FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
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THEME:

RE-THINKING THE FUTURE THROUGH STEM AND TVET FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS

Conference PROCEEDINGS

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EFFECTS OF CONTEXT-BASED AND INQUIRY-BASED INSTRUCTIONAL APPROACHES ON STUDENTS' ACHIEVEMENT IN BIOLOGY IN NIGER STATE

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Abstract
The study investigated the effects of context and inquiry-based instructional approaches on students' achievement in Biology in Niger State, Nigeria. The research adopted a quasi-experimental design involving a pretest, posttest, non-equivalent, non-randomized experimental control group design. The population of the study was 57,947 Senior Secondary School two (SSII) students. The sample for the research study comprised 225 male and 187 females making a total of 412 students drawn from nine co-educational senior secondary schools selected randomly through a stratified sampling technique. The instruments for the study are Treatment Instruments and Test Instruments. The treatment instruments are a Context-based instructional approach and an Inquiry-based instructional approach while the Test Instrument is the Ecology Achievement Test (ECOLAT). The ECOLAT contains 50 items and was used as a pretest to determine the students' entry behavior and a post-test to determine the student's achievement. The Instruments were subjected to face and content validation by 3 experts. ECOLAT was pilot-tested and reliability coefficient of r = 0.79 was obtained. Experimental groups one and two were exposed to context and inquiry-based teaching approaches respectively and control group was exposed to traditional teaching methods. Mean and Standard deviation was used to answer the research questions while ANCOVA and MANCOVA were used to analyze the research hypotheses. The results revealed that the two experimental methods were very effective in enhancing the academic achievement of biology students in Ecology concepts better than the traditional method. The study also found out that the multivariate effect of gender was not statistically significant on the combined pretest and posttest test mean scores of students taught Ecological Concepts with the two experimental methods. Conclusion was established that context and inquiry based instructional approaches were very effective in enhancing the academic achievement and they are gender friendly in ecology concepts among senior secondary school biology students of Niger State The study recommended among others that Science teachers should incorporate the idea of using Context and Inquiry based instructional approaches in teaching science subjects in secondary schools to enhance students' achievement. Also, since the two experimental methods are gender friendly, they were recommended to be used as means of disseminating instructions in secondary schools in order to reduce the gap in the performance of male and female students.

Keywords: Context-based approach, Inquiry-based approach, Achievement and Gender

Introduction
The importance of good teaching methods in the teaching-learning process cannot be over-emphasized. It is obvious that if teaching processes are to be productive, an active teaching method that allows learners' participation in the learning process must be encouraged in our classrooms. Many teaching approaches have facilitated improvement in teaching and learning processes, some of the known approaches such as the field trip, lecture method, concept mapping, game method, discussion method, role-playing, cooperative learning, and many more have produced different results when used in classroom instruction in formal school systems. The need to adopt newer techniques to stimulate constructive social activities within and outside the formal education system cannot be over-emphasized and this could be successfully done through science.

The emphasis placed on science and its essential role in national development made it relevant and practically necessary for it to be taught in an organised and well-structured pattern that involves activities

for both teachers and students (CAIE, 2019). This is because when science is delivered using methods that involve activities for both students and teachers, teaching becomes effective, learning becomes more meaningful, and these, in turn, bring positive development to the educational system. Knowledge of science enables learners to acquire technical know-how in solving problems in an ever-changing society (Lee *et al.*, 2020). Furthermore, scientific ideas make students independent and thus task themselves to cope with their environment, making life easier. The economic and political strength of a country is always assessed in terms of its achievement in science and technology. This is why the National Policy on Education (FRN, 2014) emphasised the provision of science education at all levels of education in Nigeria. The policymakers of education in Nigeria believe that the provision of science education at all levels of education in Nigeria could improve the economic and political strength of the country.

The significance of Biology cannot be over-emphasized as it is important in food production, hybridization, cross-breeding, in-vitro fertilisation, blood transfusion, marriage counseling, pest control, development of early maturing of plants and animals (Inyang, 2021). All these aspects of life mentioned above and many more are very important for the effective living of the human race on this earth and they can never be studied without the knowledge of Biology. A very important topic in biology is Ecology which is a practical science that involves finding out how living organisms depend on themselves and their non-living environment for their survival, measuring factors affecting the environment, and studying the distribution of living organisms (Sarojini, 2010). For this important concept in biology to be taught properly in secondary schools, the need to use active-learning instruction among students is inevitable.

