JOURNAL OF SCIENCE EDUCATION (JOSE) VOL. 18, NO. 1. 2024 (ISSN: 1118 - 1364)
Indexed in Google Scholar, School of Secondary Education (Science), Federal College of Education, Abeokuta, Nigeria.

EFFECTS OF SEQUENTIAL TEACHING METHODS ON SENIOR SECONDARY SCHOOL II BIOLOGY STUDENTS' ACHIEVEMENT IN OYO STATE

ADEGOKE Adebare Idowu
Oyo State College of Education, Lanlate, Oyo State.
Department of Integrated Science

Abstract
The study investigated the effects of sequential teaching methods on senior secondary school Biology student's achievement in Oyo State. The research design used was quasi-experimental using pre-test and post-test control group approach. Two research questions and two null hypotheses were formulated. The population of the study consisted of all SSS II Biology students in Oyo East Local Government Areas of Oyo State. The sample size consisted of 100 SSS II Biology students from two selected public senior secondary schools in Oyo East Local Government, Oyo Zone. The instruments for data collection were 30-item Biology Achievement Test (BAT) validated by experts from Department of Biology, Federal College of Education, Special Oyo. Split half method was used to established the reliability of BAT and the results obtained gave the reliability coefficient r = 0.85. Descriptive statistic was used to answer the two research questions, while ANCOVA was used to test the null hypothesis. The results of the analysis showed that there was significant difference in students' academic achievement in Biology between those exposed to sequential teaching methods and their counterparts taught with conventional method. It was also shown that there was no significant difference in students' academic achievement of male and female taught Biology using sequential teaching methods. The results of the findings concluded that sequential teaching method has positive effect on students' academic achievement and is gender friendly. It was recommended among others that regular workshops, seminars and conferences should be encouraged to use it in their classroom teaching and learning.
Keywords: Achievement, Biology, Gender and Sequential Teaching Method

Introduction

Education, in its general sense, is a form of learning in which knowledge and skills of a group are transferred from one generation to the next through teaching or research. This is done under the guidance of teachers who impacts knowledge on to others. Education leaves long-lasting impact on global development. Science has a uniquenature. It is an organized body of knowledge in form of concepts, laws, theories and generalizations. Ugbong (2016) defined science as a study of nature and natural phenomena in order to discover their principles and laws. Scienceenhances national development and also exposes an individual to recent ideas through reasoning and mental efforts (Orji & Anaduaka, 2010). All nations in the world including Nigeria are striving hard to improve or developtechnologically and scientifically. This could be achieved through laying a solid foundation in science and technologystudies. Science as school subjects comprises of Physics, Chemistry, Mathematics, Agriculture and Biology. Of all, Biology is the only descriptive science which is very much linked to human life unlike Chemistry and Physics which arequantitative in nature. Science Education is defined as the study of the connection between science as a discipline andthe application of educational principles to

comprehend science teaching and learning in the classroom (Dabah, 2016). Therefore, science education acquaints students with certain basic knowledge, skills and attitudes needed for futurework in science and science-related fields. The impact of science education on national development could be felt inseveral ways; as it provides humanity with knowledge about the environment, attitudes and values for social living, knowledge and skills to explore and transform resources change in quality of life and improvement in economy (Udofia, 2010).

Biology is one of the core science subjects that senior secondary school students offer in Nigerian secondaryschools, it was introduced to students at this level as a preparatoryground for human development, where career abilitiesare groomed, potentials and talents are discovered and energized (FGN, 2013). It is also a prerequisitefor higherlearning in a number of science related professional courses like medicine zoology, botany, biochemistry andmicrobiology. Biology is very wide with many branches such as genetics, ecology, morphology, evolution and the moreadvanced cell biology among others. As a natural science subject, Biology studies the living world that is; it deals withthe study of living organisms (plants and animals) including their structure, functioning, growth, origin, evolution, distribution and interrelationship growth. Its studies life processes of a group or only for students but the whole ofhuman populace as well as its achievement.

