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The Effect of Japanese Multiplication on Pupils Interest in Mathematics

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ABSTRACT

The study of the effect of Japanese multiplication on pupils' interest in mathematics in Makurdi Local Government Area of Benue State was an attempt to ascertain the effect of Japanese method of multiplication on primary school pupils' interest in mathematics and to determine its effect on male and female pupils' interest in mathematics. The study used a quasi-experimental design. The study sampled 25 pupils of whichthe experimental group were expose to the Japanese multiplication method while the control group were taught mathematics using the conventional long multiplication method. The instrument used for data collection was Mathematics Interest Inventory (MII) with a reliability coefficient of 0.78 using Cronbach's Alpha. Two research questions and two research hypotheses were raised for the purpose of the study. The research questions were answered using the descriptive statistics of mean and standard deviation while the Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Result from the study revealed that there is a significant difference in the mean interest rating of pupils taught mathematics using the Japanese multiplication method and those taught mathematics using the conventional multiplication method. The study also revealed that there is a significant difference between the interest rating of male and female pupils taught mathematics using the Japanese multiplication method – the significant difference is in favour of the female pupils. The study recommends that mathematics teachers should make mathematics appealing, admiring and interesting by visualizing mathematics concepts as visualization triggers students' interest in learning.

Keywords: Interest, Japanese-Multiplication, Mathematics

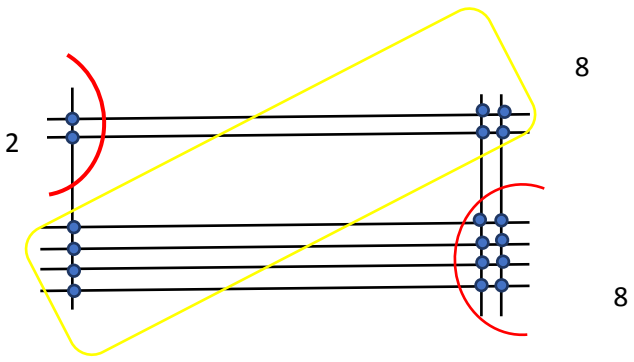
1. INTRODUCTION

Mathematics is the key that opens doors for technology; it is considered to be the father of sciences. The selection of mathematics as one of the core subjects offered in primary and post primary institutions in Nigeria, as well as its status as part of mandatory requirement of admission into post-secondary institution in the country are clear indication of the relevance of the subject in Nigerian education (Allahnana, Akande, Vintseh,Alaku&Alaku,2018). Mathematics has been regarded as a fundamental subject because arithmetic and logical reasoning are the basis of science and technology. For this reason, educational authorities emphasize students' proficiency in computational skills and problem-solving (Charles, Yeh, & Cheng, 2019). Considering how pertinent Mathematics is to all fields of studies, it is expected that it should be naturally enjoyed, cherished and accepted with single-mindedness by learners mostly by students in the primary schools. In contrast, hatred, anxiety, lack of interest and phobia

is usually expressed and manifested by students in the primary schools towards mathematics (Abari&Tyovenda, 2021).

One of the fundamental aspects of mathematics is multiplication. In mathematics, multiplication is a method of finding the product of two or more numbers. Multiplication is one of the basic arithmetic operations aside addition, subtraction and division that we use in everyday life. In arithmetic, the multiplication of two numbers represents the repeated addition of one number with respect to another. These numbers can be whole numbers, natural numbers, integers, fractions etc. If x is multiplied by y, then it means either x is added to itself y number of times or vice versa. Long multiplication method is usually used as a traditional way of multiplying numbers. This is done by multiplying the multiplicand by each digit of the multiplier, thereafter adding the results. However, there are alternative algorithms that allow many students to find other methods that are appealing and easier to navigate. Occasionally, students prefer them to the traditional multiplication method. Some of these alternative methods include Lattice multiplication method, Area multiplication method, Egyptian multiplication method, Russian Peasant multiplication method and Japanese multiplication method (Delbert, 2020).