Studies have shown that active-learning instruction among students can be highly effective in facilitating the development of conceptual understanding and scientific thinking skills (Peters *et al.*, 2020; Freeman *et al.*, 2014). Based on the report by the above researchers, it is believed that active learning processes such as context-based and inquiry-based instructional strategies could be effective methods of teaching biology and could be a priority at all levels of our secondary education system, hence the need for examining them in this study.

The context-based approach is described as the starting point for developing scientific ideas in science teaching. In this approach, real-life contexts are used to introduce concepts into the classroom to improve learning and application of knowledge (Gercek & Ozgur, 2015). It is the use of real-life and fictitious examples in an environment of teaching to learn through the actual practical experience with a subject rather than just its mere theoretical parts (Grospietsch & Mayer, 2018). Practical learning experience could make learning more permanent and retained because of the adage that says 'seeing is better than hearing'. Furthermore, the context-based learning strategy is student-centered, giving students a more active and self-steering role, thereby making students to be actively aware and involved in all activities going on in the class and not allowing the class activities to be dominated by the class teacher (Susanne, 2016).

Inquiry-based Instructional Strategy is a style or method of teaching where the learner seeks to discover and create answers to recognised problems through the procedure of doing a diligent search (Shaibu, 2017). Diligent search is a process of seeking the truth or a query into an idea that is not known previously. The search shed light extensively on the unknown. Inquiry-based teaching strategy has developed independent and critical thinking skills, positive attitudes and curiosity toward science, and increased achievement in biological content (Franklin, 2015). The development of independent and critical thinking skills, positive attitudes, and curiosity toward science by Biology students may go a long way in solving the problem of underperformance in biology. Furthermore, Marcus (2017) describes an inquiry-based teaching strategy as a learning and teaching method that prioritizes student questions, ideas, and analyses. When students' questions, ideas, and analysis are prioritized in a teaching and learning situation, it becomes a student-centred teaching method, making learning more interesting, meaningful, and permanent. According to Marcus (2017), inquiry-based learning focuses on investigating an open question or problem from the

student's point of view. Here students must use evidence-based reasoning and creative problem-solving to reach a conclusion, which they must defend or present in order to improve students' achievement in biology.

Achievement is also known as a learning outcome. The learning outcome is the knowledge we acquire from the teaching process. It is the extent a student has attained in their academic work at any level of education (Bajon, 2015). The author, Bajon (2015) further defined achievement as the act of successful performance and also an act of achieving a result gained by efforts, the quantity and quality of a student's work. Achievement is when a student shows a positive performance in his/her study, this positive performance usually gives the teacher feedback that he/she has done a great job in his/her teaching. Therefore, achievement may be defined as the act of achieving or successful performance (Anra & Yamin, 2017). The academic achievement of the student is the ability of the student to study and remember facts and being able to communicate his knowledge either practically, orally or in written form in an examination condition (Peter *et al.*, 2014). This can be achieved by using appropriate methods of instruction that are gender friendly.

Gender is one factor that is very important in the relationship between instructional strategy and cognitive achievement. Gender issues have been related to student's achievement in academic tasks in several studies but without any definite conclusion (Ekineh & Adolphus, 2019). Some literary works have revealed that there is no significant difference in the academic achievement of both male and female students (Le *et al.*, 2019 & Ikechukwu, 2022). Others discovered that females performed better than their male counterparts in their studies (Vooren *et al.*, 2022) while Ibrahim (2016) discovered in his research work that males performed better than females academically.

Statement of the Research Problem

The problem of underachievement by students in Biology may be due to the nature and type of instructional strategies adopted by Biology teachers, which is mostly lecture methods. Different kinds of Instructional strategies have been used by teachers in teaching biology and it's still facing the problem of poor performance over the years. The Chief examiner reports in WAEC 2016, 2017 & 2018 stated that students' performance in some concepts of ecology such as adaptation in organisms, ecosystem, association in organisms, soil organisms, and pollution has been unsatisfactory. Poor performance of students in Biology in five years WAEC report of Niger State between 2017 and 2021 is not a good one as well. Hence, it is necessary to look into current methods of teaching science to get suitable approaches that would lead to effective teaching and learning of ecology and biology in general that will in turn improve the biology performance of Senior Secondary School Students in Niger State. Based on the reasons above, this study focused on "context and inquiry-based instructional approaches on secondary school students' achievement in biology in Niger state, Nigeria".

