Indonesian Journal of Mathematics Education
Vol. 5, No. 1, 2022, pp: 19~25
p-ISSN: 2654-3907, e-ISSN: 2654-346X DOI: 10.31002/ijome.v5i1.5435
e-mail: ijome@untidar.ac.id, website: jurnal.untidar.ac.id/index.php/ijomE

The Effect of Montessori Math Model Method in Learning Addition and Subtraction of Fractions on Grade V Pupils

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Abstract

The study was conducted to determine whether the utilization of the Montessori Math Model Method in learning the addition and subtraction of fractions has an impact on the improvement of students' performance. A quantitative design was used in the study. The essential data were gathered from a total number of 67 respondents, 34 students from the experimental group and 33 students from the control group, with the aid of a validated questionnaire. Data were analyzed and interpreted using the Average Weighted Mean and *t*-test as statistical tools. According to the findings of the study, data revealed that the result of the pre-test and post-test of both experimental and controlled groups is significant. The result showed that there is a significant difference in the utilization of the Montessori Math Model Method in learning addition and subtraction of fractions in Grade 5 Pupils in an elementary school in Kaputian, Philippines.

Keywords: Montessori Math Model, fraction, pupils, addition, subtraction, Philippines

INTRODUCTION

Mathematics has always been difficult, especially for elementary students. It cannot just be discussed plainly in front of the class by using chalk and a blackboard. The aim of this study is not to contradict traditional teaching but to improve teaching strategies.

Research conducted by the International Academy of Education found that students around the world have difficulties learning fractions (Fazio & Seigler, 2011). Japan and China are countries where the majority of students have an excellent conceptual understanding but still consider fractions a difficult topic. One of the difficulties in learning fractions is not the concept itself, but because of the operations and the way they are typically taught (Fazio & Seigler, 2011).

The Trends in International Mathematics and Science Survey (TIMSS) revealed that in Mathematics out of 38 participating countries, the Philippines ranked as the 34th placer; this was based on the 2003 result. In the 2008 TIMSS result, the Philippines ranked the lowest among the ten participating countries. One of the reasons for the country's flat performance in the international examination might be the children's difficulties in understanding fractions. This is due to the children's lack of mastery of the topic (Bilbao, Dayagbil, & Corpuz, 2014).

In the research of the students at De La Salle University, it has been shown that many students are still having difficulties in understanding fractions even after they reached high school. The difficulties may vary with students' performance during their elementary years, in which they must have a strong foundation in understanding the concept of fractions in preparation for advanced mathematics (Almeda, Cruz, & Dy, 2013).

The researchers opted to use the Montessori Math Model Method because we believe that this method will cater to and address the needs of the children for their conceptual understanding of fractions. This method will allow the children to learn the

process of adding and subtracting fractions, which will develop their mastery of the topic.

METHOD

The researchers made use of the experimental method of research in finding the effectiveness of the Montessori Math Model Method in teaching Addition and Subtraction of Fractions to Grade V pupils. The Montessori Math Model Method uses hands-on methods to help children advance at their own pace. These methods include manipulating bead and stamp material, utilizing strip boards, using physical shapes to learn fractions, and memorizing essential math facts (Jones, 2021).

Ross and Morrison (2004) stated that experimental research is a systematic and scientific approach where the researchers have control over the independent variable. There were two variables that the researchers used, i.e., the independent variable, which refers to the Montessori Math Model Method, and the dependent variable, which refers to Learning Ability in Fractions, specifically in adding and subtracting fractions.

This study was conducted at an elementary school in Kaputian, Island Garden City of Samal, Philippines. The distribution of respondents was according to the class section, which was categorized into experimental and controlled groups. Each group was given a pretest and a posttest. The instrument that the researchers used in the data gathering and processing in this study was a researcher-made questionnaire. It was used to identify the students' performance in adding and subtracting fractions. The researchers expected that the students had followed the rules on how to add and subtract fractions. The research instrument was submitted first to the adviser and panel of examiners for corrections, validation, and approval.

