Instructional aids, school variables and pupil's Mathematics achievement in primary schools in Cross River State, Nigeria

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The aim of the study was to determine the effects of the use of instructional aids, and school variables on pupils' Mathematics achievement in both public and private schools in Cross River State, Nigeria. The study adopts the quasi – experimental research design involving pretest – posttest with the use of instructional aids as the treatment for the experimental group. School variables (school location and school type) were the main variables, while gender was the moderator variable. A random sample of 600 pupils was selected using the multi - stage sampling technique for the study. The experimental group was subjected to the treatment, which was teaching with instructional aids. The administration of the treatment lasted for six weeks. A 20–item multiple-choice Mathematics Achievement Test (MAT), designed by the researchers, with a split–half reliability index of 0.67 was the instrument used to gather data. The MAT was used as pretest and posttest for both the experimental and the control groups. Data collected from the study were subjected to the Analysis of Covariance (ANCOVA) with the pretest scores as the covariate. The results of the analysis showed that pupils' Mathematics achievement was significantly dependent on the treatment, school type and school location but not on their gender. Also all the interactions of the treatment, gender, school type, and school location were statistically significant in explaining pupils' Mathematics achievement. In fact, in the urban areas, pupils in the experimental group in private schools achieved significantly higher than their counterparts in the public schools. However, in the rural areas, the difference between the mean Mathematics achievement of the pupils in private and public schools was not statistically significant.

Keywords: Instructional aids, mathematics achievement, primary school,

Introduction

Mathematics is one of the formal disciplines that help man lay a solid foundation for future survival. Scientific and technological developments are dependent on Mathematics. The Nigerian government has made mathematics compulsory both at the primary and secondary school levels (Federal Republic of Nigeria 2004). Also mathematics is a basic requirement for admission into some degree courses in most tertiary institutions in Nigeria. Okeke (2006) noted that there was a general fear and hatred for mathematics; a situation which results in decline performance in the subject. Esu (2006), attributed the pupil's poor performance in Mathematics to factors such as: the notion among pupils that mathematics is an abstract and difficult subject, inadequate qualified teachers to teach the subject as

specialist, improper method of teaching mathematics, lack of mathematics laboratory, insufficient instructional aids and poor use of instructional materials.

Basically the goal of teaching mathematics, especially at the primary level is to prepare pupils to develop critical and creative outlook as they confront the challenges of daily life (Meremikwu 2008). Thus for the teaching of mathematics to be meaningful teaching must exist at the concrete operational level. By the nature of children, they need a large number of and variety of educational or instructional resources to interact with. Children at the primary level like to explore, experiment, create and interact intensively with the environment. The use of copious types of instructional resources, therefore, helps create an enabling environment for effective learning of the subject.

Several studies have shown other indices that could affect pupils' mathematics achievement. Stringfield and Teddie (1991), in their study of rural education in the United States showed that classes and schools differ in terms of their learning environment and school resources. Okoyeocha (2005), in a comparative study of public and private schools in 22 schools (11 public and 11 private schools) in Nigeria found that public schools were better equipped than their private counterparts. The location of the school could also influence the level of academic achievement of pupils. Daramola (1985) showed that pupils in urban schools performed significantly better than their counterparts in rural schools.

The purpose of this study therefore is to determine the effect of the use of instructional aids and some school variables (school type and school location) on pupils' mathematics achievement. With the pupils' gender as the moderator variable the study sought to test the following hypotheses: (i) There is no significant interaction effect of the use of instructional aids, type of school and gender on pupils' mathematics achievement in Cross River State, Nigeria. (ii)There is no significant interaction effect of use of instructional aids, location of school and gender on pupils' mathematics achievement in Cross River State, Nigeria.

Methodology

The study adopted a quasi-experimental research design involving a pre-test and post test of both the experimental and the control groups. The treatment (which was the teaching of mathematics using a variety of instructional aids) was administered on the experimental group for six weeks. The topics taught were selected in line with the curriculum of the schools. Regular class teachers of those classes were trained on the use of the instructional aids and in the presentation of the lessons, before the actual experiment started. Both the experimental and control groups were taught in their normal class state.

