# IMPACT OF CHALLENGE-BASED LEARNING STRATEGY ON ACADEMIC ACHIEVEMENT AMONG LOW ABILITY JUNIOR SECONDARY SCHOOL BASIC SCIENCE AND TECHNOLOGY STUDENTS IN MINNA EDUCATIONAL ZONE OF NIGER STATE

**BY**

**1HASSAN, A.M (PhD), 2GIMBA, R.W, (PhD), 3USMAN, G.A (PhD) & 4ABDULLAHI, S.M (PhD)**

**1 & 3INDUSTRIAL AND TECHNOLOGY EDUCATION DEPARTMENT**

**2SCIENCE EDUCATION DEPARTMENT**

**SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION**

**FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA**

**4SCIENTIFIC EQUIPMENT DEVELOPMENT INSTITUTE, MINNA**

**Tel: 1+2348035872654, 2+2348032853603, 3+2348035989208, 4+2348035864119**

**Email: 1**[yabhass@yahoo.com](mailto:yabhass@yahoo.com), 2[ramatu.gimba@futminna.edu.ng](mailto:ramatu.gimba@futminna.edu.ng), 3[garba.usman@futminna.edu.ng](mailto:garba.usman@futminna.edu.ng), 4[abdulshab@yahoo.com](mailto:abdulshab@yahoo.com)

# ABSTRACT

This study investigated the Effects of Challenge-based Learning Strategy on Performance among Low Ability Junior Secondary School Basic Science and Technology Students in Kano, Nigeria. Quasi Experimental pretest and posttest control group research design was adopted for data collection. Pretest was conducted on the two groups. After treatment, posttest was administered. The experimental groups were given treatment for six weeks, using challenge-based learning. While the control group was exposed to teaching for six weeks using lecture method. The population consists of 6,715 students. A sample of 120 subjects of both experimental and control groups was selected. The instrument used for data collection was Basic Science and Technology Achievement Test. Simple random sampling using balloting method involving a pick from a hat, was used. The Basic Science and Technology Achievement Test has reliability coefficient of 0.78. Four null hypotheses were stated in line with the research questions. Data collected were analyzed using t-test statistics at P ≤ 0.05 level of significance. The findings revealed that: there was a significant difference in the mean scores of experimental groups, with experimental group performing better. And there was a significant difference in the mean scores of female students. Both the male and female low ability students exposed to challenge-based learning strategy performed better when compared to their counterparts‟ low ability students exposed to lecture method. It was recommended that curriculum planner’s and Basic Science and Technology teachers to consider its suitability and in cooperate challenge-based teaching strategy for the teaching of Basic Science and Technology concepts among low ability students.

**Keywords:** Challenge-based, achievement, low ability, Basic Science and Technology and technology

# Introduction

The enormous importance of science in the technological, economic and political development of nations globally explains why technological attainment is often used to determine the level of development of every nation. Mathematics, Science and Technology are essential tools for socio-economic and cultural development of any nation (Usman, 2016). Because of this, every nation is strategizing on how to develop Science and Technology to earn national recognition. The world is becoming a global village with every nation struggling to control the global market through technological innovations with capacity to attract global acceptance. Lawal, (2013) stated that, science and technology provides the foundation for wealth creation and advancement of quality life.

Prominent among teaching and learning approaches that are rooted on problem based learning are challenge based learning and activity-based approaches. Challenge based learning (CBL) is an engaging multidisciplinary approach to teaching and learning that encourages students to leverage the technology they use in their daily lives to solve real-world problems (Johnson, Smith, Smythe, Varon (2009).The authors maintained that challenge based learning begins with a big idea and cascades to the following: the essential question; the challenge; guiding questions, activities, and resources; determining and articulating the solution; taking action by implementing the solution. Further, Johnson, Smith, Smythe, Varon (2009) stressed that Challenge – Based learning builds on the practice of problem-based learning, in which students work on real-world problems in challenge-based teams, but with key distinctions that add a great deal of relevancy for students. At the center of Challenge – Based learning is a call to action that inherently requires students to make something happen. They are compelled to research on their topic, brainstorm strategies and solutions that are both credible and realistic in light of time and resources, and then develop and execute one of those solutions that addresses the challenge in ways both they themselves and others can see and measure. Therefore, challenge based teaching and learning approach is a teaching approach where students use technology to research and find solution to problems.

