International Journal of Innovative Social & Science Education Research 12(2):127-137, April-June, 2024

© SEAHI PUBLICATIONS, 2024 www.seahipublications.org ISSN: 2360-8978

Impact Of Expository Game-Based Strategy On Interest And Performance In Genetic Concepts Among Senior Secondary School Students In Katsina Metropolis

Dr. Ismaila Ado[1]; Dr. Babangida Isah[2], Muhammad Bello Idris[3]

[1,3]Department of Integrated Science,
Isa Kaita College of Education Dutsin-Ma, Katsina State, Nigeria

[2]Department of Primary Education,
Isa Kaita College of Education Dutsin-Ma, Katsina State, Nigeria

[3]Department of Integrated Science,
Isa Kaita College of Education Dutsin-Ma, Katsina State, Nigeria

ABSTRACT
The study investigated the Impact of Expository Game-Based Strategy on Interest and Performance in Genetic Concepts among Senior Secondary School Students in Katsina Metropolis, Katsina State, Nigeria. The study has four objectives, answered four Research questions and tested four null hypotheses. The research questions were answered using descriptive statistics that is mean and standard deviation, while null hypotheses were tested at $p \leq 0.05$ significant levels. Wilcoxon-Ranked and t-test were used to analyze the data collected. Pretest, posttest control group quasi experimental design was adopted. The population consists of 6,722 students drawn from twenty (20) public Senior Secondary Schools in Katsina Metropolis. The sample for the study consists of 100 students selected from two Senior Secondary Schools in Katsina Metropolis purposive sampling technique was adopted in the selection of the experimental group while simple random sampling by balloting was used to select the control group. One of the schools served as control group (N=50) and the other served as the experimental group (N=50). Two instruments were developed by the researcher and validated these are: Genetic Interest Inventory Questionnaire (GIIQ) and Genetic Concept Performance Test (GCPT) both instruments were pilot tested. GCPT had a reliability coefficient of 0.88 while GIIQ had a reliability coefficient of 0.86. The major findings of the study Include: students taught Genetic Concepts using Expository Game-Based Strategy performed significantly better in their academic performance as compared to those taught using lecture method alone: and that the use of Expository Game-Based Strategy is not gender-friendly. Recommendations were made from the findings of the study such as Expository Game-Based Strategy should be encouraged to be used by Biology teachers for teaching Genetic Concepts in Secondary Schools.
Keywords: Expository Game-Based Strategy, Genetic Concepts, students

INTRODUCTION

The nations of the world accord priority to science and technology in their developmental efforts. The reason for according such priority to science and technology is that it is a road map to great economic

improvement and equally serves as the only means to national development (Ajewole, 2010). In this age of fast-developing technology, it has become necessary for all countries of the world, especially the developing ones, to organize and improve the teaching of science that helps in understanding the foundation base to develop technology. Science has also become such an indispensable tool that no nation, developed or developing, wishing to progress in socio-economic sphere can afford to relegate its learning in schools to the background (Feynman 2011). Science is a discipline, a body of knowledge about the universe, the structure and reactions of matter, the conservation and transfer of energy, the interaction between living things and their environment (Ezeudu, 2011). Aladejana (2007) opined that science teaching at various levels still retains the old conventional approach with the teacher in most cases, acting as the repertoire of knowledge and the students the dominant recipients. There is over reliance on textbooks with only occasional demonstrations and experimental classes (Aladejana 2013). Ibe (2013) defines science as a system of thought. Any nation that ignores scientific literacy according to Oden and Asim (2002) may find it difficult to fit into the world's affairs.

Biology is a branch of science that involves the study of living things. Biology is a fascinating study that ranges from the study of microscopic organisms to the biosphere, encompassing the earth's surface and its living organisms. It is a core subject offered at the Senior Secondary Certificate Examination (SSCE), a unique subject which promotes the acquisition of specialized scientific skills and knowledge. It explains the relationship between man, his environment and that between living and non-living components in the environment (Obiekwe, 2010). Biology occupies a unique position in the school curriculum and it is central to many science related courses such as medicine, pharmacy, agriculture, nursing, biochemistry, genetics to mention a few and it is made up of branches like: Anatomy, cytology, Evolution, Genetics and so on.

