More so, John Dewey's "learning-by-doing principle" supports the concept of this study. According to (Dewey, 1859-1952), a child learns best when he is actively engaged in any hands-on activities. This may also be referred to as learning through actual experiences.

Arayat National High School recorded a low performance in Mathematics in the National Achievement Test for the S.Y. 2018-2019. The result alarmed the school officials and teachers since the school gained only a Mean Proficiency Score of 52.6 which is too far from the target score of 75%.

On this premise, this study was conceived in order to address such issues as the perceived negative attitude of the students toward Mathematics; to enable the students to gain a deeper learning of fractions; to help the respondent school improve its performance in NAT. It is hoped that this study could offer better strategies that would make teaching and learning fractions easier and enjoyable.

Coneptual framework

To have positive outcome in teaching fractions, the teacher must develop a technique in teaching the topic. A good personality of a teacher and an experimental approach in teaching fractions are keys to make students interested in learning the topic.

In this research, the respondents were divided into two; the control group and the experimental group. The experimental group was exposed to the use of manipulatives while the control group was taught using the traditional method.

Both groups were required to take the pretest and post-test to evaluate their understanding of the basic concepts on fractions. The test results of each group were analyzed and compared to determine which would perform better.

Figure 1 shows the overview of this study.

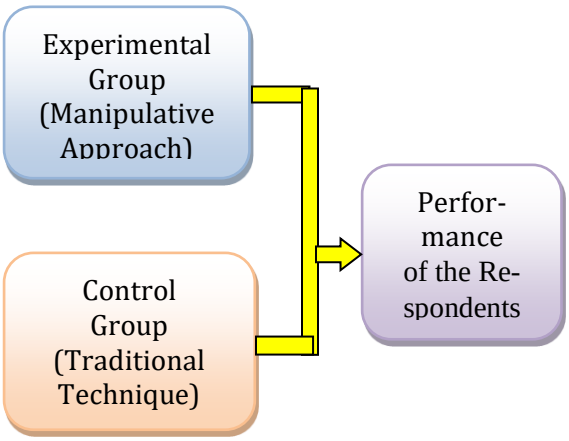

Figure 1. Paradigm of the Study

Statement of the problem

This study aimed to use manipulative approach in teaching fractions to the seventh graders in Arayat National High School.

Specifically, the study sought to find answers to the following questions:

1. How may the scores of the respondents in the pre-test and post-test be described in the following groups:
   1.1. Control Group; and
   1.2. Experimental Group?
2. Is there a significant difference between the pre-test and post-test results of the respondents in the following groups:
   2.1. Control Group; and
   2.2. Experimental Group?
3. Does the use of manipulatives in teaching fractions significantly affect the performance of the respondents in the operations of fractions?

Hypotheses

This study was guided by the following hypotheses.

1. There is no significant difference between the pre-test and post-test results of the respondents in the following groups:
   1.1. Control Group; and
   1.2. Experimental Group.
2. The use of manipulatives in teaching fractions does not significantly affect the performance of the respondents on the operations of fractions.

Significance of the study

The result of this study is hoped to be of great help to the following:

Students. The study offers insights to students on how to perform the basic operations on fractions while enjoying learning with the help of hands-on activities. It may also encourage them to be actively engaged in the discussion. Through the use of manipulatives, students may better understand and appreciate the lessons.

Teachers. The study is beneficial for them in a way that it may help how to teach fractions using an easy, enjoyable, and meaningful strategy such as using manipulatives.

Administrators. The result of the study may serve as a guide to help them in making the curriculum or school programs that could promote active learning inside the classroom.

Future Researchers. Findings of the study may also serve as a guide or pattern for the future researcher in conducting studies related to this research.

Scope and delimitation of the study

The study focused on the effectiveness of using virtual and concrete manipulatives in teaching basic topics on fractions.

The study was delimited to analyzing the test scores obtained by the two groups of respondents- control and experimental groups, in solving operations on fractions. The test re-

sults would determine if the use of manipulatives is an effective strategy in teaching fractions. The respondents of the study were the seventh graders of Arayat National High School, during the first grading period of school year 2019-2020.