Introduction of Basic Science and Technology and Technology in school curriculum implies an attempt for a radical change in emphasis and focus. Cyril further stated that innovation in Basic Primary and Junior Secondary Schools in Nigeria is characterized by features of the national core curriculum which is the incorporation of concept formation and process skill acquisition. Also Olarewaju (2011) found that Basic Science and Technology is child centered and emphasis is laid more on learning science as a process than as a body of knowledge. Basic Science and Technology also involves the basic training in scientific skills requirement for human survival, sustainable development and societal transformation (Dung and Udofia, 2010). Peni (2014) stated that thus themes of Basic Science and Technology reflect the relationship of the learner with component concepts to be learnt and his environment, for example; ‛You and Technology.‟

Gender issue is topical in Science Education, more so with increasing emphasis on ways of boosting manpower for technological development as well as increasing the population of females in science and technology (Ogunkola and Bilesanmi-Awoderu, 2012).

The search for improved strategies for teaching and learning of science is therefore a continuous process. That is basically what triggered the need for this study, and to find out whether or not challenge-based learning strategy will enhance the academic achievement of low ability Basic Science and Technology students. One of the most successful methods of helping students learn actively is challenge-based learning strategy. It has been clearly stated by researchers like Kaufman, (2013), Olorukooba, (2011), Slavin, (2015) and Dyel (2011) that when it is used, students tend to exhibit higher Academic Achievement, critical thinking skills and deeper understanding of learned materials among others. Gokhale, (2014) defined Challenge-based learning as “an instructional method in which students work together in small groups toward a common goal”. Students who engage in challenge-based learning are responsible for each other’s learning as well as individual, and as a result, the success of one student assists other students to succeed. Thus, challenge-based learning entails the formation of an informal setting, whereby students work challenge-based on a particular task, to analyze, synthesize and evaluate problems together, facilitate discussion and interaction.

Despite the importance of challenge-based teaching and learning strategies, low ability Basic Science and Technology students are not carried away, in which Bani (2012) stated that there is an increase in the number of low ability Basic Science and Technology students. Most of the science teachers adopt the use of traditional method of teaching like lecture method, which brings about the total negligence of low ability learners (Usman, 2015). Emily, Robert, and Michael, (2003) found that if students are grouped homogeneously, there is the fear that low-ability students will be deprived of opportunities to learn i.e. they may be left behind and also unmotivated to learn because of peer, personal and teachers‟ expectations of poor performance, as low ability students learn very slowly. This study therefore seeks to determine if challenge-based learning strategy enhances learning among low ability learners, or not. It will also identify peculiar problems that low ability students face in teaching and learning and potent solution. Although, Aliyu, (yoghurt) stated that the way Basic Science and Technology is taught without adequate provision taken to ensure low ability students weakness in learning is catered for through the use of effective mechanisms and the right instructional method. Esther (2012) defined low ability students as those whose score falls below 40% in a given standardized test of cognitive ability in which students in this category may not be expected to achieve mastery or recall stored information within a reasonable amount of time; such students are considered low ability students.

Scholars like Cused, (2010), Lauri, (2012), and Young, (2008), have conducted studies involving challenge-based learning; they separately found that when students participate in challenge-based learning activities their performance and retention of learned material is improved. Therefore, this study aims to investigate the effects of challenge-based learning strategy on academic achievement of low ability among junior secondary school students of Basic Science and Technology. Despite the efforts by various scholars for instance, Srinivas (2010), Panitz (2013), Chris Watkins (2013), carried out to investigate the effect of challenge-based learning strategy, an extensive study is yet to be carried out with low ability students. Therefore, the purpose of this study is to examine the effects of challenge-based learning strategy at improving academic achievement of low ability learners in Basic Science and Technology.