Aim and Objectives of the Study

The aim of this research is to determine the effects of the context-based and inquiry-based instructional approaches on students' achievement in Biology in Niger State.

Therefore, the study strived to achieve the following:

i. Examine the effect of context and inquiry-based instructional approaches on achievement in ecological concepts among senior secondary school students in Niger State.
ii. Find out the effect of Context and Inquiry-based instructional approaches on the achievement of male and female students taught Ecological concepts in senior secondary schools in Niger State.

Research Questions

The following research questions were raised:

i. What are the effects of Context and Inquiry-based instructional approaches on secondary school students' achievement in Ecological concepts in Niger State?

ii. What is the effect of Context and Inquiry-based instructional approaches on the achievement of male and female students taught Ecological concepts in senior secondary schools in Niger State?

Hypotheses

The following null hypotheses were formulated and tested at a 0.05 level of significance.

HO_1: There is no significant difference in the achievement scores of students taught ecological concepts using context and inquiry-based instructional approaches and those taught with the traditional method.

HO_2: There is no significant difference in the mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches.

Methodology

The research adopted a quasi-experimental research design which was a pretest, posttest, non-equivalent, non-randomised experimental control group design. The population of the study comprises 57,947 Senior Secondary School two (SSII) students, which comprises 32,029 males and 25,917 females spread across Senior Secondary Schools in Niger State. The sample for this research study comprised 225 males and 187 females making a total of 412 students and they were drawn from nine co-educational senior secondary schools selected randomly through a stratified sampling technique from the three (3) senatorial zones of the state (zones A, B & C). The Treatment instruments for the study are Context and Inquiry-Based Instructional Approaches. The Test Instrument for the study is the Ecology Achievement Test (ECOLAT) which contains 50 multiple-choice questions with four options (A-D) in which only one of the options is correct. ECOLAT was used at the pretest to determine the students' entry behaviour and also at the post-test to determine the student's achievement. The Instruments were subjected to face and content validation by 3 experts. The two experimental groups and control group were all given a pretest before the treatment. Experimental group one was exposed to a context-based teaching approach, experimental group two was exposed to an inquiry-based teaching approach while control group was exposed to traditional teaching methods as treatments. The treatment was administered on the groups for six weeks while the posttest was conducted on the groups after treatment. Mean and Standard deviation was used to answer the research questions while ANCOVA and MANCOVA was used to analyze the research hypotheses.

Results

Research Question One: What are the effects of Context and Inquiry-based instructional approaches and traditional methods on secondary school students' achievement in Ecological concepts in Niger State?

Table 1: Mean and Standard Deviation of Pretest and Posttest Scores of Context-Based Instructional Approach, Inquiry-Based Instructional Approach and Traditional Method on Secondary School Students' Achievement in Ecological Concepts.

Group	N	Pretest		Posttest		Mean Gain	Mean Difference
		$\bar{X}$	SD	$\bar{X}$	SD		
Context-Based	152	24.95	5.19	74.18	10.29	49.23	6.59
Inquiry-Based	153	25.63	7.22	68.27	12.15	42.64	
Traditional Method	107	24.95	5.193	43.88	9.79	18.93	23.71

Table 1 shows the mean and standard deviation of achievement scores of the two experimental groups and the control group in the pretest and posttest. The result revealed that the mean and standard deviation scores of the pretest and posttest of experimental group one, context-based are $\bar{X}$ =24.95, SD = 5.19 and $\bar{X}$ = 74.18, SD = 10.29 respectively. This gives a mean gain of 49.23. The table also shows the mean and standard

deviation of the pretest and posttest of the Inquiry-based as $\bar{X}$ = 25.63, SD = 7.22 and $\bar{X}$ =68.27, SD 12.15 respectively. This also gives a mean gain score of 42.64. On the other hand, The mean and standard deviation of the pretest and posttest of the Traditional method are $\bar{X}$ = 24.95, SD = 5.19 and $\bar{X}$ =43.88, SD= 9.79 respectively. The results revealed that experimental group one, and two and the control group, had mean gains of 49.23, 42.64, and 18.93 respectively with a mean difference of 6.59 between experimental groups 1 and 2, a mean difference of 23.71 between experimental group 2 and the traditional method and mean difference of 30.30 between experimental group 1 and traditional method. Therefore, both Context-Based and Inquiry-Based instructional strategies improve the achievement of biology students in Ecology far better than the traditional method while the experimental group one which is Context-Based has the highest mean gain.