A random sample of 600 pupils was selected using a multistage sampling approach. The resulted of the selection was from 12 primary schools in 3 Local Government Areas of the State. There were four (4) schools in each Local Government Area. Two (2) schools being public (one rural and one urban) and two schools were private (one rural and one urban). Thus a total of 25 pupils' were selected from each school. In all 300 pupils were involved in the experiment while the other 300 pupils' served as the control.

A well-validated 20 item multiple choice Mathematics Achievement Test (MAT) with a split half reliability index of 0.67 was the major instrument for data collection. The MAT was administered on the pupils' before and after the administration of the treatment on both the experimental and control groups. Scores obtained from the pretest served as covariate during the data analysis. The data obtained were subjected to Analysis of Covariance (ANCOVA).

Results

Hypothesis 1

The result of the data analyses for the test of hypothesis one is presented in Tables 1 and 2. Gender alone did not significantly influence pupils' mathematics achievement. The use of instructional aids and/or the type of schools pupils attended significantly influenced their level of mathematics achievement. The analysis also showed that the interactions of gender and the treatment, gender and school type, and treatment and school type were all significant at 0.05 level. The significance of these interactions could be due to the use of the treatment. Pupils in the treatment and control groups in public and private school differed significantly in their mean Mathematics achievement. The interaction between gender and school type could be explored using the Fischer LSD as presented in Table 2.

Table 2 shows the results of the Fischer's protected t-post hoc analysis. The adjusted mean scores of female pupils taught with instructional aids in private school were significantly higher than those of their male counterparts. There was no significant difference in the mean Mathematics achievement of male and female pupils in public schools taught with instructional materials. Thus the use of instructional aids in the teaching of pupils helps to reduce the incidence of gender stereotype and improves on their mathematics achievement.

Table I
Summary of Analysis of Covariance (ANCOVA) of pupils' post test mathematics achievement on their gender, type of school and treatment with pre-test as covariate

Source of variation	Sum of squares	Df	Mean Squares	Fcal	p-value
Model	33936.847	8	4242.106	72.045	.000*
Covariate (pretest)	24746.734	1	24746.734	420.283	.000*
Intercept	53350.118	1	53350.118	906.065	.000*
Main effect					
Treatment	836.153	1	836.153	14.201	.000*
Gender	38.383	1	38.383	.652	.420
Type of school	584.415	1	584.415	9.925	.002*
Interaction effects:					
Treatment X gender	255.839	1	255.839	4.345	.038*
Treatment X type of school	307.090	1	307.090	5.215	.023*
Gender X type of school	295.754	1	295.754	5.023	.025*
*Treatment X gender					
X type of school	59.496	1	59.496	1.010	.315
Error (residual)	34798.751	591	58.881		
Total	68735.598	599			

* significant at 0.05 level. F critical = 3.06; $R^2 = 0.494$; Adjusted $R^2 = 0.487$

Table II
Fischer's LSD post hoc comparison test of the adjusted mean mathematics achievement of pupils based on their gender and school type

Group		N	1	2	3	4
1. private school	Male	150	67.161n	2.834	1.501	2.735
2. Private school	Female	150	2.291*c	69.995	4.335	5.569
3. Public school	Male	150	1.213	3.504*	65.660	1.234
4. Public school	Female	150	2.211	4.502*	0.998	64.426

* $p < 0.05$, df = 598, t = 1.645, MSE = 58.881, SS res = 7173.789, SSreg = 9853.544

Table III
Summary of means and standard deviation of the pupils' mathematics achievement

Group	Gender	School location	N	X	SD
Treatment	Male	Urban	50	74.080	10.300
		Semi-urban	50	67.041	7.214
		Rural	50	59.633	9.398
	Female	Urban	50	71.860	11.482
		Semi-urban	50	68.451	8.866
		Rural	50	61.275	12.570
Control	Male	Urban	50	64.706	10.199
		Semi-urban	50	62.820	8.073
		Rural	50	68.469	9.487
	Female	Urban	50	63.531	11.787
		Semi-urban	50	59.500	8.252
		Rural	50	60.877	9.048

Hypothesis 2

The result of the test of hypothesis two is as presented on Table 3 and 4
Table 3 shows the results of the mean post test mathematics achievement of the pupils in the study. In the experimental group, male pupils in the urban centres had a higher post test mathematics achievement (X = 74.080, SD = 10.300) than their female counterpart (X = 71.86). Female pupils from semi-urban (X = 68.45) and rural (X=61.28) had higher mean mathematics achievement than their male counterparts in semi-urban (X = 67.04) and rural (X = 59.63) areas respectively. Table 4 shows that the use of instructional material does not have significant impact for pupils in the rural areas.

