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EFFECTS OF ACTIVITY-BASED LEARNING APPROACHES ON BASIC SCIENCE AND TECHNOLOGY STUDENTS' ACHIEVEMENT IN JUNIOR SECONDARY SCHOOL, NIGER STATE

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Abstract

This study investigated effects of activity-based learning approaches on Basic Science and Technology students' achievement in junior secondary school. Three objectives, three research questions and three hypotheses were set for the study. The population for the study was 1,552 students in Junior Secondary School II in Minna and Bida Local Government Areas of Niger State. The design for the study was quasi-experimental using pretest posttest non-randomized control group with an intact class. The sample consisted of 52 students, (29 experimental group, 23 control group). (Gender16 males and 11 females). Two instruments, Basic Science and Technology and Technology achievement test(BSTAT) and Basic Science and Technology Interest Inventory (BSTII) were used. The instruments were subjected to validity and reliability test. The result obtained from trial testing was used to determine the reliability

coefficient for BSTAT and BSTII using K-R20 (Kuder Richardson) and Cronbach alpha respectively. The reliability coefficient of BSTAT and BSTII is 0.73 and 0.77 respectively. The BSTAT was re-administered to the same 20 Students to test for the stability of the instrument since the BSTAT would be used for both pre-test and post-test in view of the research design. The scores from the two tests were calculated using Pearson Product Moment Correlation Coefficient. The calculated Pearson r is 0.69 which was considered good enough. The data collected were statistically analyzed using t-test. The results showed that significant difference exists in the achievement and interest of subjects in Basic Science and Technology taught with web-based software teaching strategy. The application of Multiple Classification Analysis (MCA) showed that students taught with web-based learning strategy achieved and developed more interest significantly than those taught with lecture method. Based on the findings, web-based learning strategy is more effective in the enhancement of students' academic achievement and interest in Basic science and technology. The study recommended that the teaching of basic science and technology should be very flexible to incorporate new strategies. Web-based learning strategy should be adopted and integrated into the Junior Secondary School Curriculum.

Introduction

The main objective of teaching and learning of Basic Science and Technology in Nigerian schools is that learners are expected to develop interest in science and technology; acquire basic knowledge and skills in science and technology; apply scientific and technological knowledge and skills to meet contemporary societal needs; take advantage of the numerous career opportunities provided by science and technology; become prepared for further studies in science and technology; avoid drug abuse and related vices; and to be safety and security conscious (NERDC, 2012). In order to achieve the objectives of Basic Science Technology, the thematic approach to content organization was adopted by NERDC for the holistic presentation of scientific and technological concepts, knowledge and skills to learners for better achievement.

Achievement in opinion of Ogundukun and Adeyemo (2010) is the exhibition of knowledge attained or skills developed by students in a subject as determined by test scores of students, assigned by teachers. Abakpa (2011) defines achievements the measure of accomplishment in a specific field of study. The authors argued that achievement of students is the demonstration of their abilities to attain certain levels of instructional objectives outcome of their classroom instructions and experiences. The achievement of students in Basic Science and Technology cannot be compromised, because it is essential for the productive economic sector of our nation, for the production of labour force that is scientifically and technologically literate to bring about the desired changes for sustainable national development (Cyril, 2013).

According to Inekwe (2002), activity-based learning is the method that enables students to learn with the same vigour that marks their natural activity. David (2007) said it introduces element of joy, team spirit, respect for each other's opinions and it reduces the abstractness in science concepts. Mari (2001) said that in this method, the work is carried out in friendly manner, gladly with motivating spirit and activeness throughout the whole lesson, even to an uninteresting topic. Activity-Based learning is in-line with Piagetian tasks as it affords the students a variety of activities and experiences that involve the use of concrete objects. This hastens the learners' ability to order events through application, knowledge and predict changes. Accordingly, adequate and appropriate use of this method through a rich variety of stimulating experiences, progress from concrete to abstract and then a powerful conceptualization maybe achieved. Thus the learner now will reason or make hypothesis with symbolic or ideas rather than needing objects, in physical world as the basis for thinking. The learner according to him can therefore use a hypothetical, deductive procedure that no longer ties his thought to existing reality but could consider all possible explanations to problem and can evaluate alternative explanations or solution to the problem.

