WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Effects of 7Es Instructional Strategy on Students' Academic Achievement in Basic Science and Technology in Junior Secondary Schools in Taraba State

Abubakar, F. B., Adejoh, M. J., Okwara, O. K. & Chibabi, A. A.

Department of Science Education, Joseph Sarwuan Tarka University Makurdi

ABSTRACT

The study determined the effects of 7Es instructional strategy on students' academic achievement in Basic Science and Technology in Junior Secondary Schools in Taraba State. The study was guided by two (2) specific objectives. Two (2) research questions were also raised for the study. Also, two (2) hypotheses were formulated and tested at 0.05 level of significance. Quasi-experimental research design was employed in this study. Specifically, the design was the pre-test post-test non-randomized control group design. This study was carried out in Jalingo, Taraba state. The population for this study was 1421 Junior Secondary Two (JS II) Students in all the 17 public schools in Jalingo, Taraba State. The sample size for the study was 142 students. The sample size was selected using 10% of the total population of the students. The instrument used for data collection in this study was a Basic Science and Technology Achievement Test (BSTAT). The instrument was subjected to face and content validation by giving it to three experts. The Basic Science and Technology Achievement Test (BSTAT) yielded a reliability coefficient index of 0.69. Data for the study were collected with the help of two research assistants who were Basic Science and Technology teachers from the sampled schools. Means and standard deviation were used in answering the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypothesis formulated for the study at 0.05 level of significance. The findings of the study revealed that; students' achievement in learning Basic Science and Technology was dependent on the teaching method used; the 7Es instructional strategy was not gender bias; both the male and female students had the same level of achievement in Basic Science and Technology with the aid of 7Es instructional strategy. In view of the findings of this study, it was concluded that the use of 7Es instructional strategy improved students' academic achievement in Basic Science and Technology. In view of the findings of this study, it was recommended among others that teachers should be encouraged by principal to use teaching strategy like the 7Es that can help improve students' achievement in Basic Science and Technology.

INTRODUCTION

Education remains a vital instrument par excellence for sound national growth and development. The quality of education determines the extent to which recipients acquire the skills, knowledge and competencies to contribute effectively in national development. This explained why Imogie (2010) reported that no nation can develop to its fullest and keep pace with modern trends in Science and Technology without an effective educational system. This yearning was re-emphasized in the National Policy on Education (FGN, 2014), which state that education is responsible for empowering its recipients with appropriate skills, knowledge, competencies and understanding needed for sustainable development. This therefore means that education is the pivot for national growth, global competitiveness, and sustainable development of individual and society at large. The needs to keep pace with global trends of developments demand that people should be scientifically literate according to Osuafor and Okoli (2013). Without scientific literacy among a sizable proportion of the society, progress in achieving modernization will be difficult.

Knowledge in Basic Science and Technology is central and indispensable to the development of every nation. This is due to its crucial roles in the child's survival, adjustment and adaptation to his/her immediate and wider environments dominated by scientific activities. At Junior Secondary School level; Integrated Science (now Basic Science and Technology) was introduced for the purpose of giving foundation skills and knowledge for subsequent science studies at the higher level (Iwuji, 2012). The acquisition of appropriate skills and the development of mental, physical and social abilities and competencies for the individual to live in and contribute to the development of the society in which he lives, has been a major concern of Basic Science and Technology. The subject views nature in a holistic approach and this makes it a discipline in its own right. Basic Science and Technology concepts (content is almost the same except for introduction of some basic technological concepts) are generally geared towards technological development and appropriate strategy for the acquisition of relevant skills needed for meaningful learning of science concepts (Ukpai, Gabriel, Okechukwu & Ugama, 2016). According to National Policy on Education (2004), the specific goals of basic education shall be the same as the goals of the levels of education to which it applies (i.e. primary education and junior secondary education).

