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EFFECT OF PRIOR KNOWLEDGE OF BEHAVIOURAL OBJECTIVES ON MATHEMATICS ACHIEVEMENT OF HIGH AND LOW ABILITY SECONDARY SCHOOL STUDENTS IN IMO STATE, NIGERIA

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Abstract

The high rate of failure in external mathematics examination among secondary school students in Nigeria calls for great concern. The sole use of conventional methods by mathematics teachers in teaching could be one of the factors that lead to high rate of failure in mathematics examinations. Against this background, this study determined the effect of prior knowledge of behavioural objectives on Mathematics achievement of high and low ability secondary school students in Imo State, Nigeria. Two research questions and two null hypotheses provided focus to this study. Quasi experimental design specifically the pre-test, post-test non-equivalent control group design was adopted. A sample of 94 (45 male and 49 female) mathematics students with average age of 15 years was used for the study. Two instruments: General Mental Ability Test (GMAT) and Mathematics Achievement Test (MAT) were used for data collection. The instruments were face and content validated by experts. The reliability of MAT was established using Kuder Richardson formula 21 (KR-21) for section A and Cronbach alpha for section B and were found to have

internal consistency of 0.99 and 0.96 respectively. The reliability of GMAT was ascertained using Kuder Richardson formula 21 (KR-21) which yielded an internal consistency of 0.99. Mean was used to answer the research questions while Analysis of Co-variance (ANCOVA) was used to test the hypotheses at 0.05 level of significant. Results showed that: High ability students who had prior knowledge of behavioural objectives performed better than the high ability students who did not have prior knowledge of behavioural objectives; Low ability students who had prior knowledge of behavioural objectives performed better than the low ability students who did not have prior knowledge of behavioural objectives. Based on the findings, the researcher recommended that mathematics teachers should expose learners to the knowledge of behavioural objectives before the lesson's content development begins.

Keywords

Behavioural Objective, Mental Ability, Prior Knowledge

1. Introduction

The function of mathematics in the development of science and technology as well as arts and humanities cannot be overemphasized. Mathematics is continuously and rapidly growing because of intellectual curiosity, practical application and inventions of new ideas associated with it. Moseri, Onwuka and Smart (2010) opined that there will be meaningful development in science and technology if there would also be a corresponding development in mathematics. The application of mathematics in scientific activities shows that everybody in the society needs mathematical knowledge to be able to function well in the society.

Despite the importance of mathematics, it is very disheartening to note that students' achievement in mathematics at external examinations has remained consistently poor. Olosunde and Olaleye (2010) reported that the failure rate of mathematics students in percentage was 25.13% in 2001 to 34.74% in 2006 with annual increase rate of 2%. Similarly, the West African Examinations Council (WAEC) Annual Reports of 2010 – 2014 reveals that only 24.93%, 30.71%, 38.81%, 38.591% and 37.05% respectively of the total enrolment in mathematics for the respective years obtained credit pass and above grades (A1- C6) in West African Senior Secondary Certificate Examination (WASSCE). Among the factors that have been found to account for this poor achievement in mathematics, teaching method, particularly the sole use of expository method by mathematics teachers in teaching mathematics has been deemed to be the most crucial.

Expository method of teaching is a teacher-centered, student-peripheral teaching approach in which the teacher delivers a pre-planned lesson to the students with or without the use of instructional materials (Onyemerekeya, 2008). Obasi (2014) opined that 95% of mathematics teachers still make use of only sole expository method in teaching mathematics. There is therefore an urgent need to seek for ways of modifying the expository method of teaching mathematics in order to improve students' performance.

It is pertinent to observe that classes (especially mathematics classes) in our present day secondary schools are large and thus students of various abilities constitute such classes (Mankilik & Umaru, 2011). In line with this, Bello and Abimbola (2007) equally stressed that in the Nigeria educational system, classrooms are generally composed of students of different abilities. It is expected that abilities of students should be considered in studies involving their academic achievement.

Mental ability describes a person's ability to learn and remember information, to recognize concepts and apply the information to one's own behaviour in an adaptive way (Newman, 2006). Aremu and Sangodoyin, (2010); Sophie, Benedikt, Chamorro-Premuzic and Tomas (2011) described two mental abilities, namely: high mental ability and low mental ability. According to them, high mental ability learners are able to deal with several things at the same time, think divergently, reason in abstract forms, and manipulate their environment effectively. They also perceive, think quickly in order to recognizing the similarities and differences in objects. Low mental ability learners on the other hand, are able to recall fairly previous knowledge in terms of what was read and heard. They gradually grasp ideas and concepts being taught in class.

In line with the foregoing, using all students in a class without considering their different abilities is capable of making research results from studies involving teaching methods and strategies unreliable. This is because the performance of high ability students may have been responsible for any observed significant difference in mean achievement scores in such studies whereas the low ability students in that class may have contributed little or nothing. This may have informed Onwukwe's (2010) conclusion that mental ability is a strong variable in academic achievement of secondary school students. It therefore became necessary to carry out this study, taking into consideration the ability of students.