In the activity-based learning, local resources are effectively utilized in the teaching process. Activity-Based is a type of research-oriented teaching technique recommended for Basic Science instruction by National Policy on Education, Federal Ministry of Education (FRN, 2014). Activity-Based instructional strategy promotes instruction in the three domains of knowledge and activity-based teaching enables students to handle concrete materials which reduce the abstract nature of the concepts learned. This makes learning more meaningful and when concepts are meaningfully learned, it enhances retention and heightens students' achievement. Activities given to students help to widen their mental horizon. They begin to see that many other matters, besides those of purely scientific interest are involved when scientific knowledge is used to benefit a community. Besides, the Nigerian Integrated Science Project (NISP) is built around activities that are expected to encourage the

development of science process skills in the learners, (Shaibu & Mari, 2002).

Purpose of the Study

The purpose of this study was to determine the effects of activity-based learning approaches on basic science and technology students' achievement in junior secondary schools, Niger State. Specifically, the study sough to;

1. Determine the difference between the mean Basic Science and Technology achievement scores of Students exposed to Activity-based learning and those not exposed to it as measured by the Basic Science and Technology Achievement Test (BSTAT).
2. Determine the gender difference between the mean Basic Science and Technology achievement scores of Students exposed to Activity-based learning and those not exposed to it as measured by Basic Science and Technology Achievement Test(BSTAT).
3. Find out the difference between the mean Basic Science and Technology interest scores of Students exposed to Activity-based learning and those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII).

Research Questions

The following research questions were developed to guide this study:

1. What is the difference between the mean Basic Science and Technology achievement scores of Students exposed to Activity-based learning and those not exposed to it as measured by the Basic Science and Technology Achievement Test (BSTAT)?
2. What is the influence of gender on the Basic Science and Technology mean achievement scores of Students exposed to Activity-based learning and those not exposed to it as measured by the Basic Science and Technology Achievement Test (BSTAT)?
3. What is the difference between the Basic Science and Technology mean interest rating of Students exposed to Activity-based learning and those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII)?

Hypotheses

This study was guided by the following hypotheses and tested at 0.05 level of significance.

$H0_1$: There is no significant difference between the mean Basic Science and Technology achievement scores of Students exposed to Activity-based learning and those not exposed to it as measured in the Achievement Test (BSTAT).

$H0_2$: Gender has no significant influence on the Basic Science and Technology mean achievement scores of Students exposed to Activity-based learning and those not exposed to it as measured by Basic Science and Technology Achievement Test(BSTAT).

$H0_3$: There is no significant difference between the Basic Science and Technology mean interest rating of Students exposed to Activity-based learning and those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII).

Research Method

This study adopted a quasi-experimental research design which is a non-equivalent pre-test post-test control group design. This is considered appropriate because, according to Hassan, Kareem, Bala & Abba (2016), there will be no randomization of the subjects into treatment and control groups. Intact classes were used to avoid disturbing the normal classes in

terms of classroom schedule.

The study was carried out in Bida & Minna in Niger State, the target population for this study consists of all the 1,552 JSS II Students in the Junior Secondary schools in Bida and Minna Niger State, the sample for this study was made up of 52 Students. The study adopted multi-stage sampling technique to select the sample for the study. Purposive sampling technique was used to select two JSS II schools from Bida and Minna Niger State. The purposive sampling technique was used based on the criteria that:

- The school was a public school.
- The teachers possessed the same professional qualifications.

Simple random sampling technique was used to assign the schools to the experimental group and the control group. Two instruments were used for collecting data for the study. They are the Basic Science and Technology Achievement Test (BSTAT) and the Basic Science and Technology Interest Inventory (BSTII). The instruments were used for the pre-test and the post-test. However, the items used for the post-test were reshuffled.

BSTAT is a teacher made achievement test constructed from the Basic Science and Technology curriculum for JSS II. The test items were generated by the researcher. The BSTAT is a Thirty (30) item multiple choice

Face and content validity was established for BSTAT by presenting it to five experts in Science Education Department and industrial and Technology Education Department Federal University of Technology Minna.

