

Inquiry Laboratory Technique of Teaching: An Effective Tool for Enhancing Biology Students' Retention Ability in Secondary Schools in Gombe South Education Zone of Gombe State, Nigeria

¹MANU, Joseph, ²O. R. Ugwuadu, ³JAMES, Obadiah Junduwa, ⁴KUNTA, Danyo

^{1,4} Science Education Department, Federal University Kashere, Gombe State, Nigeria

² Environmental and Life Science Education Department, ModibboAdama University of Technology, Yola, Adamawa, Nigeria

³ Senior Education Officer, Lamurde Local Education authority, Adamawa, Nigeria

Submitted: 01-08-2021

Revised: 10-08-2021

Accepted: 13-08-2021

ABSTRACT

The study investigated inquiry Laboratory technique of teaching an effective tool for enhancing biology students' retention in secondary schools in Gombe south education zone of Gombe state. Two objectives were formulated and two research questions were raised. Two null hypotheses tested at 0.05 level of significance guided the study. The design of the study was quasi- experimental design, specifically the pre-test, post-test non equivalent control group design with 196 Biology senior secondary school II students from four selected schools in Gombe south education zone of Gombe state. Instrument used for data collection was a Biology Achievement Test (BAT) and Biology Retention Test (BRT) adapted from WAEC past questions 2000-2015. The instrument was content validated by three experts and was tested for reliability using KR formula 20. The reliability coefficient of 0.76 was obtained. The treatment lasted for five weeks and data were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). Results showed that: There is significant difference in the effect of teaching methods on Students' retention in biology $F=0.33$ ($df=1$) $p < 0.000$. The effect of gender on students academic achievement in biology is not significant $F= 0.03$ ($df=1$), $P= 0.86$. It was recommended that, seminars and workshops should be organized and made compulsory for practicing teachers so that they can acquire the skills of the inquiry laboratory technique of teaching for effective implementation of the strategies in teaching biology. Schools should organize workshops and seminars internally which will enable teachers and their students to share

ideas on the skills of inquiry laboratory technique of teaching.

Keywords: Inquiry Laboratory technique, retention, Secondary School, Gender, Biology.

I. INTRODUCTION

Education is the bedrock of any meaningful development. Abagi, (2001); Kyalo, Osano, Maundu and Kipkemboi (2006) lamented that, Education is fundamental in the development of human beings and has been viewed principally as a fundamental human right. Worldwide, education is viewed as a prominent factor that helps in shaping the future of individuals. Such an important attachment to education can be established based on the investment that goes towards education in relation to other programs in most countries, for instance, in USA, UK and Australia.

The National Policy on Education (2014) has made provisions to make education of the citizenry both functional and relevant with a view to ensuring all round development. Specific provisions have also been made for different levels of education system so as to ensure effective curriculum delivery in schools. For the benefits of all citizens, the country's educational goals was clearly set out in terms of their relevance to the needs of the individual and those of the society, in consonance with the realities of the environment and the modern world (Federal Republic of Nigeria, (FRN, 2014). Orji and Uka (2012), argued that in order to actualize this in any society, there is the need of attending to certain unavoidable variables such as teaching materials, methods

adopted, curriculum, teacher as well as students' interest. With particular reference to secondary education in Nigeria, various subjects have been included in the curriculum to enable Students acquire knowledge and skills. Certain subjects are categorized as core while others are either vocational electives or non-vocational electives. Biology is found under both core and non-vocational electives categories.

Nwagbo (2005) defines science as intellectual activity carried out by man and designed to discover information about the natural world in which he lives as well as to discover the ways in which the information can be organized to benefit human race. Science education is a distinct form of creative human activity which involves distinct ways of seeing, exploring and understanding reality. Science, being a fundamental part of everyday living and essential to our understanding of the world, teaches us the ways of finding out about the world. This helps us to develop a growing body of ideas and information about the way things work. Science and technology play an important role in nation building and development (Abbas, 2007). The reason is that science can exert a dominant, if not decisive influence on the life of an individual as well as on the developmental effort of a nation.