Basic Science and Technology helps students to acquire scientific knowledge, science process skills and attitude that will facilitate making and informed decision and development of survival strategies in the global community. Basic Science and Technology taught at Basic Education level assumes a central position in science and in addition provides students with basic knowledge about themselves and their environment, equipping them with the necessary skills required to foster development. Social constructivist theory by Vygotsky asserted that learning takes place when an individual builds knowledge based on socio-cultural environment.

In social constructivist classrooms, learners are allowed to construct knowledge collaboratively with peers and teachers. Among the constructivist instructional approaches are the learning cycles. Ozbek, Celik, Ulukok and Sari (2012) stated that learning cycles can help a student learn Science concepts, correct misconceptions and apply knowledge in their day-to-day lives. Various types of learning cycles have been developed over the years. These include: 3E (Karplus & Thier, 1967), 5E (Bybee, 1997) and 7E (Eisenkraft, 2003). As Science curriculum is quite dynamic, the highly successful 5E instructional model was expanded to 7E Learning Cycle Model (7E LCM). Eisenkraft (2003) extended the 5E learning model into 7E learning Cycle Model, with elicit and extend at the beginning and at the end respectively. This was not to make it complex but to ensure that teachers do not skip important elements for learning. 7E LCM is vital as it ensures that students' prior knowledge and experience are prompted. It also emphasizes "transfer of learning" which is the most important part in science education. 7E LCM is organized in seven successive stages. These stages are: Elicit, Engage, Explore, Explain, Elaborate, Evaluate and Extend (Eisenkraft, 2003). Balta and Sarac (2016) suggested that science teachers should embrace 7E LCM in teaching as it leads to improvement of students' academic performance. After new knowledge has generated, existing learning model ought to be modified to maintain its usefulness (Eisenkraft, 2003). 7E LCM stages are interconnected and planned in such a manner that the leaner carries out scientific inquiry by exploring instructional material and applying a learnt idea or a principle in a new situation.

The 7E LCM steps are described as follows: In elicit phase, the leaners' prior knowledge is prompted to ascertain what they know about a concept to be taught (Eisenkraft, 2003). Existing knowledge forms a base for construction of new knowledge likely to be applied to new areas (Adesoji & Idika, 2015). When misconceptions are not addressed, learners may develop ideas that are different from the ones the teacher intended. A teacher may prompt prior knowledge by asking questions such as "what do you think" and posing scenarios at the beginning of learning session (Naade, Alamina & Okwelle, 2018). From the learners' responses, the teacher will ascertain what they already know and any misconception will be corrected during the learning process. During this phase, the learners actively participate in trying to relate the given concept with their prior knowledge hence convey their own opinions. Engage is a phase that is planned to capture learners' attention on what is to be learnt (Eisenkraft, 2003). This is achieved through the use of short activities that stimulate their thinking, thereby increasing their interest and eagerness to learn new concept (Naade, 2018). The teacher ensures all students are given opportunities to express their opinions to their peers by use of techniques such as "think-pair-share".

Explore is a phase where "learners are provided with the opportunity to observe and record data, isolate variables, design and plan experiments, create graphs, interpret results, develop hypotheses and organize their findings" (Eisenkraft, 2003). Learners get to work collaboratively in developing skills and concepts. During this phase, the teacher directs learners' investigation and ensures that the learners are involved in building new concept.

During the explanation phase, "the teacher guides students toward coherent and consistent generalizations, helps students with distinct scientific vocabulary, and provides questions that help students use this vocabulary to explain the results of their explorations." (Eisenkraft, 2003). The teacher motivates the learners to describe concepts using their words at the same time listening critically to their peers. Learners are given the opportunity to construct their own knowledge as the teacher assesses their growing understanding of the new concepts.

Elaborate phase aids in expanding learner's conceptual understanding. The learner applies learnt concepts to new areas through additional activities. "Transfer of learning" takes place as the leaners apply learnt ideas to new context. Their practical skills are refined leading to deeper understanding of the concept. Elaborate phase aids in expanding learner's conceptual understanding. The learner applies learnt concepts to new areas through additional activities. "Transfer of learning" takes place as the leaners apply learnt ideas to new context. Their practical skills are refined leading to deeper understanding of the concept.