Definition of Terms

Here are some terminologies used in the study with their conceptual and operational meanings:

Concrete Manipulatives are concrete objects used as tools that allow students to experiment and explore mathematical concepts (Burns & Hamm, 2011).

In this study, it refers to hands-on tools or concrete objects that were used as instructional materials for the discussion of fractions.

Control Group is a group separated from the rest of the experiment where the independent variable being tested cannot influence the results. This isolates the independent variable's effects on the experiment and can help rule out alternate explanations of the experimental results. (http://chemistry.about.com/od/chemistryterminology/a/What-Is-The-Difference-Between-Control-Group-And-Experimental-Group.htm)

In this study, it refers to the group of respondents exposed to thetraditional method of teaching.

Experimental Group is the group in a scientific experiment where the experimental procedure is performed. This group is exposed to the independent variable being tested and the changes observed and recorded.(http://chemistry.about.com/od/chemistryterminology/a/What-Is-The-Difference-Between-Control-Group-And-Experimental-Group.htm)

In this study, it refers to the group of students who were taught with using manipulatives.

Fraction(from the Latin fractus, broken)is a very small proportion or an amount less than the whole. It is always expressed in terms of a numerator and a denominator (The New Lexicon Webster's Encyclopedia Dictionary of the English Language, Deluxe Edition, 1997).

In this study, it represents a part from a whole and this will be the focus in this study.

Mathematics Performance refers to the actual academic accomplishments of students in Mathematics on formal study at an institution of learning as distinguished from potential ability in certain period of time usually designated by grades or marks assigned by teachers. This term is also referred to as Mathematics Academic Achievement (Belle, 2009).

In this study, it refers to how well the students perform the basic operations on fractions which was measured through their post-test scores.

Post-test is a test given to a class after the appearance of an advertisement to try to establish whether the objectives set for it have been met (Webster's Universal Dictionary and Thesaurus).

In this study, it refers to the test given to measure the performance of the respondents in dealing with fractions after teaching them.

Pre-test a test given before to a class to determine the readiness to the material to be taught (Webster's 3rd New International Dictionary).

In this study, it refers to the test given to the respondents before teaching fractions using traditional and manipulative approach.

Virtual Manipulatives are static and dynamic visual representations of concrete manipulatives (Spicer, 2000).

In this study, it refers to the instructional materials that cannot be touched or held by the students.

Review of Related Literature and Studies

This chapter presents the related literature and studies conducted both local and foreign. These were gained from books, journals, magazines, and other research works which are found to have great relevance to the present study.

Related literature

Local literature

According to (Ureta, 2008), mathematics is a difficult subject. Some pupils are afraid to deal with it because they do not want to be humiliated when they got incorrect answer. Moreover, they easily get disappointed if they do not get the exact answer instantly. On the part of

the teacher, they should encourage the learners to have positive attitude towards the subject. Mathematics should be interesting, not difficult. For the learners to appreciate the subject, it must find significance in their lives and experiences. Pupils will be motivated to learn the subject because they are able to do it.

According to (Salandanan, 2001), instructional materials are very important in a classroom discussion. They offer the best means by which a teacher can provide direction in his/her students' daily search for new understanding and verification, particularly with the use of printed materials (Salandanan, 2001, p.121).

(Seras, 2009), argued that the use of manipulative objects such as marbles, rubber bands, sticks, pebbles and other concrete things that could help explain mathematical principles is better than mere memorization of the formula and procedures as presented by the teacher.

Foreign literature

(Smith, 2002), first used the term 'quotient' in naming any ambiguous numeral because the context has not been set. Where the context has been set, then the term "fraction" was utilized, which refers to a quantity that has been divided into some number of equal sized parts (e.g. ¾ = three parts out of a total of four equal parts). The example given is referred to as a common fraction. While the decimal fraction is a fraction where the denominator is a power of 10 which are commonly expressed without a denominator. For example, 8/10 is expressed as 0.8, 73/100 as 0.73, 64/1000 as 0.064 and so forth.

