

7E's Learning Cycle Instructional Strategy and Secondary School Biology Students' Academic Achievement in Genetics in Akwa Ibom State, Nigeria

Isaac, Esther O., Akanwa, U. N & Ndirika, M. C.

Department of Science Education Michael Okpara University of Agriculture, Umudike

Corresponding author: estherisaac173@gmail.com

Abstract

The study investigated 7E's Learning-Cycle and Biology students' academic-achievement in Akwalbom State. Two research questions and two null hypotheses guided the study. Quasi-experimental precisely non-equivalent groups design was used. Population of this study comprised 6810 SS3 students in 254 co-educational schools. Sample of 128 SS3 students were drawn through Multi-stage sampling technique. Adapted Biology Academic-Achievement Test was used for data collection. The instrument has 0.84 reliability index using Kuder-Richardson-formular. Mean, standard deviation and Analysis of Covariance were used to test hypotheses at 0.05 significance level. Results showed that students taught with 7E's learning-cycle achieved significantly higher than students taught using lecture method. 7E's learning strategy enhances female achievement than their male counterparts. It was concluded that 7E's learning-cycle is effective in enhancing students' achievement than lecture method. The study recommended that Biology teacher should be encouraged by Government to teach using 7E's Learning strategy and teachers should encourage gender integrated-classroom-seating.

Key words: Academic achievement, Biology. 7E's learning cycle strategy and genetics

Introduction

Biology is one of the science disciplines taught in senior secondary school in Nigeria which enable learner to explore the natural world. Biology as a natural science is viewed by Akintola, 2017 and Edet, 2018 as the living world which describe how the world is structured, how it functions, how it develops, how living things come to existence and how they react to one another and the environment. As a natural science subject, Biology is designed to prepare students to acquire adequate laboratory and field skills, meaningful and relevant knowledge in biology and also to enable students apply scientific knowledge to everyday life issues in matters of personal, community, health and agriculture among others (Federal Ministry of Education, 2013, Aniaku & Nwankwo,2022; Edet, 2018 and Ado & Udoh, 2018). Biology is considered the broadest, cutting across almost all science fields. As a subject, it is a requirement for further learning, training and development for many science related professional courses such as Medicine, Pharmacy, Agriculture, Genetics, Biotechnology among others (Udoh, 2022). In spite of the richness of the curriculum of Biology and its importance on academic aspiration of students, empirical evidence have shown that performance of students in the subject is low and fluctuating (Ministry of Education, Statistics,

Planning and Research Department, Uyo report, 2022).

Low and fluctuating academic achievement of Biology students in West African School Examination and in other examination have become a matter of concern to many stakeholders. Evidences from many Biology researchers concluded in resent time have shown the low academic achievement in senior secondary school certificate examinations (Ntukidem, 2023). According to 2017 and 2021 WAEC reports (Ministry of Education, Statistics, Planning and Research Department, Uyo) the trend was not different as the percentage of students with credits and higher grade passes in WAEC Biology in AkwaIbom State ranged from 34.41% in 2017 to 48.31% in 2021. Problem associated with low achievement in Biology in general and specific concepts such as Genetics highlighted by WAEC Chief Examiner in the year reviewed (between 2017 and 2021) includes among others: students' lack of interest and inability to retain most genetics concepts learnt, candidates' shallow knowledge of the subject matter and poor grasp of genetics concept (Akwa Ibom State Ministry of Edu, 2022). Other problems include: Inability of the Biology teachers to put across the teaching of Biology concept correctly to learners due to abstract nature of some biology topics and

Biology teachers' persistent use of conventional teaching method and or mismatch of instructional strategy to concept thus, poor academic achievement (Etibon and Udoh, 2017).

Moreover, observations and reports have shown that success or high academic achievement has become a herculean task to accomplish by students in recent times (Renninger&Hidi 2016; WAEC, 2019 & 2022). In recent time, poor academic achievement recorded both at the secondary and tertiary levels of education in Nigeria is worrisome (Ayodele, 2016).