Genetics is a branch of Biology that deals with the functions and behaviour of genes that influences many aspects of daily life; of every organism from the food we eat to treatment of diseases, among others. Inspite of the crucial role genetics played in our daily life; studies by Ogenyi, (2015) and WAEC Report, (2017) have shown that students' performance in Biology has been persistently low.

The concept of Game-Based Strategy is as a result of the advent of Information Communication Technology (ICT). Game-Based Strategy can be used for teaching and learning at any level of education. Games are educational tools which allow students to learn through the application of theory and decision-making to a stimulated real-world scenario (Sowunmi & Aladejana, 2013). Games like Peek-A-Boo, a game for amusing a small child, in which one covers one's face or hides and then returns to view saying "peek a boo". It is thought by developmental psychologist Piaget (1970) to demonstrate an infant's inability to understand object permanence which is an important stage of cognitive development for infant, to the complex ones such as Dungeons and Dragons (D&D) which is a structured yet open-ended role playing game. It is normally played indoors with the participants seated around a table top. Games have inspired and engaged people for decades. The game the researcher used for this study is the dragon genetic game, the game first made appearance in 1974, invented by Gary Gygex and David Arneson in 1972 which was originally used as a means of expanding the rules of large-scale war games, allowing players to settle disputes between individual squad members with dice rolls. However, those roles (settling disputes between individual squad members) proved to be popular and soon spun off into what is known as dragon game though it has metamorphosed over the years. The rules were fairly complex and difficult to master, which put new players off. However, as time went on, game producers continued to take steps toward making it simpler.

The researcher used dragon genetic game breeder because of the game relevance to the concept of genetics. It is a game in which players' progress by using the principles of Mendelian genetics in breeding target dragons, to determine the genotypes of the dragons in their den. In the game, drakes are used to help figure out the diseases of dragons in a way that is similar to how scientists use mice to understand human genetic diseases. To advance to the next level, players have to solve the genetic problems plaguing the drakes. The game is based on real Biology with a narrative thread that interest and excites students in science.

Interest is a subjective feeling of concentration there in or persisting tendency to pay attention and enjoy some activity or content (Imoko & Agwagah, 2010). A conducive learning environment, functional teaching material and a motivating teacher have positive effect on students' interest in learning (Mangal, 2010). Teachers should help students improve their performance and develop interest in genetics by reducing the abstractness of the concepts and remove their apathy and fears of the subject. Antonie (2013) stated that without interest, there can be no learning and with it, learners cannot be prevented from learning. An interested student is therefore, one who has inner state and energy which channels and maintains his or her behaviour and directs it to some desired need or goal.

Mangal and Mangal (2007) explained that in exposition the main emphasis in the exposition strategy is on the manner and way of exposing the topic and subject matter to the students. Killen (2007) stated that in these methods of teaching, the teacher has direct control over what is taught and how learners are presented with the information they are to learn. It means that, expository teaching is equal with direct instruction and deductive teaching term. Expository Game-Based Strategy goes beyond just presenting students with the facts. It involves presenting clear and concise information in a purposeful way that allows students to easily make connections from one concept to the next. Science educators believe that students learn new concepts and ideas better if all of the information they need to know are laid out before them (Selim & Shrigley 2009). According to Killen in Miller and Stoeckel (2011) no one single teaching strategies is effective all the time for all learners. The present state of science (Biology) teaching and learning in Nigeria is a concern to all.

Adesoji, F.A. (2008) Students Ability Levels and Effectiveness of Problem-Solving Instruction Gender inequality in education has remained a perennial problem of global scope (UNESCO, 2003; Larkin, 2003; and Connelly, 2008). In general, there has been inequality in the opportunities for boys and girls in later life translated into unequal access to education, health and employment (Bello, 2002; Reid, 2003). Gender disparity over the years as to who performs better in classroom situations and during evaluation process has long remained a controversial issue (Nweke, 2010 & Lawal, 2012). Research findings by Ochu and Atagher, (2010) showed that gender imbalance in science education is not a recent trend but stretches back to pre-historic culture.

Lecture method is a traditional talk and chalk method of teaching in which the teacher does most of the talk, while the students listen and write notes. This is the method of teaching that teachers embrace for easy coverage of the school syllabus (Stanley, 2008; Dunya, 2009 & Obeka 2009). This method involves verbal presentation of ideas, concepts, and generalization of facts. It is used to introduce students to a new subject, summarize ideas, showing relationships between theory and practice and highlighting the main points. Joshi (2008) opined that lecture method is teacher-centered with little or no participation of students; consequently, they remain passive listeners. This method does not promote optimum academic performance in science as observed by James (2009).