# Statement of the Problem

The ability level of students is the construct of their academic achievement (Aremu, 2001). Salami (2000) discovered that students’ achievement depends on their cognitive ability. Studies have shown that learners are different in their ability levels and in learning problems. In order to help those low ability learners among students of different ability levels to improve more, a (Akinlaye, 1998). The low ability students are usually stigmatized, uncared in a class setting, and were denied the opportunity to receive attention due to the teacher from the general assumption of the teachers that all is well with all members of the class. They are also unmotivated to learn because of the personal fear of poor performance. The great challenge to a science teacher is teaching a child who is a low achiever. It is an admitted fact that every class has a composition of 20% to 30% or more low achievers. The low achievers students do not fall into category of special education children as they do well outside the classroom and show no evidence of having a medical problem, they simply do poorly in science and mathematics subjects as reported by Yusha‛u, (2012).

Okebukola (1984) confirmed that the use of appropriate instructional strategies could influence the performances of low achieving students. He further stated that there is need to redirect efforts towards knowing more about the interactions between our environment and science teaching. Challenge-based learning is a learning strategy where students have the opportunity to share ideas and interact with students of the same or with varied ability in order to get experiences. The interactions are expected to enhance their performance, build-up their self-importance, stimulate them to inquiry and make ideas clear. Thus, they are expected to surmount some of their learning difficulty and this study is aimed at establishing performance if it can be enhanced as they engage in challenge-based instruction.

This study intends to find out the impact of challenge-based learning strategy on academic achievement of junior secondary school students of low ability in Basic Science and Technology in Minna educational zone of Niger State.

# Purpose of the Study

1. Consider and examine the difference in the Academic Achievement of low ability students taught using challenge-based learning strategy and those taught using lecture method.
2. Compare the Academic Achievement of male and female junior secondary school class two students of low ability in Basic Science and Technology taught using challenge-based learning strategy.
3. Compare the Academic Achievement of female Basic Science and Technology low ability students taught Basic Science and Technology using challenge-based learning strategy and those taught using lecture method.
4. Compare the Academic Achievement of male low ability Basic Science and Technology students taught Basic Science and Technology using challenge-based learning strategy and those taught using lecture method.

# 1.4 Research Questions

1. What is the difference in the Academic Achievement of low ability students taught Basic Science and Technology using challenge-based learning strategy and those taught using lecture method?
2. What is the difference in performance of low ability male and female junior secondary school two students taught Basic Science and Technology using challenge-based learning strategy differ or not?
3. What is the difference in the Academic Achievement of female low ability students taught Basic Science and Technology using challenge-based learning strategy and those taught using lecture method?
4. What is the difference in the Academic Achievement of male low ability students taught Basic Science and Technology using challenge-based learning strategy and those taught using lecture method?

# Null Hypotheses

The following null hypotheses are formulated to be tested at P ≤ 0.05 level of significance.

HO1 There is no significant difference in Academic Achievement of low ability students taught Basic Science and Technology using challenge-based learning strategy and those taught using lecture method.

HO2 There is no significant difference in the Academic Achievement of male and female junior secondary school two students of low ability taught Basic Science and Technology using challenge-based learning strategy.

HO3 there is no significant difference in Academic Achievement of female low students taught Basic Science and Technology using challenge-based learning strategy and those taught using lecture method.

HO4 there is no significant difference in Academic Achievement of male low ability students taught Basic Science and Technology using challenge-based learning strategy and those taught using lecture method.

# METHODOLOGY

The research design for this study is quasi experimental pretest posttest control group design. A pretest was administered to determine the equivalence in ability level of these two groups (experimental and control groups). The population for this study comprised all the second year students in Junior Secondary School (JSS II) Students in Minna educational zone of Niger State. In selecting the schools for this study, only a sample of separate male and female schools was used, no co-education school was selected. There are twenty-five junior secondary schools in the study area, 14 male, 8 female and the other 3 are co-educational schools. Two schools were randomly selected from each of the male and female schools. Simple random sampling technique using balloting method involving a pick from a hat method was used in selecting the sampled schools for this study. The instruments and the instructional tools used for data collection in this study are; Basic Science and Technology Achievement Test (BSTAT), Lesson plan for both experimental and control groups, Challenge-based Learning Package (CLP) and Basic Science and Technology Achievement Test (BSTAT) was adapted from Dyel (2011). The instrument faced validation by two experts. In this study, pilot testing was carried out based on the data of the schools collected from the Niger State Senior Secondary School Management Board. The researcher selected two schools for pilot testing, one boys schools and one girls schools. This was done in schools different from the sampled schools. The reliability co-efficient of the Basic Science and Technology Achievement Test (BSTAT) was determined using the test retest method, in which the researcher administered the same test twice at an interval of two weeks, and obtained the students‟ scores. Pearson Product Moment Correlation Coefficient (PPMCC) using statistical package for social sciences (SPSS) of computer was used to analyze the data and the reliability Co-efficient (r) 0.78 was obtained. For the purpose of data collection, the following procedures were used in collecting relevant data; Treatment of the Experimental Group and Treatment of the Control Group. The data collected for this study was used to test the hypotheses stated. Each of the hypotheses is restated below along with the description of the statistical technique used. The level of significance for rejection or retention of the stated hypothesis was set at P≤ 0.05