The following procedures were observed in the data gathering: 1) Asking for permission to conduct the study. The researchers wrote a letter asking permission from the School Principal to conduct the study and also complied with due diligence; 2) Construction of questionnaires. The researchers constructed questionnaires that serve as a guide in identifying the effect of the Montessori Math Model Method in teaching addition and subtraction of fractions in grade v pupils; 3) Validation of questionnaires. The researchers presented the questionnaires to the panel of examiners for validation and approval of the questionnaires that the researchers made; 4) Distribution of the questionnaires. With the approval of the said request, the researchers personally administered the questionnaires to the identified respondents; 5) Retrieval of the questionnaires. The questionnaires were retrieved after having been accomplished by the respondents; 6) Tabulation of the questionnaires. The retrieved questionnaires were tallied, collated, and recorded accordingly. Results were analyzed, interpreted, and statistically computed to answer the questions being raised by the researchers; 7) Delivering the instruction. The researchers conducted a separate discussion for both groups. The experimental group had the intervention of concrete materials while the control group had the traditional one. The delivery of the lesson was conducted for one week of discussion proper; 8) Distribution of questions. The researchers administered the same questionnaires to the separate groups again after the class has been delivered; 9) Retrieval of questionnaires. The questionnaires were retrieved after having been retaken by the separate groups of respondents; 10) Collation and tabulation of the data. The retrieved questionnaires were tallied and recorded accordingly. The results were analyzed, interpreted, and statistically computed.

The results which were gathered from the questionnaires were tallied and tabulated in a master data sheet. The researchers used the Statistical Package for Social Science version 22 (SPSS v. 22) to compute the data. Shown in Table 1 is the descriptive interpretation of the scores for the experimental and control groups.

Table 1. Descriptive Interpretation of the Score Interval

Range of Test Scores	Descriptive Equivalence
25.20 – 30.00	Outstanding
22.80 – 25.19	Very satisfactory
20.40 – 22.79	Satisfactory
18.01 – 20.39	Fairly satisfactory
0.00 – 18.00	Unsatisfactory

RESULTS

Pretest Mean Scores of the Experimental and Control Groups

Table 2 shows the pretest mean score of the pupils before the application of the Montessori Math Model Method on learning addition and subtraction of fractions. In the experimental group, thirty-one (34) respondents obtained the pretest mean score of 13.18, while in the control group there were thirty (33) respondents who obtained the pretest mean score of 10.30.

Table 2. Pre-test Mean Scores of the Experimental and Control Groups

Groups	*N*	Mean	Descriptive Equivalent
Experimental	34	13.18	Unsatisfactory
Control	33	10.30	Unsatisfactory

Both experimental and controlled groups have a descriptive equivalent of unsatisfactory. This indicates that the respondents need improvement in their performance in adding and subtracting fractions.

As cited by Charalambous and Pitta-Pantazi (2007), students only know what a fraction is but they don't know the concept of fractions. The respondents, specifically grade V pupils, already have the knowledge of what fractions are because it was introduced to them when they were in grade IV, but they don't have a deeper understanding of fractions as numbers. This is in line with the study of Lestiana, et al. (2014) that found students have misconceptions about fractions. One common mistake students make in adding fractions is the procedure "top+top" over "bottom+bottom" since they think of fractions as two different whole numbers.

Posttest Mean Scores of the Experimental and Control Groups

Table 3 shows the post-test mean score of the pupils who experience the use of the Montessori Math Model Method in learning the addition and subtraction of fractions. The experimental group obtained a post-test mean score of 24.91 and the controlled group obtained a post-test mean score of 13.88.