Orukotan (2007) stated that science education has introduced a lot of changes in our world today and it will continue to do so in the near future. For science and technology to successfully achieve the goals of the millennium development in Nigeria, there is need to engage creatively in science and technology education. Bajah (2000) noted that no nation can make any meaningful progress in the information technology age, particularly in economic development without technology which has science and physics as its foundations. This is because the level of Science, Technology and Mathematics Education (STME) of any nation has been widely accepted to be indicative of that nation's socio-economic and geopolitical development (Nwachukwu, 2008). Akpan (2008) opined that science contributes to the quality of life in such areas as health, nutrition, agriculture, transportation, material and energy production, and industrial development. The author further stated that science ensures that the air we breathe, and the water we drink are life sustaining, and not vectors of disease and decay. The author finally concluded that if science and technology form the bedrock of sustainable development, then that revelation should constitute a beacon to our nation, so that science education must be given prominence in Nigerian schools.

Biology is a branch of science which deals with the study of living things. This includes all organisms on land and in water bodies. Biology as a subject is taught in the senior secondary school level in Nigeria. The objectives of the senior secondary school Biology curriculum are; to enable students acquire meaningful and relevant knowledge and apply the knowledge of Biology in everyday life, acquires laboratory and field skills and scientific attitudes that are pragmatic and environment conscious (National Examination Council, 2006). Biology as a branch of science and prerequisite subject for many fields of learning contributes immensely to the technological growth of a nation. These fields include medicine, forestry, agriculture, biotechnology and nursing. The study of biology in senior secondary schools can equip the students with useful concepts, principles and theories that will enable them face the challenges before and after graduation. Biology being a science subject is aimed at developing science skills in the learners to enable them fit into the scientific field so that they can be scientist who can bring positive development in the area of science and technology. Obiekwe (2008) reported that all is not well with science instruction in Nigerian secondary schools, and noted that science teachers lay much emphasis on content and the use of "chalk and talk" method neglecting the laboratory practical activities method which may enhance teaching and learning as well as students academic achievement.

Despite all the strategies taken by the Federal and state governments of Nigeria in providing adequate instructional materials and other facilities, the poor performance of students in national examinations, especially in sciences persists. For instance, the performance of students in Biology in public examinations such as the West African senior school Certificate Examination (WASSCE) and the Senior Schools Certificate Examination (SSCE) have persistently been poor, West African Examinations Council (WAEC) (chief Examiners Reports, 2013) indicates that there was massive failure in Biology where 61.5% Candidate failed. The search for effective approaches for the teaching and learning of Biology that will enhance the students' academic achievement and retention have been a problem over the years. Studies have indicates that most teachers teach biology with conventional lecture method (CLM) which does not involve much of students' active participation in a lesson (Ndioho, 2007; Ugwuadu&Joda, 2013). Biology is a subject that requires practical and active students' participation. Okoli (2006) indicated that many science teachers use the traditional teaching

method, a teaching method which the teacher presents a spoken discourse on a particular subject instead of activity-oriented teaching method which is student centered such as practical in the laboratory. Nwagbo (2006) observed that such teacher centered method which places the teacher as sole possessor of knowledge and the students passive listeners of knowledge may not enhance students' achievement and retention in biology. Teaching method that involves the students in active problem solving situation includes experimental, discovery, demonstration, discussion, field trip and project method.