Research Question Two: What are the effects of Context and Inquiry-based instructional approaches on the achievement of male and female students taught Ecological concepts in senior secondary schools in Niger State?

Table 2: Mean and Standard Deviation of Pretest and Posttest Achievement Scores of Male and Female Experimental Groups Context-based and Inquiry-based

Group		N	Pretest		Posttest		Mean Gain
			$\bar{X}$	SD	$\bar{X}$	SD	
Context-based	Male	77	26.36	7.12	74.52	10.49	48.16
	Female	75	26.59	7.26	73.84	10.14	47.25
Inquiry-based	Male	72	22.31	5.08	69.25	12.10	46.94
	Female	81	22.22	4.82	67.41	12.21	45.19

Table 2 shows the mean and standard deviation of the pretest and posttest achievement scores of male and female of the two experimental groups (Context-based and Inquiry-based). From the result, it can be seen that mean score of the pretest and posttest score of male in context-based group are $\bar{X}$ = 26.36, SD = 7.12 and $\bar{X}$ = 74.52, SD = 10.49 respectively. The mean gain is 48.16. Similarly, the mean and standard deviation of pretest and posttest score of female in context-based are $\bar{X}$ = 26.59, SD = 7.26 and $\bar{X}$ = 73.84, SD = 10.14 respectively, the mean gain for the female here is 47.25. The male has slightly more gain score than the female. From the table also, the mean and standard deviation of the pretest and posttest scores of male in experimental group two(Inquiry-Based) can be seen that mean score of the pretest and posttest score of the male are $\bar{X}$ = 22.31, SD = 5.08 and $\bar{X}$ = 69.25, SD = 12.10 respectively. The mean gain for the male here is 46.94. Also, the mean and standard deviation of pretest and posttest score of female in inquiry-based are $\bar{X}$ = 22.2, SD = 4.82 and $\bar{X}$ = 67.41, SD = 12.21 and the mean gain is 45.19.

Hypothesis One: There is no significant difference in the achievement scores of students taught Ecological Concepts using Context and Inquiry-based instructional approaches and those taught with the traditional method.

Table 3a: ANCOVA Analysis of achievement scores of students taught Ecological Concepts using Context-based, Inquiry-based and traditional methods.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	69321.831[a]	3	23107.277	228.911	.000
Intercept	56401.216	1	56401.216	558.735	.000
PRETEST	7445.392	1	7445.392	73.757	.000
GROUP	59915.282	2	29957.641	296.773	.000
Error	41185.341	408	100.944		
Total	1804337.000	412			
Corrected Total	110507.172	411			

Table 3a shows the ANCOVA comparison of Posttest Scores of the experimental groups (Context and Inquiry based instructional approaches) and traditional method. An examination of table shows F (2, 408) = 296.773, $p < 0.05$, the results of the analysis indicate that hypothesis one was rejected on the basis that the main effect (treatment) was significant. The results revealed that the Context-based instructional approach, Inquiry-based instructional approach and traditional method produced a significant effect on the posttest achievement scores of students when covariate effect (pretest) was controlled. The result indicates that the treatments used, which are Context and Inquiry based instructional approaches and traditional method accounted for the difference in the posttest achievement scores of the students. This implies that a statistical significant difference exists among the three groups. Since it was established that there was a significant difference in the post-test scores of the groups, Sidak post-hoc test analysis was done to identify the direction of the difference among the treatment groups as shown in Table 3b.

