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Effect of Stimulus Variation Strategy on Students' Academic Achievement in Energy in Nasarawa State, Nigeria

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Abstract

The study investigated the effect of stimulus variation strategy on students' academic achievement in Energy in Nasarawa State, Nigeria. 17,807 males and 13,924 females were used as the population of the study. The sample comprised two intact classes with 138 JSII Students using multistage random sampling technique. The design used was a quasi- experimental pretest, posttest post posttest non-equivalent control design. Two research questions with correspondent hypotheses were used.The instruments used were: Energy Achievement Test (EAT). The validity and reliability indices were 0.83 and 0.81 using content validity and using Kuder-Richardson K_R20. Description statistics of mean and standard deviation were used to answer the research questions, while inferential statistics of ANCOVA was used to test the hypothesis at 0.05 level of significant. The findings among others revealed that students who were taught Energy using stimulus variation strategy performed better than those taught using conventional method. The study therefore concludes that teaching students of Basic Science using stimulus variation strategy improved students' academic achievement of knowledge in Energy. Based on this finding, it is recommended among others that Energy teachers should be encouraged and develop and adopt the use of stimulus variation strategy in teaching Energy. Government should endeavor to organize regular workshops to train Energy teachers on development and use of these strategies at JSII level.

Keywords: Stimulus, variation, strategy, academic, achievement.

Introduction

Trends of development in the developed and developing countries show that Science, Technology and Mathematics (STM) have been employed by many countries for rapid economic and technological transformation. The technological development of any nation lies in the study and application of science. Science is discovery. Science is a tool from which man learns from his environment. Bajah (1982) define science as the study of our environment. Science is a dynamic human activity concerned with the understanding of the workings of our world. This understanding helps the scientist to probe further into nature for things and events and to control and harness such things and events for the benefit of human kind (Ogunniyi, 1986). Science and technology is incomplete without Basic science.

Stimulus variation, in the Stanford sense, focuses mainly on those things the student teacher is trained in to do in a class, and how he/she use movement of the body within the classroom in a systematic way and the avoidance of teaching from one spot, the use of gestures, and the development of verbal and non-verbal methods of focusing students' attention, the development of teaching methods other than the teacher monologue by encouraging pupil participation, the systematic use of pauses, and the controlled use of different sensory channels by switching primary

modes of communication (Thurmond &Wambach 2013). The skillful change in the stimuli is known as the skill of stimulus variation. Just to avoid boredom, it is the teacher's skills to stimulate the students, increase their active participation, enthusiasm and spirit of study. The chief aim of the teacher's teaching in the class room is to make the lesson impressive and interesting. For this, use of various types of strategies such as stimulus variation is essential. However, under the stimulus variation the following components of stimulus variation were used: body movement, teacher gesture, change in speech strategies, focusing and switching.

For a dialogic discourse, teachers need to be aware of the function of talk in education and how it guides and supports teaching (Alexander, 2012). Even though the significance of patterns variables in classrooms is emphasized, research shows that 85% of the class time is devoted to monologue elements, namely, lecture, recitation and seatwork. The main purpose of teaching is transmission of knowledge to the learners. For effective teaching and learning to take place, the teacher needs to use different methods and techniques in teaching, unfortunately this has not been so. Therefore, poor achievement in Basic Science has been attributed to poor approach to teaching strategies employed by teachers (Samuel, 2017; Alabi, 2014; Osokoya, 2013). The present Nigerian Basic Science classroom does not provide hand-on-mind-on challenging, interactive and stimuli environment needed by new generation of students. The problem of students' underachievement can be solved using student-centered learning approaches.

Academic achievement refers to the extent to which a student teacher or institution has achieved the educational goal. The meaning of academic achievement can be appreciated in how well one does in school and how students in particular deal with their studies. It is however important to note that all students are required to maintain a satisfactory academic record and meet the obligations of the courses for which they enroll. Considering government's huge investment in education, its output in terms of quality of students has been observed to be unequal to its expenditure. Consequent upon the observed deterioration in the academic achievement of secondary school students in public secondary schools, one wonders if the high failure rates and the poor quality of the students are not a reflection of the consequences of their unhealthy and discouraging disposition toward academics. In other words, the widely acclaimed deteriorated standard of education in Nigeria, to a large extent, depends on factors resident in learning strategy (Gibbs, 2011). Academic achievement has become an index of a child's future in a highly competitive world and one of the most important goals of the educational process. It is also a major goal, which every individual is expected to perform in all cultures.

