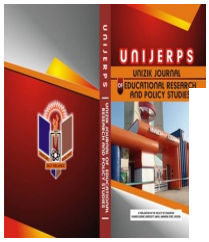

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EFFECTS OF INSTRUCTIONAL MATERIAL ON MULTIPLICATIVE THINKING OF PRIMARY SCHOOL PUPILS IN MATHEMATICS IN KADUNA STATE, NIGERIA

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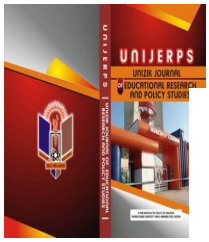
Abstract

This study assessed the Effect of Instructional Material on Multiplicative Thinking of Primary School pupils in mathematics in Kaduna State, Nigeria. The pre-test, post-test quasi experimental research design involving two groups (one experimental and the other control) was used. Ninety (90) pupils participated as sample for the study (48 male and 42 female). One instrument: Multiplicative Thinking Performance Test (MTPT) was used for data collection. The hypotheses were analyzed using the t-test at P≤0.05 level of significance. The results showed a significant difference in performance in favor of the experimental group. In addition, the result revealed no significant difference in performance of male and female pupils when exposed to instructional materials. Based on the findings recommendations were made such as: teachers should use instructional material in the teaching of multiplication to pupils to enhance pupils' Multiplicative thinking skill and general performance in mathematics. Finally, workshops and seminars for mathematics teachers should be organized by the Ministry of Education and the State Universal Basic Education Board for each LGEA Kaduna State on the use of instructional materials to teach multiplication.

Keywords: Instructional Materials, Performance, Multiplicative thinking

Introduction

Teachers in primary schools are under pressure to provide more effective and efficient learning environments and educational experiences to their pupils. In primary schools, teaching serves as an important vehicle for achieving institutional goals of enhancing pupils' knowledge and learning and engaging them in the learning community to prepare them for future citizen. Therefore, educators are always looking for



ways to make their educational initiative effective. The learning experience in primary education has shifted paradigms from an instructor focused approach to learner-centered pedagogical methods (Hurrell& Hurst, 2016).

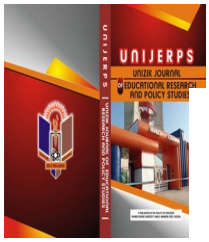
Instructional materials have gained great attention by educators in order to enhance pupils' learning. Educators have become aware of the benefits and short comings of various conventional methods used to provide instruction and training to pupils and practitioners (Feinstein, Raab and Stefanelli(2005). Good instructional material can be a gate way to good thinking needed for a proper mathematical foundation that can be sustained throughout an individual's life.It has been noted by Wright, (2011) that children need to re-conceptualize their thinking in order to make the conceptual leap from additive thinking. Siemon, Bleckly, and Neal(2012) asserted that such development is essential if children are to understand ratio, proportion, percentages and concepts associated with algebraic thinking.

Multiplicative thinking has been variously described and is as well encapsulated in the definition provided by Siemon, Breed, Dole, Izard & Virgona, (2006) as being the ability to work flexibly and efficiently with an extended range of numbers, recognize and solve a range problems involving multiplication and/or division including direct and indirect proportion, and communicate this effectively in various ways. Given its multi-faceted nature and critical position, it seems important to be able to comprehensively assess children's multiplicative thinking and provide teachers with a tool for doing so.

Multiplicative thinking is considered a 'big idea' of mathematics that underpins mathematical understanding beyond middle primary years (Siemon, Bleckley & Neal, 2012; Hurst & Hurrell, 2014).Multiplicative performance test have been used for a number of years in mathematics education Clarke & Roche, (2011) and they have the capacity to help teachers understand their pupils' learning and develop tasks to support that learning Sowder(2007). They can be used to enhance the knowledge and skills of the knowledge and skills of mathematics teachers by developing a deeper understanding and awareness of the way that pupils construct their mathematical understanding Heng & Sudarshan, (2013). Indeed, multiplicative performance test is a way of joining research with educational practice Mulisan (2004).