Inquiry laboratory technique is a teaching method in science that refers to a way of questioning, seeking knowledge or information or finding out about phenomena; it involves data collection, analysis and arriving at a conclusion (Sola & Ojo, 2007). These researchers added that inquiry laboratory technique help students to learn when they are left alone and learn not only concepts, but also self direction, responsibility and social communication. The inquiry laboratory technique is supported by knowledge that emerges from research (Bransford, Brown & Coking, 2000). They added that in inquiry laboratory technique in science education, learners become engaged in many activities and thinking process that science use to produce new knowledge. Inquiry Laboratory technique is an activity based; student centered teaching method where students learn by carrying out activities in the laboratory (Omosewo, 2002). These activities include touching seeing, feeling, weighing, measuring and demonstrating, Carrying out testing/experiments and other practical activities in the laboratory. Omosewo (2002) asserted that laboratory work promotes competence in the skill of gathering information, organizing, communicating, interpreting, observing, drawing conclusions and making inferences.

Lecture method is a method of teaching in which the teacher delivers the lesson to students with no active participation by the students. It is a teacher-centered approach involving largely a one-way form of communication from the teacher to the students. For this reason, it is termed a didactic approach because most of the talking is carried out by the teachers; the students remain as passive listeners taking down notes. At secondary school level there is strong objection to the exclusive use of the lecture method in teaching science, hence there is need to bring in a method which requires conceptual perspective through which content can be understood (Nworgu, 1997).

Retention is the ability to remember task, material or learned concept. Bichi (2002) defined

retention as the ability to remember and recall information or knowledge gained after learning. Other researchers such as Mangal and Obeka (2010) found out that several variables determines retention. Factors which includes the constant practice of task to be performed, learners past experience, the interval between the lesson and evaluation and instructional strategies employed. Learning is of three kinds, first is cognitive learning that refers to fact, knowledge or ideas. The second is affective learning that refers to the feeling, attitude, interest, values and appreciation. The third is psychomotor which manifests in physical skills in the use of fingers as in writing, drawing, typing, and playing, football. The ultimate aim of learning or the acquisition of knowledge that a high percentage of what is learned can be retained, easily recalled and applied. The major burden in the heart of science teacher and stake holders is to find the most suitable teaching approach that can maximize student's academic achievement and retention in learning science irrespective of gender of students.

Gender according to Onyegegebu (2008) is the sum total of cultural values, attitudes, roles, practices and characteristics based on sex. Onyegegebu further describe sex as the innate biological differences between women and men. So both women and men differ by their physiology. Okeke (2008) describe the men as bold, tactful, intelligent, aggressive etc. and the women as dull, passive, submissive, talkative, etc. Damie(2001) supported that gender difference could also be an important factor in performance of students in biology. Damie(2001) and Kurpius (2004) reported that gender difference could also be a factor that is responsible for failure in biology. Yahaya (2012) submitted that gender difference in the performance of boys and girls in the standardized examination in science have been seen over the years. In line with the background above this study explores the effect of Inquiry Laboratory Teaching Method (ILTM) on student's academic retention.

Purpose of the Study

The purpose of this study was to investigate the effect of inquiry Laboratory technique of teaching on biology students' academic retention in secondary schools in Gombe south education zone of Gombe state. Specifically, this study was expected to achieve the following objectives:

1. Determine the effect of inquiry laboratory technique on biology students' retention of biology concepts.

2. Determine the effect of inquiry laboratory technique on gender in students' academic retention.

Research Questions

The following research questions were answered in this study.

1. What is the post test mean retention scores of students when taught biology using inquiry laboratory technique and lecture teaching methods?
2. What is the post test mean retention scores of male and female students when taught using inquiry laboratory technique and lecture teaching methods?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 alpha level of significance in this study.

HO₁ There is no significant difference in the effect of teaching methods on students retention in biology when taught biology using inquiry laboratory technique of teaching and lecture method of teaching.

HO₂ There is no significant difference in the effect of gender on academic achievement of students in biology when taught biology using inquiry laboratory technique and lecture methods of teaching.

II. METHODOLOGY

This study employed a quasi-experimental design, specifically the pre-test, post-test non equivalent control group design. This design allowed for maximum control of extraneous variables. This study has 2x2x2 factorial matrix design made up of method 2, gender 2. Treatment at two levels and gender at two levels.