The Japanese multiplication method is an algorithm for multiplying two large numbers by representing both numbers by a group of lines that form a diagonal pattern. The number of points of intersection near each vertex of a diamond are then counted in a certain order to obtain the solution (Vreken, 2017; Garain& Kumar, 2018). In the Japanese multiplication method, a student is able to complete a multiplication problem of two large numbers by merely drawing a few lines and counting the points of intersections. The Japanese multiplication method can be extended to handle more digits by creating a larger diamond, and a digit of zero by drawing a different coloured line. In some cases, carrying is required in the final addition steps. Unfortunately, the Japanese multiplication method is too time-consuming for multiplying numbers with larger digits, but remains a great visual aid for the multiplication process (Vreken, 2017). To do this, draw sets of parallel lines representing each digit of the first number to be multiplied (the multiplicand). Draw sets of parallels, perpendicular to the first sets of parallels, corresponding to each digit of the second number (the multiplier). Put dots where each line crosses another line. On the left corner, put a curved line through the wide spot with no points. Do the same with the right. Count the points in the right corner. Count the points in the middle. Count the ones in the left corner. If the number on the right is greater than 9, carry and add the number in the tens place to the number in the middle. If the number in the middle is greater than 9, do the same thing except add it to the number from the left corner. Write all those numbers down in that order and you will have your answer. For example, let us find the product of 24 and 12.



This means that 24x12=288

The Japanese multiplication method was invented by professor Fujisawa Rikitarol in the 1900. His method is geometric based multiplication method. Fujisawa gave a concept for multiplying two numbers in his own way which is known as Japanese multiplication method (Garain& Kumar, 2018). By the help of the Japanese multiplication method, students even those at the primary level can visualize mathematics. Studies such as Juliana and Lester(2018) have proven the effectiveness of Japanese Abacus method on students learning outcome.

The goals of primary mathematics curriculum are to: stimulate interest in the learning of mathematics, help students understand and acquire basic mathematical concept and computational skills, help students develop creativity and the ability to think, communicate and solve problems (Abari, 2021). Mathematics at the primary level introduces children to concepts, skills and thinking strategies that are essential in everyday life and support learning across the curriculum. Over the years, it has been observed that students even those at the primary level dread mathematics. Many of these students offer mathematics not because of its importance but they do so because it is a compulsory subject. This clearly show that students have zero interest in mathematics learning thus, leading to their poor performance in the subject (Abari&Tyovenda, 2021). However, when the interest of the students is stimulated to love, cherish and learn mathematics, they tend to achieve greatly in mathematics.

Interest is a subjective feeling intentness or curiosity over something. The interest in a particular thing is a feeling manifested in an activity (Hidi&Renninger, 2006). Interest is a tendency to become absorbed in an experience and to continue in it. It is the zeal or willingness to participate in any activity from which one derives some pleasure continuing (Usman, 2007). Edward (2000) referred to interest as motivation. Motivation is a drive or force that propels an individual in a particular direction. Interest is the feeling of wanting to know or learn about something or somebody (Abari&Tyovenda, 2021).

Subject-specific interest is an important determinant for successful learning and achievement (Hidi&Renninger, 2006). Students who are interested in their leaning activities are likely to report high competence beliefs, high achievement levels and choose high school courses that are related to their interest (Lazarides&Ittel, 2012). Mathematics interest is the passion an individual may have towards mathematics (Silvia, 2005). It is believed that there are gender differences in mathematics interest (Ajai&Imoko, 2014).

Gender refers to the economic, social, political and cultural attributes and opportunities associated with being women or men (Jose, 2011). Thus, gender plays a significant role in the general interest of students in mathematics.

The achievement of students in mathematics is closely linked with the interest they have in the subject (Ezeamenyi, 2002). Unfortunately, many students lack interest for the subject which is compulsory and applied in everyday life. Many students believe that competence in the subject is reserved for a selected few, while others are of the opinion that it is a nightmare that should be avoided (Owora& Chika, 2019). Despite the high position and place given to mathematics, students still do not like the subject. Majority of students perceive mathematics as difficult, abstract, unattractive, boring, not captivating, un-motivating and not related to their daily living. It was discovered that student's lack of interest in mathematics was caused by the teacher's use of inadequate, monotonous way of exposing or impacting mathematical concepts to students using conventional strategy (Usman &Nwabuezer, 2011). Making the students interested in learning mathematics can be a real challenge (Abari&Tyovenda, 2021). Many studies have made effort in intervening through different approaches to promote and develop students' interest in mathematics learning. It has become necessary for teachers to adapt strategies that

would build students' interest in learning mathematics in the light of the persistent abysmal achievement of students in mathematics which could be a reflection of apathy, or loss or interest in the subject.

Mathematics occupies an important place in the curriculum. Keeping in view its importance, strategies for arousing student's interest in mathematics should be used in order to achieve the teaching aim (Owora& Chika, 2019). How well can the Japanese method of multiplying numbers arouse pupils interest in mathematics? Hence, the main purpose of this study is to investigate the effect of Japanese multiplication on pupils interest in mathematics. Specifically, the study seeks to;

i. Determine the mean interest rating of pupils taught mathematics using the Japanese multiplication method and those taught using the conventional multiplication method
ii. Determine the mean interest rating of male and female pupils taught mathematics using the Japanese multiplication method

Research Questions: The following research questions were asked to guide the study:

1. What is the mean interest rating of pupils taught mathematics using the Japanese multiplication method and those taught using the conventional multiplication method?
2. What is the mean interest rating of male and female pupils taught mathematics using the Japanese multiplication method?