Acadecategory of living organisms. A lot of reasons are borne in mind while studying Biology. These include among others, the understanding of self and theenvironment surrounding us, appreciation of nature as well as pollution control. Thus, Biology and its study are necessary not mic achievement is the extent to which a student, teacher or institution has been able to achieve theireducational goals (Okeke, 201l). Hornby (2015) defines achievement as a thing that somebody has done successfully especially using their own efforts and skills. There are conflicting reports in the literature concerning the effect of teaching strategies on students' achievements. Lawal, (2011) opined to this fact that another trigger of poor achievementin Biology is ineffective teaching method because most teachers resolve to the use of talk-chalk method or method because it saves time, gives wider coverage of syllabus, less tedious and so on. Other factors have beenidentified by researchers as being responsible for the decline and poor achievement ofstudents in Biology; some of theseinclude; lack ofqualified teachers, lack of educational facilities like laboratories, overloaded syllabuses, laziness, poorattitude and lack ofinterest on the part of the students, large class size, family/home background of the students (Osuafor&Okonkwo, 2013). Based on this premise, sequential usage of three teaching methods was applied: demonstration, discussion and conventional (talk-chalk) in teaching Biology content in a sequence of use in order to ascertain their effects on students' achievement and retention.

Sequence is an act of putting events, ideas, and objects in a logical order (Frank, 2013). Sequential teaching method is an instructional method that engages students to learn a particular topic in logical order of display or is aprocess ofimparting knowledge to learners using different instructional methods in logical order. It provides a concretebasis for conceptual thinking (promoting critical thinking skills). Demonstration method involves the use of instructional materials to show learners how something is done in order to enable them acquire skills necessary forperforming the given task. The method is mostly used in showing the students correct use of certain science equipment. Demonstration can be carried out as: teacher centred approach, quasi student centred approach or student centred approach. It is a strategy thatapproach. The method encourages students' participation which is necessary for effective

teaching. It is a strategy that focuses on achieving psychomotor and cognitive objectives (Azubuike&Umuni, 2018).

Discussion method involves a group of people in a class who come together to exchange ideas, facts, opinionsand expressions orally about a topic ofmutual concern and interest under a guide. In a discussion class, the students talkto each other about the concept or problem until there is an agreeable understanding to it mentally. This methodencourages children to be independent of teacher and discover knowledge and also see relationship on their own. Thediscussion method involves intelligent exchange of views, ideas and opinions on a topic, which coversa wide range ofclassroom activities and interactions or it involves written and oral expression of different points of view in a givensituation (Cashin, 2011). The lecture method (talk-chalk) is concerned with the teacher being the controller of thelearning environment. It does not encourage deeper students' involvement as they are passive recipient of informationalready acquired by the teacher. Also, it does not facilitate the development of reasoning skills and processes in thestudents. These among other reasons had not enhanced learning in students and thus had led to poor achievement andretention of Biology concepts among students in secondary schools (Merriam and Grace, 2011).

The intervening variable influencing students' achievement in Biology at SSCE is gender. Gender is a socialconstruct that differentiate male from female based on physical features. Many researchers (Apochi, 2017, Nneka,2015: Abdul-Raheem, 2012 &Okoro, 2011) have shown gender to be of significant influence in an investigation of thisnature, hence the inclusion of gender as an intervening variable in this study, In this study, therefore, the effect ofsequential teaching methods (STM) on senior secondary school Biology students' achievement was investigated.

Education is an indispensable instrument for the development of any nation and teachers are the implementers of the educational programme and theories into practice. The teaching of science particularly Biology should be consistent with the nature of science which lays greater emphasis on engaging students in inquiry activities as the use ofone-size-fits-all curriculum no longer meets the needs of majority of learners. However, due to the usefulness ofbiology in nearly all fields of human endeavor, the poor achievement of students at senior secondary schools' level is of significant concern to stakeholders in education. In addition, Biology teachers use talk-chalk/lecture method to teach the subject, which does not in any way provide sequence of learning experience that is, the talk-chalk/lecture method is imperfect because it involves verbal presentation of pre-planned lesson to the students which requires little or noinstructional aid and so does not promote students' higher level of thinking (Dajal and Mohammed, 2019). More so, thepersistent use of this method makes students passive rather than active learners and does not promote insightfullearningand long-term retention of some abstract concepts in biology (Umar, 2011). Therefore, considering the importance ofbiology in all round development there is need for change in strategy/method of teaching so as to enable students insenior secondary schools to acquire adequate knowledge and skills in science. In the same vein, researchers in science education especially Biology have always been searching for better teaching method that will enhance better students'achievement and promote their attitude so that they perform well in Senior Secondary School Certificate Examinations.Hence, the needs to improve on the teaching and learning ofBiology by exploring using an innovative learner-centredmethod like sequential teaching methods.