Academic achievement is a parameter used in determining student success or failure. Academic achievement is evaluated in a number of ways in order for the students to demonstrate their knowledge. Teachers evaluate student academic achievement in the form of assignment, oral or written test and examination to describe how well or poor a student has done. Similarly, academic achievement of students in Biology has been below expectation and unimpressive thus, it has become a source of concern to researchers on appropriate instructional strategy to address the situation (Inyang, Usendu& Okono,2018; Oyewumi&Adeoye, 2021).

Instructional strategy can be viewed as the plan and skills employ by a teacher to achieve teaching objectives, including instructional organization and techniques, subject matter, and the use of teaching tools and materials (Onah&Onwubuariri, 2018). Strategy is very vital in any teaching- learning situation and the strategy adopted by the teacher may promote or hinder learning. Based on the conflicting results on the effects of instructional strategies on students' academic achievement in Biology in regards to gender, this study therefore, intend to address this gap and investigate whether Biology students' academic achievement may be positively affected with 7E's Learning Cycle Instructional Strategy.

7E's Learning cycle is viewed as seven ordered process for both learning and instruction. It places focus on series of steps that encourage more thorough understanding and deeper application of content. Learning cycle provide students with formula for learning and a teachers a process for instruction. It is an activity oriented strategy that promotes students' meaningful understanding of the scientific concept, explores and deepens their understanding in application to a new situation (Sadi & Cakiroghu, 2010; Khashan, 2016).

7E's learning cycle as an instructional strategy consisting teaching and learning steps, used by the teacher with his students inside the classroom, aiming at enabling the students to build their scientific

knowledge acquisition by themselves (Khashan, 2016;Naade,Alamina & Okwelle, 2018).

The seven steps are Excitement, Exploration, Explanation, Expansion, Extension, Exchange and Evaluation. Excitement stage aims at motivating and enhancing learners' curiosity for learning the concept. Exploration stage aims at satisfying the learners' curiosity through providing them with necessary experiences and aid, in order to enable them acquire the meaning of the concept. The next stage help in explaining of the concept such is termed Explanation stage. Expansion stage (application stage) aims at discovery of new applications for the concept. Extension stage illustrate the relationship of the concept with other concepts through asking questions that help them discover such relationships. Exchanging stage is a stage where student interchange their experiences and ideas, as the teacher encourages students' cooperation and participation through well-designed activities. Evaluation stage aims at testing and or examining students' learning of the concept and providing them with feedback (Afaneh & Al Jaish, 2008; Naade, Alamina & Okwelle , 2018). 7E's learning cycle help to develop students' skills of scientific research, improves their problem solving abilities and develops dialogue skills as well as encouraging team work. In addition, it helps them amend their wrong visions on the previous concepts related to the lesson topic, (Abdulliani, Jibrin, Dauda & Danjuma 2021).

Moreover, Lecture strategy refers to the traditional teaching method which is teacher-centred. It is mainly authoritarian in nature whereby teaching-learning process is not based on hands-on activities. In this teaching strategy, teachers often teach sometime using only textbook and notebook. According to Etiubon (2013), in conventional teaching strategy, teachers are expert information providers while students learn by rote memorization, regurgitation of facts and reproduce the facts during the examinations.

The effectiveness of the 7E's learning classroom strategy from empirical evidence in Enugu and Adamawa states of Nigeria, other science field like Physics and Mathematics; and other biological concepts (circulatory system, Osmosis and diffusion) Abdulliani, Jabrin & Danjuma, 2021; Khashan, 2016; Abdullahi & Nor, 2020) inspired the researcher for further. However, none of these studies was on genetics. Therefore, the researcher intends to investigate 7E's learning classroom instructional strategy and secondary school Biology students' academic achievement in AkwaIbom State, Nigeria as well as moderating effects of gender.