**RESULTS**

**Research Question One**

What is the difference in the Academic Achievement of low ability students taught Basic Science and Technology using challenge-based learning strategy and those taught using lecture method?

**Table 1 Means and Standard Deviations Score for Academic Achievement of Low Ability Students of Experimental and Control groups**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **N** | **X** | **SD** | **Mean difference** |
| Experimental | 60 | 81.75 | 13.56 | 25.67 |
| Control | 60 | 56.08 | 7.65 |

From Table 1 the mean score for experimental group of students exposed to challenge-based learning strategy is 81.75 while those who were exposed to lecture method is 56.08. The mean difference between experimental and control groups therefore, is 25.67. This shows that challenge-based learning strategy improved Academic Achievement among Basic Science and Technology students of low ability.

**Hypothesis One:**

**HO1** There is no significant difference in Academic Achievement of low ability Basic Science and Technology students taught Basic Science and Technology using challenge-based learning strategy and those taught using lecture method.

To test this hypothesis, the posttest scores of students from the Academic Achievement test of the experimental and control group were collated and analyzed using t-test statistical technique to find out if there is any significant differences in their academic achievement at P ≤ 0.05. The result is presented in Table 2.

**Table 2: Results of t-test Analysis of Mean Academic Achievement Score of Basic Science low Ability Students for Experimental and Control groups**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **N** | **X** | **SD** | **SE** | **t-cal** | **df** | **p-value** | **Remark** |
| Experimental | 60 | 81.75 | 13.56 | 1.750 | 7.64 | 118 | 0.001 | \*Significant |
| Control | 60 | 56.08 | 7.65 | 0.988 |

\* P≤ 0.05

The result in Table 2 shows that the P-value obtained is 0.00 at P≤0.05 with df = 118. This implies a significant difference in the Academic Achievement of experimental group exposed to challenge-based learning strategy and that of the control group exposed to the lecture method. The result reveals that challenge-based learning strategy enhances Academic Achievement of low ability students. Thus, the null hypothesis that stated there is no significant difference is rejected.

**Research Question Two**

What is the difference in performance of low ability male and female junior secondary school two students taught Basic Science and Technology using challenge-based learning strategy differ or not?

# Table 3 Means and Standard Deviations Score for Academic Achievement of Male and Female Experimental groups

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **N** | **X** | **SD** | **Mean difference** |
| Male  Female | 30  30 | 81.33  85.17 | 10.66  13.49 | 3.84 |

From Table 3, the result shows that the Academic Achievement of both male and female subjects of experimental groups among junior secondary school two students of low ability in Basic Science and Technology differs. Male subjects have a mean score of 81.33 while the female subjects have the mean score of 85.17. This shows that females performed better with mean difference of 3.84 compared to their male counterparts. Therefore, there is a difference between the performance of the two groups. This result has answered the research question two.

# Hypothesis Two

**HO2** There is no significant difference in the Academic Achievement of male and female junior secondary school two students of low ability in Basic Science and Technology exposed to challenge-based learning strategy.

