

## EFFECT OF BRAIN-BASE APPROACH AND GENDER AND ACHIEVEMENT, INTEREST AND RETENTION OF STUDENTS IN BASIC SCIENCE AND TECHNOLOGY AT JUNIOR SECONDARY SCHOOL LEVEL

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**Abstract:** *The study adopted quasi experimental design and was carried out in Minna, Niger State. The population for the study was 410 male and female students. The sample size for the study was 114 Basic science and technology second year students which comprised 72 males and 42 females randomly selected from two junior secondary schools in Minna, Niger. The instruments for data collection were Basic science and technology cognitive achievement test (BSTCAT) and Basic science and technology interest inventory (BSTII). Both were subjected to face validation by three experts from Industrial & Technology Education Department, Federal University of Technology, Minna. The Kuder Richardson 20 (K-R20) was employed for determining the reliability of the BSTCAT while Cronbach alpha reliability method was used to determine the internal consistency of the BSTII and 0.82 and 0.84 were obtained respectively. The data collected were analysed using mean to answer the research questions while analysis of covariance (ANCOVA) was used to test the three hypotheses. The study found, among others, that students taught Basic science and technology with brain-base learning had a higher mean achievement score, mean interest and mean retention score than those taught using traditional teaching. It was recommended that Basic science and technology teachers in technical colleges should adopt the use of the brain-base learning technique to teach Basic science and technology trades to students and facilities that could encourage the use of brain-base learning should be provided to Basic science and technology teachers in technical colleges.*

**Keywords:** *Academic Achievement, Basic Science and Technology, Interest, Retention, Brain-Based Learning*

### Introduction

Basic Science and Technology is one of the pre-vocational subjects offered at the junior secondary schools in Nigeria. It is a preparatory core subject of vocational and technical education. Basic Science and Technology being one of the skill oriented subjects which enables the individual to acquire appropriate skills and abilities to live in and contribute effectively to the development of his society (Olaitan, 2016). Basic Science and Technology is also a basic subject on which future technological development of students are built for those interested in vocational technical courses or engineering in higher institutions. According Federal Republic of Nigeria (2013), Basic Science and Technology is an essential subject in the 9 year basic education programme. Its purpose according to the report is to contribute to the achievement of the national education goals by inculcation of technology literacy, experience of students to the world of work to match their talents and interests for wise vocational choice and inculcation of positive attitudes towards work as a source of human identity, livelihood and power. Basic Science and Technology is a practical-oriented and requires skills field of study and aims at equipping the students with essential technical skills. Uwameiye and Ogiegbaen (2017) described Basic Science and Technology which as a core subject among the pre-vocational subjects in junior secondary school syllabus that involves the academic practical study of materials and sources of energy with the ultimate intention of applying knowledge from the study to provide a comfortable environment for man. The study further lamented that teachers in Nigerian public schools today were comfortable using the conventional teaching method which has led to poor academic achievement by students in most subjects. Although, lecture method is effective in delivering knowledge to a large number of students as well as covering a wide range of topics within a short time, it involves students receiving information mainly through input given by teachers in the classrooms. This, however, hinders students' innate learning potentials and ignores their individual differences.

Since learning is to affect a change in the learner, there is need for intellectual improvement in learners in order to foster intellectual development. Rowland (2010) opined that learners need to interact directly with their world through discourse and hands-on experiences with peers and adults. Therefore, creating a stimulating and conducive environment will make learning take place naturally (Jensen, 2017). If teachers design learning environments that allow each learner process information and form knowledge based on their individual differences and abilities, learning will be more interesting and productive. Smilkstein (2003) stated that although the brain is innately able to facilitate learning, the knowledge, skills, or concepts the brain acquires by means of its innate learning process depends on the learner's experience and the environment. For this reason, research on cognitive neuroscience (Farnsworth, 2018) based on findings on the structure and functionality of the brain, has emphasized a brain compatible instructional method, which is also known as brain-based learning.

Brain-Based Learning (BBL) is a student-centred learning approach that utilizes the whole brain and considers the different learning styles preferred by the students. It takes care of students' individual differences for effective and lasting learning (Kinach, 2019) and is more concerned with 'how' learning takes place rather than 'what' is learnt. When the learning environment is designed to allow each learner process information and form knowledge based on their individual differences and abilities, learning becomes more interesting and contextual. Brain-based learning proposes a shift in instructional approach from focus on the teacher to the learner for effective learning to occur. It involves active participation of students in constructing their own knowledge in diverse learning situations and contexts (Kinach, 2019). Brain-based learning strategies aim at maximizing the functional ability of the brain in a conducive environment. Uwameiye and Ogiegbaen (2017) therefore explained that teaching and learning of basic science and technology in Nigeria also demands effective use of instructional techniques in order to maintain gender balance and good academic achievement. Students' achievement in basic science and technology is not encouraging at junior secondary school level.

