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Effect of Prior Knowledge of Behavioural Objectives on Students' Achievement in Basic Science among Private Schools in Yenagoa Local Government Area of Bayelsa State

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Abstract
The study investigated the effects of prior knowledge of behavioural objectives on junior secondary school students' achievement in basic science. The moderating effect of gender was also examined on the dependent variable. A pretest-posttest, control group, quasi-experimental design was adopted. One hundred and five (105) JS2 private school students in Yenagoa Local Government Area of Bayelsa State, Nigeria, was purposively selected for the study. Four schools were randomly assigned to experimental and control groups and the study lasted for eight weeks. Three instruments were used for the study. They were two Instructional Guides and Basic Science Achievement Test (BSAT) with a reliability of 0.75 using Kuder-Richardson Formula 21(KR-21). Two research questions were answered and two null hypotheses were tested at 0.05 level of significance. Mean and standard deviation were used to analyze the research questions and Analysis of Covariance (ANCOVA) for the hypotheses. Treatment had significant effect on students' achievement in Basic Science F (1,102) = 80.574; p < 0.05; and partial eta squared = 0.441). A non-significant effect of gender was observed. The findings showed that prior knowledge of behavioural objectives improved students' achievement in Basic Science more than without the prior knowledge of behavioural objectives. It was recommended among others that, teachers should expose students to behavioural objectives before instruction to improve students' achievement in Basic Science in Junior Secondary Schools.

Keywords: Prior Knowledge, Behavioural Objectives, Students' Achievement, Gender and Basic Science

Introduction

Basic science lays the foundation for future work in science as it prepares its' recipient with requisite knowledge, skills and attitude in subsequent levels of education in science. In Nigeria basic education curriculum, basic science assumes a core subject status. To Akporehwe and Akporehwe (2015), this is premised upon the fact that it is principally by means of science and technology that people can achieve national development. It has been asserted by Turner in Holbrook (2011) that school science represents one of a vital pipeline which channels science oriented students from schools through primary to post-secondary institutions and ultimately supplying highly trained scientific and engineering personnel to the economy. Accordingly, Oludipe (2012) asserted that for a student to be able to study single science subjects at the senior secondary school level successfully, such a student has to be well grounded in basic science at the upper basic level. The National Policy on Education

(2004) emphasized that basic science should be directed at enabling students to acquire the following skills:

1. Observe carefully and thoroughly;
2. Report completely and accurately what is observed;
3. Organize information acquired;
4. Generalizing on the basic of information acquired;
5. Predicting as a result of generalization;
6. Designing experiments (including control to when necessary to check prediction;
7. Using models to explain phenomena where appropriate; and
8. Continuing the process of inquiry when new data do not conform to predictions.

Acquisition of these skills will require a well-designed programme of teaching which enables pupils internalize the learning material with less difficulty. Learning theories and principles aimed at enhancing meaningful learning have advocated specification of the learning tasks in ways that will be clearer and achievable by the learner. For instance, Gagne (1977) proposed the use of intellectual skills as the basic element of learning. He proposed that before a particular skill can be learned, the prerequisite skill must be mastered; arguing that prior knowledge determines what further learning may take place.

The use of behavioural objectives has been a long standing practice by teachers to direct their activities in terms of the expected learning outcomes of students. Amadi (2006) defines behavioural objective as a statement of proposed change expected of learners after they have been exposed to learning for a specified period of time. This change desired and valued by the teacher is expected to occur in thoughts, action and feelings of the students. Smaldino (2007) asserts that, behavioural objectives are performance oriented, beginning with an action verb written in the future tense, typically specifying the desired level of performance. Few examples can illustrate the concept of behavioural objectives in basic science as follows:

i. State three effects of heat after applying heat to different substances.
ii. Mention four ways of producing heat after engaging in activities that lead to heat production,
iii. Mention three ways in which heat is transferred after demonstrating how heat is used at home,
iv. State how heat can be measured after being exposed to the concept of temperature (Akporehwe, 2013)

As important as these destinations, specifying where one intends to go are to the teachers, the researchers hold the view that, students should be acquainted with these destinations before the commencement of instruction. Inyang-Abia (1988) avers that, if you know what you want, you can always tell when you get it; you can also reject those ones you do not want. These destinations (objectives) he said are usually prepared or determined by the teacher, and in most cases reserved for themselves, principals and school inspectors, but never for the students. Prior knowledge of behavioural objectives is an approach which involves giving the students properly formulated behavioural objectives by the teacher before the content development of any lesson. Mbakwe (2015) reported that prior knowledge of behavioural objectives provide students with a means to organize their own efforts towards

the accomplishment of the objectives. Similarly, Uche and Umoren (2007) opined that, prior knowledge of behavioural objectives enable students to focus their energies and have more accurate idea of what is expected of them to achieve at the end of the lesson.