There are many different forms of energy, including: Heat energy, Light energy, Motion energy, Electrical energy, Chemical and Gravitational energy. These forms of energy can be grouped into two: Potential or stored energy and Kinetic or working energy. Andrew, (2018) defined energy as the capacity of a physical system to perform work. Modern civilization is possible because people have learned how to change energy from one form to another and then use it to do work, energy is an abstract concept treated in junior secondary school. Walker et al, (2014) asserted that "Energy is a number that we associate with a system of one or more objects." They continue "If a force changes one of the objects by, say, making it move, then the energy number changes. After countless experiments, scientists and engineers realized that if the scheme by which we assign energy numbers is planned carefully, the numbers can be used to predict the outcomes of experiments and, even more important, to build machines, such as flying machines.", thus relating energy to changes. They explain "This success is based on a wonderful property of our universe: energy can be transformed from one type to another and transferred from one object to another, but the total amount is always

the same (energy is conserved). No exception to this principle of energy conservation has ever been found."

Globally, there have been debates on students' achievement in science with respect to gender, which has continued to be of interest (Akani, 2017). Alabi (2014) observed that male students achieve better in science than their female counterparts. Cases where female students dominate their male counterparts in terms of achievement in science are rare. Many factors responsible for the dominance of male students in science are; gender imbalance, task difficulty, cognitive competence, perceived negative attitude toward female students by their teachers amongst others (Udo, 2010). Poor approach to teaching invariably translates to students' inability to put into practice what they have learnt. In most cases, what is taught in the classroom cannot be transferred to real life situations by the students. The under-achievement in Basic Science among JS 2 School students raises doubt on the efficacy of the learning strategies utilized by Basic Science teachers which if not mitigated will jeopardize the students' placement of 60:40 in favour of the sciences at the tertiary level of learning as stipulated in the National Policy on Education. This will affect the competitiveness required to develop national capability and self-sufficiency in Science, Technology and Innovation. This study therefore was set out to find the effect of stimulus variation strategy on students' academic achievement in energy in Nasarawa state, Nigeria.

Theoretical Framework

This study is anchored on B.F Skinner 1957 the theory of operant conditioning. This theory states that learning is a function of change in overt behavior. Changes in behavior are the result of an individual's response to events (stimuli) that occur in the environment. A response produces a consequence such as defining a word, hitting a ball, or solving a mathematical problem. When a particular Stimulus-Response (S-R) pattern is reinforced (rewarded), the individual is conditioned to respond. The distinctive characteristic of operant conditioning relative to previous forms of behaviorism (e.g., connectionism, drive reduction) is that the organism can emit responses instead of only eliciting response due to an external stimulus. Reinforcement is the key element in Skinner's S-R theory. A reinforce is anything that strengthens the desired response. It could be verbal praise, a good grade or a feeling of increased accomplishment or satisfaction. The theory also covers negative rein forcers — any stimulus that results in the increased frequency of a response when it is withdrawn (different from aversive stimuli — punishment — which result in reduced responses). A great deal of attention was given to schedules of reinforcement (e.g. interval versus ratio) and their effects on establishing and maintaining behavior.

Literature Review

Danjuma (2015) recommended that Basic Science students should be encouraged to develop and adopt the use of stimulus variation learning strategy in learning basic science. However, there have been debates on students' achievement in science with respect to gender, which has continued to be of interest (Akani, 2017). Alabi (2014) observed that male students achieve better in science than their female counterparts. Cases where female students dominate their male counterparts in terms of achievement in science are rare. Many factors responsible for the dominance of male students in science are; gender imbalance, task difficulty, cognitive competence, perceived negative attitude toward female students by their teachers amongst others (Udo, 2010). Ishaq (2015) observed that there was no significant difference between male and female students taught basic science using collaborative strategy and therefore, recommended that curriculum planner's and basic science

teachers should in-cooperate collaborative teaching strategy for the teaching of Basic Science concepts among low ability students. Laatsch-Lybech (2010) suggests that classroom interaction method and individual learning produce similar achievement and attitudinal results. Chianson, Kurumeh, and Obida (2010) recommendations that, students would be able to retain, taught and learnt concepts in mathematics for a longer period of time if mathematics teachers applied the cooperative learning strategy in teaching.

Statement of the Problem

Poor approach to teaching invariably translates to students' inability to put into practice what they have learnt. In most cases, what is taught in the classroom cannot be transferred to real life situations by the students. The under-achievement in Basic Science among Upper Basic School students raises doubt on the efficacy of the learning strategies utilized by Basic Science teachers which if not mitigated will jeopardize the students' placement of 60:40 in favour of the sciences at the tertiary level of learning as stipulated in the National Policy on Education. Basic Science teachers still employ conventional teaching method in teaching; these methods are perceived as not encouraging, promoting and improving learners' understanding of the subject, as such students' achievement is not as desired, students are equally not interested. Basic Science concepts cannot be taught in abstract form, there is need for students to conduct themselves in small groups to exchange ideas on given concepts for better understanding and retention. Therefore, students' activity-based learning which will result in the use of mind-on; hands-on activities need to be encouraged. The problem of this study therefore was to find out the Effects of Stimulus Variation strategy on students' Academic achievement in Energy in Nasarawa state, Nigeria.