The diagrammatic sketch of the design is thus;

E= O₁ x O₂ O₅

C=O₃ -x O₄ O₅

E= Experimental group

C= Control group

X= Treatment with laboratory practical

-X= Lecture teaching method

O₁=Pre-test measurement for experimental group

O₂=Post-test measurement for experimental group

O₃= pretest for control group

O₄=post test for control group

O₅=Retention test measurement

The Target population of Senior Secondary two Biology students' in 395 Senior Secondary Schools of Gombe State was 19,669,(Gombe State Ministry of

Education,(2015). The sample of the study consists of 196 Biology senior secondary school II students from four selected schools in Gombe south education zone of Gombe state. Gombe south was selected by using simple random sampling. Multi stage sampling was used to select the sample where purposive sampling was used to select the four schools that have equipped laboratories, co-educational institutions and qualified biology teachers. Each of the four schools has four intact classes of SS2 by random (lucky dip) sampling technique; one intact class was selected for the study.

The instrument that was used for data collection were the Biology Achievement Test (BAT) and Biology Retention Test (BRT) adopted by the researcher drawn from WAEC (2000-2015) past biology question papers. BAT consisted of items drawn from WAEC past question papers based on the topics selected for the study. BRT also consist of items drawn from WAEC past questions papers based on the topics selected for the study. It consisted of 40 multiple choice objective test items used for pre-test and post-test and retention test respectively. In the BRT the items were reshuffled to avoid familiarity to the students. The adopted items were from the selected topics namely: Diffusion, Photosynthesis, Osmosis, Mammalian Reproductive system (cow), and Unicellular Organism. Three experts in biology education from Department of Science Education and Plant Science at ModiboAdama University of Technology Yola were given the instrument in order to cross check that the instrument were selected from the stated period, and to ensure content and face validity. The reliability of BAT and BRT was determined using Kuder-Richardson 20. The reliability coefficient of 0.76 was obtained, which is the coefficient of internal consistency of the items. The data collected from the study were analyzed using a statistical package for social sciences (SPSS version, 23). The research questions were answered using mean and standard deviation while the hypotheses were tested at 0.05 level of significance using ANCOVA.

III. RESULTS AND DISCUSSION

Three research question were raised and analyzed using descriptive statistics, while the hypotheses were tested using ANCOVA tested at 0.05 level of significance.

Answering Research Questions.

The research questions were answered using descriptive statistics.

Research question 1: What is the mean retention scores of students when taught biology using

inquiry laboratory technique and lecture teaching methods?

Table 1: Descriptive statistics of students' retention scores

Teaching Method	N	Gender	Mean	S.d
Inquiry Lab	44	Male	25.61	2.14
	56	Female	25.00	3.83
	100	Total	25.27	3.20
Lecture	44	Male	13.00	2.37
	52	Female	13.19	2.47
	96	Total	13.10	2.42
Total	88	Male	19.31	6.73
	108	Female	19.31	6.80
	196	Total	19.31	6.72

From the result in Table 1, in the retention test Inquiry Laboratory Technique has mean score of 25.27 with standard deviation of 3.20, while lecture method has a mean score of 13.10 and a standard deviation of 2.42. Therefore, from the above descriptive statistics results, we can say that inquiry laboratory technique has the highest mean retention score than lecture method.

score of 27.05 and standard deviation of 3.12, while females have mean score of 27.86 and standard deviation of 2.05. In lecture method males have mean score of 19.73 and standard deviation of 1.34, while females have mean score of 19.13 and standard deviation of 1.44. The result showed that, males and females have similar mean scores in the descriptive statistics

Research Question 2: What is the post test mean score of males and females students when taught biology using inquiry laboratory technique and lecture teaching methods.

Hypotheses Testing

The hypotheses were tested using ANCOVA at 0.05 level of significant.