At the evaluation phase, the teacher assesses learners' conceptual understanding both formatively and summatively. The teacher does this through assessing the extent to which instructional objectives have been met. Students are also encouraged to evaluate themselves. The teacher can assess students through questions, mind maps and interpretation of data (Sharma, 2018). Balta and Sarac (2016) suggested that during the evaluation phase students can be evaluated through puzzle as well as questions. Extend phase was added to elaboration phase with the sole purpose of ensuring that science teachers implement "transfer of learning". Transfer of learnt concepts in a novice area helps learners retain ideas for a longer period of time. In this phase, students apply knowledge in a new context as well as to their everyday life (Kajuru & Kauru, 2011). This activity based approach may ignite students' academic achievement.

Achievement is the measure of accomplishment gotten from completing a given task. Siki (2016) defined student's academic achievement as a measure of success accrued for a given effort by a student. Achievement of students is the demonstration of their abilities to attain certain levels of instructional objectives in their classroom experiences. Ezeh (2013) emphasizes that instructional methods adopted by the instructor influences the cognitive, affective and psychomotor achievement of the learners. Method of teaching is very important aspect of students' learning of science in general and most especially Basic Science and Technology. Students' academic achievement in Basic Science can be frighten by poor teaching method, lack of facilities, inadequate number of Basic Science and Technology teachers, poor policy implementation, students' negative attitude towards the subject among others (Atoo, 2011). Other could be students' inability to understand, comprehend and assimilate Basic Science and Technology topics taught in the class room which may be attributed to the alien nature of Basic Science and Technology in schools. Agwagah (2018) reported students' academic achievement in Basic Science and Technology is be-wilder with the use of traditional methods which are guilty of imposing poor concept formation. This can also pose a great

threat to retention abilities of the students. It has been argued that the inability of students to adhere and retain knowledge could vary in respect of the gender of the learner.

Gender issue is topical in science, more so with increasing emphasis on ways of boosting manpower for technological development as well as increasing the population of females in Science and Technology (Popoola & Ajani, 2011). In Nigeria, and perhaps the whole of Africa, gender bias is still very prevalent in the teaching and learning of science. This is a view to which Ifeanacho (2012) has also mentioned in which he pointed out that "sex roles are somewhat rigid in Africa particularly in Nigeria where gender differences are emphasized". It is commonplace to see gender stereotype manifested in the day-to-day learning and life of an average Nigerian. Because, certain vocations and professions have traditionally been regarded as "for men only": (medicine, engineering, architecture) and others as "for women only": (nursing, catering, typing, arts). Typically, parents call boys to wash cars, cut grass, fix bulbs, or climb ladders to fix or remove things, On the other hand, chores such as washing dishes, cooking, cleaning and so on, are reserved for the girls. In a nutshell, complex and difficult tasks are allocated to boys, whereas girls are expected to handle the relatively easy and less demanding tasks. As a result of this way of thinking, the larger society tended to see girls as the "weaker sex". Consequently, an average Nigerian child goes to school with these fixed stereotypes. Gender issues, both on the part of the teachers and students, have been documented to affect achievement generally and specifically in secondary schools (Ahmad & Asghar, 2015).

There is need for active participation of students in the learning process has this can help ignite their interest and also help in their academic achievement and retention. It is on this basis that this study examines the effect of 7Es instructional strategy on students' achievement in Basic Science and Technology in Junior Secondary Schools in Taraba State

1.2 Statement of the Problem

The cardinal objective of the teaching and learning of Basic Science and Technology as core subject at Junior Secondary School level is to produce scientists for national development and see that the scientist which are the learners should be able to perform tasks and if possible transfer the experience in solving problems in a new situation and excel in both local and external examinations.