Nonetheless, Gender is a specially constructed phenomenon that is brought about by the society as they ascribe different roles, duties, behaviours, and mannerisms to the two sexes, (Riffert, Hagenauer & Strahi, 2020). The term based on the context may refer to biological sex i.e. the state of being male, female (Agbejaye & Adegbola, 2017). Also Fashina and Akanji (2017); Bala, (2018) found that female students were significantly better than their male counterparts apparently under equivalent condition of learning of mathematics and other sciences. From research, there are substantial body of literature on gender differences in academics achievements, among such are: (Oyewumi & Adeoye (2021), found out that male student performed better than their female counterparts. Agbaje and Alake, (2014); Inyang, Usendu and Okono (2018) affirmed that female students often perform better than their male counterparts in Biology. The consensus among science educators is that some instructional strategies are gender biased while some on are gender friendly. However, the degree of gender related differences in learning vary from one instruction strategy to the other as well as the concept being learnt. Hence, the need for further study on influence of gender on students' academic achievement in genetics with the use of 7E's learning cycle and conventional strategies and senior secondary biology students.

Research Questions

1. What are the mean achievement scores of students taught Genetics with 7E's Learning Cycle Instructional Strategy and Lecture method?
2. What are the male and female students' mean achievement scores taught Genetics with 7E's Learning Cycle Instructional Strategy ?

Hypotheses

HO₁: There is no significant difference in the mean achievement scores of Biology students taught Genetics with 7E's Learning Cycle Instructional Strategy and Lecture method.

HO₂: There is no significant difference in the mean achievement scores of male and female Biology students taught Genetics with 7E's Learning Cycle Instructional Strategy.

Material and Method

The study adopted quasi-experimental Specifically, the non-equivalent pre-test, post-test and control design. The population of the study consisted of all Senior Secondary Three (SS3) Biology students in 2023/2024 co-educational schools in AkwaIbom State. The population size was six thousand, eight hundred and ten (6,810) students. Out of these, three thousand, eight hundred and seventy one (3871) were female students while two thousand, nine hundred and thirty nine (2,939) were male students (AkwaIbom State Secondary Education Board, class by class students' enrolment for 2023/2024 academic session. A multi-stages sampling procedure was adopted to select 128 secondary schools three (SS3) students of 2023/2024 academic session. This comprises seventy-four female and fifty-four male students. First purposive sampling technique was used to select two co-educational schools from the educational zone that met the criteria (schools with a functional Biology laboratory; Professional degree holder and Co-educational school owned by Government) were used for school selection. Finally, sampled schools was assigned experimental group and the control group by balloting. Data was collected using an adopted Biology Academic Achievement Tests in Genetics (BAATIG). The BAATIG contained forty (40) multiple-choice questions with four options A,B,C and D. The correct answer was scored 1mark each and incorrect answer, 0 marks. The BAATIG was validated by researchers' supervisors, Biology and Measurement and Evaluation lecturers in Science Education Department, Michael Okpara University of Agriculture. Content validation was ensured using Revised test blue print. The instrument had a reliability index of 0.84 using Kuder-Richardson formular.

Mean and standard deviation were used in answering the research questions while the Analysis of Covariance (ANCOVA) was used in testing the hypotheses at 0.05 level of significance. This implies that any p-value that is less than 0.05 is significant and therefore the null hypothesis was rejected. Any p-value that is equal to or greater than 0.05 is not significant and therefore the null hypothesis was retained.



Results

Table 1: Mean and Standard Deviation of Pre-Test and Post- Achievement Test Scores of Students Taught Genetics with 7E’s Learning Cycle and Conventional

Instructional strategies	N	Pre-Test		Post-Test		Mean Gain
		X	SD	X	SD	
7E’s L cycle	69	13.80	3.68	31.39	3.57	16.59
Lecture Method	59	13.32	3.63	25.71	4.06	12.39

N=number of respondents, X = mean, SD = Standard deviation

Table 1 shows that the mean pre-test scores of the students taught the concept of Genetics using 7E’s learning cycle and lecture strategies are 13.80 and 13.32 with standard deviation of 3.68 and 3.63 respectively while their post-test scores are 31.39 and 25.71 with their standard deviation scores as 3.57 and 4.06 respectively. The table also shows the mean gain scores of students taught the concept of genetics using

7E’s learning cycle and lecture strategies as 16.59 and 12.39 respectively. Comparing the mean gain scores of 7E’s learning cycle and Lecture) groups, it indicates that 7E’s learning strategy with the mean gain scores of 20.08 is higher in enhancing student’s academic achievement than conventional lecture group with the mean gain score of 12.39 in enhancing student’s academic achievement in genetics.

