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Instructional Aids and Gender Differences in Mathematics Achievement of Primary School Pupils in Cross River State: Implications for Teaching Mathematics

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Abstract

The objective of this study was to determine the effects of instructional aids with respect to their gender on primary school pupils' achievement in Mathematics. The study adopted the quasi-experimental factorial research design. A random sample of 600 pupils from public and private schools in Cross River State, Nigeria were selected using the multi-stage sampling technique for the study. A 20-item multiple choice Mathematics Achievement Test with a split half reliability index of 0.67 was the instrument used to gather data. The data collected were subjected to the analysis of covariance (ANCOVA) with the pretest scores as the covariate. The results of the analyses showed that both the main and the interactive effects of instructional aids and gender significantly influence pupils' achievement in Mathematics. Female pupils in the treatment group achieved significantly higher than their male counterparts in the control groups.

Keywords: Gender, Instructional aids, mathematics, primary school

1. Introduction

Throughout Africa, Nigeria in particular, education is looked upon as one of the vital means of claiming the freedom that so many of its nations have struggled for and now attained. But no superficial accumulation of knowledge will suffice to remove the suspicions and fears that divide men or the poverty and ignorance that hinder progress. Only a real understanding of what education is and a determined effort by teacher to provide their pupils with real education will succeed in shaking off the shackles that prevent true happiness from being enjoyed. Thus, mathematics plays a central role in education and development. This is due to the fact that scientific and technological developments of any country depend to a larger extent on mathematical development. Mathematics is essentially a dynamic science which serves as the underlying knowledge for science and technology (Meremikwu, 2008). Owing to the importance of mathematics, the Federal Government of Nigeria made it a compulsory subject both at the primary and secondary levels of education (FRN, 2004). The ultimate goal of teaching mathematics is to prepare pupils to develop critical and creative outlook as they confront the challenges of daily life.

The goals and objectives of mathematics education are stated in broad terms in the National Policy on Education (FRN, 2004). This why mathematics is so important that every child must study it for six years in primary school, three years in junior secondary school and three years in senior secondary school. Primary education is the foundation upon which subsequent education is built (FRN, 2004). Most importantly, primary mathematics forms the foundation upon which mathematics and science education at higher levels of secondary and tertiary institutions are built.

Primary school educations are basically at the concrete operational level. By their nature, they need a large number and variety of educational or instructional resources to interact with. Teaching and learning involves a dynamic interaction of human and material resources. Children at the primary school level like to explore, experiment, create and interact intensively with the environment. For a lesson to be meaningful, children would therefore require copious use of instructional resources so as to provide them with enabling environment to learn mathematics (Meremikwu, 2008).

Instructional materials/aids make teaching and learning more effective. They can be manipulated, seen, heard or talked about as instruments which facilitate such activity. Esu, Enukoha and Umoren (2004) stated that instructional materials are necessary ingredients in the development of any curriculum. There also serve to facilitate the learner's acquisition and evaluation of knowledge and skills. According to Esu (1995), the main

aim of instructional aid in the teaching of mathematics is to increase the effectiveness of teaching mathematics as a means of preparing learners for future responsibilities as adults.

Apart from instructional aids which have been identified asa strong factor that could improve mathematics achievement, gender has also been implicated in mathematics achievement. According to Becker and Hedges (1984) women are dramatically under-represented in university science and mathematics facilities and in technical careers, even in relation to the number of women trained in graduate programs. Many explain the under-representation of women in Mathematics and Science on the basis of gender differences in cognitive and psychological tasks (Feingold, 1998). Carr and Jessup (2006), Multhen (1979), Khale and Lakas (1983) and Fennema (1990) are of the opinion that there is a significant gender difference in mathematics achievement of pupils and that males have more frequently held aspirations for Mathematics-oriented career then females. Researches have shown that boys participate in mathematics class activities, and class discussions to a greater extent than girls (Sadker et al 1985). Another study by Haggerty (1987) on gender and tasks showed that gender and achievement are significantly related. Based on the expressed importance of instructional aids, this study is designed to determine the effect of instrumental aids and gender differences on pupils' achievement in mathematics.

Purpose of study

The purpose of this study is to determine how instructional aids affect mathematics achievement of male and female primary school pupils.

2. Theoretical framework, research questions and hypotheses

2.1 Theoretical framework

Theoretically, the study is anchored on two frameworks that of (i) the Dale-Brunnerian Core of Experience Instructional Aids Theory (Dale, 1946 and Brunner, 1966) and (ii) Achievement Goal-Theory. In brief, Dale-Brunner theory postulates that learners could make profitable use of more abstract instructional activities to the extent that they had built up a stock of more concrete experiences to give meaning to the more abstract representations of reality. The central hypothesis which this study sought to test derives its basis from this theory.

2.2 Research Questions

The following research questions were proposed to direct, guide and to sharpen the focus of the study:

1. To what extent does the use of instructional aids affect pupils' achievement in mathematics?
2. To what extent does gender interact with instructional aids to influence pupils' achievement in mathematics?

2.3 Research Hypotheses

The following research hypotheses were formulated and tested in the study.

i. There is no significant difference in the achievement of pupils taught mathematics with instructional aids and those taught without instructional aids.

ii. Pupils' gender does not significantly influence their achievement in mathematics when taught with or without instructional aids.

3. Methodology

3.1 Research Design

The study is quasi-experimental factorial research design; involving pre-test-post-test of treatment and control groups was used.

3.2 Study Area and Population

The study area is Cross River State, Nigeria. The population of the study consists of 32, 529 primary four pupils in all private and public primary schools in Calabar Education Zone of Cross River State.