Problem Statement

The learning of genetics had been found to be difficult for students as shown in their performance in SSCE. The WAEC and NECO Chief Examiners' Report of 2013-2017 revealed that only 34%-49% of the students pass Biology annually. The pass score of students is below 50% and the percentage failure score is above 50%. The Chief Examiners' Report (2017) stated that candidates presented very poor and inaccurate genetic diagram and candidates seem not to understand genetic terminologies. Students low performance in Biology is due to low performance in genetic concepts and lack of knowledge of the real concepts of genetic (Umeh, 2009). This reveals that only very few students attempt questions under genetic concepts in biology while majority of the students do not even attempt such questions. Lewis and Kattmann (2014) observed that genetics is considered to be one of the most difficult concepts in biology and the mechanisms are hard to understand because it is difficult to make the ideas to be tangible without the help of special instrument. The study further revealed that students come to the classroom with their own conception of genetics from their own experiences and observations. Also Anaso (2008), Jimoh (2005) and Ogenyi (2015) noted that many teachers employ methods that enable them cover their syllabuses, in most cases, but fail to pay attention to the students, especially in terms of their interest and

academic performance. According to them, the predominant method used by teachers in Nigerian schools is lecture method which does not allow active participation of the student in the lessons and this leads to memorization of facts and concepts by students without the basic understanding of the concepts. This study investigated the Impact of Expository Game-Based Strategy on Interest and Performance in Genetic Concepts among Senior Secondary School Students in Katsina Metropolis, Katsina State, Nigeria.

Objectives of the study

This study has the following objectives which are to:

i. determine the mean scores of students taught genetics before and after exposure to Expository Game-Based Strategy;
ii. determine the difference in the mean scores of students taught using Expository Game-Based Strategy and those taught using lecture method;
iii. determine whether the use of Expository Game-Based Strategy has effect on the interest of students in genetics;
iv. determine whether the use of Expository Game-Based Strategy has effect on the interest of male and female students taught genetics before and after using Expository Game-Based Strategy.

Research Questions

The following research questions were formulated to guide the study

i. What is the difference in the mean scores of students taught genetics before and after exposure to Expository Game-Based Strategy on students' performance in genetics?
ii. What is the difference in the mean scores of students taught genetics using Expository Game-Based Strategy and those taught using lecture method?
iii. What is the effect of Expository Game-Based Strategy on the interest of students in genetics?
iv. What is the effect of Expository Game-Based Strategy on the interest of male and female students taught genetics concept before and after using Expository Game-Based Strategy?

Null Hypotheses

The following null hypotheses were tested at $p \leq 0.05$ levels of significance

H_{01} There is no significant difference between the posttest means scores of students taught genetic before and after exposure to Expository Game-Based Strategy.

H_{02} There is no significant difference between the mean scores of students taught using Expository Game-Based Strategy and those taught using lecture method.

H_{03} There is no significant difference on the interest of students taught genetic concept using Expository Game-Based Strategy and those taught using Lecture method.

H_{04} There is no significant difference between male and female students academic performance taught using Expository Game-Based Strategy.

METHODOLOGY

The study adopted pretest, posttest control group quasi experimental design. Two groups of students were involved; that is experimental and control groups. The experimental group (EG) were exposed to the treatment (X_1) using Expository Game-Based Strategy in genetics while the control group (CG) were exposed to conventional lecture method (X_0). Pretest (O_1) was administered to the students before treatment to ensure comparative ability in the study subjects. Posttest (O_2) was administered after treatment to determine the impact of Expository Game-Based Strategy on students' academic performance.

RESULTS

The result and analysis of data obtained is presented under the following: Answering Research Questions; Testing Null Hypotheses

Research Question 1: *What are the mean scores of students taught genetic before and after exposure to Expository Game-Based Strategy?*

Table 1: Mean and Standard Deviation for Pre-test and Post-test Scores of Experimental Group

	N	Mean	SD	Mean diff.
Pre test	50	21.34	3.51	36.38
Post test	50	57.72	5.66	

Results in Table 4.1 indicate that the pre test has a mean score of 21.34 while the post test has a mean score of 57.72. This implies that the post test of Expository Game-Based Strategy on students' academic performance in genetics is higher than their pre test with a mean difference of 36.38. This finding answers research question one. There is a difference in the mean scores before and after exposure to Expository Game-Based Strategy on students' academic performance in genetics.

