

# The Effects of Manipulative and Visual Models in Conceptualizing Fractions

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**Abstract:** This study is all about the effect of manipulative and visual models in conceptualizing fractions of the four randomized schools in Cebu City. This study utilized quantitative research specifically Solomon four group designs. Thus, every student in a classroom comprehends and reacts to a mass instruction contrastingly and the instruction was more powerful for certain students than others. Along these lines a few students will require intercession which was the manipulative and visual models in conceptualizing fractions. In this study the researcher noticed that student's needs to have the intervention like the manipulative and visual models wherein intercession was the extra instruction and exercises expected to meet an understudy's individual conditions and needs. A significant segment in powerful intercession is the determination of techniques and instructional materials. By using the Solomon four group design, the researcher come up with the findings that when the students undergo intervention there was a great possibilities to improve the students' performance in terms of conceptualizing fraction by the used of manipulative and visual models. The researcher found out also that in order for the students to increase their academic performance, this can be done through introducing students to a number of methods for increasing conceptual understanding, such as the used of representations, models and various manipulative.

**Keywords:** Conceptualizing Fractions, Manipulative and Visual Models, effective methods and instructional materials.

## 1. Introduction

Fractions are most important thoughts that are first introduced in the grade two levels. This thought continues throughout their mathematical education. Manipulative models or Enactive, students can undoubtedly comprehend part in light of the fact that it is a hands on use of the objects that may prompt students truly comprehend of the said topic. It is to change into other structure by the utilization of hand or any machine. Then again, Visual Models or Iconic is the realistic representation of objects and frameworks of interest utilizing graphical dialects. Visual model is the use of words and different images to depict experiences. Through the three phases of intellectual representations the learner can easily conceptualized the said portions. Conceptualize is to form (a concept or concepts) out of observations, experience and data. This study claims that using manipulative and visual models can enhance students' academic performance in conceptualizing fraction In the National Council of Teachers of Mathematics (NCTM, 2000) Principles and Standards for School Mathematics, illustration was acknowledged as one of the significant procedures in the instructing and learning of mathematics [1]. Having the ability to teach mathematics effectively obliges teachers to pick the kinds of representations that will support important mathematics learning in classrooms. These kinds of representations have an immediate effect on students learning of mathematics. Through giving an action the three parts (action, innovation, formalizing) not just we give students with distinctive learning styles diverse approaches to see an issue, moreover we give them the additional time they may require for learning. By this NCTM, 2000 and in relation to our study it clarifies that we need to used visual and manipulative models in enhancing students' academic performance in conceptualizing fractions. Teachers tussle to teach this thought efficiently, while students tussle to increase an intangible understanding. The goal of fraction instruction is for students to be able to visualize fractional expanses truthfully. There are lots of rules in studying fractions, what's more, numerous students acquire them as it were

involuntarily, not by any means understanding the primary thoughts and main beliefs. Now lots of mistakes end up by the students because they complicate the various principles and either apply the off-base one or apply the correct guideline, yet don't recall it very right. This can make students even fear fractions in math. This study utilized quantitative research specifically Solomon four group design, we can say that the used of manipulative and visual models is more effective than the used of traditional way of teaching in enhancing the students' academic performance in conceptualizing fractions.

## 2. Theoretical Framework

The main theory of this study which is the Intellectual Development by Brunner recognized the three phases of cognitive representation wherein this study is adopting [2]. The Enactive is the representation of learning through activities or a hands-on application. It is an approach to manage learning number-crunching that each new thought is presented at the strong level with the usage of manipulatives. Iconic is the visual rundown of pictures that students are broadly perceived of the said pictures. Symbolic representation is the utilization of words and different images to portray experiences. Symbolic is a traditional method for showing wherein instructors educate the students numerically. And it supported by Multiple Intelligences by Howard Gardner (1991), Gardner's theory had the best effect inside of the field of education, where it has get significant consideration and utilization. His conceptualization of knowledge as more than single, lone quality has opened the doors for further research and distinctive methods for contemplating human insight. Wherein students have its own ability on how and when to get the learning and it is a method for arranging ideas and learning by discovery [3]. This study is also supported by the theory of constructivist learning theory by John Dewey as support to the theory of Multiple Intelligences by Howard Gardner. His theory stated that dynamic learning requires the student to persistently acclimatize and suit new data to develop knowledge [4]. A