The general performance of pupils in primary school mathematics examination is poor. The worst result usually come from multiplicative thinking aspect. The poor performance is attributed to lack of facilities, lack of adequate motivation, lack of instructional materials, poor method of instruction, inadequate funding and many other variables. Learning mathematics includes solving various types of problems, from those which requires performing arithmetical operations to those which require problem solving skills. According to McIntosh and Ramagge (2011) fluency with multiplication reduces the cognitive load in learning later topics such as division.

In teaching and learning process, gender has attracted the attention of many researchers. Gender is a socio-cultural construct, a category that sort and organizes social relationship between human male and female Scott, (2005). Besides the influence of



teaching strategies and other related problems, gender has also been considered another important factor that mediates between performance and cognitive achievement in mathematics. Available literature have not been able to identify a single direction of difference in performance in mathematics between male and female students Kadiri (2004). Although most researchers have found boys performing better than girls, a few others saw girls out-performing boys while some others established no significant difference.

Statement of the Problem

Pupils' performance in primary school leaving certificate mathematics placement examinations conducted annually in Kaura Local Government of Kaduna State has generally been very poor. They rarely or completely avoid attempting questions on multiplication or multiplicative thinking aspect of mathematics. Most teachers use irrelevant and ineffective methods of teaching which among other factors contribute to pupils' poor performance in mathematics. Multiplication has posed a lot of problems to pupils of primary schools (Semion, 2005; Ado& Ekwueme (2017).

The problem necessitates the need for exploration and application of effective teaching strategies that have been found to be effective to some specific environments. The performance in mathematics is becoming an international issue, this is because the conventional method of teaching mathematics which teachers in primary schools have been utilizing have not been productive hence the rate of failure been recorded. This informs the need to try out instructional material which hopefully could improve pupils' performance in multiplicative thinking.

Research Questions

The study provided answers the following questions:

i. What is the effect of instructional material on pupils' multiplicative thinking skills?

ii. What is the difference between male and female pupils' multiplicative thinking skills using instructional materials?

Null Hypotheses

On the basis of the research questions, the following hypothesis stated in null forms are formulated for testing at 5% significant level.

H_{01} There is no significant difference in multiplicative thinking skills between pupils taught using instructional material and those taught by the conventional method.

H_{02} There is no significant difference between the multiplicative thinking skills of male and female pupils taught instructional materials.

Method

The study utilized the pretest, posttest quasi experimental design involving two groups; experimental and control. The population of this study covered all the primary five (5) pupils of Kaura Local Government Area of Kaduna State which comprised of 104 primary schools with a total enrollment of 32,200 pupils (SUBEB, 2019). Two schools were selected using the simple random procedure from which 90 (44 experimental and 46 control) pupils were selected from two intact

classes as sample for the study. The selected schools were homogenous with very similar conditions in terms of staffing, provision of equipment, instructional materials and enrollment.

A validated instrument tagged: Multiplicative Thinking Performance Test (MTPT) adopted from Hurst and Hurrell (2016)was used to collect data for the study. MTPT had a reliability index of 0.74 when subjected to the Person Product Moment Correlation (PPMC) using the test retest method. The treatment period lasted for six weeks after which a post test was administered. The research questions were answered from the mean and standard deviations scores while the hypotheses were tested using the t-test statistics at $P \leq 0.05$ level of significance by the aid of the computer software statistical packages for social sciences (SPSS v23).

Results

Research Question one and Null Hypothesis one

What is the effect of instructional material on pupils' multiplicative thinking skills?

H_{01} There is no significant difference in multiplicative thinking skills between pupils taught using instructional material and those taught by the conventional method.