Null Hypothesis One:

There is no significant difference between the mean scores of students taught genetic before and after exposure to Expository Game-Based Strategy.

Table 2: Summary of t-test Analysis of Mean Scores of Students taught Genetic before and after Exposure to Expository Game-Based Strategy

	N	Mean	SD	df	t-cal	t-crit	P
Pre test	50	21.34	3.51	49	8.19	1.96	0.002
Post test	50	57.72	5.66				

Result in Table 4.7 reveals that there is a significant difference in the mean scores of students taught genetic before and after exposure to Expository Game-Based Strategy. This was because the calculated p value of 0.002 is less than $p \leq 0.05$ levels of significance. Therefore, the null hypothesis which states that, there is no significant difference in the mean scores of students taught genetic concept before and after exposure to Expository Game-Based Strategy is rejected. Thus, the use of Expository Game-Based Strategy has improved the academic performance of students towards learning of genetics concept of Biology.

Research Question 2: *What is the difference in the mean scores of students taught genetic using Expository Game-Based Strategy and those taught using Lecture Method?*

Table 3: Mean and Standard Deviation of Post-test Scores of Students Taught Genetic using Expository Game-Based Strategy and those taught using Lecture Method

	N	Mean	SD	Mean diff.
Expository Game-Based Strategy	50	49.18	6.15	21.84
Lecture Method	50	27.34	3.81	

It can be seen from the result in Table 3 above that the Expository Game-Based Strategy has a mean score of 49.18 while Lecture Method has a mean score of 27.34 with a mean difference of 21.84. This implies that there is difference in the mean scores of students taught genetics using Expository Game-Based Strategy and those taught using Lecture Method. This is an indication that the treatment has positive effect on students' academic performance.

Null Hypothesis Two:

There is no significant difference between in the posttest means scores of students taught genetic using Expository Game-Based Strategy and those taught using Lecture Method.

Table 4: Summary of t-test Analysis of Mean Scores of Students taught using Expository Game-Based Strategy and those taught using Lecture Method

	N	Mean	SD	df	t-cal	t-crit	p
Expository Game-Based Strategy	50	49.18	6.15	98	8.01	1.98	0.007
Lecture Method	50	27.34	3.18				

Table 4 reveals that there is a significant difference in the mean scores of students taught using Expository Game-Based Strategy and those taught using Lecture Method. This was because the calculated p value is 0.007 which is less than $p \leq 0.05$ levels of significance at 98 degree of freedom. Therefore, the null hypothesis which states that, there is no significant difference in the mean scores of students taught using Expository Game-Based Strategy and those taught using Lecture Method is hereby rejected. The result thus showed that Expository Game-Based Strategy is more effective in improving students' performance in genetic concept than lecture method.

Research Question 3: *What is the effect of Expository Game-Based Strategy on the interest of students in genetics?*

Table 5: Mean and Standard Deviation of the Result of Students Interest in Genetics Taught Using Expository Game-Based Strategy

	N	Mean	SD	Mean diff.
Pre test	50	13.72	3.61	27.32
Post test	50	41.04	8.81	

Result in Table 5 indicate that the pre-test of Expository Game-Based Strategy on the interest of students in genetics has a mean score of 13.72 while posttest Expository Game-Based Strategy on the interest of students in genetics has a mean score of 41.04. This implies that the posttest of Expository Game-Based Strategy on the interest of students in genetics is more than the pretest with a mean difference of 27.32. This finding reveals that there is positive effect of Expository Game-Based Strategy on the interest of students in genetic.

Null Hypothesis Three:

There is no significant difference on the interest of students taught genetic concepts before and after using Expository Game-Based Strategy.

Table 6: Summary of Wilcoxon Signed Ranked Test of Interest of Students taught Genetic Concept Using Expository Game-Based Strategy

	N	Mean	SD	df	z-cal	z-crit	p
Pre test	50	13.72	3.61	49	6.71	1.98	0.001
Post test	50	41.04	8.81				

Table 6 revealed that there is significant difference in the interest of students taught genetic concepts using Expository Game-Based Strategy. This was because the calculated p value is at 0.001 which is less than $p \leq 0.05$ levels of significance at 49 degree of freedom. Therefore, the null hypothesis which states that, there is no significant difference on the interest of students taught genetic concepts using Expository Game-Based Strategy is hereby rejected. Thus, the use of Expository Game-Based Strategy improves interest of students towards learning genetic concepts.