The result obtained from trial testing was used to determine the reliability coefficient for BSTAT. The internal consistency reliability coefficient was determined using the K-20 (Kuder Richardson) procedure. The calculated K-R20 BSTAT is 0.73. The internal consistency was considered high enough. To test for stability, the instrument was re-administered to the same 20 Students. Scores from the two tests were calculated using Pearson Product Moment Correlation Coefficient. The calculated Pearson r is 0.69. This was considered good enough. The test of stability became necessary since the BSTAT would be used for both pre-test and post-test in view of the research design.

For the BSTII, Cronbach Alpha reliability method was used to test the internal consistency. An internal consistency reliability of 0.77 was obtained. This was considered high enough. Pre-test on both BSTAT and BSTII was administered to the Students in the experimental and the control groups prior to the commencement of treatment. That was done by thire class teachers in charge. The scores of the pre-test served as a covariate to the Students' post-test scores. The Post-test on BSTAT and the post-test on BSTII were administered to the experimental and control groups immediately after the teaching exercise.

The data collected from the administration of the tests were analyzed in line with the research questions and hypotheses using Mean, Standard Deviation and Analysis of Covariance. The Mean and Standard Deviation were used in answering the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at $P<0.05$ level of significance.

RESULTS

The results of the study are presented in line with the research questions and hypotheses that guided the study.

Research Question One

What is the difference between the mean Basic Science and Technology achievement scores of Students exposed to Activity-based learning and those not exposed to it as measured by the Basic Science and Technology Achievement Test(BSTAT)?

Table 1: Students' Basic Science and Technology Achievement Pre-test and Post-test Mean Scores and Standard Deviation

Experimental Condition	N	Pre-Text $\bar{X}$	SD	Post-Test $\bar{X}$	SD	Mean Gain Score
Experimental Group	27	23.37	12.57	43.04	21.77	19.67
Control Group	25	12.36	6.26	17.44	10.69	5.08
Total	52	18.08	11.40	30.73	21.40	12.65

Table 1 shows that students exposed to activity-based learning had a pre-test mean score of 23.37, with a standard deviation of 12.57 while the post-test mean score was 43.04 and a standard deviation of 21.77. The mean gain score between the pre-test and the post-test in experimental group was 19.67.

The students in the control group had a pre-test mean score of 12.36 with a standard deviation of 6.26 and a post-test mean score of 17.44 with a standard deviation of 10.69. The mean gain score for the control group was 5.08. The mean gain scores difference of the experimental and control groups 12.65.

This suggests that the Students who were exposed to Activity-based learning achieved more than those who were not exposed to it. A corresponding hypothesis formulated to further answer the research question isHO_1.

Hypothesis One

$H0_1$: There is no significant difference between the mean Basic Science and Technology achievement scores of Students exposed to Activity-based learning and of those not exposed to it as measured in BSTAT.

Table 2: Summary of the 2 Way Analysis of Covariance (ANCOVA) of Students'Post-test mean Basic Science and Technology Achievement Scores

Source	Type III sum Of squares	df	Mean square	F	Sig.	Decision at 0.05 level
Correlated model	14848.747[a]	4	3712.187	20.532	.000	
Intercept	080.933	1	808.933	4.474	.040	
Pre-test	5575.851	1	5575.851	30.840	.000	
Treatment	1691.231	1	1691.231	9.354	.004	S
Gender	47.525	1	47.525	.263	.611	NS
Treatment* Gender	99.520	1	99.520	.550	.462	NS
Error	8497.483	47	180.798			
Total	72454.000	52				
Correlated Total	23346.231	51				

a. R squared = .636 (Adjusted R Squared =.605)

Table 2 indicates that activity-based learning, which is treatment, as a main factor has a significant effect on Students' achievement in Basic Science and Technology. The calculated F-value of 9.354 is significant at 0.004 at 0.05 levels of significance. This implies that Activity-based learning significantly enhanced Students' achievement in Basic Science and Technology. The null hypothesis of no significant difference in the mean achievement scores of the experimental and control groups is, therefore, rejected.