Manipulating rational numbers, especially fractions is a big battle for the students. Having a clear apprehension of the vocabulary may help students gain a wider understanding of fractions and performing operations on them. This simply mean thinking beyond the formal definitions. For example, the denominator may referred as distinguishing the kind of fractional pieces the fraction is made of while the numerator then can be thought of how many or the count of those fractional pieces. Through this, it may help students in the operation addition and subtraction of fractions. Before adding or subtractiong fractions, they must be made of the same kind of fractional pieces. Then, to add them, just combine the total count; to subtract, a certain number must be deducted from the first count. The kind of fractional piece remains the same (Charles & Zbiek, 2010).

The usual mistakes that the students encounter in dealing with fractions is that they apply the whole number thinking. They consider that a fraction is two separate whole numbers. For example, when ordering and comparing unit fractions, students will refer only to which has a bigger denominator. For them, this indicate that this is the bigger fraction which is not correct way of thinking. Then, for other unlike fractions, students just assume the larger numerator indicates the larger fraction which is not always true. These wrong notion indicate that students donot have deeper understanding of fractions. This is an instance when manipulatives can be helpful. Through the use of concrete manipulatives and pictorial representations over and over again, students will gain a strong conceptual understanding of the relative size of fractions (Cramer & Whitney, 2010).

Elementary teachers in New York State are now incorporating the Common Core State Standards (CCSS) into their daily instruction of mathematics and English Language Arts. The CCSS mathematics standard number four, "model with mathematics" ("National Governors Association Center for Best Practices," 2010) highlights students' use of models to represent their mathematical reasoning.

In the study of Durmus and Karakirik (2006), they said that mathematical modeling or manipulatives is used to "understand, to explain, to describe, and to predict the different aspects of the real world". This modelling is the best way to help students encounter real-world experiences. Moreover, "concrete objects that resemble everyday items should assist students in making connections between abstract mathematical concepts and the real world" (Carbonneau et al., 2013, p.381).

(Martin, 2006) stated that incorporating manipulatives into the curriculum in mathematics provides a great opportunity to stimulate multiple intelligences. Instead of focusing only to a kind of multiple intelligence, you can also incude other kinds of intelligence. Through group activities and discussion with groupmates, the verbal-linguistic and interpersonal

intelligences can easily be stimulated. Students could also write down their thoughts and the discoveries they made.

"Manipulatives by themselves do not teach" – (Gallenstein ,2003). Teachers should still facilitate the learning by guiding the students in making connection between manipulatives and the formal knowledge. Students' level of understanding can be determined then through careful observation and teacher's support may be adjusted depending on their needs.

According to (Naiser et al., 2004), the use of manipulative was one way that teachers made the lessons more engaging by creating a hands-on experience. The use of manipulatives makes the lesson more active and engaging. This provide teachers the opportunities to observe and understand what the students are thinking. When the students use fraction strips, teacher will easily determine if they are selecting the correct strip for a specific task. But, when students accomplish paper-and-pencil seatwork, genuine thinking about the fraction problem is not ensured.

(Walle, 2007) recommended the use of manipulatives as much as possible, to achieve a deeper and clearer understanding of the conceptual knowledge. Having manipulatives available and always accessible to the students will help them gain confidence. Then, that is the cue to move to the next step which is understanding the process.

In addition, (Packenham & Suh, 2011), defined representational as "configuration of signs, characters, icons, or objects that stand for something else".

Related studies

Local studies

(Calma, 2012) conducted a study comparing the performance of the control group using the traditional method and the experimental group with the use of concrete manipulatives in teaching the operations on fractions. He found out that the post-test results of the experimental groups were shown to be significantly higher than the post-test results of the control group. This tells that teaching the operations on fractions using concrete manipulatives is more effective than the traditional classroom discussion since there is a significant difference in the post-test results of the two groups.

(Carreon, 2011) developed a technique in simplifying any complex fraction. From the findings of the study, the following conclusions were extracted: the researcher developed a technique through trials and errors, and presentations before he finally decided the final technique; on the performance of the respondents, elementary obtained average in traditional and fair in proposed technique, high school obtained fair in traditional and proposed techniques, and the college obtained average in traditional and proposed techniques; on the perception of the respondents, elementary agreed on traditional and proposed techniques, high school agreed on traditional and proposed techniques, and college agreed on traditional and strongly agreed on proposed technique.