Achievement is the action of accomplishing something. Achievement according to Bakare and Orji (2019) is the outcome of level of accomplishment in a specified programme of instruction in a subject area or occupation which a student had undertaken in the recent past. Academic achievement of students therefore is the translation of the students' performance in achievement test into scores obtained in a cognitive test. Students' academic achievement refers to students' performance or attainment in a subject. Jimoh (2019) stated that students' academic achievement connotes performance in school subject as symbolized by a score or mark on an achievement test. The method is executed by example and activities by the teacher while the learners observe and listen (Jimoh, 2019). Besides the use of good teaching method in the classroom, another important role of the teacher is to order and structure the learning environment. Included in this role are all the decision and action required of the teacher to maintain order in the classroom such as laying down rules and procedures for learning and use of motivational techniques to secure and sustain the attention and interest of the learner (Bakare & Orji, 2019).

Interest is a persisting tendency to pay attention and enjoy some activities. Interest has been viewed as emotionally oriented behavioural trait which determines a student's vim and vigour in tackling educational programmes or other activities (Nwaodo & Ariyo, 2020). Students' interest and achievement in any learning activity is sustained by the active involvement of the learner in all aspects of the learning process. Hassan *et al.* (2016) emphasized that unless the teacher stimulates students' interest in learning, students' achievement will be minimal. Hence, it is essential that technical teachers use teaching method which ensures students' active involvement in learning and provide suitable learning environment to improve achievement and stimulate interest of students in Basic science and technology. Instructional techniques are subsumed in teaching methods as ancillaries to ensure the effectiveness of the method in improving interest of the students. The shortcomings of the present traditional teaching methods partly accounted for the poor performance of students in the National Technical Certificate Examination due to low retention of topics learnt.

Retention is the power of retaining and recalling past experience. Alhassan *et al.* (2020) described retention of learning as a repeated performance by a learner, of behaviour earlier acquired, elicited after an interval of time. It is affected by degree of original learning, the method of learning and learner's memory capacity, among other factors. Alhassan *et al.* (2020) effect of place-based and activity-based approaches in technical education, interest and retention to (lecture method and teacher dominated classroom) and the approach found very active. The place-based and activity-based approaches also improves students understanding in science subjects and enhances their interest while students' interest in music was increased in other related studies. Oranu (2012) explained that most problems associated with teaching and learning of basic science and technology at technical colleges is methodology of teaching the subject matter, inadequacy in structural facilities and the teacher inability to teach. Hence, it is against this background to determine the effect of brain-base learning on gender and achievement, interest and retention of students in basic science and technology at junior secondary school level.

### **Statement of the problem**

Basic Science and Technology is a subject whose teaching requires an interdisciplinary approach to the exclusion of subject's boundaries. Educators like Usman *et al.* (2020) seriously noted that teacher quality is a strong predictor of student quality. More so, that it is widely acknowledged that no educational system can rise above the quality of its teachers". There is therefore great doubt as to the adequacy of teachers, in terms of quality teaching strategy, now handling the subject in our various junior secondary schools. Reports from many states in Nigeria indicated poor performance of students in their Junior Secondary School Examination in Basic Science and Technology (Babalola, 2019). This could be attributed to the poor method of teaching. Federal Republic of Nigeria (2013) then observed that the present groups of teachers teaching the subject are grossly incompetent and incapable. Some recent studies carried out in the area of teaching strategy for the junior secondary school Basic Science and Technology in some states of the federation indicate negative disposition. In a similar survey technical teacher production noted that out of all the militating factors against the full implementation of the Basic Science and Technology programme, the teaching strategy factor ranks highest. As result of the problem of inadequate used of proper teaching strategy, therefore there is need to adopt brain-base learning in teaching Basic Science and Technology in Minna Niger state.

### **Purpose of the study**

The general purpose of this study was to investigate the effect of brain-base learning technique on academic achievement, interest and retention of students in Basic science and technology in Niger State. Specifically, the study sought to determine the:

1. Effect of brain-base learning technique on the achievement of male and female students in Basic science and technology.
2. Effect of brain-base learning technique on the interest of male and female students' in Basic science and technology.
3. Effect of brain-base learning techniques on the retention of male and female students in Basic science and technology

### **Research questions**

1. What is the achievement of male and female students' using brain-base learning method in Basic science and technology?
2. What is the effect of brain-base learning method on the interest of male and female students' in Basic science and technology?
3. What is the effect of brain-base learning method on retention of male and female students in Basic science and technology?