Table 2: Summary of Analysis of Covariance (ANCOVA) of Students’ Post Achievement Test Scores Classified by 7E’s Learning Cycle and lecture method with Pre- test as Covariate

Source	Type III Sum of Squares	Mean Df	Square	F	Sig.	Decision
Corrected Model	1949.69 ^a	3	649.90	42.02	0.00	
Intercept	11105.96	1	11105.96	718.01	0.00	
Pre-test	8.05	1	8.05	0.52	0.47**	NS
Strategies	1925.65	2	962.83	62.25	0.00*	S
Error	2907.93	120	15.47			
Total	181337.00	123				
Corrected Total	4857.62	122				

*=Significant at 0.05 level of significant **= Not significant at 0.05 level of significant

Result in Table 2 shows that the analysis of Covariate (pre-test scores) of the two groups of students taught genetics using 7E’s learning and lecture strategies have F-value of 0.52 and P-value of 0.47. Since the calculated F- value 0.52 with calculated p-value 0.47 is greater than the significant level of 0.05, indicating that the mean pre-test of the two groups were statistically equivalent. The table

also shows that the calculated F-value 62.25 having calculated P-value 0.00 of the main effects of the strategies is less than the significant level 0.05, therefore, the null hypothesis is rejected. This implies that there exists a significant difference in the mean achievement scores of students taught Genetics using 7E’s learning and those taught using lecture strategy. Therefore, the null hypothesis is rejected.

Table 3: Mean and standard deviation of male and female biology students' Pre/Post Achievement test scores when taught genetics using 7E's learning strategy

Gender	N	Pre-Test		Post-Test		Mean Gain
		\bar{X}	SD	\bar{X}	SD	
Male	27	16.70	3.21	32.67	4.56	15.96
Female	42	13.57	3.47	30.57	2.49	17.00

N= Number of respondents \bar{X} =Mean SD= Standard Deviation

Result in Table 3 showed that the mean pre-test scores of the male students taught genetics with 7E's learning cycle as 16.70 with standard deviation score of 3.21 and pre-test scores of their female counterparts as 13.57 with standard deviation of 3.47, and the post-test score of the male is 32.67 with standard deviation score as 4.56 and their female post-test score was 30.57 with standard deviation score as 2.49. The data in Table 3 also showed the

mean gain scores of student taught concept of genetics using 7E's learning strategy as 15.96 and 17.00 respectively. By comparing the mean gain scores of the male and female students, it indicated that the female students' achievement scores with mean gain of 17.00 was more highly enhanced than their male counterparts with the mean gain score of 15.96.

Table 4: Summary of Analysis of Covariance (ANCOVA) of Students' Post-Achievement Test Scores Classified by 7E's learning cycle Strategy with Pre- test as Covariate

Source	Type III	df	Mean		Sig.	Decision
	SS		Square	F		
Corrected Model	99.20 ^a	2	49.60	4.27	.02	
Intercept	3752.26	1	3752.26	322.78	.00	
Pre-test	27.05	1	27.05	2.33	.13**	NS
Gender	97.83	1	97.83	8.42	.01*	S
Error	767.23	66	11.63			
Total	68860.00	69				
Corrected Total	866.44	68				

*=Significant at 0.05 level of significant **= Not significant at 0.05 level of significant

Result of Table 4 shows that the analysis of covariate pre-test scores of the male and female Biology students when taught genetics with 7E's learning cycle strategy with the calculated F-value 2.32 and the calculated p-value 0.13 is greater than the significant level 0.05 indicating that the mean pre-test score of both male and female Biology student taught genetics using 7E's learning cycle were statistically equivalent before treatment. Table 4 also

shows that the calculated F-value 8.42 having a calculated p-value 0.01 of the main effects of the strategy on gender is less than the significant level 0.05, this, implies that the null hypothesis is rejected, indicating that there is significant difference between the mean achievement test scores of male and female Biology students taught genetics using 7E's learning cycle strategy.