Table 3b: Sidak Post-hoc Analyses of the Groups Mean Scores Context-based, Inquiry-based instructional approaches and traditional method

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
Tradition method	Context-based	-29.875*	1.269	.000	-32.917	-26.833
	Inquiry-based	-23.968*	1.267	.000	-27.006	-20.930
Context-based	Tradition method	29.875*	1.269	.000	26.833	32.917
	Inquiry-based	5.907*	1.151	.000	3.148	8.666
Inquiry-based	Tradition method	23.968*	1.267	.000	20.930	27.006
	Context-based	-5.907*	1.151	.000	-8.666	-3.148

Sidak post-hoc analysis on Table 3b indicated that the observed significant difference between traditional method and Context-based instructional approaches group is with the mean difference of 29.87, P-value of .000 which was significant at 0.05 level in favour of the context based group. There was also a significant difference between traditional method and inquiry instructional approach, the mean difference is 23.96, *P*-value of .000 which was also significant at 0.05 levels. The mean difference here is in favour of inquiry-based learning group. Similarly, there was a significant difference between context-based and inquiry-based learning strategy group with the mean difference of 5.90, p=0.00, the mean difference is in favour of the

context-based group. Therefore, context-based and inquiry-based groups did better than the traditional method, however, the group that contributed most to making it significant was found to be context-based group because of its highest mean differences of 29.87 when compared with other groups. There was significant difference between the 3 groups, therefore, hypothesis one is rejected.

Hypothesis Two: There is no significant difference in the mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches.

Table 4: MANCOVA Analysis of mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches.

		Value	F	Hypothesis Df	Error Df	Sig
GENDER of Achievement Context-based * gender Inquiry based	Pillai's Trace	.023	1.687[b]	2.000	145.000	.189
	Wilks' Lambda	.977	1.687[b]	2.000	145.000	.189
	Hotelling's Trace	.023	1.687[b]	2.000	145.000	.189
	Roy's Largest Root	.023	1.687[b]	2.000	145.000	.189

Table 4 shows the Multivariate effect gender on pretest and posttest mean scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches; Pretest as Covariate. The table reveals that when dependent variables (pretest and posttest score) were combined and pretest controlled, there was no significant difference in the mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches. $F(2, 145) = 0.97$, $p > 0.05$, Wilkis' $\lambda = 1.687$. The results of the analysis indicate that hypothesis two should be accepted on the basis that the multivariate effect of gender was not statistically significant on the combined pretest and posttest test mean scores of students taught Ecological Concepts with Context and Inquiry-based instructional approaches. There was no significant difference in the mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry based instructional approaches. Base on this, hypothesis two is retained.

Discussion of Findings

This study showed that there was significant difference in the achievement scores of students taught Ecological Concepts using Context and Inquiry based instructional approaches and those taught with the traditional method in favour of the two experimental groups . This is in support of the findings of Fikadu and Shimeles (2019) who investigated the effect of context-based instructional approaches on students' problem-solving skills using a quasi-experimental design. The study found that context-based instructional approaches are relatively better than traditional instruction in enhancing students' problem-solving skills. This study is also in support of the study of Esra and Figen (2015) who studied the effect of a "context-based learning approach" towards students' biology success and attitudes on biology courses where the result of the analysis shows that there is a meaningful difference between the context-based learning approach and traditional learning on students' success and attitudes towards biology in favour of context based group. The findings of this study also aligned with the study of Mwenda and Ndayambaje (2021) who examine the effect of inquiry-based teaching method on secondary students' academic achievement in Biology and the findings of the study showed that the use of inquiry-based teaching had a significant effect on the students' achievement in Biology. The findings of this study is also in agreement with the study of Oyovwi (2021) who examined the effects of concept mapping and inquiry method in teaching difficult curriculum in secondary school Biology on students' academic achievement in Delta State. The result of the study showed a significant difference between the performance of students exposed to the two experimental groups (Concept-Mapping and inquiry methods) and the control group (lecture method) in favour of the experimental groups.