Research Hypotheses: The following hypotheses were formulated and tested at 0.05 level of significance;

1. There is no significant difference in the mean interest rating of pupils taught mathematics using the Japanese multiplication method and those taught using the conventional multiplication method
2. There is no significant difference in the mean interest rating of male and female pupils taught mathematics using the Japanese multiplication method.

2. METHODOLOGY

The study adopted a quasi – experimental design of non-equivalent group. The population for this study is the primary six pupils in the co-education primary schools in Makurdi Local Government Area of Benue State, Nigeria. The sample for this study was 25 pupils (15 male and 10 female) drawn from the selected primary schools. For the purpose of this research work, Mathematics Interest Inventory (MII) was used to collect data. The MII is divided into two sections (section A and B). section A contains the Bio-data of each respondent, while section B contains information on the research problem. A Likert-type scale of Strongly Agree, Agree, Disagree, and Strongly Disagree was used to determine the opinion of the respondents. The result of pre-test was used to calculate the reliability coefficient of the MII using the Cronbach alpha Coefficient which gives 0.78 showing that the instruments were reliable to be administered to the entire respondents.

The researchers administered the pre-MII and post-MII to all the primary six pupils in the two groups. The pre-MII, and post-MII were administered to the two groups in different schools to control interaction effect. Data collected were analyzed using descriptive statistics of mean and standard deviation to answer the research questions while the hypotheses were tested at 5% significance level using Analysis of Covariance (ANCOVA).

3. RESULTS

The data is presented according to research questions and hypotheses

Question 1: What is the mean interest rating of pupils taught mathematics using the Japanese multiplication method and those taught using the conventional multiplication method?

Table 1: Mean Interest Score and Standard Deviation

Group	Pretest		Posttest	Mean Difference	
	$\bar{x}$	SD	$\bar{x}$	SD	
Japanese Method	50.50	5.84	78.40	17.50	27.90
Conventional Method	50.47	6.44	59.60	9.06	9.13
Total	**50.49**	**6.14**	**69.00**	**13.28**	**18.77**

In table 1, the mean interest pretest scores of pupils taught mathematics using the Japanese multiplication method is 50.50 with standard deviation 5.84 while the mean pretest scores of pupils taught mathematics using the conventional multiplication method is 50.47 with standard deviation 6.44. This shows that the students in both groups demonstrated a similar interest in mathematics before the administration of the test. However, the mean interest posttest scores of pupils taught mathematics using the Japanese multiplication method and those taught mathematics using the conventional multiplication method is 78.40 and 59.60 respectively. The mean difference of the experimental and control group is 27.90 and 9.13 respectively. From the mean difference, it could be seen that the pupils taught mathematics using the Japanese multiplication method improved upon their interest in mathematics more than those taught mathematics using the conventional method. However, to ascertain the level of significant difference in the interest rating hypothesis 1 was tested at 5% level of significance.

Hypothesis 1: There is no significant difference in the mean interest rating of pupils taught mathematics using the Japanese multiplication method and those taught using the conventional multiplication method

Table 2: Summary of ANCOVA Result of Pupils' Interest in both Groups

Source	Type III Sum of squares	df	Mean Square	F	Sig.
Corrected Model	2978.242[a]	2	1489.121	10.747	.001
Intercept	128.193	1	128.193	.925	.347
Pretest	857.602	1	857.602	6.189	.021
Group	2113.233	1	2113.233	15.251	.001
Error	3048.398	22	138.564		
Total	118654.000	25			
Corrected Total	6026.640	24			

a. R Squared = .494 (Adjusted R Squared = .448)

In table 2, the p-value for group is 0.001. Hence $p<0.05$ the null hypothesis rejected. This implies that there is a significant difference in the mean interest rating of pupils taught mathematics using the Japanese multiplication method and those taught mathematics using the conventional multiplication method. It therefore means that the pupils that were exposed to the visual multiplication method by the Japanese improve better on their interest in mathematics than those that were taught mathematics in the conventional way.

Question 2: What is the mean interest rating of male and female pupils taught mathematics using the Japanese multiplication method?