From the result in Table 1, in post-test inquiry laboratory technique, males have the mean

HO₁ - There is no significant difference in the effect of teaching method on students' retention in biology.

Table 2: Two Way Analysis of Covariance on Retention

Source	Type III Sum of Square	Df	Mean Square	F	Sig.
Corrected Model	7267.82	4	1816.95	223.87	0.000
Intercept	4920.29	1	4920.29	606.23	0.000
PRETEST	8.31	1	8.31	1.02	0.31
Teaching Method	6956.69	1	6956.70	857.13	0.00*
Gender	2.65	1	2.65	0.33	0.56
Method*gender	8.88	1	8.90	1.09	0.29
Error	1550.20	191	8.12		
Total	81911.00	196			
Corrected total	8818.02	195			

R. Square = 0.84 (Adjusted R-squared = 0.82)

Also, from Table 2, shows that there is significant difference in the effect of teaching method on students retention, in biology F = 857.13 (df = 1) p (0.00) > F (0.33). Since the computed p – value (0.56) is greater than the F – value (0.33) at 0.05 level of significant; therefore,

the null hypothesis of no significant difference in the effect of teaching method is rejected. Thus inquiry laboratory technique is more effective in enhancing students' retention.

HO₂. There is no significant difference in the effect of gender on students' academic

achievement in biology. From Table 2 the main effect of gender on students academic retention in biology is not significant $F = 1.09$, $df = 1$, $P = 0.29$. Since the computed p – value (0.86) is greater than the F – value (0.03) at 0.05 level of significant; therefore, the null hypothesis of no significant difference in the effect is not rejected. This means gender does not have any significant effect on this teaching method. Hence, effect of this teaching technique in biology according to this finding has nothing to do with student gender.

IV. DISCUSSION OF RESULTS

The aim of this study was to investigate the effects of inquiry laboratory technique of teaching and lecture method on secondary school students' retention in biology in Gombe State. To this end, the scores obtained from the BRT administered to experimental and control groups were compared. The study found out that, students taught biology contents using inquiry laboratory technique of teaching retained biology concepts better than those taught with lecture method as confirmed by Ali, and Obeka, (2014), Ndioho, (2011) who in their study found out that students who were taught with inquiry laboratory technique retained the learnt biology concepts better than their counterpart who were taught using lecture method. The high retention might be as a result of practicality of inquiry laboratory technique of teaching and active students' involvement in the learning process.

The result also showed that there is no significant effect of gender on students' retention of biology concepts this agreed with the findings of Chukwu, (2011) who found that gender is not a factor in students' retention in biology. This means students' performance and retention significantly differs based on the teaching methods used for the study (inquiry laboratory technique and lecture methods). Students taught biology contents using inquiry laboratory technique performed and retained better than those taught with lecture methods. This means inquiry laboratory technique is the best teaching method between the two teaching methods in delivering biology content. This finding agrees with findings of Ali and Obeka, (2014).

V. CONCLUSION

Based on the findings of the study, the use of inquiry laboratory technique enhanced students' academic retention in biology. There is no significant gender difference in the experimental group.

VI. RECOMMENDATIONS

From the result of this study, the following recommendations were made:

1. Government should also show more commitment in improving facilities for teaching and learning in secondary schools so that the implementation of inquiry laboratory technique of teaching will relatively be hitch-free by provision of well equipped laboratories, libraries etc because it encourages students retention. These facilities enable students to participate actively in biology lessons when incorporated with inquiry laboratory technique method.
2. It is evident that, the inquiry laboratory technique of teaching is effective in improving students' achievement in biology. Therefore, teachers should use this teaching method to facilitate their biology teaching.