**Table 4**: **Results of t-test Analysis of post-test Scores of Male and Female low** **ability Basic Science and Technology Students taught using Challenge-based Learning Strategy**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **N** | **X** | **SD** | **SE** | **t-cal** | **df** | **p-value** | **Remark** |
| Experimental | 30 | 81.33 | 10.66 | 1.95 | 1.22 | 58 | 0.004 | \*Significant |
| Control | 30 | 85.17 | 13.49 | 2.46 |

From the result in Table 4, it was observed that the t-value was 1.22, and the P value of 0.004 at degree of freedom 58. Since the P-value of 0.004 is less than P≤ 0.05, therefore, there is significant difference thus, the null hypothesis is rejected. The significant difference is in favour of female students. The results show that female low ability students who were taught Basic Science and Technology using challenge-based learning performed better when compared with counterpart male low ability when taught Basic Science and Technology using challenge-based learning.

**Research Question Three**

What is the difference in the Academic Achievement of female low ability students taught Basic Science and Technology using challenge-based learning strategy (experimental) and those taught using lecture method (control)?

**Table 5”: Means and Standard Deviations of Score for Academic Performance of Female Experimental and Control Groups**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **N** | **X** | **Mean difference** |
| Experimental  Control | 30  30 | 85.33  55.33 | 30 |

Table 5 of descriptive statistics shows that differences exist in the Academic Achievements of female students taught Basic Science and Technology using challenge-based learning strategy (experimental) and those taught using lecture method (control). The calculated mean Academic Achievement of female students of experimental group is 85.33, while that of females‟ students of control group is 55.33 respectively. This shows that the female students of experimental group had significantly higher Academic Achievement than their females counterparts taught with lecture method, because of the mean difference of 30.

**Hypothesis Three**

That there is no significant difference in Academic Achievement of female low ability students taught Basic Science and Technology using challenge-based learning strategy (experimental) and those taught using lecture method (control).

**Table 6: Results of t-test Analysis of Academic Achievement of Female Experimental and Control Groups**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **N** | **X** | **SD** | **SE** | **t-cal** | **df** | **p-value** | **Remark** |
| Experimental | 30 | 81.33 | 10.26 | 1.95 | 9.72 | 58 | 0.001 | \*Significant |
| Control | 30 | 57.17 | 8.48 | 0.988 |

\* P≤ 0.05

Results from Table 6 independent t-test shows significant difference exists in Academic Achievement of female low ability students of experimental group and those of control. Because the calculated P-value of 0.001 is lower than the 0.05 level of significance. This shows that female students of experimental group have significantly higher Academic Achievement compared with their counterparts of control group. Therefore, the null hypothesis, which stated that there is no significant difference in Academic Achievement of female students taught Basic Science and Technology using challenge-based learning strategy (experimental) and those taught using lecture method (control) is hereby rejected.

**Research Questions Four**

What is the difference in the Academic Achievement of male students taught Basic Science and Technology using challenge-based learning strategy (experimental) and those taught using lecture method (control)?

**Table 7: Means and Standard Deviations of Score for Academic Achievement of Male Experimental and Control Groups**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **N** | **X** | **SD** | **Mean difference** |
| Experimental | 30 | 81.33 | 10.66 | 24.16 |
| Control | 30 | 57.17 | 8/48 |  |

Table 7shows the mean statistics in the Academic Achievement of male low ability students of experimental group and those of control. The calculated mean of Academic Achievement of both Experimental and Control groups are 81.33 and 57.17 respectively, with a mean difference of 24.16 between them, shows that male low ability students of experimental group have higher Academic Achievement than their male low ability counterparts of control group.

To determine whether the difference is significant, the post-test scores were subjected to t-test or analysis.

There is no significant difference in Academic Achievement of male students taught Basic Science and Technology using challenge-based learning strategy (experimental) and those taught using lecture method (control).

**Table 8: Result of t-test Analysis of Academic Achievement of Male Experimental and Male Control Groups**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **N** | **X** | **SD** | **SE** | **t-cal** | **df** | **p-value** | **Remark** |
| Experimental | 30 | 81.33 | 10.26 | 1.95 | 9.72 | 58 | 0.001 | \*Significant |
| Control | 30 | 57.17 | 8.48 | 0.988 |

\*P ≤ 0.05

Independent t-test statistics of Table 11 shows that significant difference exists in Academic Achievement of male low ability students of experimental group and those of control group. Because the calculated p-value of 0.001 is lower than the 0.05 level of significance. This shows that male low ability Basic Science and Technology students of experimental group have higher Academic Achievement compared with their male low ability counterparts of control group. Therefore, the null hypothesis, which stated that there is no significant difference in Academic Achievement of male low ability students taught Basic Science and Technology using challenge-based learning strategy (experimental) and those taught using lecture method (control), is hereby rejected.