Research Question 4: To what extend does gender influences the performance of Students taught using Expository Game-Based Strategy?

Table 7: Mean and Standard Deviation of Expository Game-Based Strategy on the Interest of Students in Genetics

	N	Mean	SD	Mean diff.
Male	35	24.15	6.94	4.11
Female	15	20.04	3.11	

Result in Table 7 indicate that the male students taught Expository Game-Based Strategy of genetics have a mean score of 24.15 while female students taught Expository Game-Based Strategy of genetics have a mean score of 20.04. This implies that the male students out-performed their female counterparts with a mean difference of 4.11. This implies that Expository Game-Based Strategy has positive effect on the interest of male students in genetic.

Null Hypothesis Four:

There is no significant difference between male and female students academic performance taught using Expository Game-Based Strategy.

Table 8: Summary of t-test Analysis on Males and Females Students Academic Performance taught using Expository Game-Based Strategy

	N	Mean	SD	df	t-cal	t-crit	p
Male	35	24.15	6.94	48	6.91	1.96	0.005
Female	15	20.04	3.11				

Table 8 revealed that there is a significant difference on the interest of students taught genetic concepts using Expository Game-Based Strategy. This was because the p calculated is at 0.005 which is less than p $\leq$ 0.05 levels of significance at 48 degree of freedom. Therefore, the null hypothesis which states that, there is no significance difference on males and females' students' academic performance taught genetic concepts using Expository Game-Based Strategy is hereby rejected. The result indicates that the use of Expository Game-Based Strategy in learning is not gender friendly.

DISCUSSION

This study aimed at investigating the Impact of Expository Game-Based Strategy on Interest and Performance in Genetic Concepts among Senior Secondary Schools Students in Katsina State, Nigeria.

The result of the analysis as presented shown that, students taught using Expository Game-Based Strategy have a higher mean score than in pretest group. This indicates that the use of Expository Game-Based Strategy has helped in improving students' academic performance. This can be adopted to enhance students learning of genetic concept. This significant academic performance is in line with the study of Mahmoud and Tanni (2012) whose work supports the view that Game-Based Strategy improves academic performance of students and influences students attitudes towards learning. The use of games in the class is not just for fun but also served many educational purposes such as creative thinking, critical thinking, problem solving and collaborative work, among others.

It was also found that students taught genetic concepts using Expository Game-Based Strategy have a greater mean than those taught using Lecture Method alone. This finding is in line with the study carried out by Liao (2010) who compared the effectiveness of game-based learning and traditional instruction and found out that Game-Based Learning is more effective than the traditional instruction.

It was indicated that the use of Expository Game-Based Strategy increases and boosts the students' interest towards learning of genetic concepts. Increased interest of students towards genetic concepts as recorded could be due to stimulating effect of using Expository Game-Based Strategy, conducive learning environment, rising of students' concentration and the general fun experienced during lessons when Expository Game-Based Strategy was used. This conforms to the findings of Okigbo and Okeke (2010) who observed that games enhanced learners' interest and it is also effective in improving students' interest in Mathematics.

The result also show that there is significant difference on the interest of students taught genetic concept using Expository Game-Based Strategy. This indicates that the use of Expository Game-Based Strategy is not gender friendly. The findings conform to that of Agwugah (2009), Kolawole (2010) who observed in their studies that male students performed better academically than female students in the cognitive, affective and psychomotive skill achievement. This shows that there is a strong association between

gender and response to science but the disputable issue is whether Game-Based Strategy is equally motivating and effective for both genders.

CONCLUSION

In conclusion on the findings of this study, Expository Game-Based Strategy has the potential of enhancing senior secondary school Biology students' academic performance as it boosts interest level.