Empirically, studies abound to assess the efficacy of improving students' achievement through prior knowledge of behavioural objectives. Igbojinwaekwu (2012) investigated the effect of prior knowledge of behavioural objectives on students' academic achievement in chemistry at the senior secondary school level and found a positive effect on the experimental group exposed to prior knowledge of behavioural objectives. Similar, studies were carried out by Anchor and Ogbeba (2012) in biology, Nkwo, Akinbola and Ikitide (2008) in physics and Umoren and Ogong (2007) all observed a positive correlation with students' achievement in science.

Despite the convincing empirical evidence of the efficacy of prior knowledge of behavioural objectives on students' achievement, criticisms abound on the efficacy of behavioural objectives. Tumposky (1998) objected that many educators and educational administrators have accepted the above mentioned justifications without a thorough examination of their own motives for doing so or of the empirical data in the literature, and without considering the possible limitations of such a narrow definition. He further asserts that, research on the effects of behavioural objectives on learning has been inconclusive, and there is little empirical data to support it. Other criticisms are that, learning is rendered too mechanistic, realistic teaching situation involves learning outcomes which could not have been anticipated when the objectives were originally formulated, they are incompatible with different styles of learning and teaching and that behavioural objectives stifle creativity and innovation by imposing a rigid style of teaching among other criticisms. It is the intension of the researchers to empirically investigate the place of prior knowledge of behavioural objectives in basic science. Besides, all the studies cited are carried out elsewhere, and not in Bayelsa State and on the various specific science subjects. Also, the effect of the moderator variable of gender is investigated since gender differentials on students' achievement in science are not conclusive.

Statement of the Problem

There have been reported cases of poor achievement of students in basic science (Aja, 2011 and Ojerinde, 2008). Also, the West African Examination council (WAEC, 2007) reports of 2007 revealed high failure rates in science subjects, and is attributed to poor backgrounds in basic science. It is worthy of note that in the Federal Unity Colleges in Nigeria, a student can only transit to senior secondary classes to be placed in science class only after having satisfied the condition of passing Mathematics, English Language and Basic Science and Technology. This low achievement of students in science at the foundational level will definitely stifle the nation's hope of building a strong and self-reliant nation. Various measures have been tried to stem this downward trend. It is the intention of the researchers to investigate the effect of prior knowledge of behavioural objectives on students' achievement in basic science concepts of flooding and ozone layer depletion. Also, the moderating effect of gender was determined on the dependent variable.

Research Questions

Two research questions were posed to guide the study.

1. What difference exists in students' achievement in basic science when taught with prior knowledge of behavioural objectives and those taught without prior knowledge of behavioural objectives?
2. What difference exists between male and female students' achievement in basic science when taught with prior knowledge of behavioural objectives and those taught without prior knowledge of behavioural objectives?

Null Hypotheses

The following two null hypotheses were tested at 0.05 significant level

$H0_1$. There is no statistically significant difference in students' achievement when taught basic science with prior knowledge of behavioural objectives and those taught without prior knowledge of behavioural objectives.

$H0_2$. There is no statistically significant difference between male and female students' achievement in basic science when taught with prior knowledge of behavioural objectives and those taught without prior knowledge of behavioural objectives.

Methodology

The study adopted a pretest-posttest, control group, quasi-experimental design. A 2x2 factional matrix was adopted with (prior knowledge of behavioural objectives and without prior knowledge of behavioural objectives) as treatment and gender (male and female) as moderator variable. Four private schools in Yenagoa Local Government Area of Bayelsa State were purposively selected and assigned to treatment and control groups. The selection was based on the following criteria.

1. The schools must be private schools
2. The teachers must be specialist in basic science education and having been teaching basic science for at least five (5) years and
3. The teachers must be willing to be involved in the experiment

One intact class of junior secondary two (JS2) students was randomly selected and two (2) schools were randomly assigned to treatment and control groups. A total of one hundred and five (105) students (males=53, females=52) were involved in the study.

Three instruments were used in this study; namely;

1. Basic Science Achievement Test (BSAT),
2. Instructional Guide on Prior Knowledge of Behavioural Objectives (IGPKBO)
3. Instructional Guide on Without Prior Knowledge of Behavioural Objectives (IGWPKBO)

IGPKBO and IGWPKBO were used as teaching guides for the experimental and control groups respectively. The Basic Science Achievement Test (BSAT) had a reliability of 0.75

using Kuder-Richardson Formula 21(KR-21). All the instruments were duly validated by expert review.