Foreign studies

(Sakidin & Chuan, 2006) made a research on how to improve students' understanding on fractions. Their findings revealed that students have difficulties on the addition and subtraction concept of fractions rather than multiplication. Also, they said that students learned best through problem solving approach in a cooperative mode of learning.

(Borseth, 2012) suggested that incorporating manipulatives into lessons may address the problems/issues in difficulty on learning fractions that may also help students to better understand mathematical concepts and acquire mathematical skills. Another problem she encountered is that some teachers are not aware of the available manipulative tools around them and how they can be utilized in their classroom discussions. They do not even know what manipulatives are or how to incorporate them into their classrooms.

The comparison between the effectiveness of Web-based and traditional instruction on preservice elementary teachers' procedural knowledge and their conceptual knowledge of fractions is the study of (Lin, 2009). The students in the experimental group were instructed with Web-based resources related to fraction concepts, while students in the control group were taught with traditional instruction.

The results showed that Web-based resources related to fraction concepts constituted an effective method in providing students an opportunity to promote both their procedural and conceptual understandings.

According to (Flórez & Wilkins, 2010), teachers believe that it is important for students to explore mathematical concepts with hands-on activities such as manipulatives.

One study looked specifically at the benefits of concrete manipulatives. (Hunt et al., 2011), found many perceived benefits on the use of concrete manipulatives. The benefits included opportunities to experience trial and error. Trial and error give opportunities to the student to try multiple times to find the correct answer allowing students to learn from their mistakes. Students can see and touch concrete manipulatives to practice math concepts and to understand how a problem is solved. "A good manipulative bridges the gap between informal math and formal math."

In the classroom study of (Reimer & Moyer, 2005), they investigated using virtual manipulatives. They compared the use of it over paper-and pencil instruction and they found out that students performed well on fractions using virtual manipulatives. In addition, they revealed one advantage of using virtual manipulatives is that they provide a connection between dynamic images and abstract symbols.

Another study made by (Brown, 2007), she investigated the impact of using computer-simulated (virtual) manipulatives and hands-on (concrete) manipulatives on elementary students' learning skills and concepts in equivalent fractions. The researcher's primary interest was whether or not students who used virtual manipulatives would out-perform students who used concrete manipulatives on the researcher/teacher-generated posttest. The results concluded that students who received equivalent fraction instruction with concrete manipulatives out-performed students who received equivalent fraction instruction with virtual manipulatives. The researcher also concluded that the use of manipulatives, both virtual and concrete, enhanced the learning environment in the elementary mathematics classroom.

Synthesis

The reviewed studies are relevant to the present study. They also provided the researcher a sufficient background regarding the present study.

(Calma's, 2012) study is mostly similar to the present study. Both used control group and experimental group. The control group taught using the traditional method of teaching fractions while the experimental group with the use of concrete manipulatives. The difference is that the present study will use two kinds of manipulatives, concrete and virtual, while the study of Calma focused only on concrete manipulatives. The previous study found that the experimental group performs better compared to the control group.

The study of (Carreon, 2011) is somewhat related to the researcher's study because it tackles to one topic and it is all about fractions, the only difference is that his study is all about complex fractions while this study focused on the four fundamental operations of similar and dissimilar fractions and changing mixed number to improper fractions and vice versa.

(Sakidin & Chuan's, 2006) stressed that fraction is a topic where students suffers difficulty most especially in adding and subtracting fractions. Both studies aimed to improve students regarding the concepts of fractions. While on the study of (Borseth, 2012), she suggested a way to addressed the problem in teaching fractions which is by using manipulatives, same with the present study. Another comparative study made by (Lin, 2009) focused on how to improve teaching of fractions through Web-based or traditional instruction. (Hunt et al., 2011) and (Flórez & Wilkins, 2010) enumerated some benefits by using manipulatives. In addition, the study of (Reimer & Moyer, 2005) said that virtual manipulatives contribute a lot to the improvement of students' performance on fractions. Another study performed by (Brown, 2007) said that using manipulatives has an impact on the learning of students. This study compared the use of concrete and virtual manipulatives. He concluded that concrete manipulatives is much better in teaching fractions rather than virtual manipulatives.