However, over the years, these objectives are hardly achieved as the rate of failure in both local and external examination in Basic Science and Technology in Taraba State is high. This has become a matter of concern to educational stakeholders and the general public at large. This ugly trend might have been the poor foundation of students in Basic Science and this may also be connected to the recruitment of qualified teachers and the method of teaching used by the teachers, because a good learning is a product of a good method of teaching. This persistent poor achievement in Basic Science and Technology exhibited by science students at Basic education level leaves no doubt about the ineffectiveness of the teaching method used by teachers for teaching this subject as students may have seen Basic Science and Technology as abstract and meaningless concepts. Students neither understand the basic concepts nor the underlying process that gave rise to the Basic Science and Technology concepts which in turn questions their interest in the subject. This may be true as the teaching methods used by the teacher seems to be teacher's centered and does not allow students' participation, therefore imposing poor concept formation and reducing interest of the students in subject. This makes students resort to learning by memorization, which also results into lack of interest and poor retention of what has been taught and consequently failure.

Looking at the position of Basic Science and Technology in school curriculum, poor achievement of students in the subject may spell doom for the educational sector as without a good and strong solid Basic Science and Technology background, there will be no meaningful learning of Biology, Physics and Chemistry at the senior secondary school level. Also, lack of interest in Basic Science and Technology by students may results to lack of interest in science and this has great consequences on developing Nations and State like Taraba. There is however a believe that instructional approaches such as 7Es which has projects features and activities that could make teaching and learning active, interesting, attractive and apparently could be useful in promoting the teaching and learning of Basic Science and Technology content with respect to the students' achievement. Thus it is imperative to determine the effect of 7Es instructional strategy on students' achievement in Basic Science and Technology in Junior Secondary Schools in Taraba State.

Objectives of the Study

The objective of this study is to determine the effect of 7Es instructional strategy on students' academic achievement in Basic Science and Technology in Junior Secondary Schools in Taraba State. Specifically, the study:

i. determined the effect of 7Es instructional strategy on students' academic achievement in Basic Science and Technology.

ii. ascertained the effect of 7Es instructional strategy on male and female students' academic achievement in Basic Science and Technology

Research Questions

The following research questions guided the study.

i. What is the difference in the mean achievement scores of students taught Basic Science and Technology using 7Es instructional strategy and those taught using conventional method?

ii. What is the difference in the mean achievement scores of male and female students taught Basic Science and Technology using 7Es instructional strategy?

Statement of Hypotheses

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

$H0_1$: There is no significant difference in the mean achievement scores of students taught Basic Science and Technology using 7Es instructional strategy and those taught with the conventional method

$H0_2$: There is no significant difference in the mean achievement scores of male and female students taught Basic Science and Technology using 7Es instructional strategy

METHODOLOGY

The quasi-experimental research design was employed in this study. Specifically, the design was the pre-test post-test non-randomized control group design. This study was carried out in Jalingo, Taraba state. The population for this study is 1421 Junior Secondary Two (JS II) Students in all the 17 public schools in Jalingo, Taraba State (Taraba State Ministry of Education, 2022). The sample size for the study is 142 students. The sample size was selected using 10% of the total population of the students. Simple random sampling technique was used to select four schools out of the 17 Junior Secondary schools in Jalingo metropolis of Taraba State. Two of the schools were used as the control groups while the other two were used as the experimental groups. The control group has 69 students comprising 29 female and 40 male students while the experimental group has 73 students comprising 32 female and 41 male students. The instrument for data collection was Basic Science and Technology Achievement Test (BSTAT). This instrument (BSTAT) consists of 30 multiple choice questions which were generated by the researcher from Junior Secondary School curriculum of Basic Science and Technology. This instrument (BSTAT) has Pre- BSTAT and Post- BSTAT. The instruments were subjected to face and content validation by giving it to three experts. Test re-test method was used to determine the stability of the responses of the respondents on the Basic Science and Technology Achievement Test (BSTAT). The Basic Science and Technology Achievement Test (BSTAT) yielded a reliability coefficient index of 0.69. Data for the study were collected with the help of six research assistants who are Basic Science and Technology teachers from the sampled schools. Data collected were analyzed with respect to the research questions and hypotheses formulated for the study. Means and standard deviation were used in answering the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses formulated for the study at 0.05 level of significance.