RECOMMENDATIONS

From the findings of this study, the following recommendations are made:

i. Biology teachers should adopt the use of Expository Game-Based Strategy in teaching genetic concepts because it boosts interest, academic performance in students.
ii. Heads of Department of Science at senior secondary school level should encourage the use of Expository Game-Based Strategy since it has the ability of engaging the students to be active during the teaching and learning of abstract concepts like genetic.
iii. Curriculum planners and curriculum development bodies in Nigeria like NERDC should design programme and policies that will incorporate the use of Expository Game-Based Strategy in teaching and learning of science concepts, since it has the potential of bringing about meaningful learning and improved academic performance.
iv. Professional associations like Science Teachers Association (STAN), Mathematics Association of Nigeria (MAN) and Research Centers like Nigerian Educational and Research Development Council (NERDC) should incorporate Expository Game-Based Strategy in their science curricular at senior secondary schools and encourage the use of the strategy by science teachers.
v. Workshops and seminars should be organized by Secondary Education Board, STAN, NERDC and all stakeholders of education in order to train teachers for effective implementation on the use of Expository Game-Based Strategy.

REFERENCES

Adesoji, F.A. (2008). Students Ability Levels and Effectiveness of Problem-Solving Instruction Strategy. *Journal of Social Science, 17(1), 5-8*.

Ahmed, M.A. (2008). Influence of Personality Factors on Biology Lectures' Assessment of Difficulty Levels of Genetics Concepts in Nigerian Colleges of Education. Unpublished Ph.D Thesis, University of Ilorin, Nigeria.

Ajewole, G.S (2010). Curriculum Development in Science Technology and Mathematics Education in Secondary Schools Global Challenges and Possible Remedies. *49th Annual Conference Proceedings of Science Teachers Association of Nigeria, (STAN)* 18-20.

Aladejana, F.O. (2007). The Implication of ICT and NKS for Science Teaching Complex Systems. 17, 113-124.

Altunoglu, B.D., & Seker, M. (2015). The Understandings of Genetics Concepts and Learning Approach of Pre-Service Science Teachers. *Journal of Educational and Social Research* MCSER Publishing, Rome-Italy, 5(1), 234-238.

Anaso, J.N. (2008). Effects of Class-size on the Academic Achievement and Retention of Different ability Groups among Senior Secondary School Chemistry Students. Ph.D Dissertation A.B.U., Zaria.

Antonie, K.A. (2013). Effect of Graphic Organizers on Science Education: Human Body Systems. Unpublished MSc. Thesis in Department of Biological Science, B.S. Louisiana State University.

Atadoga, M.M. & Onaolapo, M. (2009). *A Handbook on Science Teaching Methods.* www. Nov. Edu.Ng retrieved on 3rd October, 2015.

Ayodele, G. (2006). Effective Biology Teaching: A Value-Added Instructional Improvement Analysis Model. *Educational Research Report* 5 (28). Retrieved June 6, 2014 from http:/suscpss.net/evaluation-research.

Bichi, S.S. (2008). Resources for Science, Technology and Mathematics Education in Nigeria in 21st Century. *Journal of Educational Research and Development*, 3 (1), 68-174.

Duniya, J.N., (2009). Efficacy of Indoor and Outdoor Laboratory Approaches on Acquisition of Science Process Skills and Performance among Biology Polytechnic Students. Seminar Presentation Department of Science Education Ahmadu Beloo Universitty, Zaria.

Dike, H.I. (2008). *A Textbook of Educational Technology*. Port-Harcourt: University of Port Harcourt

Dike, G. & Abimbola, J.O. (2010). Gender Influence of Biology Students, "Concept Mapping, Ability and Performance in Evolution. *Journal of Science, Teaching and Learning*, 3(1&2), 8-17.

Ezeudu, F. O. (2011). *Fundamentals of Science Education for Colleges and Universities.* Onitsha: Bels Book Publishers. 29-35.

Feynman, R. (2011). Some Definitions of Science. *American Scientist,* 87 (462).

Flores, F, Tovar, M, & Gallegos, L (2003). Representation of the Cell and its Processes in High School Students: An Integrated View. *International Journal of Science Education,* 25(2), 269-286.

Heather, D. (2007). Gender Gaps in Math and Science Education James Madison University. Retrieved on 21/10/2016 from http://www.kon.org/urc/v7/davis.html.

Ibe, E. (2013). Effects of Constructivist Model of Instruction on Scientific Literacy Levels and Interest of Upper Basic Science Students'. Unpublished Ph.D Thesis University of Nigeria, Nsukka.

Imoko, I.B. & Agwagah, U.N.V. (2010). Improving Students' Interest in Mathematics through the Concept Mapping Technique: A Focus on Gender. *Journal of Research in Curriculum and Teaching,* 1 (1), 30-38.