This study showed that there was no significant difference in the mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches. This is in support of the study of Aransi (2018) who examined the impact of age and gender on High School students' academic performance in Economics and the findings indicated that there was no interactive influence of gender on the academic performance in Economics. It is also in line with the study of Oludipe (2012) who examined the influence of gender on Junior Secondary Students' Academic Achievement in Basic Science using Co-operative Teaching Strategy, findings of the study revealed that there was no significant difference in the academic achievement of male and female students in the pretest, post-test and delayed post-test levels. This result also supported the study of Nkok and Anietie (2022) who conducted a study on the interaction effect of gender on teaching methods and the result revealed that teaching method by gender interaction is not significant. On the other hand the finding of this study is not in support of the study of Vooren *et al.*, 2022 who compared success of female students to their male counterparts in the STEM fields, an empirical analysis from enrollment until graduation using longitudinal register data and discovered that females performed better than their male counterparts in their studies. Also, this study is not in support of Ibrahim (2016) work on the Effects of computer assisted instruction with animation and concept mapping on achievement and retention of secondary school Biology students who discovered in his research work that males performed better than the female academically.

Conclusions

The study investigated Context and Inquiry Based Instructional Approaches on Secondary School Students' Achievement in Biology in Niger State, Nigeria". From the findings of the study and discussions that followed, the following conclusions were made:

Context and Inquiry based instructional approaches were very effective in enhancing the academic achievement in Ecology concepts among senior secondary school biology students of Niger State, probably because the two methods were active methods of teaching that allowed the students to be actively involved in the teaching learning method.

Based on the findings of this research, it was found also that gender does not have any influence on the achievement of both male and female biology students taught Ecology concepts with context and Inquiry-based instructional approaches, indicating that the two experimental methods are gender friendly.

Recommendations

Based on the findings of this study, the following recommendations were raised:

1) Science teachers should incorporate the idea of using Context and Inquiry-based instructional approaches in teaching science subjects in secondary schools since the study has shown that the students taught with the two experimental methods perform far better in achievement than those taught with the traditional method.
2) The two experimental methods are gender friendly, it is therefore recommended to be used as means of disseminating instructions in secondary schools to reduce the gap in the performance of male and female students.
3) Government and stakeholders of education at all levels should provide adequate funds to purchase instructional materials and for easy movement needed in this teaching method since it involves teaching students with real life situations.

References

Anra, Y., & Yamin, M. (2017). Relationships between lecturer performance, organizational culture, leadership, and achievement motivation. *Форсайт*, *11*(2 (eng)), 92-97.

Aransi, W. O. (2018). Impact of Age and Gender on High School Students' Academic Performance in Economics: A Case Study Analysis. *International Journal for Innovative Research in Multidisciplinary,* 4(1), 52-65.

Bajon, R. H. (2015). Effect of mode of laboratory work on senior secondary school students' achievement in Biology in Jalingo local government area of Taraba State. Department of science Education, University of Nigeria.

Cambridge Assessment International Education. (2019). *Implementing the Curriculum with Cambridge: A Guide for School Leaders*. Available at:www.cambridgeinternational.org/images/134557-implementing-the-curriculum-with-cambridge.pdf.

Ekineh, D. R., & Adolphus, T. (2019). Influence of Gender on Students' Performance in Biology when Taught Reproduction Using Collaborative Strategy in Secondary Schools in Rivers State. *Rivers State University Journal of Education*, *22*(1&2), 62-73.

Esra, Ö. K. & Figen, Ç. T. (2015). Effects of Context Based Learning On Students' Achievement and Attitudes in Biology. *KastamonuEğitimDergisi23 (4), 1425-1436.*

Franklin, W. A. (2015). Inquiry based approaches to science education: Theory and practice. Retrieved on 15/5/2019 from http://www.brynmawr.edu/Biology /franklin/ Inquiry Based Science.html.

Freeman, S., Eddy, S. L., McDonough, M. Smith, M. S. Oloroafor, N. Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences, 111(23), 8410–8415.*

Federal Republic of Nigeria (2014). *National Policy on Education:* Federal Government Press, Lagos.

Fikadu, E. & Shimeles, A. (2019). Effects of Context-Based Instructional Approaches on Students' Problem-Solving Skills in Rotational Motion. *EURASIA Journal of Mathematics, Science and Technology Education, 15(2).* Retrieved online @ OPEN ACCESS Research Paperhttps://doi.org/10.29333/ejmste/102283

Gercek, C. & Ozgur, O. (2015) Views of Biology Teacher Candidates about Context Based Approach. *Procedia - Social and Behavioral Sciences*.197:810-814.Available online at www.sciencedirect.com.

Grospietsch, F., & Mayer, J. (2018). Professionalizing pre-service biology teachers' misconceptions about learning and the brain through conceptual change. *Education Sciences*, *8*(3), 120.