Purpose of the Study

The general purpose of this study was to investigate the effects of sequential teaching methods on senior secondaryBiology students' achievement.

Specifically, the objectives of the study were to:

i. compare the academic achievement scores of students taught Biology with sequential teaching methods andthose taught with conventional method;
ii. determine the mean achievement scores of male and female students taught Biology with sequential teaching methods.

Research Questions

The following research questions were generated to guide this study:

1. What are the academic achievement scores of students taught Biology with sequential teaching methods andthose taught with conventional method?
2. What are the mean achievement scores of male and female students taught Biology with sequential teaching methods?

Research Hypotheses

The following null hypotheses were generated from the statement of the problem and tested at 0.05 level of significance.

$H0_1$: There is no significant difference in the mean achievement scores of students taught Biology with sequentialteaching methods and those taught with conventional method.

$H0_2$: There is no significant difference in the mean achievement scores of male and female students taught Biologywith sequential teaching methods.

Methodology

The research design for this this study was quasi-experimental that specifically, applied pre-test and post-test non-equivalent control group. Being an experimental study, the samples for the studies were grouped into experimental andcontrol groups. The experimental group was taught biology concepts using sequential teaching methods while thecontrol group was taught the same biology concept using conventional talk-chalk method. Intact classes were used inorder to avoid distortion on the normal class settings using the school timetables. The design is presented symbolicallyin Table 1

Table 1: Representation of Research Design

Group	Pre-test	Treatment	Post-test
Experiment	O_1	X_1	O_2
Control	O_1	X_2	O_2

Where: O_1 = Pretest

X_1 = Treatment of experimental group

O_2 = Post-test

The population of the study comprised of all the SSS II Biology students in the Oyo East Local GovernmentAreas of OyoState, Oyo.One hundred sample size formed in this study was selected using purposive sampling technique. Multistage sampling technique was used in Oyo East Local Government Area and two schools for the research out of eleven public school in Oyo East Local

Government. Random sampling was used to select one Local Government Area from the thirty-three (33) Local Government Areas in OyoState. The reason for the choice of simple random sampling technique is to give each Local Government Area equal chance of being selected in the study. Two co-educational secondary schools were selectedusing simple random sampling technique from Oyo East. The choiceof co-education schools was because gender is one of the variables in the study. One intact class of Biology students in SS II from the two sampled schools were selected randomly and the two classes were assigned experimental group and control group. The instruments used for data collection in this study were Biology Achievement Test (BAT) and Lesson plan. Biology Achievement Test (BAT) was used as pre-test and post-test in the study. It consisted of two sections: Section A and Section B. Section A entails the general information of the students while Section B entails the Biology Achievement Test questions (Appendix V). The BAT comprised of thirty (30) items multiple choice objective test questions with four (4) options lettered A, B, C and D. The test items were based on concepts in ecological management: association, tolerance, adaptation, pollution, nutrients cycling in nature, basic ecological concepts, population studies and conservation of natural resources adopted from past West African Examination Council (WAEC 2017-2020 standardized questions). The researcher prepared a table of specification (Test blue print) to guide the test development, in accordance to the senior secondary curriculum. The researcher prepared two sets of lesson plans for teaching both experimental and control groups for each topic that was taught; each unit contained eight lessons that lasted for eight weeks. One set of lesson plan was prepared using sequential teaching methods while the other set was prepared based on conventional method.