Research Questions

1. What are the achievement mean scores of students taught energy using stimulus variation strategy and those taught using conventional method?
2. What are the achievement mean scores of male and female students taught energy using stimulus variation strategy?

Objectives

1. Compare the achievement mean scores of students taught energy using stimulus variation strategy and conventional method.
2. Compare the achievement mean scores of male and female students taught energy using stimulus variation strategy

Hypotheses

1. Achievement mean scores of students taught energy using stimulus variation strategy and conventional method has no significant difference.
2. Achievement mean scores of male and female students taught energy using stimulus variation strategy has no significant difference.

Methodology

This study adopted a quasi-experimental research of pre-test, post-test, post-post-test, non-equivalent, non-randomized control group design. This represents one treatment group and one control group Stimulus Variation and control group. All students in the two intact classes were pre-tested to determine their entry level behaviour or status. The experimental group received treatment

on Stimulus Variation strategy, while the control group did not receive any treatment. Also, all the groups were subjected to post-test to determine the effect of the treatment on students' achievement and post-posttest (to determine the effect of the treatment on their retention ability). 17,807 male and 13,924 students were used as the population of the study. The sample comprised two intact classes with 138 JSII Students using multistage random sampling technique. The design used was a quasi- experimental pre-test, post-test and post-posttest non-equivalent control design. Two research questions with correspondent hypotheses were used. The instruments used were: Energy Achievement Test (EAT). The validity and reliability indices were 0.83 and 0.81 using content validity and using Kuder- Richardson K_R20. Description statistics of mean and standard deviation were used to answer the research questions, while inferential statistics of ANCOVA was used to test the hypothesis at 0.05 level of significant. The choice of ANCOVA was because of the nature of the design of the study i.e. Quasi-experimental (specifically non-equivalent control-group design). This is because the design permitted the use of pre-test, which acts as covariate; therefore, ANCOVA helped to establish the homogeneity or equivalence of the two groups before treatment. Besides this, since intact classes were used for the study, ANCOVA also helped to increase the power of the test because of error that might have occurred because of non-randomization of the subjects of the study (i.e. Type1 error was reduced). Statistical Package for Social Science (SPSS-Version 22) was used to run the analysis.

Results

Research Question One

What are the achievement mean scores of students taught energy using stimulus variation strategy and those taught using conventional method?

Table 1: Achievement Mean Scores of Students Taught Energy Using Stimulus Variation Strategy and those Taught Using Conventional Method

Group		Pre-test	Post-test
Stimulus Variation	N	46	46
	Std Deviation	5.699	3.502
	Mean	28.92	23.72
Conventional Method	N	47	47
	Std Deviation	3.203	3.490
	Mean	27.40	21.54

Table 1 shows the achievement mean scores of the students in the experimental and control groups. The students taught using stimulus variation in the post-test had mean scores of 28.92 and 23.72 respectively and standard deviations of 5.699 and 3.502 respectively. Students taught using conventional method had mean scores of 27.40 in the post-test and the standard deviations of 3.203. Students taught using stimulus variation had highest mean score while those taught using conventional method had lowest mean score. The standard deviation scores for the post-test were not at much variance implying that the efficacy of the treatment is sustainable.

Null H_{01}: Achievement mean scores of students taught energy using stimulus variation strategy and conventional method has no significant difference.

Table 2: ANCOVA Results of Students in Stimulus Variation Strategy

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	453.349	3	151.116	11.349	.000
Intercept	748.619	1	748.619	56.224	.000
Posttest	247.610	1	247.610	18.597	.000
Group	161.029	2	80.515	6.047	.000
Error	1784.187	134	13.315		
Total	118733.000	138			
Corrected total	3312.123	137			

Table 2 shows the summary of the one way Analysis of Covariance (ANCOVA) result in the mean ratings of students taught energy using stimulus variation strategy and those taught using conventional method. The results indicated that the noted difference between the mean scores of students taught energy using stimulus variation strategy is not significant at 0.05 alpha level. This means that stimulus have the same effect due to the fact that f = 6.047 and p = 0.000 <0.05. The null hypothesis that achievement mean scores of students taught energy using stimulus variation strategy and conventional method has no significant was therefore accepted.