REFERENCES

- [1]. Abbas, A. B. (2007). Achieving National Economic Empowerment and development strategy Through chemistry. STAN conference proceedings.
- [2]. Abagi, O. (2001), Mobilization and Utilization of Resources for Primary Education: Policies that World make sense, Nairobi Institute of Policy and Research.
- [3]. Ali, M. S. &Obeka, S. S. (2014). Effects of Inquiry method of teaching on students academic achievement and retention in Chemistry among Diploma students of Kano State Polytechnic. Journal for Standard Scientific Research and Essay, 2(7), 273 – 282.
- [4]. Amedu, O. I. (2015). Effect of gender in the academic achievement of students in Biology in AkwangaNasarawa State. Journal of Education and Practice, 6(17), 17 – 27.
- [5]. Akanbi, A. S. & Adewumi, G. (2007). Effect of inquiry and project strategy on students Achievement in Selected abstract concepts in biology. Department of teacher education, faculty of education, University of Ibadan. Retrieved 23/5/2016 www.academia.edu/7993609/
- [6]. Akpan, B.B. (2008). Nigeria and the Future of Science Education. Oluseyi Press Ltd Ibadan.
- [7]. Bajah, S.T. (2000). Teaching Integrated Science Creativity. Ibadan University press.
- [8]. Bichi, S. (2002). Effects of Problem Solving Strategy and Enriched Curriculum on Students' Achievement in Evolution Concepts among Secondary School

- Students. Unpublished Doctoral Dissertation Faculty of Education, Ahmadu Bello University, Zaria.
- [9]. Busari, A. T. (2000). Field Study in Geography, an Inevitable Tool for Acquiring Observatory and Analytical Skills. *Informational Journal of Research in Education*, 6 (1&2), 1 – 15.
- [10]. Bransford, J. D., Brawn, A. & Cooking, R. R. (2000). How people learn brain mind, experience and School. Washington D. C. National Academic Press.
- [11]. Chukwu, C. E., (2011). Effect of integrated model of teaching on student retention in biology in Enugu East Education zone, Enugu State. *The Nigerian Journal of Research and Production*, 18(1), 20 – 32.
- [12]. Damie, R. T. (2001) & Kurpiuasa, B. (2004). Some problems of science education in developing Countries of Africa. Retrieved September, 20, 2006 www.vrdjournals.com
- [13]. Dinah, C. S. (2013). Factors which influence academic performance in biology in Kenya: a perspective for global competitiveness. *International Journal of Current Research* 5(12),
- [14]. Federal Republic of Nigeria, (2014). National Policy on Education. 4th edition Lagos:
- [15]. Ghumdia, A. A. (2016). Effects of inquiry based teaching strategy on students science Process skills acquisition in some selected Biology concepts in secondary schools in Borno State. *International Journal of Scientific Research* Vol. 1 (2), pp 96.
- [16]. Khan, M. & Igbal, Z. M. (2011). Effect of inquiry method Laboratory teaching method on the development of science process skills through the teaching of biology in Pakistan Language in India, 11 (1), 69-178 retrieved 12/6/2006
- [17]. Kyalo, E., Osano, M., Maundu, K. & Kipkemboi, I. (2006). Education in Kenya: Towards the Geography. Retrieved from <http://scholar.google.com/teachingmethod/geography>.
- [18]. Lawan, T. E. (2007). Think and Do! Activity and its Effect on the Performance of Pupils in Primary Science in Selected Primary Schools in Zaria Municipality, Nigeria. *Journal of Science and Mathematics Education*, University of Cape Coast, 3 (1), 87-92.
- [19]. Mangal, S. K. (2010). Essentials of Educational Psychology. New Delhi. PHI Learning Private Limited. 351 359.
- [20]. Ndioho, O. F. (2007). Effects of a constructivist instructional strategy on affective academic achievement of secondary school students. www.uob.edu.bh/~v3-N1.pdf. Retrieved 27-9-2016, 8:38am
- [21]. Ndioho, O. F. (2011). Effect of guided inquiry learning strategies on Senior Secondary Schools Academic Achievement and Retention in Biology in Port Harcourt. www.imsabizness.journals.org/index.php/j... 11:39, 28 -2-2017
- [22]. Nwachukwu, C.O. (2008). Problems and Prospects of Development of Science Education in Nigerian Schools. A Philosophical Perspective. Paper Presented at the 17th Annual National Conference of the National Association For Research and Development. Abuja Nigeria. 8 September.
- [24]. Nwagbo, C. R. (2006). Effects of two teaching methods on the achievement in and attitude to biology students of different level science literature. *International Journal of Educational Research* 2(48), 216-229.
- [25]. Nwagbo, C. (2005). Effects of Guided Discovery and Expository teaching methods on Attitude towards Biology of students of Different levels of scientific literacy. *Journal of Science Teachers Association of Nigeria*, 34(1&2), 66-73.
- [26]. Nworgu, B. G. (1997). Method and Media in science instruction. A paper presented at the first annual conference of Enugu State Association for promotion of quality education in Nigeria, held at University of Nigeria, Nsukka.
- [27]. Oghenevwe, O. E. (2010). Effect of inquiry and discovery approaches in teaching and learning of Biology on secondary school students performance in Delta State. *Journal of Research in Education and Society* 1 (1), 23-30
- [28]. Obiekwe, C. L. (2008). Effects of Constructivist Instructional Approach on Student Achievement and Interest in Basic Ecological Concepts in Biology. Unpublished M.ed Thesis. Faculty of education, University of Nigeria Nsukka.
- [29]. Ogundokun, M. O. & Adeyemo, D. A. (2010). Emotional Intelligence and Academic Achievement: The Moderating Influence of Age, Intrinsic and Extrinsic Motivation. *The African Symposium*, 10 (2), 127 141.