Research Question 1

What is the difference in the mean achievement scores of students taught Basic Science and Technology using 7Es instructional strategy and those taught using conventional method?

Table 1: Mean Achievement Scores and Standard Deviation of Students Taught Basic Science and Technology using 7Es Instructional Strategy and Conventional Method

Group	N	Pretest		Post-test		Mean Gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Experimental Group	73	54.07	9.33	64.92	9.36	**10.85**
Control Group	69	53.97	8.70	55.71	10.30	**1.74**
Mean Difference		**0.10**		**9.21**		**9.11**

In Table 1, the mean pretest scores for the experimental group which was exposed to the 7Es instructional strategy in the teaching and learning of Basic Science Technology was 54.07 with standard deviation of 9.33 and the mean pretest scores for the control group which was taught Basic Science Technology using the conventional method was 53.97 with a standard deviation of 8.70. The mean difference in the pretest scores for the experimental and control group was 0.10. This means that before the administration of the test, the two groups were almost at the same level of knowledge. However, the mean post-test scores for the experimental and control group were 64.92 and 55.71 with standard deviation of 9.36 and 10.30 respectively. The mean difference between the post-test scores of students taught Basic Science and Technology using the 7Es instructional strategy and those students taught using the conventional method was 9.21. The mean gain for the experimental group was found to be 10.85 while the mean gain for the control group was found to be 1.74. The mean difference between the experimental and control group was 9.11 in favour of the experimental group. This clearly shows that, the students who were taught Basic Science and Technology using the 7Es instructional strategy achieved higher in the subject than those students who were taught Basic Science and Technology using the conventional method.

Research Question 2

What is the difference in the mean achievement scores of male and female students taught Basic Science and Technology using 7Es instructional strategy?

Table 2: Mean Achievement Scores and Standard Deviation of Male and Female Students taught Basic Science and Technology using 7Es Instructional Strategy

Sex	N	Pretest		Post-test		Mean Gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Female	32	54.16	9.35	66.69	10.08	**12.53**
Male	41	54.00	9.43	63.54	8.62	**9.54**
Mean Difference		**0.16**		**3.15**		**2.99**

In Table 2, the mean pretest scores for female and male students in the experimental group were 54.16 and 54.00 with a standard deviation of 9.35 and 9.43 respectively. The mean difference of pretest for the female and male students in the experimental group was 0.16. This shows that, both the female and the male students were almost at the same level of knowledge before the administration of the test. The mean post-test scores for the female and the male students were 66.69 and 63.54 with standard deviation of 10.08 and 8.62 respectively. The mean difference between the post-test scores of the female and male students that were taught Basic Science and Technology using the 7Es instructional strategy was 3.15. However, the mean gain for the female and male students in the experimental group was 12.53 and 9.54. The mean difference between the female and the male students in the experimental group that was exposed to 7Es instructional strategy was 2.99 in favour of the female students. This shows that the female students achieved higher that the male students in the Basic Science Technology.

Research Hypothesis 1

There is no significant difference in the mean achievement scores of students taught Basic Science and Technology using 7Es instructional strategy and those taught with the conventional method

Table 3: Summary of ANCOVA Result of Students' Achievement in Basic Science and Technology by Group

Source	Type III Sum of squares	df	Mean Square	F	Sig.
Corrected Model	4602.581[a]	2	2301.290	26.812	.000
Intercept	6125.486	1	6125.486	71.367	.000
Pretest	1595.241	1	1595.241	18.586	.000
Group	**2983.492**	**1**	**2983.492**	**34.760**	**.000**
Error	11930.469	139	85.831		
Total	535321.000	142			
Corrected Total	16533.049	141			

a. R Squared = .278 (Adjusted R Squared = .268)

From Table 3, the p-value for group was 0.000. Hence $p<0.05$, the null hypothesis was rejected. This implies that there was a significant difference in the mean achievement scores of students taught Basic Science and Technology using 7Es instructional strategy and those taught with the conventional method. It therefore means that the students that were taught Basic Science and Technology using the 7Es Instructional Strategy achieved higher in their achievement test than those that were taught using the conventional approach.