3,3 Sampling Procedure and Sample

A total sample of 600 pupils was randomly drawn, using the multistage sampling approach, from twelve (12) primary schools in three Local Government Areas of Cross River State.

3.4 Instrumentation/Administration

The research instruments used for data collection for this study are two namely; Mathematics achievement test administered ad a pre-test and latter as post-test. The tests were constructed by the researcher and vetted for use

by the superior and experts in Educational Tests and Measurement. The instruments were administered primary four pupils in the experimental and control groups. The treatment, which was the use of instructional aids was administered on the experimental group for six weeks while no treatment was given to the control group. The achievement test had a reliability index of 0.67.

3.5 Data Analysis

The data were analyzed using Analysis of Co-variance (ANCOVA) with pre-test as covariate. Statistical package for Social Sciences was used for data analysis.

4. Results and Discussion

4.1 Hypothesis one

The result of the analysis in this hypothesis is presented in Table 1. An examination of Table 1 showed that F-cal (F=13.4, P<.05) for mathematics post-test achievement was highly significant. This was because the F-cal is greater than the critical F at 3.06 needed to reject the null at .05 alpha levels with 1 and 5567 degrees of freedom.

This highly significant difference between the groups is probably due to the treatment main effect rather than the effect of random fluctuation. The Multiple Classification Analysis (MCA) of Table 2 was used to examine the pattern of categories of variable relationship to the criterion variable

Table 1 – Summary of Analysis of Covariance (ANCOVA) of the pupils post-Test Achievement of the Treatment with Pre-Test as Covariate.

Source of Variation	Sum of square	Df	Mean Square	F-cal	Sig	Partial Eta sq. (R^2)
Model	32376.153	2	16188.077	265.978	000*	.471
Covariate (Pre-Test)	31140.618	1	31140.618	511.310	000*	.607
Intercept	56233.923	1	56233.923	923.327	.000*	.461
Main-effect						
Treatment	821.960	1	821.960	13.496	.000*	.022
Error (residual)	36259.445	597	60.904			
Total	68235.598	599				

*Squared = .471 Adjusted R Squared = .469. *Significant at .05 Alpha level.

Table 2: - A Summary of Multiple Coefficient Analysis of Mathematics Achievement by Experimental and Control Groups

Grand Mean = 65.632					
Measure Category	Variable+ Deviation	N	Unadjusted Eta	adjusted for indep + Covariate	Deviation
Maths Achievement Treatment					
1 – Experimental		300	1.435	1.171	
2 – Control	300	- 1.435	.461	-1.171.	587
R*					.471
R^2			.686		

Table 2 indicates that the treatment was effective in differentiating pupils taught Mathematics with instructional aids and those of the control group. Hence the experimental group subjects were found to be superior in mathematics achievement than the control group. The finding is the line with the studies of Edger Dale (1946) and Jerome Brunner (1966) and Raphael & Wahistrom (1989) that a combination of concrete and pictorial than symbolic activities will lead to more effective learning. Pastore (2003) contends that learning is more effective when it is done with concrete materials. Inyang-abia and Esu (1990), Anibueze (2005) are of the same opinion.

The use of instructional materials enables the pupils to see, feel and manipulate these resources in order to solve problems. This increases their level of understanding and hence advancement.

4.2 Hypothesis Two

The result in Table 4 shows that there is no significant influence of gender on pupils' post-test achievements in mathematics (F = 0.591; P<.05). From table 3, treatment main effect was found to be significant (F= 13.98;P<.05). The interaction of treatment with gender was also found to be significant (F = 4.257; P<.05). This implies that pupils' gender significantly influenced their achievement when taught with instructional aids than when taught without instructional aids. The finding is in line with the studies of Faleyajo, Mkunjo, Okebukula, Onugba and Olubodun (1997).

Also, an earlier work by Meremikwu (2002) which studied (older) secondary school students found that in different settings, significant differences in Mathematics achievement existed between males and females students. When these means were compared, the result of the analysis of covariance is reported in Table 4.

Table 3: - Mean, Standard Deviation and 2x2 ANCOVA of the effect of Treatment and Gender on pupils' Achievement in the Mathematics Pre-Test as Covariate.

Group	Gender	N	$\bar{X}$	SD	$\bar{X}$ adjusted
Experimental	Male	150	66.966	1.789	66.382
	Female	150	67.165	11.862	67.213
Control	Male	150	65.307	9.530	65.356
	Female	150	63.087	10.113	63.564

Table 4: - summary of Analysis of Covariance (ANCOVA) of the pupils Post-Test Achievement on their Gender and Treatment with Pre-Test as Covariate

Source of Variation	Sum of Squares	Df	Mean Squares	F-cal	Sig	Partial Eta sq (R^2)
Model	32668.593	4	8167.148	134.734	.000*	.475
Covariate Pre-Test	31060.480	1	31060.480	572.407	.000*	.463
Intercept	56190.694	1	56190.694	926.582	.000*	.609
Main-effect						
Treatment	818.204	1	818.204	13.498	.000*	.022
Gender	34.6598	1	34.598	571	.450*	.001
Interaction Effects						
Treatment x Gender	257.775	1	257.775	4.253	.040*	.007
Error (residual)	36067.006	595	60.617			
Total	68735.598	599				

*Squared = .475 Adjusted R squared = .472

*Significant at .05 Alpha level.

5. Conclusion

Based on the results emanating from this study, it could be concluded that pupils taught using instructional aids performed significantly better compared to the control group. Also, female pupils taught with instructional aids perform significantly better than their male counterparts who were not taught with instructional aids. Further studies should be designed to focus on factors influencing teachers' use and non-use of instructional aids.

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