Table 3: Mean Interest Scores of male and female pupilsand Standard Deviation

Sex	**Pretest**		**Posttest**		**Mean Difference**
	$\bar{x}$	**SD**	$\bar{x}$	**SD**	
Male	52.33	6.74	74.50	17.52	22.17
Female	47.75	3.10	84.25	18.19	36.50
Total	**50.04**	**4.92**	**79.38**	**17.89**	**14.33**

Table 3 shows that the mean pretest interest rating of male and female pupils in the experimental group is 52.33 and 47.75 respectively while the mean posttest interest rating of male and female pupils is 74.50 and 84.25 respectively. However, the mean difference in the interest rating of male and female pupils exposed to the Japanese multiplication method is 22.17 and 36.50. This clearly shows that the female pupils improved upon their interest in learning mathematics more than their male counterpart. However, to ascertain the level of significant difference in the interest rating of male and female pupils taught mathematics using the Japanese multiplication method, hypothesis 2 was test at 0.05 level of significance.

Hypothesis 2: There is no significant difference in the mean interest rating of male and female pupils taught mathematics using the Japanese multiplication method.

Table 4: Summary of ANCOVA Result of male and female Pupils' Interest

Source	**Type III Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	1799.018[a]	2	899.509	6.577	.025
Intercept	200.956	1	200.956	1.469	.265
Pretest	1570.868	1	1570.868	11.486	.012
Gender	892.887	1	892.887	6.528	.038
Error	957.382	7	136.769		
Total 64222.000	10				
Corrected Total	2756.400	9			

a. R Squared = .653 (Adjusted R Squared = .553)

In table 4, the p-value for gender is 0.038. Hence $p<0.05$ the null hypothesis is rejected. This implies that there is a significant difference between the interest rating of male and female pupils taught mathematics using the Japanese multiplication method. It therefore means that the female pupils demonstrated a greater interest in learning mathematicsthan their male counterparts when taught with the visualize concept of the Japanese multiplication method.

4. DISCUSSION

In table 1, the mean interest pretest scores of pupils taught mathematics using the Japanese multiplication method is 50.50 with standard deviation 5.84 while the mean pretest scores of pupils taught mathematics using the conventional multiplication method is 50.47 with standard deviation 6.44. This shows that the pupils in both groups demonstrated a similar interest in mathematics before the administration of the test. However, the mean interest posttest scores of pupils taught mathematics using the Japanese multiplication method and the pupils taught mathematics using the conventional

multiplication method is 78.40 and 59.60 respectively. The mean difference of the experimental and control group is 27.90 and 9.13 respectively. From the mean difference, it could be seen that the students taught mathematics using the Japanese multiplication method improved upon their interest in mathematics more than the pupils taught using the conventional method. However, to ascertain the level of significant difference in the interest rating hypothesis 1 was tested at 5% level of significance. In table 2, the p-value for groups is 0.001. Hence $p<0.05$ the null hypothesis rejected. This implies that there is a significant difference in the mean interest rating of students taught mathematics using the Japanese multiplication method and the students taught using the conventional multiplication method. This finding agrees with Juliana and Lester(2018) who found that Japanese abacus has a significant effect on students learning outcome..

Table 3 shows that the mean pretest interest rating of male and female students in the experimental group is 52.33 and 47.75 respectively while the mean posttest interest rating of male and female students is 74.50 and 84.25 respectively. However, the mean difference in the interest rating of male and female students exposed to the Japanese multiplication method is 22.17 and 36.50. This clearly shows that the female students improved upon their interest in learning mathematics more than their male counterpart. However, to ascertain the level of significant difference in the interest rating of male and female students taught mathematics using the Japanese multiplication method, hypothesis 2 was test at 0.05 level of significance. In table 4, the p-value for gender is 0.038. Hence $p<0.05$ the null hypothesis is rejected. This implies that there is a significant difference between the interest rating of male and female students taught mathematics using the Japanese multiplication method. It therefore means that the female students demonstrated a greater interest in learning mathematics than their male counterparts when taught with the visualize concept of the Japanese multiplication method.

5. CONCLUSION

Mathematics is a vital tool for national development. It is not just a mere subject offered in schools but it is a pillar upon which other discipline depends on. Mathematics has its real-life application in medicine, political science, engineering, construction, computer science, business, fashion designing, cooking and baking – the list is endless. The problem has never been "the role of mathematics but the interest in mathematics". Students generally express fear, shock, phobia just at the mention of the word mathematics. Getting the students to be interested in learning mathematics has been one of the difficulties teachers of mathematics face. Research has shown that students especially those at the primary level love learning when concepts are visualized. Visualizing concepts triggers the interest of students hence, mathematics teachers are encouraged to make mathematics appealing, admiring, and interesting by visualizing mathematics concepts to the students.

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