Research Hypothesis 2

There is no significant difference in the mean achievement scores of male and female students taught Basic Science and Technology using 7Es instructional strategy

Table 4: Summary of ANCOVA Result of Students' Achievement Scores in Basic Science and Technology by Gender

Source	Type III Sum of squares	df	Mean Square	F	Sig.
Corrected Model	239.256[a]	2	119.628	1.380	.258
Intercept	10326.826	1	10326.826	119.164	.000
Pretest	60.819	1	60.819	.702	.405
Gender	**180.172**	**1**	**180.172**	**2.079**	**.154**
Error	6066.251	70	86.661		
Total	313951.000	73			
Corrected Total	6305.507	72			

a. R Squared = .038 (Adjusted R Squared = .010)

From Table 4, the p-value for gender was 0.154. Hence p>0.05, the null hypothesis was retained/not rejected. This implies that there was no significant difference in the mean achievement scores of male and female students taught Basic Science and Technology using 7Es instructional strategy. This implies that both the male and female students that were exposed to the 7Es instructional strategy improved equally on their achievement in Basic Science and Technology.

Discussion of Findings

The study found that there was a significant difference in the mean achievement scores of students taught Basic Science and Technology using 7Es instructional strategy and those taught with the conventional method. The finding of this study concords with the findings of Bunkere (2019) who conducted a study and revealed that students taught Physics using 5E learning strategy perform better than those taught using tradition method. This finding is also in agreement with the findings of Naade, et al. (2018) who investigated the Effect of 7E's's Constructivist Approach on Students' Achievement in Electromagnetic Induction Topic in Senior Secondary School in River State and discovered that, there was statistically significant difference between the mean scores of those exposed to 7E's's constructivist approach and those exposed to the traditional method. Similarly, Ematum (2018) conducted a study on Impact of 5Es Learning Model on Academic Performance in Chemical Equations Concept among Secondary School Students, Katsina Metropolis, Nigeria and the result obtained showed that student in the experimental group performed significantly better than those in control group.

The findings of the study showed that both the female and male students improved upon their achievement in the Basic Science Technology that was taught during the period but the improvement in the achievement score is more with the female students as compared to their male counterparts. The findings however revealed that there was no significant difference in the mean achievement scores of male and female students taught Basic Science and Technology using 7Es instructional strategy, hence both the male and female students that were exposed to the 7Es instructional strategy improved equally and greatly on their achievement in Basic Science and Technology. This finding agrees with the findings of Bunkere (2019) who investigate the Efficacy of 5E Learning Strategy in enhancing Academic Achievement in Physics among Students in Rano Education Zone, Kano State, Nigeria and discovered that there was no significant difference of achievement scores between male and female students when taught physics using 5E learning strategy.

Conclusion

Based on the findings, it is concluded that the 7Es instructional strategy is an effective and gender-neutral approach to teaching Basic Science and Technology, leading to improved achievement among students compared to conventional methods

Recommendations

In view of the findings of this study, the following recommendations were made;

1. Teachers should be encouraged by principal to use innovative teaching strategy like the 7Es that can help improve students' achievement in Basic Science and Technology.
2. School management should provide teachers with the needed materials and resources that can help them in the utilization of 7Es instructional strategy

REFERENCES

Agomouh, P. C. (2010). Effect of prior knowledge, exploration, discussion, dissatisfaction with prior knowledge and application (PEDDA) and the learning cycle (TLC) constructivist instructional models on students' conceptual change and retention.*An Unpublished Ph.D thesis, UNN.*

Agulanna, G. G. & Nwachukwu, J. E. (2004).*Psychology of Learning; putting theory into practice.*Enugu; Career publishers.