## Hypotheses

- H<sub>01</sub>:** There is no significant difference in the mean achievement scores of male and female students taught basic science and technology using brain-base learning method.
- H<sub>02</sub>:** There is no significant difference in the mean interest scores of male and female students taught basic science and technology with brain-base learning method.
- H<sub>03</sub>:** There is no significant difference in the mean retention scores of male and female students taught basic science and technology with Brain-base learning method.

## Methodology

A quasi-experimental design was used for this study. The study was conducted in Minna, Niger State. The population for the study consisted of 410 second year students made up of 325 males and 85 females from junior secondary schools in Minna offering Basic science and technology. The sample size for the study was 114 Basic science and technology second year students which comprised 72 males and 42 females from two selected junior secondary school in Minna. The instruments for data collection were Basic science and technology Cognitive Achievement Test (BSTCAT) and Basic science and technology Interest Inventory (BSTII) were face validated by three experts from Industrial and Technology Education Department, Federal University of Technology, Minna.

To ensure content validity of the Basic science and technology cognitive achievement test (BSTCAT), a trial test was conducted on the BSTCAT for the purpose of determining the psychometric indices of the test. In the trial test, the BSTCAT was administered on equivalent sample of Basic science and technology second year students in one of the junior secondary school not selected for the study in Minna, Niger State. Kuder Richardson 20 (K-R20) approach were employed for determining the reliability of the Basic science and technology Cognitive Achievement Test. The BSTCAT was administered on equivalent sample of Basic science and technology second year students in technical college not chosen for the study. The reliability coefficient of the BSTCAT and BSTII were found to be 0.82 and 0.84 respectively. This shows that the test was reliable. The data collected from the pre-test, post-test, and retention of learning were analysed using mean to answer the research questions. The pre-test- post-test mean gains of each of the experimental groups were compared to determine the group that achieved better. The hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance.

## Results

**Table 1: Mean of Pre - test and Post - test Achievement Scores of Male and Female Students Taught Basic science and technology with Brain-Base Learning Technique in the Achievement Test**

Group	N	Pre – test Mean	Post – test Mean	Mean Gain
		$\bar{X}$	$\bar{X}$	
Male	42	48.40	60.55	12.15
Female	18	49.83	58.33	8.50

Data in Table 1 show that male students taught Basic science and technology with learning technique had a mean achievement score of 48.40 in the pre - test and mean achievement score of 60.55 in the post - test making a pre - test, post - test mean gain of 12.15, while the female students taught Basic science and technology with brain-base learning technique had a mean score of 49.00 in the pre - test and a mean score of 58.33 in the post - test, making a pre - test, post - test mean gain of 8.50. With this result, male students taught Basic science and technology with brain-base learning technique performed better than female students taught Basic science and technology with the same brain-base learning in the achievement test.

**Table 2: Summary of ANCOVA for Test of Significance between the Mean Scores of Male and Female Students Taught Basic Science and Technology with Brain-Base Learning Technique**

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.814 <sup>a</sup>	2	1.407	.593	.556
Intercept	3159.223	1	3159.223	1332.000	.000
Pre – test	.374	1	.374	.158	.693
Gender	2.105	1	2.105	.888	.350
Error	154.172	57	2.704		
Total	111775.000	60			
Corrected Total	156.985	59			

\*Significant at sig of  $P < .05$

The data presented in the Table 2 show that the F-value for gender stood at .888 with significance of F at .350, which is greater than .05. Hence, the null-hypothesis is accepted at .05 level of significance. This result implies that there is no significant difference between the mean achievement scores of males and females taught Basic science and technology with brain-base learning technique in the achievement test.

**Table 3: Mean of Pre - test and Post - test Scores of Male and Female Students Taught Basic Science and Technology with Brain-Base Learning Technique**

Group	N	Pre – test Mean $\bar{X}$	Post – test Mean $\bar{X}$	Mean Gain
Male	42	55.78	61.61	5.83
Female	18	51.45	56.17	4.72

Data in Table 3 show that male students taught Basic science and technology with brain-base learning technique had a mean interest score of 55.78 in the pre - test and mean interest score of 61.61 in the post - test making a pre - test, post - test mean gain of 5.83, while the female students taught Basic science and technology with brain-base learning technique had a mean interest score of 56.17 in the pre - test and a mean interest score of 56.17 in the post - test, making a pre - test, post - test mean gain of 4.72. With this result, the interest of male students taught Basic science and technology with brain-base learning technique is higher than the interest of females taught Basic science and technology with the same brain-base learning technique in the interest inventory items.