The strategy advocated in this study involves giving to students behavioural objectives of lessons to emphasize on what is actually required of them instead of wondering over the learning materials. Prior knowledge is a fundamental knowledge that stems from previous experience. Prior knowledge could also be described as a combination of the learner's pre-existing attitudes and

experiences. Operationally in this study, prior knowledge is defined as the learner having an idea of what he or she is expected to achieve at the end of the lesson (behavioural objectives) before the commencement of the lesson.

Behavioural objectives usually form the starting point of the lesson plan for effective teaching. Planning of the lesson involves primarily, the setting of objectives while every other component involves how to achieve the set objectives and how to know if the objectives have been achieved. Amadi (2006) defined behavioural objective as a statement of proposed change expected from learners after they have been exposed to learning for specified period of time. This change desired and valued by the teacher is expected to occur in thoughts, actions and feelings of the students. Behavioural objectives are performance – oriented; beginning with an action verb, written in the future tense and typically specifying the derived level of performance (Smaldino, 2007).

In this study therefore, prior knowledge of behavioural objectives is a teaching strategy which involves giving the students properly formulated behavioural objectives by the teacher before the content development of any lesson. Mbakwem (2005) reported that prior knowledge of behavioural objectives provides students with a means to organize their own efforts towards the accomplishment of the objectives. Similarly, Uche and Uromen (2007) opined that prior knowledge of behavioural objectives enables students to focus their energies and have more accurate idea of what is expected of them to achieve at the end of the lesson. The need arises to find out if mathematics achievement of high and low ability secondary school students would improve if they have prior knowledge of behavioural objectives of their lessons.

1.1 Research Questions

The following research questions guided this study:

1. What is the difference between the mean achievement scores in mathematics of high mental ability students who had prior knowledge of behavioural objectives and high mental ability students who did not have prior knowledge of behavioural objectives?
2. What is the difference between the mean achievement scores in mathematics of low mental ability students who had prior knowledge of behavioural objectives and low mental ability students who did not have prior knowledge of behavioural objectives?

1.2 Hypotheses

The following null hypotheses were formulated to guide the study. They were tested at 0.05 level of significance.

1. The mean achievement scores in mathematics of high mental ability students who had prior knowledge of behavioural objectives and those who did not have prior knowledge of behavioural objectives do not differ significantly.
2. The mean achievement scores in mathematics of low mental ability students who had prior knowledge of behavioural objectives and those who did not have prior knowledge of behavioural objectives do not differ significantly.

2. Method

The design of this study was quasi-experimental. Specifically, pre-test post-test non-equivalent control group design was used. The study was carried out in senior secondary schools in Owerri Education Zone of Imo State, situated in South-East of Nigeria.

The sample for the study was made up of 94 Senior Secondary two (SS2) students with average age of 15 years. Two intact classes were sampled from each of the two schools randomly selected for the study. One intact class formed the experimental group and the other, the control group.

Two instruments: Mathematics Achievement Test (MAT) and General Mental Ability Test (GMAT) were used for the study. Mathematics Achievement Test was divided into two sections – A and B. Section A contains 30 multiple-choice questions with four response options while section B contains four essay questions. General Mental Ability Test consists of 20 multiple-choice questions adapted from Indiabix Technology (2014). GMAT was used to separate students into different abilities (high and low) in both the experimental and control groups, while MAT was used to collect achievement scores of the subjects. These instruments were face and content validated by experts. The reliability coefficient of MAT was established using Kuder Richardson formula 21 (KR-21) in section A and Cronbach alpha in section B and were found to be 0.99 and 0.96 respectively. The reliability coefficient of GMAT was ascertained using Kuder Richardson formula 21 (KR-21) and was also found to be 0.99.

The instructional tools used for teaching the students were prior knowledge of behavioural objectives cards and lesson plan. Prior Knowledge of Behavioural Objectives Cards are 5 by 5 inch cards made up of different colours produced by the researchers. They contained the behavioural objectives of each lesson. There were 12 of these cards covering the 12 sets of behavioural objectives expected to be mastered by the students at the end of the lesson.

The experimental and control groups were taught the same topics (Sequence and Series, Arithmetic Progression, Geometric Progression and Quadratic Equation) using the same

instructional materials and lesson plan. In addition, prior Knowledge of Behavioural Objectives Cards which covered the behavioural objectives expected to be mastered by the students at the end of the lessons were used in teaching the experimental group only. At the end of the treatment which lasted for six weeks, posttest was given to both groups. Data were analysed using mean and ANCOVA.

3. Results

Research Question 1

What is the difference between the mean achievement scores in mathematics of high ability students who had prior knowledge of behavioural objectives and high ability students who did not have prior knowledge of behavioural objectives?

Table 1: *Mean Achievement Scores in Mathematics of High Ability Students in Experimental and Control Groups*

Group	N	Pretest		Posttest		Mean($\overline{X}$) Difference Within Group	Mean($\overline{X}$) Difference Between Group
		$\overline{X}$	SD	$\overline{X}$	SD		
Experimental	13	26.4	4.0	84.5	9.23	58.1	24.68
Control	12	25.0	4.17	58.42	10.22	33.42	

Table 1 shows that the difference between the mean achievement scores in mathematics of high ability students who had prior knowledge of behavioural objectives and that of high ability students who did not have prior knowledge of behavioural objectives is 24.68.