Ames, C. (1984). Achievement attributions and self-instructions under competitive and individualistic goal structures.*Journal of Educational Psychology, 76*(3), 478. doi:10.1037/0022-0663.76.3.478

Bosede, A. F. (2010). Influence of sex and location on relationship between students problems and academic performance. *The Social Science, 5(4), 340-345*

Brehmer, B. (1992). Dynamic decision making: Human control of complexBsystems. *Acta psychologica, 81*(3), 211-241.

Broughton, S. H., Sinatra, G. M., & Nussbaum, E. M. (2013). "Pluto has been a planet my whole life!" Emotions, attitudes, and conceptual change in elementary students learning about Pluto's reclassification.*Research in Science Education, 43*(2), 529-550.

Chukwu, C. E. (2011). Effect of integrated model of teaching on students retention in biology. The Nigerian journal of research and production. 18(1).

Chukwu, C. O (201) investigated the effect of integrated model of teaching on students retention in biology. *The Nigerian Journal of Research and Production. 18(1)*

Conley, A. M., Pintrich, P. R., Vekiri, I., & Harrison, D. (2004). Change in epistemological beliefs in elementary science students. *Contemporar Educational Psychology, 29*, 186-204.

Dole, J.A., & Sinatra, G.M. (1998).Reconceptualizing change in the cognitive construction of knowledge.*Educational Psychologist, 33,* 109.

Eisenkraft, A. (2003). Expanding the 5E Model.*The Science Teacher,* Published by the National Science Teachers Association 70, 56-59

Ematum R., U. (2018). Impact of 5Es Learning Model on Academic Performance in Chemical Equations Concept among Secondary School Students, Katsina Metropolis, Nigeria.*International Journal of Educational Research and Information Science.*5(1): 10-14

Ezeh, D. N. (2013). Science without women: A paradox. *75th Inaugural lecture of the University of Nigeria Nsukka, delivered on May, 30, 2013. Nsukka: University of Nigeria Press Ltd*

Ezenwosu, S.U. & Nworgu L N. (2013).Efficacy of Peer Tutoring and Gender on Students' Achievement in Biology.International Journal of Scientific & Engineering Research. (4) 12,

Federal Ministry of Education (2014).*National Policy on Education*.Lagos NERDC press.

Federal Ministry of Education (2017).*National Curriculum for Senior Secondary School Biology* Lagos: Government Press. \

Gurbuz, F., Turgut, U., & Salar, R. (2013) investigated the effect of 7E model on academic achievements and retention in the unit "electricity in our life" 6th grade science and technology course. *Journal of Turkish Science Education*. 10, (3)

Heddy, B. C. & Sinatra, G. M. (2013). Transforming misconceptions: Using transformative experience to promote positive affect and conceptual change in students learning about biological evolution. *Science Education, 97*(5), 723-744.

Heddy, B. C., & Nadelson, L. S. (2012). A global perspective of the variables associated with acceptance of evolution. *Evolution: Education and Outreach, 5*(3), 412-418.

Heddy, B. C., Danielson, R. W., Sinatra, G. M., & Graham, J. (2017). Modifying knowledge, emotions, and attitudes regarding genetically modified foods. *The Journal of Experimental Education, 85*(3), 513- 533.

Heddy, B. C., Sinatra, G. M., Seli, H., Taasoobshirazi, G., & Mukhopadhyay, A. (2017). Making learning meaningful: facilitating interest development and transfer in at risk college students. *Educational Psychology, 37*(5), 565-581.

Hyslop-Margison, P. & Strobel, J. M. (2011).*Science in Elementary Education.*8th ed. New Jersey: Merrill.