Research Question Two

What is the influence of gender on the mean Basic Science and Technology achievement scores of Students exposed to Activity-based leaning as measured by BSTAT

Table 3: Means and Standard Deviation of Students' Scores in Basic Science and Technology Achievement Test by Gender

Gender of	N	Pre-Text $\bar{X}$	SD	Post-Test $\bar{X}$	SD	Mean Gain Score
Male	16	18.21	11.84	29.72	22.51	11.52
Female	11	17.91	11.08	32.00	20.33	14.09
Total	27	18.08	11.40	30.73	21.40	12.65

Table 3 indicates that male students had a pre-test mean Basic score of 18.21 and a post-test mean score of 29.72. The mean gain score of male Students is 11.52. The female Students had pre-test and post-test mean scores of 17.91 and 32.00 respectively. The females have a mean gain score of 14.09. Also at pre-test, male and female Students' standard deviations were 11.84 and 11.08 respectively while at post-test, male and female Students' standard deviations were 22.51 and 20.33 respectively. However, the female Students had a higher mean gain score than the males.

A corresponding hypothesis formulated to further address research question three isHo, which stated that Gender has no significant influence on the mean Basic Science and Technology achievementscores of Students exposed to Activity-based learningas measured by Basic Science and Technology Achievement Test(BSTAT).

Result in Table 2 indicates that there is no significant differences in the post- test mean Basic Science and Technology achievement scores of male and female Students. This is shown by the F-value of .263 in respect of gender as a factor in the study which is significant at .611 levels. This indicated that at 0.05 levels, the F-value of .611 was not significant. The null hypothesis of no significant influence of gender on the mean Basic Science and Technology achievement score of Students exposed to Activity-based learning still stands. This implies that the female Students did not achieve significantly better than the male Students in BSTAT. Therefore, gender is not a significant factor in Basic Science and Technology achievement of Students. The null hypothesis is therefore not rejected.

Research Question Three

What is the difference between the mean Basic Science and Technology interest rating of Students exposed to Activity-based learning and of those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII)?

Table 4: Students' Basic Science and Technology Interest Pre-test and Post-test Mean Scores and Standard Deviation

Experimental Condition	N	Pre-Text $\bar{X}$	SD	Post-Test $\bar{X}$	SD	Mean Gain Score
Experimental Group	27	18.52	8.38	53.48	7.19	34.96
Control Group	25	15.80	3.95	49.20	6.06	23.40
Total	52	17.21	6.71	51.42	6.95	34.21

Table 4 indicates that the pre-test and post-test interest mean scores of Students exposed to Activity-based learning were 18.52 and 53.48 respectively with the standard deviation of 8.38 and 7.19 respectively. The mean interest gain rating for the experimental group is 34.96. The pre-test score and post-test interest mean scores of Students in the control group were of 15.80 and 49.20 respectively with standard deviation of 3.95 and 6.06 respectively. The mean interest gain score for the control group is 23.40. This, therefore, suggests that Students exposed to self- instruction strategy had more interest in Basic Science and Technology than those not exposed. A corresponding hypothesis generated to further address research question two is Ho_2.

$H0_2$: There is no significant difference between the mean Basic Science and Technology interest scores of Students exposed to Activity-based learning and of those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII).

Table 5 : Summary of 2 -Way Analysis of Covariance (ANCOVA) of Students' Post -test mean Basic Science and Technology Interest Scores

Source	Type III sum of squares	Df	Mean square	F	Sig	Decision at 0.05 Level
Correlated Model	435.030[a]	4	108.757	2.521	.053	
Intercept	17106.047	1	17106.047	396.508	.000	
Pre-Test	54.194	1	54.194	1.256	.268	
Treatment	390.396	1	390.396	9.049	.004	S
Gender	149.201	1	149.201	3.458	.069	NS
Treatment* Gender	11.439	1	11.439	265	.609	NS
Error	2027.662	47	43.142			
Total	139968.000	52				
Correlated Total	2462.692	51				

Table 5 indicate that activity-based learning, which is the treatment, as a main factor has a significant effect on Students' interest in Basic Science and Technology. This is shown by the F-value of 9.049 which is significant at .004 and 0.05 levels. This implies that the null hypothesis of no significant difference in the mean interest score of Students exposed to Activity-based learning in Basic Science and Technology and those not exposed is rejected. This suggests that there is a significant difference in the mean interest rating of Students exposed to self- instruction strategy in Basic

Science and Technology and those not exposed.