The Biology Achievement Test (BAT) was subjected to scrutiny by four experts in the subject area and wascontent validated using table of specification and face validation by experts in the Department of Science andEnvironmental Education, University of Ibadan; and two Biology teachers from sampled senior secondary schools in Oyo East LGA, Oyo state. The comments and recommendations ofthe experts had helped in selection and modification ofthe test items for the study. After the validation, the BAT items were subjected to Split half reliability estimate. A splithalf method was used to compute the reliability of the Biology Achievement Test. It was administered once and thescores were divided into two to calculate the reliability of the instrument. A method of estimating reliability involvedtwenty-five (25) senior secondary II Biology students (1S male and 10 female). Pearson Product Moment Correlation Coefficient (0) was used to calculate the internal consistency of the BAT. This method of estimating the internalconsistency reliability of an instrument is appropriate for dichotomously scored items such as BAT which is a multiplechoice objective test with right and wrong answers and is easier to use. The outcome of the reliability estimate warrantedmodifications in the test item (BAT). The reliability coefficient of the instrument gave r= 0.85. Thus, BAT wasconsidered reliable. The treatment lasted for a period of eight weeks of treatment, BAT instrument was administered aspre-test for both experimental and control groups; after the first week, the researcher went round the sampled schoolsand taught students personally for eight (8) weeks during their lesson period using the prepared lesson plans and noteswas given. The researcher administered the BAT post-test. The data collected were analyzed accordingly.

Results

The Data obtained were analyzed using descriptive statistics frequent counts, mean and standard deviations forthe research questions while the hypotheses were tested at 0.05 level of significance using ANCOVA.

Research Question One:
What are the academic achievement scores of students taughtBiology with sequential teaching methods and those taught with conventional method?

Table 2: Mean and standard deviation showing achievement scores of students taughtBiology with sequential teaching methods and conventional method

		Pre-test	**Post-test**	**Mean difference**
Treatment Groups	**N**	x Sd.	x. Sd.	
Sequential Teaching Methods (Experimental)	51	27.441.00	39.9410.22	12.50
Conventional method (Control)	49	21.863.55	26.5441.38	4.680
Total	**100**			

In Table 2, the mean scores of the students in the sequential teaching methods (experimental group) on pre-testand post-test are 27.44 and 39.94 respectively. These results give a post-test - pre-test mean difference of 12.50; whilethose ofthe students in conventional method (control group) arc21.86 and 26.54 respectively, giving a post-test – pretestmean differenceof4.68, The gains in scores show that the students in the experimental group taught sequential teachingmethod (13.40) performed better than their counterparts in conventional method (5.58). Considering the researchquestion one - what are the academic achievement scores of students taught Biology with sequential teaching method did better than those taught with the conventional teacher-centered method.

Research Question Two:
What are the mean achievement scores ofmale and female students taught Biology with sequential teaching methods?

Table 3: Mean and standard deviation showing Achievement scores of Male and FemaleStudents taught Biology with sequential teaching methods

				Mean difference
		Pre-test	**Post-test**	
Gender	**N**	x Sd.	x. Sd.	
Male	27	13.541.26	13.560.62	0.02
Female	24	11.410.56	11.420.00	0.01
Total	**51**			

Table 3 the mean scores of the male students in the sequential teaching methods (experimental group) on pre-testand post-test are 13.56 and 13.54 respectively. These results give a post-test - pre-test mean difference of 0.02: whilefemale students also taught the same instructional strategy arell.42 and 11.41 respectively, giving a post-test- pretestmean difference of 0.01. The gains in scores showed that both genders taught sequential teaching method had 2.14 and2.13 respectively. A comparison of these achievements indicates that both male and female in in sequential teaching methods had better achievements. These observations answered the question two- what are the mean achievement scores ofmale and female students taught Biology with sequential teaching methods?

Hypotheses testing

$H0_1$: There is no significant difference in the mean achievement scores of students taught Biology with sequentialteaching methods and those taught with conventional method

Table 4: Summary of Analysis of Covariance (ANCOVA) of Biology Students taught using Sequential TeachingMethods and Conventional Method

Source of variation	Type III Sum of squares	df	Mean square	F.cal	Sig.	Decision at p<.05
Corrected Model	7681.545[a]	3	3240.512	91.634	.000	S
Intercept	3762.004	1	3762.006	113.240	.000	S
Covariate Pre-test	185.17	1	185.17	3.330	.061	Ns
Methods	6863.206	1	3286.807	134.331	.000	S
Error	3173.710	129				
Total	119631.000	133				
Corrected total	9766.276	132				

a. R Squared = .677 (Adjusted R Square = .671)

Table 4, reading on the row Methods revealed that Mean Square =6863.206, F=134.331, df= 1 and Sig. =.000 =p. Since p<0.05, the noted difference between achievement scores ofstudents taught using sequential teaching methodsand conventional method is significant. So, the null hypothesis was rejected with the conclusion that there is asignificant difference between the mean achievement scores of the students taught using sequential teaching methods and those taught Biology with conventional method.