Ibrahim, I. K. (2016*). Effects of computer assisted instruction with animation and concept mapping on achievement and retention of secondary school Biology students in Niger State, Nigeria.* An unpublished doctoral thesis, Department of Science Education, Federal University of Technology, Minna, Niger State.

Inyang, P. E. (2021). Effects of computer simulation and guided discovery teaching methods on students' academic achievement and retention in biology. *World*, *4*(1), 45-52.

Ikechukwu, I (2022). Effect of inquiry-based and cooperative learning instructional strategies on secondary school biology students' academic achievement and retention in Abia State. Repository.mouau.edu.ng: Retrieved Aug 22, 2023, from https://repository.mouau.edu.ng/work/view/effect-of-inquiry-based-and-cooperative-learning-instructional-strategies-on-secondary-school-biology-students-academic-achievement-and-retention-in-abia-state-7-2

Lee, M. H., Liang, J. C., Wu, Y. T., Chiou, G. L., Hsu, C. Y., Wang, C. Y. & Tsai, C. C. (2020). High school students' conceptions of science laboratory learning, perceptions of the science laboratory environment, and academic self-efficacy in science learning. *International Journal of Science and Mathematics Education*, *18*, 1-18.

Lee, T. T. H., Tran, T., Trinh, T. P. T., Nguyen, C. T., Nguyen, T. P. T., Vuong, T. T., ... & Vuong, Q. H. (2019). Reading habits, socioeconomic conditions, occupational aspiration and academic achievement in Vietnamese junior high school students. *Sustainability*, *11*(18), 5113.

Marcus. G. (2017). All about inquiry-based teaching: definition, benefit and strategies downloaded at http:/www.prodigygame.com/blog.

Mwenda, K. S., & Ndayambaje, I. (2021). Effects of inquiry-based teaching on students' academic achievement in Biology in lower secondary schools in Ilala–Dar es Salaam–Tanzania. *LWATI: A Journal of Contemporary Research*, *18*(4), 2-14.

Nkok, E. & Anietie, E. (2022). Interaction effect of gender and teaching methods on students' interest, achievement and retention in sexual reproduction in plant. *International Journal of Innovative Social & Science Education Research* 10(4):56-65.

Oludipe, O. I. (2012). Gender Difference in Nigerian Junior Secondary Students' Academic Achievement in Basic Science. *Journal of Education and Social research, 2 (1), 93-99.*

Oyovwi, E. O. (2021). Effects of concept-mapping and inquiry strategies in teaching difficult curriculum concepts in biology on students' academic achievement and retention. *International Journal of Biosciences,* 18(6), 258-267.

Peter, J. K., Andy, I. J. & Tracy, O (2014). Academic Achievement Prediction: Role of Interest in Learning and Attitude towards School. *International Journal of Humanities Social Sciences and Education (IJHSSE), 1(11), 73-100.*

Peters, T., Johnston, E., Bolles, H., Ogilvie, C., Knaub, A., & Holme, T. (2020). Benefits to students of team-based learning in large enrollment calculus. *Primus*, *30*(2), 211-229.

Sarojini, T. R. (2010). *Modern Biology:* Senior Secondary Science Series. Onitsha, Africana-Fep Publishers Limited.

Shaibu, S. T. (2017). *Assessment of the effects of Inquiry and Demonstration methods On Performance of Biology Students' in Secondary Schools in Federal Capital Territory, Abuja, Nigeria.* A published thesis from the Department of Educational Foundations and Curriculum, Faculty of Education, Ahmadu Bello University, Zaria, Nigeria.

Susanne, W. (2016). *From doing to learning. Inquiry- and context-based science education in primary school*. A doctoral thesis from Department of Environmental and Life Sciences, Faculty of Health, Science and Technology, Karlstad University, Karlstad, Sweden.

Vooren, M., Haelermans, C., Groot, W., & van den Brink, H. M. (2022). Comparing success of female students to their male counterparts in the STEM fields: an empirical analysis from enrollment until graduation using longitudinal register data. *International Journal of STEM Education*, *9*(1), 1-17.

West African Examination Council (2016-2021). Senior School Certificate Examination. *The Chief Examiner's Reports*, Yaba, Lagos: WAEC Publishers.