**Discussion of Findings**

The results in Tables 2 show that the experimental group, which was exposed to challenge-based learning strategy, performed better than their counterpart in the control group who were taught using lecture method. The finding of this study is in line with that of Davis (2013), which suggests that the students learn better when actively involved in the challenge-based learning. In addition, students who collaborate in a group seem to be more satisfied with their course. Furthermore, in study on competitive and challenge-based learning in senior secondary schools by Kolawole (2011), the findings of the study showed that Academic Achievement of the students were highly improved. In a separate studies by Slavin (2015) and Gokhale (2014) it is shown that when students work in challenge-based learning, they engage in active learning which required them to use critical thinking, and fostered the development of critical thinking. Johnson and Johnson (2012) highlighted that challenge-based learning increases students‟ abilities in leadership and effective communication as well as enable them to manage conflicts constructively. Also in support of this study, the findings of Webb (2011), Lakpini (2012), Olorukooba and Lawal (2010) believed that small group interaction enhances the performance of low ability students and students who collaborate and work together as a team results in the positive performance. This clearly shows that the higher performance is in favour of experimental group, which suggests that the challenge-based learning strategy is more effective than the lecture method of teaching.

The results in Table 4.2b shows that there is a significant difference in the Academic Achievement of low ability male and female junior secondary school two students when taught Basic Science and Technology using challenge-based learning strategy. This finding is in agreement with the findings of Nwanso (2014), who in their separate studies, described that using activity oriented teaching strategies increased students abilities to come up with divergent view on issues hence their creative ideas improved. Curtis & Lawson, (2011) in their study showed that male and female students who were exposed to challenge-based learning, had an increase in their involvement and critical thinking as well as understanding of the subject matter. Furthermore, this is in agreement with findings of Mari (2009) and Bichi (2012) where they separately stated that girls performed better than the boys in problem solving type of activity. However, Gipps (2012), and O’Connor (2011), found that as boys and girls grew up, the differences they have in achievement in other subjects tend to diminish except in the sciences, and mathematics. In addition, this finding is in deviations with the findings of Bichi (2014) and Usman (2016), where in their separate findings they found out boys‟ performance is better in any rigorous work while girls showed to settle for less rigorous work. In other related studies, Billings (2000), and Lawal (2013) in their studies found that male students performed better than female students in the cognitive, affective and psychomotor skill achievements. In addition, Alfa (2007) reported that most researchers found boys performing better than girls especially in higher order knowledge. Joel and Usman (2016) found that boys perform better than girls in chemistry problem solving which requires the use of mathematics. However, Ohunkola (2011) also added that science in most cultures is defined as a masculine domain. But Yoloye, (2014) opined that if boys and girls are given equal opportunities they will perform equally well. This clearly shows that the higher performance is in favour of experimental group, which suggests that the challenge-based learning strategy is more effective than the lecture method of teaching. Based on these, therefore Usman (2016) stated that the issue of a gender in science teaching seems to be a controversy.

In addition, the results obtained from Table 4.3b, show that low ability female students taught Basic Science and Technology using challenge-based learning performed better than the low ability female students taught Basic Science and Technology using lecture method. The finding of this study is in agreement with the finding of Dambana (2011) where he found that female students taught using STS performed better than the female students taught using the traditional lecture method. Also, this finding is in line with the finding of Usman (2016) which found that students taught using challenge-based learning performed better. This shows that challenge-based learning enhances the Academic Achievement of low ability female students who are exposed to challenge-based learning.

The results obtained from Table 4.4b show that low ability male students taught Basic Science and Technology using challenge-based learning strategy have significantly higher Academic Achievement than their low ability female counterparts taught using lecture method. This is in line with finding of Dambana (2011) where he found that the male students taught using Science-Technology and Society (STS) performed better than male students taught using the traditional lecture method. In another direction, this finding is in line with the findings of Dyel (2011) and Sadi (2014) found that challenge-based learning strategy enhances the Academic Achievement of students. This shows that low ability male students taught Basic Science and Technology using challenge-based learning strategy have significantly higher Academic Achievement, than low ability male counterparts taught with lecture method.