student does not inactively receive knowledge from the environment; it is problematic for learning to be exchanged faithfully starting with one individual then onto the next. A student is a dynamic participant in the development of his/her own particular mathematical learning. The development movement includes the gathering of new thoughts and the cooperation of these with the students' surviving thoughts is received. The Enactive is the representation of knowledge through activities or traditionally of instructing. Iconic is the visual synopsis of pictures that students are broadly perceived the said pictures. Symbolic representation is the use of words and different images to describe experiences. It is an approach to manage learning math prompts that each new thought is introduced at the strong level with the usage of manipulatives. In this study, the researcher would like to compare if the use of manipulative and visual models is more effective than the use of traditional way of teaching in enhancing the students' academic performance in conceptualizing fractions.

### 3. Methodology

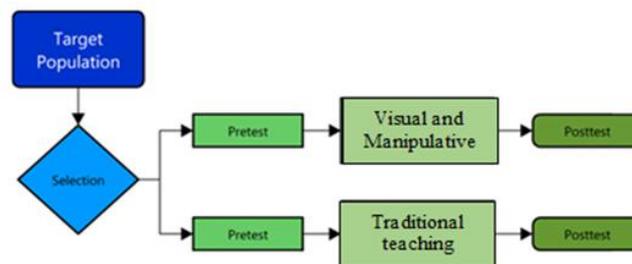
This study utilized quantitative research specifically Solomon four group designs. The Solomon four group designs was a technique for maintaining a strategic distance from a portion of the troubles related with the pretest-posttest design. This structure contains two control gatherings and two exploratory gatherings which serve to decrease the impact of jumbling factors and enable the analysts to test whether the pretest itself affects the subjects. This study was a quantitative design because it involves the measurement of the student's performance wherein students need numerous chances to encounter various translations of fraction so as to build up a full-bodied, develop understanding. A profound understanding will give a strong establishment. There were a few unique approaches to demonstrate fractions, and it is critical to open the students to every one of them in an assortment of ways. Variety was the way to making a full-bodied understanding and adaptable reasoning.

		Pre-test		Post-test
100 Students with 80 below grades of Mathematics	R	O <sub>1</sub> .....	X.....	O <sub>2</sub>
	R	O <sub>3</sub>		O <sub>4</sub>
	R		X.....	O <sub>5</sub>
	R			O <sub>6</sub>

Diagram 1 Solomon Four-Group Design

The initial two groups of the Solomon four group configuration are structured and translated in the very same manner as in the pretest-post-test plan, and give similar checks upon randomization. In the diagram 1, it shows that there were 100 randomized students with the grades of 80 and below in Mathematics wherein the researchers divided the respondents into 4 groups using simple random techniques. The four groups were also randomly selected of which school will be in the Experimental Group 1 and who will be in the Experimental Group 2. On the other hand, which school will be in the Control Group 1 and be in the Control Group 2. While the pre-posttest design will permit as to quantify the potential impacts of an intercession by looking the distinction in the pre-test and post-test results, it doesn't permit as to test whether this distinction would have occurred in the absence of our intervention. For instance, maybe the impact of improved scholastic accomplishment was because of the students becoming acclimated to stepping

through an exam instead of the utilization of instructive manipulative models. It was necessary to provide both experimental group and control group to acquire the candid influences of the program or intercession. As the names recommend, the experimental group receives the intercession. In any case, the control group gets the traditional teaching approaches, which mean students possibly get the mediation that in the event students will not have the interest in the study. The researcher can control for the likelihood that different factors may not identified with the intervention by having both a group that underwent the intercession and another group that did not. The impact will be shown or not if both the experimental group and the control group will have significantly satisfactory.