Table 4 shows that the treatment main effect was significant (F = 13.945, $p<0.05$); gender main effect was not significant (F = 0.672); location of school was significant (F = 4.207, $p<0.05$). The interaction of treatment and location of school was significant (F = 5.954; $p<0.05$) implying that the use of instructional aids in

different school location significantly affect pupils' mathematics achievement. The interaction of effect of the treatment, gender and location of school was not statistically significant (F = 1.336; p<0.05). Table 4 showed that the treatment main effect accounted for 49.6% (R^2 = 0.496) of the total variance in the pupils' Mathematics achievement whereas gender accounted for only 0.1% (R^2 = 0.03) and location of school accounted for only 1.4% (R = 0.12) of the total variance.

Table IV
Summary of Analysis of Covariance (ANCOVA) of the pupils' post test achievement on location of school, gender and treatment with pretest as covariate

Source of variation	Sum of squares	df	Mean square	Fcal	p-value
Model	34095.905	12	2841.325	48.149	.000*
Covariate (pretest)	22408.385	1	22408.385	379.730	.000*
Intercept	46563.665	1	46563.665	789.062	.000*
Main effects:					
Treatment	822.929	1	822.929	13.945	.000*
Gender	39.671	1	39.671	.672	.413
Location of school	496.495	2	248.247	4.207	.015*
Interaction effects:					
Treatment X gender	269.777	1	269.777	4.572	.033*
Treatment X location of school	702.660	2	351.330	5.954	.003*
Gender X location of school	10.498	2	5.249	0.089	.915
Treatment X gender X location of school	157.649	2	78.825	1.336	.264
Error (residual)	34639.694	587	59.011		
Total	68735.599	599			

* significant at 0.05 level. R^2 = .496, Adjusted R^2 = .486.

Discussion

The findings of this study have shown that the use of instructional materials is very important in boosting pupils' Mathematics achievement, with instructional materials alone accounting for up to 49.6% of the variance in the pupils' Mathematics achievement. This underscores the need to use instructional aids in teaching mathematics at the primary school level. Instructional materials had much more significant effect in the urban areas than the rural areas. The interaction of the treatment and school location was statistically significant. The study showed that pupils in the urban centres achieve significantly higher than their rural counterparts regardless of their sexes. Oriaifor (1986), contended that pupils in the urban centres have well-equipped schools, with rich infrastructures and facilities. Aside from this pupils in the urban centres are exposed to modern learning materials. Most of them have teachers that teach them at home. These therefore have contributed positively in enhancing their Mathematics achievement level.

The study also showed that the interaction of the treatment and the type of school is statistically significantly in the consideration of pupils' Mathematics achievement. Post hoc analysis revealed that on the average pupils in private schools

taught with instructional materials perform significantly better than their counterparts in public schools. Eluwa (2005) also noted in his research that there are higher mathematics average scores for private schools than their counterparts in public schools. It is worth noting that private schools in Nigeria have more effective and efficient supervisory capacity than these public schools. There has been a boom in enrolment into private schools in Nigeria as the public schools system appears to have bowed to political and economic pressures.

In conclusion, mathematics achievement of primary school pupils significantly depends on the use of instructional aids. When instructional aids are used, there is bound to be discrimination in the mathematics achievement level of the pupils in terms of the school type and school location. The usage of instructional aids has an added advantage on the mathematics achievement level of the female pupils especially in private schools located in urban centers in Nigeria. Interaction between type of school and location of schools helps to remove gender biases in mathematics achievement of primary school pupil taught with instructional aids.

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