The results of these study show that low ability students when taught Basic Science and Technology using challenge-based learning strategy were observed to generate more positively for the students performance in Basic Science and Technology. The results further shows that low ability female students performed better when compared to their counterpart low ability male students. Consequently, this learning strategy holds a viable promise for improving teaching and learning process of Basic Science and Technology of low ability students at the junior secondary school level.

**Conclusions**

Based on the findings of this study, the following conclusions are drawn:

* + 1. Low ability Basic Science and Technology students exposed to challenge-based learning strategy performed better in Basic Science and Technology than those low ability Basic Science and Technology students who are exposed to the lecture method of teaching.
    2. Challenge-based learning strategy enhanced the performance of low ability female students in Basic Science and Technology than the male. Generally, challenge-based learning strategy has the potential of enhancing low ability Basic Science and Technology students‟ performances.

In conclusions, using challenge-based teaching strategy for the improvement of Science Education at the JSS level is a welcome idea, and challenge-based learning strategy has the potentiality of enhancing low ability students‟ Academic Achievement in Basic Science and Technology at junior secondary school level.

* + 1. Female low ability students who were taught Basic Science and Technology using challenge-based learning strategy performed better when compared with the low ability female students taught Basic Science and Technology using lecture method.
    2. Male low ability students taught Basic Science and Technology using challenge-based learning performed better when compared with the low ability male students taught Basic Science and Technology using lecture method.

**Recommendations**

Based on the conclusions from this study, the following recommendations have been formulated:

* + 1. Challenge-based learning strategy enables the low ability students to performance better in Basic Science and Technology; therefore using this learning strategy would enhanced teaching and learning of the subject, and as such should be used to teach low learners.
    2. This study would help Curriculum planners to examine the effectiveness of challenge-based learning strategy, and consider its suitability for the teaching of Basic Science and Technology concepts. Since it has the potentiality of bringing about meaningful learning and improved Academic Achievement of low ability students, educational administrators as well as the principals and teachers of secondary schools should use it as the point of reference in formulating other educational policies in Basic Science and Technology.
    3. Conferences, seminars and workshops should be organized by professional associations, professional bodies and research organizations like the Science Teachers Association of Nigeria (STAN) and The Nigerian Educational and Research Development Council (NERDC) to incorporate challenge-based learning strategy in Basic Science and Technology curricula and textbooks at both the Junior and the Senior Secondary School levels.
    4. Federal, State and Local government should assist in the provision of necessary materials for effective use of Challenge-based learning for the teaching of Basic Science and Technology.
    5. Non-Governmental Organizations (NGOs) and Parent Teachers Association (PTA) should supplement and compliment government effort by providing materials for effective use of teaching strategy for the teaching of Basic Science and Technology.

# REFERENCES

Aliyu, A (2012): Effects of Meta cognitive Teaching Strategy on the Achievement of Students With Low Ability Groups in Mathematics, Unpublished M.Ed Thesis Department of Education, A.B.U. Zaria.

Alfa, Y.M. (2011) Gender disparity in Achievement in Mathematics of Senior Secondary School Students in Bosso Local Government Area. Unpublished B.Teach Project. Federal University of Technology, Minna.

Bani, B. (2012). Challenge-based Learninig in Distance Education: A Case Study. From <http://www.onlineresearchjournals.org/IJER>

Batin, D. (2000). Science Facilities-Foster Curiosity and Creativity. “*the science classroom” AAAS notes*. Wwwedfacilities.org/pubs/science3.html of 2/11/2005

Bichi, S.S. (2004). The Effect of Gender on Academic Achievement in Education Concepts among Secondary School Students using Problem Solving Instructional Strategy. *Zaria Journal of Studies in Education 3. (1) 123-138*

Bichi, S.S (2002). Effect of Problem Solving Strategy and Enriched Curriculum on Students Achievement in Evolution Concept Among Secondary School Students. Unpublished Phd Thesis. Faculty of Education Ahmadu Bello University Zaria.