Discussion of Findings

The result of the study indicates that activity-based learning has a significant effect on Students' achievement in Basic Science and Technology. Students who were taught Basic Science and Technology using activity-based learning achieved significantly higher than those taught without using the strategy. The finding of this study is in line with the findings of some earlier studies on the positive effect of different learning strategies with respect to students' achievement in Basic Science and Technology. The studies conducted by Obiekwe (2008), Usman, Hassan, Maik and Musa (2015); Mandor (2002); Cyril (2013) provide credence for the present study. The studies showed that there is a significant difference in the Basic Science and Technology achievement of students in the treatment group that used self-instruction strategies than in the achievement of students in the control group. The enhancement in students' achievement in Basic Science and Technology could be due to the students' understanding of the self- instruction strategy. The finding of this study suggests that activity-based learning help students to actively be in-charge of the learning process and to monitor the progress in learning exercise. As students are deeply involved in active learning, they are able to learn the processes involved in solving BSTAT problems.

The result of this study showed that male and female students in the experimental group performed better than their counterparts in the control group in Basic Science and Technology achievement. An important finding is that the female Students in the experimental group had higher mean achievement scores than their male counterparts. However, the analysis of covariance (ANCOVA) for gender as main effect indicates that gender has no significant influence on the Basic Science and Technology achievement of Students. This means that gender is not a significant factor in the use of the learning strategy. The finding is in consonance with the studies conducted by Atadoga & Lakpini (2013), Ezeudu (2011) and Mandor (2002) which also showed that there is no significant difference in the performance of boys and girls in Basic Science and Technology achievement using learning strategies.

These findings, however, contradict some earlier finding which portray gender as a significant factor in Basic Science and Technology achievement (Akalonu, 2001; Etukudo, 2002; Eraikhuemen, 2003; and Ongundokun & Adeyemo, 2010). The results obtained indicate that male students had higher mean scores than the females in Basic Science and Technology Achievement Test. The findings of this study could be explained in line with the view of Ezeudu (2011) who stated that gender has no direct effect on Basic Science and Technology achievement. Exposing Students to Activity-based learning may have removed the differences that existed between the two genders. This implies that both male and female Students benefited significantly from the strategy. However, the non-significant difference in Basic Science and Technology achievement of male and female students could also be attributed to effective use of Activity-based learning which ensured students' active participation in the learning process.

The results of this study show that activity-based learning significantly enhanced the interest of Students in Basic Science and Technology. Those in the treatment group had a significantly higher mean interest rating in Basic Science and Technology interest inventory than those in the control group. The finding of this study is in line with the findings of some earlier studies which indicated that interest determines the level of learning outcomes. Harbour- Hassan (2016), Ezeudu (2011), Ogundokun & Adeyemo (2016) found that students develop more competence in subjects they are interested. In effect, the interest students show in an activity or in an area of knowledge predicts how much they will attend to it and how well they process, comprehend and remember it (Atadoga &

Lakpini (2013). As the students practice and realize some positive outcomes and success, they gain greater confidence in their ability to succeed in Basic Science and Technology. Their interest and urge to do more also increases. This could be the reason for the higher interest in learning Basic Science and Technology as demonstrated by Students in the experimental group.

Conclusion

This study indicated that using activity-based learning for teaching multiplication and division in Basic Science and Technology enhanced Students' achievement and increased their level of interest in the subject. Male and female students taught Basic Science and Technology content with Activity-based learning achieved equally and exhibited the same level of interest in the subject. This implies that gender has no significant influence in the achievement and interest of Students exposed to activity-based learning in Basic Science and Technology. Equally, the interaction effect of teaching Basic Science and Technology content with activity-based learning and gender was not significant in the achievement and interest of Students.

Recommendations

Based on the findings of this study and the educational implications, the following recommendations were made:

1. Students should be exposed to Activity-based learning since the findings of this study indicate that it has a facilitative effect on their achievement and interest in Basic Science and Technology irrespective of gender.
2. Evidence from the study indicates that the Activity-based learning could be taught so in-service teachers should, therefore, be taught this strategy as they themselves need to be equipped with the most effective ways of teaching their Students Basic Science and Technology.
3. Through these conferences, workshops, seminars and enlightenment programmes, teachers should be encouraged to make learning pupil-centred and not teacher-centred. They should ensure that Students are actively involved in the learning activity by allowing them to take active participation in every learning situation.

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