Discussion of Findings

The result of the study shows that the Biology students taught using 7E's learning cycle strategy had higher achievement mean gain than the conventional lecture strategy group. This implies that teaching with 7E's learning cycle strategy enhances students' academic achievement than conventional lecture strategy. A significantly higher achievement of student taught genetics using 7E's learning cycle, when compared with those taught using lecture method could be attributed to the students' active engagement in the teaching- learning process. Series

of steps in 7E's learning cycle help to encourage student thorough understanding and deeper application of content. 7E's learning cycle strategy prompt students' active participation, such which could not be possible in the conventional classroom (lecture method). This study supported the study of Abdullahi and Nor (2020) who investigated the effects of 7E's instructional strategy on overall attitude of students of the 11 grade, in Biology, in public secondary schools in Adamawa state Nigeria. The result of the finding showed that 7E's instructional strategy significantly improved

students' interest in Biology. The findings supported Khashan, (2016) study on effectiveness of teaching Mathematics with 7E's Learning cycle strategy in immediate and delayed Achievement and Retention among preparatory year students as King saud University (KSU), Saudi Arabia, in comparison with the traditional method.

The result obtained in respect to male and female Biology students taught genetics using 7E's learning cycle strategy showed that female had a higher mean gain scores than their male counterpart. However, testing of the corresponding hypothesis also affirmed a significant difference in favour of the female students. This result implies that teaching with 7E's learning cycle instructional strategy is not gender friendly. The significantly higher achievement of female student taught with 7E's learning cycle strategy when compared with their male counterpart might be due to the fact that female were more attentive in the class to gain better on the concept than the males. The finding of the present study is in line with. Abdullahi and Nor (2020) who studied the effects of 7E's learning cycle strategy on senior secondary school students' achievement in Biology. The results showed a significant difference between male and female students in favour of female students. The finding of the present study contradicts with the study of Ajaja (2013) who carried a study to compare the achievement and retention of student taught biology using concept mapping and 5E's learning cycle. From the finding, it was observed no significant difference on gender.

Conclusion

On the basis of the findings of this study, it was concluded that teaching with 7E's learning cycle was more effective in enhancing students' achievement in genetics than lecture method.

Recommendations

Sequel to the results of this study, the following recommendations are made:

1. Biology teachers in secondary school in Akwalbom State, Nigeria should be encourage by Government to use 7E's Learning cycle instructional strategy to teach in order to enhance students' academic achievement in teaching of genetics and other concepts in Biology.
2. Seminars and workshops should be organized by Government and Stakeholder for training and re-training of new and old teachers on the various ways of using 7E's Learning cycle for effective classroom instructions. This will

ensure continuity and flexibility in teaching-learning process.

References

- Abdullahi, A. C., Jibrin, A. G. Dauda, M.O. and Danjuma I. M. (2021). Effect of 7E's Learning Strategy on Retention Secondary School Students in Biology in Bauchi Metropolis, Bauchi State, *Nigeria Global Journal of Education, Humanities and Management Sciences (GOJEHMS)*; Vol.3 No.1, pg.125 - 136; ISSN(Print): 2705-2494; ISSN(Online):2705-2486.
- Abdullahi, S. & Nor A.I. (2020). Effect of the 7E instructional strategy on the overall attitude of students in biology in public schools in Adamawa State, Nigeria. *Asia Pacific Journal of Educators and Education*, 35(2), 171–186.
- Abdulranham, Taiwo & Abimbola (2019) Effects of 5E's Learning Cycle and Concept Mapping Strategies on Students Performance on Ecology in Secondary School Students' Performance on Ecology, illorin.
- Ado, I. B. & Udoh, N. M. (2018). Awareness of mathematics and biology teachers' research pedagogy, material resources and assessment strategies for innovative teaching in Uyo municipality. *Research Journal's Journal of Education*.
- Afaneh, A & Jaish, Y. (2008). Teaching and Learning using both of the brain hemisphere. First Edition, Palestine; Alafaaq publishing company.
- Agbaje, R. O. and S Alake, E. M. (2014). Students' Variables as Predictor of Secondary School Students' Academic Achievement in Science Subjects. *International Journal of Scientific and Research Publications*, 4(9), 33.
- Ajaja, O. P. (2013). Which way do we go in teaching biology? Concept mapping, cooperative learning or learning cycle? *International Journal of Science and Technology Educational Research* 4(2).
- Akwalbom State Secondary School Board Annual Report, (2022), Statistic, Planning and Research
- Ayodele, C. S. (2016). Study habits as influence of academic performance of university undergraduates in Nigeria. *Research Journal in Organizational Psychology & Educational Studies* 2(3) 72-75. © Emerging Academy