All of these studies are related to the present study because they have only one goal- to enhance the teaching and learning of fractions.

Methodology

This chapter presents the required skills and scheme of action to attain the objectives of the study.

Research method

The quasi-experimental method of research is an empirical study aimed to estimate the causal impact of an intervention on its target population.

This method was used in this study in order to determine the effectiveness of using concrete and virtual manipulatives in teaching fractions among the seventh graders.

To gather the needed data in this study, the researcher constructed a pre-test and post-test, had these evaluated by some experts, and administered to the seventh graders. Results were analyzed and interpreted to determine the performance of the respondents on some basic topics on fractions.

Locale of the study

This study was conducted in Arayat, Pampanga. The respondents were the two sections from the seventh graders of Arayat National High School for the school year 2019-2020.

Respondents of the study

The respondents of the study were the seventh graders of Arayat National High School during the school year 2019-2020. There were two groups of respondents – the control group, composed of 35 students (18 males and 17 females) from section Rosal, and the experimental group, from section Sampaguita with 35 students (19 males and 16 females). These two sections wererandomly selected through the fish bowl method. The control group was taught fractions using the traditional method, while the experimental group was exposed to the use of manipulatives.

Research instruments

The researcher conceptualized, created and exposed the experimental group to the use of manipulatives. Below is the list of manipulatives applied to the given topics on fractions that were covered in the discussion:

Topics	Manipulatives
1. Fractions in Number Line	Visual Manipulatives
2. Converting Fractions to Decimals and Vice Versa	Visual Manipulatives
3. Addition of fractions	Unifix Cubes
4. Subtraction of fractions	Two-Color Counters
5. Multiplication of fractions	Brownie-Pan Method
6. Division of fractions	Area Model

Data gathering procedure

The researcher constructed a pretest and a post-test which included the fraction concepts covered in the discussion. Experts who are also Math teachers from other schools and the respondent school were consulted to evaluate if the test was appropriate to the level of the student-respondents.

A letter seeking permission from the school administrators of Camba High School to conduct pilot testing was writen. When approval was granted, one section from the seventh graders took the pre-test. The results of the pilot test helped the researcher to improve the instrument.

Prior to the start of this study, the researcher had already obtained the consent of the involved persons. A letter of permission was signed by the principal.

Once consent was obtained, the respondents of both groups took the pretest covering the topics on fractions included in the study.

The result guided the researcher as to which topics needed to be addressed. After giving the pre-test, the control group was taught fractions using the traditional approach while the experimental group was instructed using manipulatives. The post-test was given to both groups after covering all topics included in this study.

The data gathered underwent statistical treatment and interpretation.

With a written permission from the principal, the researcher distributed the pretests

prior to the discussion of the topics on fractions and personally taught to both groups. The control group was instructed through the use of traditional method while the experimental group through the use of manipulatives. Then, the researcher distributed the post-test to both groups of respondents. The data were collected, tabulated, and analyzed before comparing the results of their performance in the fraction concepts.

Statistical treatment of data

The data that were gathered on this study were analyzed using the Statistical Package for Social Sciences (SPSS). Mean, t-test and ANCOVA were used to calculate the results gathered on this study.

Presentation, Analysis, And Interpretation Of Data

This chapter presents the results, analysis and interpretation of the data gathered.

Pre-test and post-test results of the respondents

Performance of the respondents- control group and experimental group, were assessed through pretest and posttest results.

Control group

Table 1 shows the mean pre-test and post-test scores of the respondents in the control group after the discussion using the traditional method.

As shown in this table, the lowest mean pre-test score of 1.69 was recorded in the topic fractions in number line. However, this topic also received the highest mean post-test score of 7.17. This shows that there is a big improvement after the discussion of the topic. The highest mean pre-test score of 3.23 was gained by the topic subtraction of fractions and the mean post-test score of 7.14 which is next to the highest mean post-test result of 7.17. This implies that the respondents understand this topic and find it easy to learn.

As reported by (Giok, 2008), teachers lack skills in integrating manipulatives effectively. They use manipulatives for demonstration and explanation purposes only. Due to limited supply of available materials, she stated that pupils were not given opportunities to manipulate concrete objects. The findings from her study also revealed that the factors influencing teachers' choice of manipulative materials in their teaching were time factor, class size, availability of resources and teacher's pedagogical skills.