Bichi, S.S (2008) Effects of Gender on History Enriched Curriculum on Academic Achievement in Evolution Concept

Chris W. (2013).*Teaching in times.* Retrieved on 24-6-2019. [www.teachingtimes.co.uk](http://www.teachingtimes.co.uk/)

Curtis, D.D. & Lawson, M.J. (2011). Exploring challenge-based online learning. *JALN,*

*5*(1), pp. 21−34.

Cused, J (2010) Challenge-based Learning and Collage Instruction; *Effective use of Student Learning Tearms,* California State University, California.

Datom, N. A. (2012), Effects of Class Size on Students Academic Achievement In Basic Science and Technology in Zaria Educational Zone, Kaduna State Nigeria. Department of Science Education *Postgraduate Seminar Series* Ahmadu Bello University, Zaria. Vol 1 No. 1

Davis, B. G. (2013). *Tools for Teaching*. San Francisco, Jossey-Bass. http://teaching.berkeley.edu/ bgd/challenge-based.html

Dyel B. D. (2011), Effects of Cooperative Learning Strategy on Academic

Performance and Attitude of Basic Science and Technology Students in Large Classes. Unpublished M.ed Dissertation Science Education Department Ahmadu Bello University Zaria.

Esther E. (2012), Influence of Cognitive Ability on Junior Secondary Two Students’ Achievement in Home Economics. *Journal of Research in Curriculum and Teaching*.

Gipps C (2012). A fair test. In: P. Ramroop (Ed). *A Gender inclusive multi dimension approach to the empowerment of learners in science education.* Mauritus: M.I.E. Publishers.

Gokhale, A.A.(2014).Challenge-based Learning Enhances Critical Thinking. *Journal of Technology Education, 7*(1), 22–30.

Johnson, D. W. and Johnson R. T. (2012) *Cooperative Learning and Feedback in Technology-Based Instruction*. In Dempsey, J., and Sales, G. C. Ed. Interactive Instruction and Feedback. Englewood Cliffs NJ: Educational Technology Publications.

Kaufman, D.B., Felder, R.M., Fuller, H. (2013). “Accounting for Individual Effort in Cooperative Learning Teams,” *J. Engr. Education, 89*(2), 133–140. View atwww2.ncsu.edu/effective\_teaching/

Kolawole, E.B. (2011). Effects of Competitive and Cooperative Learning Strategies on Academic Achievement of Nigerian Students in Mathematics. *Educational research Review, 3 (1)*, 33-37.

Lawal, F.K. (2012). Primary Science Teacher Preparation in Nigeria for the 21st century: The Challenges. *Journal of Educational Research and Development*. 2(1), 115-118.

Mari, J.S (2010), The Understanding of Science Process and its Relationship to Achievement in Integrated Science. An Unpublished M.ed Thesis Department of Education ABU Zaria.

O‟Connor JP (2011). An Overview of FEMSA. A paper presented at FEMSA/AFCLIST Gender Workshop, Nairobi Kenya. December, pp.6-8.

Ogunkola, J.B. & Bilesanmi-Awoderu (2011). Effects of Laboratory and Lecture Methods on Students‟ Achievement in Biology. *African Journal of Education, 5 (2)*, 247-260.

Slavin, R.L.(2015). Students Team Learning in Mathematics. In Davidson, N., ed. *Cooperative Learning in Mathematics*: a Handbook for Teachers, 69-102. Reading, M.A,Addison-Wesley.

Srinivas, H. (2010). Global Development Research Center: *Challenge-based learning.*

Retrieved from http://www.gdrc.org/kmgmt/c-learn/index.html on January 29, 2019.

Usman, I.A (2016). Effects of Indoor Laboratory Instructional Methods on Academic Achievement of Junior Secondary School Integrated Science Students in Zaria Local Government Area Kaduna State. *Journal of Studies in Science and Mathematics Education.* Department of Education Ahmadu Bello University Zaria.

Johnson, Laurence F.; Smith, Rachel S.; Smythe, J. Troy; Varon, Rachel K. (2009). Challenge – Based Learning: An Approach for Our Time. Austin, Texas: The New Media Consortium