$H0_2$: There is no significant difference in the mean achievement scores of male and female students taught Biology with sequential teaching methods.

Table 5: Summary of Analysis of Covariance (ANCOVA) of Male and Female Students taught Biology using Sequential Teaching Methods

Source of variation	Type III Sum of squares	df	Mean square	F.cal	Sig.	Decision at p<.05
Corrected Model	65.457[a]	2	32.539	.681	.462	Ns
Intercept	3036.640	1	30.36.640	70.231	.000	N
Covariate Pre-test	52.027	1	52.027	1.203	.277	Ns
Sex	6.483	1	6.483	.156	.802	Ns
Error	3023.610	70				
Total	86481.000	73				
Corrected total	3081.276	74				

a. R Squared =.678 (Adjusted R Squared = .672)

Table 5, reading on the row heading Sex, revealed that Mean Square =6.483, F =.156, df= l and Sig, =.802 p. Since p>0.05, the note in the difference of students taught using sequential teaching methods between male and femalestudents is not significant. So, the null hypothesis was not rejected with the conclusion that there is no significant difference between the achievement scores of male and female students taught Biology using sequential teaching methods.

Discussion of Findings

The first findings revealed that students taught biology using sequential teaching methods achieved significantly higher than those taught using conventional method. This finding is in agreement with Namasaka, Helen and Chrilukovian (2017) who said that sequential teaching methods are an effective method of teaching because it helps students acquire useful knowledge. Similarly, Ajaja (2013), Selviana&David (2017) said that sequential teaching methods experiencesenhanced students' understanding of process of science, improved students' attitude towards biology and significantlyinfluenced their Biology achievement. However, the results of these findings negate that of Azubuike and Mumuni (2018), who asserted that there was no significant difference in the mean scores achievement of students. Furthermore, the second findings revealed that male and female students taught biology using sequential teaching methodsperformed better equally that is, there was no significant difference in their mean achievement scores. This findingagreed with Mbacgbu, Chioma&Osuafor (2012), who underscores sequential teaching methods as gender friendly. In asimilar study by Dajal& Mohammed, (2019) recorded no significant difference in male and female students inexperimental group. This is so because the learner centered method promotes and encourage active engagement in learning and self-motivation can be easily achieved.

Conclusion

This research investigated the effects of sequential teaching methods on senior secondary school Biology students' achievement in Oyo East Local Government Area, Oyo State. The result revealed that students taught STM are more motivated to learningBiology. Also, the students are more enhanced to taking responsibility of their own learning than those taught by theconventional method. Gender has no significant effect on students' achievement. This study finally concluded that theuse of sequential teaching methods was innovative, resourceful and would be a good asset to Biology teachers and students, based on the finding of the study, sequential teaching methods enhance student's achievement due to itsstimulation of attention or curiosity in the students by making them desirous to learn and know biology. This finding makes

the researcher to conclude that sequential teaching methods are elegant to students' achievement and gender friendly.

Recommendations

Based on the findings in this study the following recommendations were made:

1. Biology teachers in schools should be encouraged to use sequential teaching methods in teaching other concepts
2. Teacher education institutions are encouraged to include sequential teaching methods in their biology curriculum for training and retraining in workshops, seminars, etc.
3. Textbook writers should be encouraged to incorporate sequential teaching methods in their writings. This willgoa long way in making biology teachers more educated about the approach.

References

Abdu-Raheem, B. O. (2012). The Influence of Gender on Secondary School Students' Academic Performance in South- West, Nigeria. *Journal ofSocial Science*, 31(1),93-98.

Ajaja, O. P., (2013). Concept Mapping as a Study Skill: Effects on Students Achievement inBiology, Delta State University, Abraka, Nigeria. *Electronic Journal of Science Education*, 17(1). Retrieved from ejse.southwestern.edu.