Table 3. Posttest Mean Scores of the Experimental and Control Groups

Groups	*N*	Mean	Descriptive Equivalent
Experimental	34	24.91	Very satisfactory
Control	33	13.88	Unsatisfactory

This indicates that the performance of the experimental group is verbally described as Very Satisfactory which means that the respondents show high performance in adding and subtracting fractions. Whereas, the performance of the controlled group is verbally described as Unsatisfactory which means that the respondents need improvement on their performance in adding and subtracting fractions.

This is supported by Rule and Harrel (2006) in their paper, which introduced a new method of analyzing mathematics by using concrete materials as a strategy for teaching elementary students. This study shows the positive effect of using symbolic concrete materials in teaching numbers like the Montessori Math Model Method which uses solid materials in teaching fractions to the learners. If the pupils are exposed to a classroom wherein they have hands-on learning through concrete materials, there will be a positive effect on their performance in learning fractions since they are physically involved in the process. Unlike traditional teaching where there is chalk and board teaching, wherein the learners are just passive, which can be

compared to an empty glass that needs to be filled by the teachers.

Significance of the Difference in the Pretest Mean Scores of the Experimental and the Control Groups

Table 4 shows the significance of the difference in the pretest mean scores of the experimental and control groups. This gave a mean difference of 2.88, with a computed *t*-value of 2.66 and a *p*-value of .010.

Table 4. Significance of the Difference in the Pretest Mean Scores of the Experimental and the Control Groups

Pretest Mean Scores		*t*-value	*p*-value	Remark
Experimental	Control			
13.18	10.30	2.66	.010	Sig-nificant

This leads to the rejection of the null hypothesis and implies that there is a significant difference in the pretest mean scores of the experimental and control groups. The difference signifies that learners differ in their learning. The preliminary result further suggested that before the experiment was done, the students from the experimental group has an edge compared to the students from the control group, as revealed in their pretest scores.

This result is supported by Haberlah (2017), which states that the foundation for advanced mathematical and logical reasoning is the mastery of fractions. However, a fraction is a cognitively challenging concept that the learners encountered during primary school, which positively influences the learners' differences in their knowledge and understanding of fractions. With these differences, it can be denoted that there are learners who are more knowledgeable than others and that learners of the experimental group may have a higher level of significance than the control group in the pretest. Even though both groups are at the same grade level, the data shows that the experimental group has higher performance compared to the control group.

Significance of the Difference in the Pretest and the Posttest Mean Scores of the Control Group

Table 5 shows the significance of the difference in the pretest and post-test mean scores of the control group. It was revealed that the controlled group obtained a pretest mean score of 10.30 while its post-test means score was 13.88. This resulted in a *p*-value of .003. The null hypothesis was then rejected since the *p*-value was less than an α= .05 level of significance. This means that there was a significant difference in the pretest and the posttest means scores of the control group.

Table 5. Significance of the Difference in the Pretest and the Posttest Mean Scores of the Control Group

Mean Scores of Control Group		*t*-value	*p*-value	Remark
Pretest	*Posttest*			
10.30	13.88	3.11	.003	Significant

This is supported by Adams and Engelmann's theory of instruction (1996) cited by Liem and Martin (2013), which supports DI or Direct Instruction. Unlike constructivism which focuses on the individuals' construction of knowledge using their own experiences, direct instruction is a teacher-directed approach wherein it follows a certain scientific instruction to control and monitor children's learning throughout the process. And also, it ensures the learning of the students in the direct instruction since the children need to listen and just absorbed the lessons that are being taught inside the classroom which is also a good strategy in the teaching process. The teacher wherein learners commonly use the traditional teaching will listen to their teacher, and the teachers deliver the lesson through chalk and board. The direct instruction or teacher-direct approach is observed to be the most commonly used in the classroom setting.

Significance of the Difference in the Pretest and the Posttest Mean Scores of the Experimental Group

Table 6 shows the significance of the difference in the pretest and the posttest mean scores of the experimental group. It was revealed that the experimental group obtained a pretest mean score of 13.18 while its post-test means score was 24.91. This gave a *p*-value of .000, which was less than α= .05. Therefore the null hypothesis was rejected, that is there is a significant difference in the pretest and post-test mean scores of the experimental group. The Montessori Math Model method is very significant in teaching fractions since there is an improvement in the performance of the learners.