Research Question 2

What is the difference between the mean achievement scores in mathematics of low mental ability students who had prior knowledge of behavioural objectives and low mental ability students who did not have prior knowledge of behavioural objectives?

Table 2: *Mean Achievement Scores in Mathematics of Low Ability Students in Experimental and Control Groups*

Group	N	Pretest		Posttest		Mean($\overline{X}$) Difference Within Group	Mean($\overline{X}$) Difference Between Group
		$\overline{X}$	SD	$\overline{X}$	SD		
Experimental	33	10.1	1.68	51.3	8.55	41.2	10.1
Control	36	10.9	1.82	42.0	7.0	31.1	

Table 2 shows that the difference between the mean achievement scores in mathematics of low ability students who had prior knowledge of behavioural objectives and that of low ability students who did not have prior knowledge of behavioural objectives is 10.1.

Hypothesis 1

The mean achievement scores in mathematics of high ability students who had prior knowledge of behavioural objectives and those who did not have prior knowledge of behavioural objectives would not differ significantly.

Table 3: *One-way Analysis of Covariance (ANCOVA) for Mean Achievement Scores in Mathematics of High Ability in Experimental and Control Groups*

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1180.076[a]	2	590.038	8.949	.001
Intercept	1974.038	1	1974.038	29.939	.000
Pre test (Covariate)	191.026	1	191.026	2.897	.103
Ability	839.250	1	839.250	12.728	.002
Error	1450.564	22	65.935		
Total	117823.000	25			
Corrected Total	2630.640	24			

a. R Squared = .449 (Adjusted R Squared = .398) P=0.02 < 0.05

The analysis from Table 3 shows that p-value (0.002) is less than the alpha level (α = 0.05). The decision therefore is that the null hypothesis is rejected. Thus, the mean achievement scores in mathematics of high ability students taught with prior knowledge of behavioural objectives and those taught without prior knowledge of behavioural objectives differ significantly.

Hypothesis 2

The mean achievement scores in mathematics of low ability students who had prior knowledge of behavioural objectives and those who did not have prior knowledge of behavioural objectives would not differ significantly.

Table 4: *One-way Analysis of Covariance (ANCOVA) for Mean Achievement Scores in Mathematics of Low Ability in Experimental and Control Groups*

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1420.918[a]	2	710.459	8.862	.000
Intercept	22271.940	1	22271.940	277.813	.000
Pre test (Covariate)	211.722	1	211.722	.146	.703
Ability	1375.395	1	1375.395	17.156	.000
Error	4970.467	62	80.169		
Total	147636.000	65			
Corrected Total	6391.385	64			
a. R Squared = .222 (Adjusted R Squared = .197) P=0.00 < 0.05					

The analysis from Table 4 shows that p-value (0.000) is less than the alpha level (α = 0.05). The decision therefore, is that the null hypothesis is rejected. Thus: the mean achievement scores in mathematics of low ability students taught with prior knowledge of behavioural objectives and those taught without prior knowledge of behavioural objectives differ significantly.

4. Discussion

Major finding from this study is that high and low mental ability students who had prior knowledge of behavioural objectives achieved significantly higher than the high and low mental ability students who did not have prior knowledge of behavioural objectives. The reason that could be advanced for this finding is that high and low mental ability students who had prior knowledge of behavioural objectives were able to organize their efforts and channel their energies toward achieving the expected objectives. Another possible reason could be that prior knowledge of behavioural objectives may have generated the interest of students irrespective of mental ability. A study by Crow (2004) showed that interest-triggered learning activity leads to a higher degree of deep-level learning. Teaching and learning that had to incorporate interest-triggered learning activity enhance knowledge bond formation easily (Onwukwe, 2010). Exposing students to the knowledge of behavioural objectives before lesson could be one of such activities and should therefore be encouraged.

5. Conclusion

From the findings and discussion made, the researchers concluded that prior knowledge of behavioural objectives is an effective strategy that can be used to enhance academic achievement of high and low ability students in mathematics. In other words, low ability students will improve on their performance if they are exposed to the knowledge of behavioural objectives before commencement of their lessons while high ability students will perform even better than they can

ordinarily do. Therefore, secondary school mathematics teachers should combine prior knowledge of behavioural objectives with their usual sole expository method of teaching to enhance academic achievement of secondary school students in mathematics.

6. Recommendations

Following the findings from the analysis of the data for this study and the conclusions reached by the researchers, the following recommendations are made.

- Mathematics teachers should see it as a duty to let their students have prior knowledge of behavioural objectives before content development of a lesson commences.
- Ministry of Education policy makers should organize seminars, workshops and conferences on the use of prior knowledge of behavioural objectives strategy for serving teachers and teacher educators.
- Authors of Mathematics textbooks should include the behavioural objectives pertaining to the topics in their textbooks in order to encourage the teachers to use them.

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