Table 1: Summary of t-test analysis of Posttest Mean Scores of Experimental and Control Groups

Groups	N	Mean	S.D	Df	t-value	P-value	Decision
Experimental	44	60.23	17.13	88	4.53	0.001	Reject H_{o1}
Control	46	48.11	19.20				

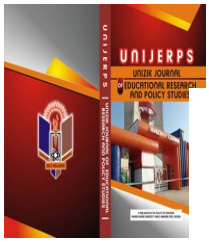
***Significant at P≤0.05**

Table1 shows that the experimental group had a mean performance score of 60.23 while the control group scored 48.11. In addition, their respective standard deviations (SD) are 17.13 and 19.20. Clearly, the experimental group outperformed the control group with a mean difference of 12.12. This implies that pupils in the experimental group had better multiplicative thinking skills compared to their counterpart in the control group.

The result also revealed that the t-value of 4.79 and P-value of 0.001 were observed at 96 degree of freedom. Since the P-value (0.001) is less than the alpha value of 0.05, it means that there is significant difference between the two groups' multiplicative thinking skills. Therefore, the null hypothesis one is hereby rejected.

Research Question Two and Null Hypothesis Two

What is the difference between male and female pupils' multiplicative thinking skills using instructional materials?



H_{02} There is no significant difference between themultiplicative thinking skills of male and female pupils taught instructional materials.

Table 2: Summary of t-test analysis of the Posttest Mean Scores of Male and Female Students in the Experimental Group

Groups	N	Mean	S.D	df	t-value	P-value	Decision
Experimental	24	68.34	22.47				
				42	0.0142	0.316	Retain H_{o2}
Control	20	67.28	16.29				

**** Not Significant at P≤0.05**

From the summary of t-test analysis in Table 2, the result shows that t-value calculated is 0.0142 and p-value of 0.316 was observed at 42 degrees of freedom. Since the p-value is greater than the α value (α = 0.05), this means that there is no significant difference in the multiplicative thinking skills of male and female pupils taught using instructional material. Therefore, the null hypothesis two is hereby retained.

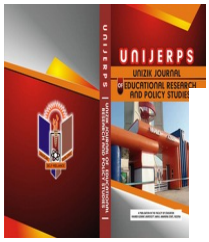
Discussions

The result of the testing of hypothesis one, shows that the pupils in the experimental group who were taught using instructional material had better multiplicative thinking skills than their counterparts in the control group. The findings is in agreement with the findings of Siemon, Bleckley & Neal(2012) who found a significant difference in multiplicative thinking skills of pupils taught mathematics using instructional material. It also tallies with Charles(2015) who added that pupils performed better when exposed to instructional materials.

The post-test scores on gender showed no significant difference between the multiplicative thinking skills of male and female pupils within the experimental group who were exposed to instructional materials. This finding agrees with the findings of Yusuf & Afolabi (2010) who observed that male and female students' multiplicative thinking skills does not differ when exposed to instructional materials.

Conclusion

Based on the findings from this study, it could be concluded that teaching with instructional materials is a more effective approach in boasting pupils of primary schools' multiplicative thinking skills. Moreover, it was observed that teaching with instructional material is gender friendly with regard to acquiring multiplicative thinking skills. These when effectively handled will hopefully lead to better performance in mathematics among pupils which they will carry with them to the secondary and tertiary levels of their educational pursuits.



Recommendations

Based on the findings, the following recommendations were made:

1. Teachers should employ the instructional material in the teaching of multiplication and multiplicative thinking skills among pupils in primary schools to enhance their academic performance.

2. Workshops and seminars for mathematics teachers should be organized by Ministry of Education and Primary Education Board for each Local Government Education Authority in Kaduna state on the use of instructional material.

3. Teachers of other science based subjects should utilize instructional material in the teaching of some concepts.

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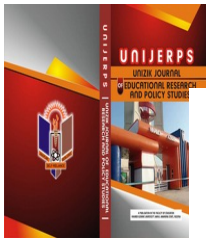

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