Table 6. Significance of the Difference in the Pretest and the Posttest Mean Scores of the Experimental Group

Mean Scores of Experimental Group		*t*-value	*p*-value	Remark
Pretest	*Posttest*			
13.18	24.91	12.68	.000	Significant

In this study, the teacher knows what is appropriate for the mathematics learning of the students with the use of concrete materials as a learning tool for the students. The assumption was supported by the statement by Kinzer, Gerhardt, and Coca (2016) that students need to have access to concrete materials as a learning tool for developing mathematical skills. Based on this study, mathematical research provides solid evidence for hands-on resources in exploring mathematics, such as problem-solving, mathematical operations, and number concepts. Through the use of concrete materials, it's easy for the students to understand the mathematical concept and easy for them to apply mathematics on their own, and through that, they always keep in mind what they have learned about mathematics.

Significance of the Difference between the Mean Gain Scores of the Experimental and the Control Groups

Table 7 shows the significance of the difference between the mean gain scores of the experimental and the control group. It can be gleaned that the experimental group obtained a mean gain score of 11.74 while the control group obtained a mean gain score of 3.58. This resulted in a *p*-value of .000 which was less than α= .05. Therefore, the null hypothesis was rejected, that there was a significant difference in the mean gain scores of the experimental and the control groups.

The data shows that even though the post-test of both groups has increased from their pretest, the difference in the increase is significant enough to conclude that the Montessori Math Model Method is better than the traditional method. The significant increase in the performance of the pupils in the experimental group is much more significant compared to the significant increase in the performance of the pupils in the control group. Furthermore, it is essential to know that the traditional method is also effective, as shown by the increase in performance.

This result is consistent with the main theory of our study, which is the cognitive learning theory of Piaget (1936) which states that learners should learn first in concrete materials to have concrete learning before going into abstract ones. By having concrete learning, learners will be engaged with physical objects and will have solid evidence of their learning.

Table 7. Significance of the Difference between the Mean Gain Scores of the Experimental and the Control Groups

Mean Gain Scores		*t*-value	*p*-value	Remark
Experimental	*Control*			
11.74	3.58	9.86	.000	Significant

CONCLUSION

The following are the conclusions based on the findings: 1) The experimental and controlled groups have the same descriptive equivalence of unsatisfactory; 2) The experimental group has a descriptive equivalence of very satisfactory, which shows an increase in the performance of students in adding and subtracting fractions, while the control group has a descriptive equivalence of unsatisfactory, which shows that the students need improvement in adding and subtracting fractions; 3) The significant difference implies that learners differ in their learning; 4) By having a teacher-directed approach which is a strategy used in the control group, there is a guarantee that there will be a significant increase in the performance of the control group in adding and subtracting fractions; 5) There is a significant difference in the pretest and posttest mean scores of the experimental group, despite the fact that the pretest score of the experimental group is already high; 6) The results that were presented by both groups show an increase in the performance from their pretest and are significant enough to conclude that the Montessori Math Model Method is more effective than the traditional method.

RECOMMENDATIONS

In light of the aforementioned findings and conclusions of the study, the following recommendations were offered: 1) Teachers should apply the Montessori Math Model Method in delivering their lessons in the classroom. They should be more thoughtful about giving activities that imply the Montessori Method; 2) The School Administration should recommend or propose a series of seminars and workshops for Math Teachers on how to use and apply strategies that involve the Montessori Math Model Method; 3) We would like to recommend that future researchers conduct the same study in a different school to confirm the effectiveness of the intervention we used. This experiment lasted just one week. To verify the result, future researchers should administer the same study for a longer period of time by exposing students to the Montessori Math Model Method. Future researchers should conduct another study using the Montessori Math Model Method in the multiplication and division of fractions.

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