Ingersoll, R.M. (2002). *Out-of-field Teaching, Educational Inequality, and the Organization of Schools: An Exploratory Analysis.* Centre for the Study of Teaching and Policy, University of Washington.

James, C., (2009). Global Status of Commercialized Transgenic Crops *Publications:*

ISAAABriefswebpage[online],http://www.isaaa.org/kc/Publications/pdfs/isaaabries /Brief s%2027.pdf.

Joshi, S.R. (2008). *Teaching of Science.* New Delhi. A.P.H Publishers Corporation. 90-99.

Jimoh, A.T. (2005). Perception of Difficult Topics in Chemistry Curriculum as Perceived by Science Teacher Nigeria. *Journal of Educational Studies and Research,* 4(1), 64-69.

Kahle, J.B. (2004). Will Girls be left behind? Gender Differences and Accountability. *Journal of Research in Science Teaching, (24),* 961-969. Retrieved on 21/10/2016 from http://www.kon.org/urc/v7/davis.html.

Kaptelinin, V., & Cole, M., (2012). Individual and Collective activities in Educational Computer Game Playing. In: T. Kosmann, R., & Nelson, M, (Eds), CSCLS; *Carrying forward the Communication* 303-315. Mahwah, NJ:Lawrence E.

Kebritchi, M. (2010). Factors Affecting Teachers' Adoption of Educational Computer Games: A Case Study. *British Journal of Educational Technology, 4(1),* 256-270.

Killen, R. (2007). *Teaching Strategies for Outcomes-Based Education*. Cape Town: Juta & Co, Ltd.

Kirikkaya, E.B., Iseri,S., & Vurkaya, G.(2010). A Board Game about Space and Solar System for Primary School Students. Turkish Online. *Journal of Education Technology,* 9(2), 1-3.

Larkin, J.E. (2003). Gender and Risk in Public Performance. *Sex Roles: A Journal of Research*, 49(43), 197-210.

Lawal, M.K., (2012). *Electronic Information System and Administrative Effectiveness of Federal Polytechnics in the South-West, Nigeria.* Unpublished paper . PGDE Project, National Teachers Institute at Kaduna.

Lewis, J. & Kattmann, U. (2014). Traits, Genes, Particles and Information: Revisiting Students Understanding of Genetics. *International Journal of Science Education, 26, 195-206.*

Mangal, S.K. (2010). *Essentials of Educational Psychology.* New Delhi. PHI Learning Private Limited. 351-359.

Mbah, C.N. & Leghara, B.N. (2009). Science Education in Nigeria: Current Curriculum Practices and Implication for National Development. *49th Annual Conference Proceedings of Science Teachers Association of Nigeria,* 31-35.

Nnachi, R.D. (2002). Relationship of Achievements, Gender and Science Self Concept to Students Attitude of Science within South Eastern States of Nigeria- *Journal of the Nigeria Society for Educational Psychologist* (NISEPT) 1(1), 77-89.

Nweke, O.C. (2010). Effect of Sychronized Multimedia on Academic Performance in English Language of UBE Secondary Schools in Port Harcourt Metropolis, Unpublished Ph.D Thesis; Uniport.

Nworgu, L.N. (2009). Assessment of Acquisition of Science Process Skills by Senior Secondary School Biology Students. *Journal of the Nigerian Academy of Education, 5 (1), 1-13.*

Nworgu, L.N. (2009). Assessment of Acquisition of Science Process Skills by Senior Secondary School Biology Students. *Journal of the Nigerian Academy of Education, 5 (1), 1-13.*

Nwosu, A.A. (2001).Gender and Science Process Skills; Implication for Science Teaching.

Obeka, S.S. (2009). EPODEWALAD *and Power Simulation Games of Geography and Environmental Education.* Zaria: Ahmadu Bello University Press Limited. 90-109.

Oden, S.N. & Asim, A.E. (2002). Towards Scientific Literacy: Motivation Primary School Children to Learn Scientific Poems. *Universal Basic Education Forum* 2 (2), 23-24.

Ochu, A.N. (2010). Global Economic Meltdown and the Challenges of Functional Chemistry Education Programme in Nigeria: The Way Out,' *Paper Presented at the 51st Annual Conference Proceedings of Science Teacher Association of Nigeria,* viewed 18 July 2013,http:www.classify.0ck.org./…clssifyingDemo?...zzScienc+teacher+associate on.