**Table 4: Summary of ANCOVA for Test of Significance in the Mean Interest Scores of Male and Female Students Taught Basic Science and Technology with Brain-Base Learning Technique**

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5.107 <sup>a</sup>	2	2.553	1.349	.267
Intercept	170.946	1	170.946	90.329	.000
Pre – test	.901	1	.901	.476	.493
Gender	4.762	1	4.762	2.516	.118
Error	123.011	57	2.158		
Total	1396386.000	60			
Corrected Total	128.118	59			

\*Significant at sig. of  $P < .05$

The data presented in the Table 4 show that the F-value for gender stood at 2.516 with significance of F at .118, which is greater than .05. Hence, the null-hypothesis is accepted at .05 level of significance. This result implies that there is no significant difference between the mean interest scores of male and female students taught Basic science and technology with brain-base learning technique in the interest inventory items.

**Table 5: Mean of Male and Female Students Taught Basic Science and Technology with Brain-Base Learning Technique in the Achievement Post - test and Test for Retention**

Group	N	Post – test	Test for Retention
		$\bar{X}$	$\bar{X}$
Male	42	60.55	73.89
Female	18	58.33	68.12

Table 5 reveal that male students had a mean achievement score of 60.55 in the post - test and a mean score of 73.89 in the test for retention of learning. The female students also had a mean achievement score of 58.33 in post - test and a mean score of 68.12 in the test for retention of learning. The result indicates that the male students taught Basic science and technology with brain-base learning technique retained better than females taught Basic science and technology in the test for retention of learning.

**Table 6: Summary of ANCOVA for Test of Significance in the Mean Scores of Male and Female Students Taught Basic Science and Technology with Brain-Base Learning Technique in the Test for Retention of Learning**

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	120.965 <sup>a</sup>	2	60.482	39.306	.000
Intercept	.415	1	.415	.270	.605
Pre – test	107.215	1	107.215	69.675	.000
Gender	5.704	1	5.704	3.707	.059
Error	100.020	57	1.754		
Total	88277.000	60			
Corrected Total	220.985	59			

\*Significant at sig of  $P < .05$

The result presented in Table 6 shows that the F-value for gender stood at 3.707 with significant of P at .059, which is greater than .05. Hence, the hypothesis is therefore not rejected at .05 level of significance. This indicates that, there is no significant difference in the mean scores of male and female students taught Basic science and technology with brain-base learning technique in the test for retention of learning.

## Discussion

Research question one reveals that males taught Basic science and technology with brain-base learning Technique performed better than females taught Basic science and technology with the same brain-base learning Technique in the achievement test. However, analysis of covariance of test of significance between mean achievement scores of males and females taught with brain-base learning Technique showed that there was no statistically significant difference between the mean achievement scores of the males and females taught with brain-base learning in the achievement test. The result is in agreement with the findings of Hassan *et al.* (2021) and Hassan *et al.* (2016) who found significant difference between male and female students achievement in basic science and technology. The obvious implication is that the difference in the mean achievement scores of male and female students taught Basic science and technology with brain-base learning strategy was due to a mere chance.

Research question two reveal that males taught Basic science and technology with brain-base learning technique performed better than females taught Basic science and technology with the same brain-base learning technique in the interest inventory items. However, the difference in the mean interest scores of male and female students was not found to be statistically significant. The result is in support of Nwaodo and Ariyo (2020) whose result indicated that there was significance difference between male and female students interest in basic science and technology.

Research question three revealed that males taught Basic science and technology with brain-base learning performed better than females taught Basic science and technology with brain-base learning in the test for retention of learning. However, the analysis of covariance revealed that the difference in the mean scores of male and female students in the test for retention of learning was not found to be statistically significant. According to Usman *et al.* (2020) providing opportunities to interact with course material through the use of advanced teaching strategy and information technology tends to change the course from a competitive endeavour to one that is more collaborative, student-centred, and focused on the cognitive development and construction of knowledge in the students irrespective of their gender. The results of these findings showed that the use of brain-base learning helped to bridge gender differences in the performance of males and females in Basic science and technology. The result disagreed with the findings of Alhassan *et al.* (2020) who found out that there was no significant difference between the retention of male and female students in technical drawing.

## Conclusion

The result of this study provides empirical evidence that the use of brain-base learning enhanced students achievement, interest and retention in basic science and technology than the use of traditional teaching method. Students taught basic science and technology with the use of brain-base learning male students performed better than their female counterpart taught same science and technology. Male students performed higher than female students. This implies that gender has significant effect on achievement, interest and retention of students in basic science and technology. Therefore, the use of brain-base learning enhanced the teaching and learning of basic science and technology.

## Recommendations

1. Since the use of brain-base learning enhances achievement, interest and retention of students in basic science and technology teachers in junior secondary schools should adopt the use of the brain-base learning technique to teach Basic science and technology to students.
2. Textbook writers should shift emphasis from teacher-centred to learners centred activities that will promote learning by doing in the teachers manual/teachers guide.
3. Curriculum developers should embrace and include brain-base learning strategies that will bring about improvement in learning, acquisition of critical thinking, problem solving and performance skills in students into the curriculum.

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