The study was directed in four National High School in Cebu City namely: W National High School, X Night High School, Y Night High School and Z Night High School. This study was focuses on the effects on Manipulative and visual model in conceptualizing fractions. There were 100 respondents who will be involved in this study. The researcher determine four schools in Cebu City using the fish bowl techniques and the four schools be involve in this study were the W Night High School, X Night High School, Night High School and Z National High School. Since, the researcher want to used Solomon Four Group Design, the researcher used simple random techniques to group the respondents in two groups which was the Experimental Group and Control Group. There were two schools which will be on experimental groups and two will be on the control groups. The researcher used the questionnaire as the main and principal instruments in gathering the relevant data and information. The research instrument was a self-formulated questionnaire of the researcher. The questionnaire was carefully made and planned by the researcher focusing mainly on how to conceptualized fractions using manipulative and visual models. The researcher provide 3 experts checked the questionnaire if it was valid or answers the purpose of the study. For the reliability, the researcher conducted the pretesting of the questionnaire among the first year high school students of University of the Visayas. Fifty (50) students where pretested and the result where treated using Cronbach alpha to get the reliability coefficient. After the treatment the result is 0.78 which means acceptable reliability value. Once the research design was approved, the researcher submitted a letter to the schools division superintendent and to the school principals of the four selected schools in Cebu City. In addition, an informed consent for the parents was given for the learners to seek approval for the involvement of their child. In the letter the parents were informed of the purpose of the research and assured them that the data collected were treated confidential and were only used for the purpose stated in the letter. As soon as all permissions were secured,

the researcher presented himself to the participants in a friendly and non-threatening way. The researcher explained the rationale of the questions gathered as they were also written in the first part of the questionnaire. They were also reminded of their rights and need to understand the verbal assent signed by them. The questionnaire did not contain the name of the learner for confidentiality sake. The researcher will give pretest to experimental group 1 and control group 1. After having the pre-test of the two groups, they will give post-test with intervention which is the manipulative and visual model to the experimental group 1 and experimental group 2. They will also give post-test to the control group 1 with intervention which is the manipulative and visual models and last they will give post-test to control group 2 without having the manipulative and visual models. As soon the data were gathered, the data were encoded in an excel sheet. Once data were safely encoded the researcher shred the answered questionnaires in order to maintain anonymity of the data. This step was essential in order to protect the participants' disclosure of their scores. The data were then analyzed. The data were subjected to the following statistical treatment; t-test was used since this statistical tool indicates significance whether or not the difference between experimental group and control group be an average of no doubt reflects a "real" contrast in the populace from which the groups were tested. Mean and standard deviation were also utilized to answers the questions regarding the mean performance of the pre-test of experimental group 1 and pre-test of the control group 1 (SOP 1). It also used in SOP 2 wherein the researcher will get the mean performance of the pre-test of experimental group 2 and the pre-test of control group 2. It is use to answer SOP 3 in order to get the mean performance of the post test of experimental group 1, experimental group 2, control group 1 and control group 2.

**Results and Discussions**

Students vary in capacity, yet additionally every student interestingly varies in culture, learning inclinations, inspiration, past encounters and an assortment of different attributes.

**Table 1. Pre-test Result**

Group	N	Mean	Standard Deviation
Experimental Group 1	25	15.80	2.92
Control Group 1	25	15.40	3.08

Table 1 shows the pre-test result of the two groups (experimental group 1 and control group 1) wherein the experimental group 1 have the mean value of 15.80 while control group 1 have the mean value of 15.40. On the other hand, the standard deviation of the experimental group 1 is 2.92 and the standard deviation of the control group 1 is 3.08. As the researcher can see to both mean value and standard deviation of the two groups, it was not quite far to each other. So the researcher can say that the pre-test of two groups were closely the same with their mean value and standard deviation. Since, the standard deviations of both two groups were quite not far to each other, it means that the scores of the pre-test of two groups were closed to each other.

**Table 2. Post-test Result**

Group	N	Mean	Standard Deviation
Experimental Group 1	25	18.760	2.7981
Control Group 1	25	16.160	1.26491
Experimental Group 2	25	19.200	1.8257
Control Group 2	25	15.800	3.0139

Table 2 show the post test result of different groups, experimental group 1 having the mean value of 18.760 with the standard deviation of 2.7981. The experimental group 2 has the mean value of 19.200 with the standard deviation of 1.8257. The mean value of control group 1 was 16.160 with the standard deviation of 1.26491 while the mean value of the control group 2 was 15.800 with the standard deviation of 3.0139. Experimental group 2 has the highest mean value of 19.200 compare to the rest of the groups and it has the second to the lowest value of the standard deviation of 1.8257 and it means that the scores of the post-test of experimental group 2 was not scattered and it was closed to the scores of others. On the other hand, the post-test result of the mean value of control group 2 got the lowest scores of 15.800 but it got the highest standard deviation of 3.0139 and it means that the scores of the post-test of control group was widely spread to the scores of others.