Research Procedure

The first two weeks were used for training the participating teachers in each of the schools by the researchers on the use of IGPKBO and IGWPKBO. The third week was used for the administration of pre-test by the teachers and researchers on BSAT. The next four weeks (weeks 4-7) were used for the administration of treatment to experimental group; Prior Knowledge of Behavioural Objectives (PKBO) and control group; Without Prior Knowledge of Behavioural Objectives (IGWPKBO) and week eight was used for the administration of posttest on BSAT by the teachers and researchers. The data collected were analyzed using Analysis of Covariance (ANCOVA). This was adopted to test the hypotheses using pre-test scores as covariates. The research questions were analyzed using mean and standard deviation

Results

Research Question 1: What difference exists in students' achievement in Basic science when taught with Prior Knowledge of Behavioural Objectives and those taught without Prior Knowledge of Behavioral Objectives?

Table 1: Summary of mean and standard deviation of pretest and posttest scores on the effect of Treatment on students' achievement in Basic science.

Treatment	N	Pretest scores		Posttest Scores		Mean gain scores
		$\bar{X}$	SD	$\bar{X}$	SD	
With Prior Knowledge of Behavioural Objectives	58	33.38	12.87	61.59	13.76	28.21
Without Prior Knowledge of Behavioural Objectives	47	29.36	13.29	44.64	10.94	15.28
Total	105	31.58	13.15	54.00	15.11	22.42

The data presented in Table 1 shows that the post-test mean score of students taught with Prior Knowledge of Behavioural Objectives 61.59 is greater than the post-test mean score of students taught without Prior Knowledge of Behavioural Objectives 44.64. The data further indicates that the mean gain score of students taught with Prior Knowledge of Behavioral Objectives 28.21 is greater than the mean gain score of students taught without Prior Knowledge of Behavioural Objectives 15.28. This implies that students taught with Prior Knowledge of Behavioural Objectives achieved better than their counterparts taught without Prior Knowledge of Behavioural Objectives.

Research Question 2: What difference exists between male and female students' achievement in Basic science when taught with Prior Knowledge of Behavioural Objectives and those taught without Prior Knowledge of Behavioural Objectives?

Table 2: Summary of mean and standard deviation of pretest and posttest scores on the effect of Treatment on male and female students' achievement in Basic science.

Treatment	Gender	N	Pretest scores		Posttest Scores		Mean gain scores
			$\bar{X}$	SD	$\bar{X}$	SD	
With Prior Knowledge of Behavioural Objectives	Male	27	35.56	13.20	64.37	14.15	28.81
	Female	31	31.48	12.47	59.16	13.15	27.68
	Total	58	33.38	12.87	61.59	13.76	28.21
Without Prior Knowledge of Behavioural Objectives	Male	26	31.31	13.53	45.85	11.16	14.54
	Female	21	26.95	12.91	43.14	10.74	16.19
	Total	47	29.36	13.29	44.64	10.94	15.28
Total	Male	53	33.47	13.41	55.28	15.73	21.81
	Female	52	29.65	12.72	52.69	14.49	23.04
	Total	105	31.58	13.15	54.00	15.11	22.42

The data presented in Table 2 reveals that the post-test mean score of male students taught with Prior Knowledge of Behavioural Objectives 64.37 was greater than their female counterparts with 59.16. Also, the post-test mean score of male students taught without Prior Knowledge of Behavioural Objectives 45.85 is greater than those of their female counterparts with 43.14. On the whole, the post-test mean score of male students taught with Prior Knowledge of Behavioral Objectives and without Prior Knowledge of Behavioral Objectives is 55.28 greater than their female counterparts with 52.69. The table further indicates that, the mean gain score of female students taught with both treatments 23.04 was greater than those of their male colleagues with 21.81. This simply implies that, the achievement of female students was slightly less than those of their male colleagues when taught with both treatments.

Null Hypothesis 1: there is no statistically significant difference in students' achievement in Basic science when taught with Prior Knowledge of Behavioural Objectives and those taught without Prior Knowledge of Behavioural Objectives.