- [30]. Okeke, A. E. A. C. (2008). Classification and analysis of gender. Focus on research, reproductive Health Education and gender sensitive classrooms. Ibadan Nigeria. School Teachers Association of Nigeria. Gender and STM Education Series No. 2, 5-8.
- [31]. Okoli, J. N. (2006). Effects of investigative laboratory approach and expository method on acquisition of science process status in biology student of different level of scientific Literacy. Journal of STAN.41(182).79-85.
- [32]. Omosewo, E. O. (2002). The relative effects of post – laboratory discussion on students Academic achievement in physics. Nigeria Journal of Educational Foundation, 4(2): 116-121
- [33]. Onyegegebu, N. (2008). Gender and Reproductive health. The what, the how, and the why, Ibadan Nigeria: Focus on Research, Reproductive health Education and Gender sensitive classrooms. Ibadan Nigeria: School Teachers' Association of Nigeria Gender and STM Education series, 2, 17 – 28.
- [34]. Orukotan, A. F. (2007). Curriculum Enrichment of STM Education as a Basis for Sustainable Development. STAN 50th Anniversary Conference Proceedings.32-35.
- [35]. Sola, A. O. &Ojo, E. (2007) Effect of project inquiry, lecture and demonstration teaching method on Academic Achievement on Senior Secondary School in separation of mixtures practices Test Education, Res. Rev. 2(6) 124-132.
- [36]. Ugwuadu, O. R & Joda F. M. (2013). Reality of teaching biology in secondary schools in Adamawa state. Nigerian educational forum: A Journal of Institute of Education Ahmadu Bello University, Zaria, 24(1), 59-76.
- [37]. Usman, I. A. (2010) and Aigboman, (2002) The Effects of Indoor and Outdoor Instructional Methods on Academic Achievement of JSS Integrated Science Students in Zaria Local Government Area, Kaduna State. Journal of Science and Mathematics Education.1 (1).66-73.
- [38]. Yahaya, A. M. (2012). Relationship Between Students Reasoning Ability and Achievement in Integrated Science, Unpublished M. Tech Thesis faculty of education, AbubakarTafawa Balewa University Bauchi Nigerian Country.