Ibrahim, T.S. (2015). Impact of 5Es learning cycle on academic performance, Retention and Attitude of Biology Students with Varied Abilities, North-West Zone, Nigeria.Unpublished Ph.D. Thesis. Ahmadu Bello University Zaria

Isa, Y. B. (2012). Effects of a Constructivist Instructional Strategy on the Academic Achievement, Retention and Attitude to Physics among Secondary School Students of Different Ability Levels in Kano, Nigeria.Unpublished Ph.D. Thesis. Ahmadu Bello University Zaria

Kocakaya, S & Gonen, S, (2010).Investigated the effects of computer-assisted instruction designed according to 7E model of constructivist learning on physics student teachers' achievement, concept learning, self-efficacy perceptions and attitudes. *Turkish Online Journal of Distance Education*, 11(3);206-22

Morgan, H. (2012). Poverty-stricken schools: what we can learn from the rest of the world and from successful schools in economically disadvantaged areas in the US. *Education,* 133(2), 291-297

Nwagbo, C & Obiekwe, C. (2010).The effects of constructivist instructional approach onstudents' Achievement in Biology.*JSTAN* 45, (1 & 2) 26-34.

Okoli, S. O. & Akuezuilo, O. E. (2015). Effect of multiple intelligence-based instruction technique (MIBIT) on students interest in the learning of difficult biology concepts. *Journal of Research Method in Education Vol 5 issue3, p 01-09.*

Okoli, S. O., Akuezuilo, E. & Okoli J. (2015), investigated the Effect of Multiple Intelligence Based Instructional Technique (MIBIT) on Students' achievement and interest in the Learning of difficult Biology Concepts. *IOSR Journal of Research & Method in Education (IOSR-JRME) 5,(3 ;01-09*

Oludipe, D.I. & Oludipe, M. O. (2010).Gender different in Nigeria junior secondary students' academic achievement in basic science.*Journal of Educational and Social Research*.2(1). 93 – 99.

Ozdemir, U. (2012). High school students" attitudes towards geography Karabuk, Turkey.*World Applied Sciences Journal* 17(3) 340-346.

Pekrun.R., & Stephens, E. J., (2012).Academic emotions. In K. R. Harris, S. Graham, T. Urdan, S. Graham, J. M. Royer, & M. Zeidner (Eds.), *APA educational psychology handbook*, (Vol. 2, pp. 3-31). Washington, DC: American Psychological Association.

Petty, R. E., & Briñol, P. (2015). Emotion and persuasion: Cognitive and meta-cognitive processes impact attitudes. *Cognition and Emotion*, *29*(1), 1-26.

Petty, R. E., Cacioppo, J. T., & Goldman, R. (1981).Personal involvement as a determinant of argument-based persuasion.*Journal of Personality and Social Psychology*, *41*(5), 847.

Petty, R., & Cacioppo, J. T. (1986).*Communication and persuasion: Central and peripheral routes to attitude change*. New York: Springer.

Piaget, J. (1957). *The equilibration of cognitive structure: the central problem of intellectual development.* Chicago, IL: University of Chicago Press.

Popoola, A. & Oke, J. (2010).The relative effectiveness of the expository and guided discovery in secondary schools student's achievement in Biology.*International NGO Journal 5(3), 59-64*

Samba & Eriba, J (2012), Innovative approaches in teaching difficult science concepts, Makurdi

Strike, K. A. (1983). Misconceptions and conceptual change: Philosophical reflections on the research program. *International Seminar on Misconceptions in Science and Mathematics, Cornell University*, 67-78.

Sugiyono. (2013). Metode Penelitian Kuantitatif, Kualitatif dan R&D. Bandung: Alfabeta

Taasoobshirazi, G., Heddy, B. C., Bailey, M. & Farley, J. (2016). A multivariate model of conceptual change.*Instructional Science*, *44*(2), 125-145.

WAEC Chief Examiners Reports (2010, 2011 and 2012) *Publication of WACE* office, Lagos.

WAEC Chief Examiners Reports (2015, 2016, and 2017).

Williams, J. & McClure, M. (2010). The effects of teaching methods in leadership knowledge retention: An experimental design of lecture, experiential, and public pedagogy. *Journal of Leadership in Education*, 9(2) , 86-100

Wilson, B Abbott, M. i., Joireman, J., Stroh, H. R. (2002). The Relations among school Environment variables and student Achievement: A structural Equation Modeling Approach to Effective schools Research, Technical Report, http://wwwspu.Edu/wsrc www.consortiacademia.org/ ../15341,25-31