Research Question Two

What are the achievement mean scores of male and female students taught energy using stimulus variation strategy?

Table 3: Mean Achievement Scores of Male and Female Students Taught Energy Using Stimulus Variation Strategy

Gender		Pre Test	Post Test
Male	N	25	25
	Std. Deviation	3.967	3.708
	Mean	18.19	27.23
Female	N	22	22
	Std. Deviation	3.221	2.942
	Mean	20.21	27.64

Table 3 shows the mean achievement scores of male and female students taught energy using stimulus variation strategy. The pre-test and post-test mean achievement ratings of male students are 18.91 and 27.23 respective. The standard deviations of male students are 3.967 and 3.708. The pre-test and post-test mean achievement ratings of female students taught basic science using stimulus variation are 20.21 and 27.64 respectively and standard deviations of 3.221 and 2.942 in pre-test and post-test mean achievement ratings respectively

H_{02}: Achievement mean scores of male and female students taught energy using stimulus variation strategy has no significant difference

Table 4: ANCOVA Result of the Mean Achievement Scores of Male and Female Students Taught Energy Using Stimulus Variation Strategy

Source	Type III Sum of Squares	Df	Mean square	F	Sig.
Corrected model	178.336	2	89.168	12.396	.000
Intercept	402.691	1	402.691	55.980	.000
Pre Test	171.348	1	171.348	23.820	.000
Gender St V.	3.073	1	3.073	.427	.517

Error	316.516	44	7.194
Total	36397.000	47	
Corrected Total	494.851		

Table 4 shows the ANCOVA result of mean scores of male and female students taught energy using stimulus variation strategy. The table reveals that the noted difference in mean achievement ratings of male and female students is not significant at 0.05. P = .517 > α = 0.05. The null hypothesis was therefore not rejected based on the P-value, indicating that there is no significant difference in the mean achievement scores of male and female students taught basic science using stimulus variation strategy.

Discussion of Findings

There was a significant difference between the mean achievement scores of student's in stimulus variation strategy and conventional method in favour of stimulus variation. This implies that stimulus variation strategy can be used to teach energy concepts in JS II Basic science. This finding is in agreement with Laatsch-Lybech in (2010) who found out that students achieve better when individual learning strategies are used in teaching students with different learning ability. This also support the work of Parimala Fathima and Saravanakumar (2019) who found out that there was significant mean difference between the pre-test and post-test scores of the experimental group and therefore could enhanced student's academic achievement due to the application of stimulus variation technique. Based on these findings, the researcher among others recommended that Basic Science students should be encouraged to develop and adopt the use of stimulus variation learning strategy in learning basic science

There was no significant difference in achievement of male and female students in stimulus variation group. This finding is in agreement with Ishaq (2015) who found that there was no significant difference between male and female students when exposed to stimulus variation strategy. This study however, contradicts the assertion of Udo (2010) who opined that it's very rare for female student's dominance in science. There was no significant difference in male and female students in the conventional group. The findings showed that the male and female students taught with conventional method achieved better. The finding also in line with the research work of Danjuma (2015) who found out that both learning strategies enhanced students' achievement in Basic Science as well as reduced the gender gap that existed between male and female students in Basic Science achievement. The result of the study also showed that the interaction effect of learning strategy and gender was statistically insignificant for students' achievement in Basic Science. This finding also supports the work of Oludipe (2012) who found out that there was no significant difference in academic achievement of male and female students at the pre-test, post-test, and delayed post-test levels respectively. The differences between stimulus variation and conventional method showed that the teacher identified and catered for the student's needs and provided a friendly learning environment, respecting the student's inputs which made the students more confidence.

Conclusion

Based on the findings of this study, stimulus variation strategy enhanced students' achievement. The study revealed that both male and female students achieved, and benefited from stimulus variation strategy. These results imply that the learning approaches employed by Basic Science teachers in

teaching might have been partly responsible for the persistent under-achievement in Basic Science since they were using the conventional methods most of the time. The implications of this study depend on the development of more virile learning approaches for teaching Basic Science. Teaching of Basic science students using stimulus variation strategy was found to be gender friendly in terms of students' achievement. Male and female students benefitted equally from the strategy.

Recommendations

1. Government should endeavour to organize regular workshops to train Energy Concept teachers on development and use of the strategy at JSII level for the adoption of activity-based method such as stimulus variation learning strategy as this encourages and motivates the students in the learning process.
2. Basic Science teachers should always be encouraged male and female students to work together and learn from each other in order to promote understanding and as well as to reduce gender gap during Basic Science lesson.

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