Table 1. Pre-test and Post-test Scores of the Control Group

Topic	Mean Pretest Scores	Mean Post-test Scores
Fractions in Number Line	1.69	7.17
Converting Fractions to Decimals and Vice Versa	2.97	5.37
Addition of fractions	2.74	6.57
Subtraction of fractions	3.23	7.14
Multiplication of fractions	2.66	6.20
Division of fractions	2.11	6.26

Experimental group

Reflected in Table 2 are the mean pre-test and post-test scores of the respondents in the experimental group. All the mean post-test scores showed improvement compared to their mean pre-test scores.

The lowest mean pre-test score of 1.77 gained by fractions in number line improved to a mean post-test score of 8.11, while the highest mean pre-test score of 3.29 obtained by the topic converting fractions to decimals and vice versa obtained the lowest mean post-test score of 6.74. This indicates that there is only a little improvement after teaching using virtual manipulatives. This method may not be effective in teaching the topic.

(Calma's, 2012) findings are similar to those of present study. Findings reveal that the post-test results of the respondents from the control group were significantly higher than

their pre-test results. This suggests that students gained knowledge on the operations of fractions after being exposed to concrete manipulative instruction.

Table 2. Pre-test and Post-test Scores of the Experimental Group

Topic	Mean Pretest Scores	Mean Posttest Scores
Fractions in Number Line	1.77	8.11
Converting Fractions to Decimals and Vice Versa	3.29	6.74
Addition of fractions	3.03	7.91
Subtraction of fractions	2.94	7.71
Multiplication of fractions	2.63	7.80
Division of fractions	2.63	7.97

Difference between the pre-test and post-test results of each group

Comparison between the pre-test and post-test mean scores of both groups is shown in Tables 3 and 4.

Mean pre-test and mean post-test scores of the control group

The difference between the mean pre-test and the mean post-test scores of the respondents from the control group are shown in Table 3.

A computed p-value of 0.000 in Table 3 shows that there is a highly significant difference between the mean pre-test and post-test scores of the respondents in the control group in all the topics discussed about fractions. This proves that the use of the traditional method in teaching fractions can improve learners' performance.

Similar to (Morris', 2013) findings that the groups exposed to virtual manipulatives, concretemanipulatives, and the no manipulatives group all showed improvement from the pre-test to the post-test scores. The no manipulatives group had a much higher mean due to the fact that two of the students scored two of the highest scores of 62% and 69% in the pre-test.

Table 3. Mean Pretest and Mean Posttest Scores of the Control Group

Topic	Mean Pretest Score	Mean Posttest Score	p-value
Fractions in Number Line	1.69	7.17	0.000**
Converting Fractions to Decimals and Vice Versa	2.97	5.37	0.000**
Addition of fractions	2.74	6.57	0.000**
Subtraction of fractions	3.23	7.14	0.000**
Multiplication of fractions	2.66	6.20	0.000**
Division of fractions	2.11	6.26	0.000**

**- significant at 5%

Mean pretest and mean posttest scores of the experimental group

Table 4 reflects the difference between the mean pre-test and the mean post-test scores of the respondents from the experimental group.

A computed p-value of 0.000 shows that there is a highly significant difference between the mean pre-test and post-test scores of the respondents in the experimental group. This group that used manipulatives showed greater improvement.

In the study made by (Yusof, 2013), he concluded that the intervention lessons in teaching operations on fractions through cooperative approach while utilizing manipulatives statistically produced highly significant improvement on the pupils' overall attainment in fraction works. There was a highly significant

improvement in the overall performance of pupils in the post-test (after intervention lessons) as compared to the pre-test (before intervention lessons).

Table 4. Mean Pretest and Mean Posttest Scores of the Experimental Group

Topic	Mean Pretest Score	Mean Posttest Score	p-value
Fractions in Number Line	1.77	8.11	0.000**
Converting Fractions to Decimals and Vice Versa	3.29	6.74	0.000**
Addition of fractions	3.03	7.91	0.000**
Subtraction of fractions	2.94	7.71	0.000**
Multiplication of fractions	2.63	7.80	0.000**
Division of fractions	2.63	7.97	0.000**

**- significant at 5%

Difference in the use of the traditional method and manipulatives

The effectiveness of the use of manipulatives is shown in Table 5.