Offor, E. I., (2007) Gender Stereotyping in some Popular Primary Science Textbooks used in Primary Schools in Imo State. *Journal of Women in Academies, 4 (1), 232.*

Ogenyi, D.S. (2015). Impact of Process Approach on Questioning Preference, Academic Achievement and Retention Span among Chemistry Students in Zaria metropolis, Nigeria. An unpublished Ph.D. Science Education. Ahmadu Bello University, Zaria.

Ogenyi, D.S. (2015). Impact of Process Approach on Questioning Preference, Academic Achievement and Retention Span among Chemistry Students in Zaria metropolis, Nigeria. An unpublished Ph.D. Science Education. Ahmadu Bello University, Zaria.

Ogunboyede M.O. (2003). *Sex differences and students Achievement* at the Primary School Level. The Nigeria Academic Forum 5(1), 152-155.

Ona, D, U. & Ugwu, E. I. (2010) .Factors which Predict Performance in Secondary School Physics in Ebony in North Educational Zone of Ebonyi State, Unpublished Master's Degree Dissertation ESUT.

Onyeizugbo, E.U. (2002). Effect of Gender, Age and Education on Assertiveness in Nigeria Sample. *Psychology of Women Quarterly*, 27, 1-16.

Omosewo, E.O. (2009). Views of Physics Teachers on the Need to Train and Retrain Physics Teachers in Nigeria, *African Research Review, 3* (1), 314-325.

Omatsa, E. & Vincent, N.L. (2003). Exploring Functions: A Strategy for Teaching Biology Concepts and Problem Solving. *Journal of Biology Education 72 (5), 625-636.*

Palmer, D.H. (2009). Student Interest Generated during an Inquiry Skills Lesson. *Journal of Research in Science Teaching*, 46 (1), 147-165.

Papastergiou, M. (2009). Digital Game-Based Learning in High School Computer Science Education: Impact on Educational Effectiveness and Student Motivation. *Computers and Education, 52* (1), 1-12.

Piaget, J. (1970). The Mental Development of the Child. In D. Elkind (Ed.), *Six Psychological Studies*, 3-73. New York, NY: Random House. Press

Reid (2003). Gender and Physics, *International Journal of Science Education*, 25(4), 509-536.

Sarojini, T.R. (2010). *Modern Biology for Senior Secondary Schools*. Ibadan; Africa FEP Publishers Limited.

Selim, M. A., & Shrigley, R. L. (2009). The Group Dynamics Approach: A Sociopsychological Approach for Testing the Effect of Discovery and Expository Teaching on the Science Achievement and Attitude of Young Egyptian Students. *Journal of Research in Science Teaching, 20* (3), 213–224.

Sowunmi, O. & Aladejana, F. (2013). Effect of Simulation Games and Computer-Assisted Instruction on Performance in Primary Science. *The 2013 WEI International Academic Conference Proceedings*. Orland, USA, 11-15.

Stanley, M. (2008). Indoor and Outdoor Laboratory Experiences on Secondary School Students Academic Achievement and Retention in Ecology in Kaduna State. Unpublished M.Ed Thesis Department of Education, ABU Zaria.

Starve, J.R. (2014). The Effect of Problem Format, Number Independent Variable and their International on Students Performance on a Control of Variable Reasoning Problem. *Journal of Research in Biology Teaching*, 23 (6), 533-542.

Tamarin, R.H. (2007). *Principles of Genetics*. New Delhi: Tata McGraw-Hill Company Ltd.

Tope, O. (2011). *The Effects of Study Habit on the Academic Performance of Students:* A Case Study of Some Secondary Schools in Ogun State, Nigeria: Ego Booster Books.

Umeh, M.O., (2009). Availability and use of Human and Material Resources in the Teaching of Ecology and Genetics in Biology Education in Secondary Schools in Anambra State, *Proceedings of 47th Annual STAN Conference*, 128-133.

UNESCO, (2003). Gender and Education for All: The Leap for Equality. Global Report 2003/2004 Retrieved from http://www,unesco/oc.unesco.org/Education/eta= report/2003pdf/chapter3.pdf.

West African Examination Council (2017). Senior Secondary Certificate Examination. Chief Examiner's Report. Private Mail Bag (P.M.B) 1076 Yaba, Lagos.

Wong, T. S. (2010). *Students Skills and Attitude Development through Group Work.* Asia Pacific Forum on Science Learning and Teaching 2 (2), 17-19.