**Table 3. Pre-test Experimental Group 1 vs. Pre-test Control Group 1**

t-test for Equality of Means					
	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	.471	48	.639	.4000	.8485

level of significance  $\alpha$  0.05

Table 3 shows that the statistical result of the pre-test experimental group 1 and the pre-test of control group 1 was .639 and since the level of significance was less than at  $\alpha$  0.05, so the researcher can say that there was no significant difference between the performance of the two groups because the statistical value (.639) is greater than the level of significance at  $\alpha$  0.05. As the result, the random samples do not have significant difference of students' academic performance because the participants of the two groups were both have below 80 as their grades in Mathematics subject. One reason also was that the two groups have the same grades of 80 and below on answering the pre-test.

**Table 4. Pre-test Experimental Group 1 vs. Post-Test Experimental Group 1**

t-test for Equality of Means					
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	-3.669	48	.001	-2.9600	.8068

level of significance  $\alpha$  0.05

Table 4 shows the statistical result of the pre-test of experimental group 1 and the post-test of experimental group 1 is .001. Since the statistical value was less than the level of significance at  $\alpha$  0.05, so there was significant difference between the performance of the pretest and post-test of the

experimental group 1. It was expected to have a significant difference between the pre and post-test of experimental group 1 since experimental group 1 undergo intervention.

**Table 5. Pre-test Control Group 1 vs. Post-test Control Group 1**

t-test for Equality of Means					
	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	-.852	48	.398	-.7600	.8920

level of significance  $\alpha$  0.05

Table 5 shows the statistical result of pre-test of the control group 1 and the post-test of control group 1 and it shows that there was no significant difference between students' performance since the statistical value (.398) is greater than the level of significance at  $\alpha$  0.05. It means that intervention was effective in the increasing students' performance in conceptualizing fractions using the intervention which was the manipulative and visual models.

**Table 6. Post-test Experimental Group 1 vs. Post-test Experimental Group 2**

t-test for Equality of Means					
	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	-.660	48	.512	-.4400	.6665

level of significance  $\alpha$  0.05

Table 6 shows the statistical result of post-test of experimental group 1 and the post-test of experimental group 2 wherein it has the statistical value of .512 and since it was greater than the level of significance at  $\alpha$  0.05 then there was no significant difference between the performance of the post-test of experimental group 1 and experimental group 2 because only experimental group 1 undergo intervention and experimental group 2 don not have the intervention before taking the post-test exam. Meaning, the intervention was effective and there are no other factors that affect students' performance but it was only the intervention which was really affects the students' performance.

**Table 7. Post-Test Control Group 1 vs. Post-test Control Group 2**

t-test for Equality of Means					
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	-.408	48	.685	.3600	.8826

level of significance  $\alpha$  0.05

The table 7 shows that there was no significant difference between the performance of the post-test of control group 1 and post-test of control group 2 since the statistical value (.685) was greater than the level of significance at  $\alpha$  0.05. Both post-test of control group 1 and control group 2 do not undergo any treatment or intervention. The post-test of control group 1 and control group 2 do not have significant

difference because the randomized students have the same grades of 80 and below in mathematics.

**Table 8. Post-test Experimental Group 1 vs. Post-test Control Group 2**

t-test for Equality of Means					
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	3.605	48	.001	2.9600	.8211

level of significance  $\alpha$  0.05

Table 8 shows that there is significant difference between the performance of the post-test of experimental group 1 and post-test of control group 2 since the statistical value was .001 and it was less than the level of significance at  $\alpha$ 0.05. It was expected to have significant difference because only experimental group 1 undergoes intervention of the said manipulative and visual models. If it is so, then it was better to have intervention which was the manipulative and visual models in conceptualizing fractions for a students can easily performed of the said conceptualizing fractions.

**Table 9. Post-test Experimental Group 2 vs. Post-test Control Group 1**

t-test for Equality of Means					
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	4.10	48	.000	-3.0400	.7409

level of significance  $\alpha$  0.05

Table 9 shows the performance of the post-test of experimental group 2 and control group 1. The statistical result shows that there was significant difference between the performances of the two groups since the statistical value was .000 and it was less than the level of significance at  $\alpha$ 0.05. It was also expected to have significant difference because only experimental group 2 undergoes intervention.