Apochi, M. A. and Abubakar, Z. (2017). The use of Learner Engagement in Science. Curriculum Delivery. *PalgoJournal ofEducation Research*, 5(4), 298-302. Retrieved from http://www.palgojournals.org/PJER/Index htm

Azubuike, E. N. and Mumuni, A. A. (2018). Effects of Teaching Strategies (demonstration and guided inquiry) on BiologyAchievement of Secondary School Students with different Learning Styles (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) in Rivers State. *Journal of Research & Method in Education* (IOSR. JRME): 8(2),01-20. Retrieved from www.iosrjournals.org.

Cashin, W. E. (2011), Effective Classroom Discussions. *Idea paper* No 49, Idea Centre, Kansas State University

Dajal, R. G, and Mohammed, A.U. (2019). Effects of Guided Discovery Method on Students' Attitude to, andAchievement in Biology in Senior Secondary Schools, Bauchi State. *International Journal of Research andScientific Innovation* (IJRSI), 6(7), 105.Retrieved from www.rsisinternational.org.

Federal Government of Nigeria, FGN. (2013). *National Policy on Education.* Lagos: NERDC Press.

Frank, E. (2013). In order to learn: How the Sequence of topics Influences Learning. Oxford series on CognitiveModels and Architectures. New York: OxfordUniversity Press.

Hornby, A. S. (2015). Oxford Advanced Learner's Dictionary. 9th Ed. New York: Oxford University Press.

Lawal, F. K., (2011). Biology Teachers' Perception of the Senior Secondary School Biology Curriculum and the need forReform. Science Teachers' Association ofNigeria (STAN) 52nd Annual.

Mbaegbu, C. S., Osuafor, M.A. and Akachukwu, E.E. (2020). Effects of Sequential Usage of Three Teaching Methods onAcademic Achievement of Senior Secondary students in

Biology. *Journal ofResearch & Method in Education (IOSRJRME),* 10(2), 49-56. Retrieved from www.iosrjournals.org.

Merriam, S. B. & Grace A.P. (Eds.), (2011). The Jossey-Bass reader on contemporary in Adult Education. SanFrancisco.

Namasaka, F. W., Mondoh, H.O. &Chrilukovian B.W. (2017), Effects of Sequential Teaching Methods on Retention ofKnowledge in Secondary Student Biology in Kenya. European *Journal of Education Studies*,3(5). Retrieved from www.oapub.org/edu.

Nneka, R. N., (2015). Effect of Cooperative Learning Instructional Strategy on Senior Secondary School Students'Achievement in Biology in Anambra State, Nigeria. *International Journal for Cross-Disciplinary Subjects in Education (IJCDSE)*, 5(1).

Okeke, O. J. (2011). Effects of Mind Mapping Strategy on Students' Achievement, Interest and Retention in SeniorSecondary Schools Chemistry. Unpublished Thesis submitted to the Department of Science Education, Faculty of Education, University ofNigeria, Nsukka.

Okoro, A. U. (2011). Effect ofInteraction Patterns on Achievement and Interest in Biology among Secondary School Students in Enugu State Nigeria. (Unpublished Master's Thesis), University ofNigeria, Nsukka.

Orji, A. B. C. &Anaduaka U. (2010). Effect of Webbing Instructional Strategy on Students Achievement in Algebraic word Problems. *Journal of Research in National Development*, 8(2).

Osuafor, A. and Okonkwo, G. (2013). Influence of Family Background on Academic Achievement of Secondary School Biology Students in Anambra State. *An International Multidisciplinary Journal, Ethiopia*, 7(3), 156-167.

Selviana N. and David B.M. (2017), Developing Students' Research Proposal Design through Group Investigation Method.*IOSR Journal of Research & Method in Education (JRME),* 7, 1(1).

Udofia, T.M. (2010). "Science, Technology and Mathematics Education: The Panacea for Economic Meltdown inNigeria"**. *51st STANAnnual Conference Proceeding.***

Ugbong, J.C. (2016). Methodology ofScience Teaching, Calabar; Dolink Publishers.

Umar, A.A., (2011). Effects ofBiology Practical Activities on Students' Process skill Acquisition in Minna, Niger State, Nigeria. *Journal of Science, Technology, Mathematics and Education (JOSTMED),*7(118-126)

West African Examination Council (WAEC), (2017-2020). Chief Examiners' Reports, Lagos.