There is no significant difference in the use of the traditional method and manipulatives in teaching fractions in number line as revealed by the computed p-value of 0.060. Likewise, no significant difference was noted in the use of the two methods in teaching subtraction of fractions as seen in the computed p-value of 0.219at 5% level of significance. But it is worth noting that of the six topics, four showed that the use of manipulatives is more effective than the traditional method. This implies that the use of manipulatives could improve student performance in converting fractions to decimals and vice versa, addition of fractions, multiplication of fractions, and division of fractions.

(Allen, 2007) conducted a study among fifth graders in a Mathematics class over a period of three days.The group was given a pre-test and a post-test. The units contained "hands-on manipulative game partner activities and everyday Mathematics tools". The result showed understanding and a positive attitude toward learning concepts that were previously difficult.

Table 5. Mean Posttest Scores of each Group

Topic	Control Group	Experimental Group	p-value
Fractions in Number Line	7.17	8.11	0.060
Converting Fractions to Decimals and Vice Versa	5.37	6.74	0.043**
Addition of fractions	6.57	7.91	0.026**
Subtraction of fractions	7.14	7.71	0.219
Multiplication of fractions	6.20	7.80	0.004**
Division of fractions	6.26	7.97	0.001**

**- significant at 5%

Summary

This study generally aimed to assess the effectiveness of using manipulatives in teaching fractions.

The quasi-experimental method of research was used in this study. The respondents of this study were randomly selected seventh graders of Arayat National High School divided into two– the control group and the experimental group. Both groups were given pre-test prior to the start of the study. After the discussion using the two methods- traditional method and manipulative approach, both groups were given post-test. The data gathered were then statistically evaluated and analyzed

to test the effectiveness of the use of manipulatives in teaching some topics about fractions.

The findings of the study were as follows:

1. The mean post-test scores of the respondents from the control group showed improvement in all the topics discussed on fractions. Likewise, the mean post-test scores of the respondents from the experimental group were significantly higher compared to their mean pre-test scores.
2. With a computed p-value of 0.000 at 5% level of significance, significant difference was noted between the pre-test and post-test results of the respondents from the control group as well as those obtained from the experimental group.
3. The use of visual manipulatives in teaching fractions significantly affected the respondents' performance in converting fractions to decimals and vice versa with a computed f-value of 0.043. Likewise, concrete manipulatives proved effective in addition of fractions with the p-value of 0.026, multiplication of fractions (p-value = 0.004), and division of fractions (p-value = 0.001). On the other hand, in the topic fractions in number line and subtraction of fractions, with their computed p-values of 0.060 and 0.219 respectively, indicated no significant difference between the use of traditional method and the use of manipulatives.

Conclusions

From the findings of the study, the following conclusions are hereby drawn:

1. The post-test scores of the control group are higher than their pre-test scores. Also, there is an improvement from the pre-test scores to the post-test scores of the experimental group.
2. There is a significant difference between the pre-test and post-test results of the control group and the experimental group.
3. There is a significant difference between the use of the traditional method and manipulatives in teaching conversion of fractions to decimals and vice versa, and addition, multiplication, and division of fractions. However, there is no significant difference between the use of the traditional method and manipulatives in teaching fractions in number line and in subtraction of fractions.

Recommendations

Based from the findings and conclusions, the following recommendations were drawn:

1. Teachers are encouraged to test the prior knowledge of their students before discussing their lessons about fractions to determine students' strengths and weaknesses.
2. Although both the traditional method and manipulative approach showed improvement on the post-test results in teaching fractions, teachers are still encouraged to enhance the use of manipulatives in teaching fractions to deepen students' performance. It is important for teachers to provide their students several opportunities to practice hands-on manipulation of objects in order to grasp the concepts of fractions easily.
3. Teachers must develop the use of concrete and virtual manipulatives in teaching fractions to promote active learning that can enhance students' mathematics performance. This may also make the students realize that mathematics can be enjoyable especially through hands-on activities.

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