**Table 10. Post-test Experimental Group 1 vs. Post-test Control Group 1**

t-test for Equality of Means					
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	3.05	48	.004	2.6000	.8524

level of significance  $\alpha$  0.05

Table 10 shows that there was significant difference between the performance of the post-test of experimental group 1 and post-test of control group 1 since the statistical value is .004 and it was less than the level of significance at  $\alpha$  0.05. The researcher can see in the table that there was a positive effect prior to the intervention given in experimental group 1 because it emphasize that there was significant difference between the post-test of the two groups.

**Table 11:** Post-test Experimental Group 2 vs. Post-Test Control Group 2

t-test for Equality of Means					
	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	4.82	48	.000	3.4000	.7047

level of significance  $\alpha$  0.05

Table 11 shows the statistical result of the performance between the post-test of experimental group 2 and post-test of control group 2. Since the statistical result was .000 and it was less than the level of significance at  $\alpha$  0.05, then there was significant difference between the post-test of experimental group 2 and post-test of control group 2. In this study, the researcher would like to compare the traditional way of teaching to the use of manipulatives and visual models in conceptualizing fractions. And based on the statistical results, it says that there is significant difference in students' academic performance between the traditional way of teaching and the use of manipulative and visual models in conceptualizing fractions. The researcher found out that the use of manipulatives and visual models are more effective than the traditional way of teaching fractions.

### Discussions of Findings

As researcher do the analysis of the data who gathered from the 100 respondents and have the random sampling technique to get the 4 groups with 25 students in each school with the average grade of below 80 in Mathematics. By using the Solomon four group design, the researcher come up with the findings that when the students undergo intervention there was a great possibilities to improve the students' performance in terms of conceptualizing fraction by the used of manipulative and visual models. As the findings, the researcher can say that the pre-test result of the two groups (experimental group 1 and control group 1) wherein the experimental group 1 have the mean value of 15.80 while control group 1 have the mean value of 15.40. On the other hand, the standard deviation of the experimental group 1 was 2.92 and the standard deviation of the control group 1 was 3.08. So the researcher can say that the pre-test of two groups were closely the same with their mean value and standard deviation. Since, the standard deviations of both two groups were quite not far to each other, it means that the scores of the pre-test of two groups were closed to each other. After the researcher do the statistical treatment, the results were as follows, (a) There was no significant difference between the performance of the pre-test experimental group 1 and the pre-test of control group 1 since the statistical value was greater than at  $\alpha$  0.05. (b) There was significant difference between the performance of the pre and post-test of the experimental group 1. (c) There was no significant difference between students' performance since the statistical value was greater than the level of significance at  $\alpha$  0.05. (d) There was no significant difference between the performance of the post-test of experimental group 1 and experimental group 2 since the statistical value was greater than the level of significance at  $\alpha$  0.05. (e) There was no significant difference between the performance of the post-test of control group 1 and post-test of control group 2 since the statistical value was greater than the level of significance at  $\alpha$  0.05. (f) There was significant

difference between the performance of the post-test of experimental group 1 and post-test of control group 2 since the statistical value was .001 and it was less than the level of significance at  $\alpha$  0.05. (g) There was significant difference between the performances of the two groups since the statistical value is .000 and it was less than the level of significance at  $\alpha$  0.05. (h) There was significant difference between the performance of the post-test of experimental group 1 and post-test of control group 1 since the statistical value was .004 and it was less than the level of significance at  $\alpha$  0.05. (i) There is significant difference between the post-test of experimental group 2 and post-test of control group 2 since the statistical result was .000 and it was less than the level of significance at  $\alpha$  0.05.

### Conclusion

As the results of the study, teachers need to understand how fractions were integrated into rational numbers and number sense, as well as the importance of developing conceptual, rather than simply procedural, understanding of fractions because when the researcher do the traditional way of teaching fractions, students usually do not know how to do operations of fractions. The Intellectual Development Theory by Brunner was applicable here in the Philippines since this study identified that the used of manipulative and visual models were very effective in developing student's academic performance in conceptualizing fractions. Through having a representation or a hands-on application student can acquire new learning. The researcher found out also that in order for the students to increase their academic performance, this can be done through introducing students to a number of methods for increasing conceptual understanding, such as the use of representations, models and various manipulative.

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## Author Profile



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