Table 3: One-way analysis of covariance (ANCOVA) of post-test scores of students' achievement in Basic science when taught with Prior Knowledge of Behavioural Objectives and those taught without Prior Knowledge of Behavioural Objectives**.**

Source of variation	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Decision at P < 0.05
Corrected Model	17547.671	2	8773.835	144.243	0.000	0.739	
Intercept	13103.991	1	13103.99	215.431	0.000	0.679	
Pretest Scores	10090.591	1	10090.59	165.891	0.000	0.619	
Treatment	4901.027	1	4901.027	80.574	0.021	0.441	*
Error	6204.329	102	60.827				
Total	329932.000	105					
Corrected Total	23752.000	104					

*R Squared = 0.739 (Adjusted R Squared = 0.734) *= Significant at p < 0.05 alpha level*

The data in Table 3 shows that treatment was significant on students' achievement in Basic science ($F_{1,102}$ = 80.574; p < 0.05; partial eta squared = 0.021), which gives an effect size of 44.1 percent. Therefore, the null hypothesis, which states that, there is no statistically significant difference in students' achievement in Basic Science when taught with Prior Knowledge of Behavioural Objectives and those taught without Prior Knowledge of Behavioural Objectives was rejected. The alternative hypothesis which states that, there is a statistically significant difference in students' achievement in Basic science when taught with Prior Knowledge of Behavioural Objectives and those taught without Prior Knowledge of Behavioural Objectives is upheld.

Null Hypothesis 2: There is no statistically significant difference between male and female students' achievement in Basic Science when taught with Prior Knowledge of Behavioural Objectives and those taught without Prior Knowledge of Behavioural Objectives.

Table 4: 2 x 2 factorial analysis of covariance (ANCOVA) of post-test scores of male and female students' achievement in Basic science when taught with Prior Knowledge of Behavioural Objectives and those taught without Prior Knowledge of Behavioural Objectives.

Source of Variation	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Decision P < 0.05
Corrected Model	17617.37	4	4404.344	71.795	0.000	0.742	
Intercept	13024.60	1	13024.607	212.313	0.000	0.680	
Pretest Scores	9683.821	1	9683.821	157.855	0.000	0.612	
Treatment	4881.375	1	4881.375	79.571	0.000*	0.443	
Gender	15.477	1	15.477	0.252	0.617	0.003	
2Way-interactions Treatment* Gender	47.587	1	47.587	0.776	0.000	0.008	*
Error	6134.625	100	61.346				
Total	329932.00	105					
Corrected Total	23752.00	104					

*R Squared = 0.742 (Adjusted R Squared = 0.731) *= Significant at p < 0.05 alpha level*

The data in Table 4 shows that the interaction was significant on male and female students' achievement in Basic science ($F_{1,100} = 0.776$; $p > 0.05$; partial eta squared = 0.008), which gives an effect size of 0.8 percent. Therefore, the null hypothesis, which states that there is no statistically significant difference between male and female students' achievement in Basic Science when taught with Prior Knowledge of Behavioural Objectives and those taught without Prior Knowledge of Behavioural Objectives was accepted.

Summary of Findings

1. There is statistically significant difference in students' achievement when taught basic science with prior knowledge of behavioural objectives and those taught without prior knowledge of behavioural objectives.

2. There is statistically significant difference between male and female students' achievement in basic science when taught with prior knowledge of behavioural objectives and those taught without prior knowledge of behavioural objectives.

Discussion of Findings

The findings of the study revealed that there was a statistically significant difference in students' achievement when taught basic science with prior knowledge of behavioural objectives and those taught without prior knowledge of behavioural objectives. This is in agreement with the findings of Uche and Umoren (2007); Umoren and Ogong (2007); and Igbojinwaekwu (2010) that prior knowledge of behavioural objectives enhanced students' achievement better than students' taught without the awareness of behavioural objectives. It also lays credence to Uche and Umoren (2008) assertion that prior knowledge of behavioural objectives enable students focus their energies on learning and have more accurate idea of what is expected of them at the end of the lesson.

The findings from research question two show that males' students had slightly higher mean score than male and females students of the group not taught with prior knowledge of behavioural objectives. This difference is significant as shown in the interaction between treatment and gender in Table 4. This finding agrees with Alachi, Ugwu, Chukwunenye and Anozie (2017) that male students did significantly perform better than female students. In the same vein, Nwagbo and Chukelu (2011) found a significant effect of gender on students' acquisition of science process skills when taught with practical method.

Conclusion

Exposing students to prior knowledge of behavioural objectives is more effective in improving students' achievement in Basic science more than teaching without prior knowledge of behavioural objectives. Exposing students to prior knowledge of behavioural objectives is suitable for both male and female students and can be used to eliminate gender difference in achievement.

Recommendations

Based on the findings, it is recommended that

1. Teachers should be encouraged to expose students to behavioural objectives before instruction.
2. More research works should be conducted to seek alternative ways of improving students' achievement in science in significant ways.
3. More comparative studies on the influence of prior knowledge of behavioural objectives should be carried out in both public and private schools.

4. Teachers should adopt interventions that care for both girls and boys alike to close any gender gap in science achievement.

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