- Resources (2013) www.emergingresource.org.
- Bala, S. S (2017), Gender effects on performance and retention in Basic Science through computer-assisted instruction among secondary school students in Kano metropolis, *59th Annual Conference Proceeding. STAN press Ltd, Abuja. 118-127*
- Etiubon, R. U. & Udoh, N. M. (2017). Effects of practical activities and manual on science students' academic performance on solubility in Uruan Local Government Authority of Akwalbom State. *Journal of Education, 8(3), 202-209.*
- Etiubon, R. U. (2013). Employing technological resource to enhance students' performance and retention in Chemistry. *Journal of Education 4(1), 230-240.*
- Federal Republic of Nigeria, (2014). National Policy on Education. (Revised Edition). Lagos: Federal Ministry of Education..
- Inyang, E. R., Usedu, U. U. and Okono, I. B. (2018). Comparative effect of Concrete and Simulation Models on Biology students' performance and Retention on Respiration Ekpene L.G.A for Nation Development. *Journal of Education, University of Uyo, 11(1), 191-198.*
- Inyang. E. R. (2018) Comparative effects of Concrete and simulation models on Biology Student academic Achievement and Retention in concept of Respiratory System, Akwalbom State. Unpublished Master dissertation, University of Uyo, Uyo.
- Khasan, k. (2016). The Effectiveness of Using the 7E's Learning Cycle Strategy on the Immediate and Delayed Mathematics Achievement and the Longitudinal Impact of Learning among Preparatory Year Students at King Saud University (KSU) Dr. Khaled Khashan King Saud University, Preparatory Year, PO box 89885 , Riyadh 11692, Saudi Arabia. *Journal of Education and Practice* ISSN 2222-1735 (Paper), ISSN 2222-288X (Online) (7)36, 201-6 40.
- Naade, N. B., Alamina, J. I. and Okwelle, P. C. (2018). Effect of 7E's's Constructivist Approach on Students' Achievement in Electromagnetic Induction Topic in Senior Secondary School in Nigeria. *Journal of Education, Society and Behavioral Science, 24(3), 1-9.*
- National Examination Council (NECO), (2018). Chief Examiner's Report for SSCE June/ July 2018. Llorin: NECO publication.
- Ntukidem, I. M. (2023), Effects of simulation models and realia on senior secondary school Biology students' interest, achievement and retention in Akwalbom State. Ph.D Dissertation, Retrieved from <https://repository.Mouau.edu.ng>. 12th May, 2024.
- Onah, J.C. & Onwuburairi, P. C. (2018). Effects of demonstration and lecture teaching methods on senior secondary school students' academic achievement in chemistry. Unpublished Undergraduate Project, Nsukka. University of Nigeria.
- Oyewumi, F. A., Alayonde, E. (2021). Effect of flipped classroom strategy on senior Secondary school students' achievement in Biology, Department of Curriculum and Instruction Emmanuel Alanyander College of Education, Oyo, Nigeria. *International Journal of Innovative Social and Science Education Research, 9(3): 208-212. 8.7*
- Renninger K.A. & Hidi, S. (2016) The power of Interest for Motivation and Encouragement. New York.
- West African Examination Council, WAEC (2013, 2015, 2016, 2017 to 2021). *Chief Examiner's Report on Biology*. www.waeconline.org.ng.