



AL-HIKMAH JOURNAL OF EDUCATION

VOLUME 4 NO. 1 JUNE, 2017

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EFFECTS OF SEQUENCING OF TOPICS ON SENIOR SCHOOL STUDENTS' GENETICS ACHIEVEMENT IN ILORIN METROPOLIS

H. I. ALABI, A. S. OLORUNDARE, G. BELLO & I. O. ABIMBOLA

Abstract

This study explored the effects of sequencing of topics on senior school students' achievement in genetics in Ilorin, Nigeria. The researchers developed, validated and administered a 20 item short-questions tagged Biology Achievement Test in Genetics (BATG) on 107 senior school students. The BATG was used as a pre-test and post-test to measure the equivalence of the groups prior to the commencement of the treatment and students' gain after the instruction respectively. A quasi-experimental design was adopted, and mean and standard deviation were used to answer the research questions, while t-test was used to test the formulated hypotheses. The study found that there was no significant difference in the achievement of students taught genetics using the researchers' structured order and those taught with the officially prescribed order. The study also found that there was no significant difference in the achievement of male and female students taught using the researchers' structured order. It was recommended that concepts in genetics could be taught independently, as learning of one concept does not affect the other; and that, both male and female students should be given equal consideration as far as genetics teaching is concerned.

Keyword: *Sequencing of topics, Senior School, Students' Genetics Achievement*

Introduction

Sequence and structure are used synonymously. Kliebard (1965) defined structure as the dissection of certain recognized discipline with a view to exposing their underlying components. Johnson (1977) also described structure as a map consisting of network of facts and principles linked together by analytic and empirical proposition. Structure is the basis of curriculum organization and plays an active role in understanding, retention and transfer of knowledge.

Sequence, on the other hand, describes the manner in which contents and materials in curriculum are arranged in order of succession. Sequence, according to Encarta Premium is the order in which things are arranged, actions are carried out or events happen. Tyler (1949) was of the view that sequence emphasizes the importance of having successive experiences built on the preceding ones and going more broadly and deeply into matters involved. Sequencing is one of the many skills that contribute to students' ability to comprehend what is read (Pearson Education, 2009).

Genetics is an important aspect of Biology that has impacts on everyday life. It is the basis for diversity of species and resemblance of organisms. Genetics is often referred to as biology of heredity and it plays an important role in the transmission of characters from parents to offspring via the genes (Ambuno, Egunyomi & Osakwe, 2008). Idodo-Umeh (2011) described genetics as the science that deals with questions and answers on inheritance.

However, genetics is one of the topics in Biology whose studies have established that students found difficult to learn (Abimbola, 1998; Olorundare & Oni, 2007). These difficulties may be due to separation of inheritance from reproduction and meiosis as well as occurrence of hereditary phenomena at different levels of biology organization (Knippels,

2011 Mills-Shaw, Horne, Lang & Boughman (2008) reported that genetics problems might be due to lack of proper understanding of genetics concept and that these might serve as barrier to students' achievement. This situation adds to abstract characteristics of genetics.

Other factors that contribute to difficulty encountered in genetics is also identified by Laxue (1999) include students' lack of proper understanding of process of science as well as inability to interpret instructions in genetics. Kappala, Wazito & Bwemba (2007), Olorundare & Oni (2007) found that lack of teaching experience and required qualifications greatly influence students' perception of difficult concepts. Pinar and Laskaya (2008) submitted that inadequate prior knowledge greatly influences students' performance in genetics.

In classroom setting, especially in co-educational schools, students can either be males or females, thus there is need to examine whether or not the performance varies based on gender. Gender refers to a state of being male or female. Researchers such as Bello & Abimbola (1997) explored gender influence on biology students' concept mapping skills and achievement, and found that there is no gender influence of concept mapping skills on their achievement in evolution.

Sambo & Sambo (2011) conducted a research on causal attributions for academic success and failure among genders in colleges of education in north western Nigeria and the results for psychological and counselling intervention. Findings from the study revealed that there was no significant difference between male and female students in their causal attributions. One of the purposes of education is to ensure meaningful understanding of teaching and learning exercises of the concerned concepts. In an attempt to do this, the 6th National Policy on Education has a number of goals among which is to ensure effective use of strategic planning to improve the quality of education provision and service delivery evaluation (FCPE, 2012).

Poor performance by the students could be an indication for poor educational quality and poor service delivery by the teacher. Genetics is a fundamental concept that has relationship with reproduction, cell, cell division, etc., and one of the topics in biology perceived difficult by teachers and students (Abimbola, 1999). These difficulties, however, resulted to poor performance in biology (Chief Examiners' Reports, 2010, 2011). In an attempt to solve this, Danmole (2011) submitted that the 21st Century biology teachers should be helped in tackling the difficulties in teaching biology concepts such as genetics, ecology and evolution through initial teacher education and retraining workshops on the Millennium Development Goals.

Purpose of the Study

The study mainly investigated the effect of sequencing of topics in genetics on senior school students in Ilorin, Nigeria. Specifically, it examined influence of gender in sequencing of topics in genetics. The study attempted to provide answers to the following questions:

- Does sequencing affect students' achievement in genetics?
- Is there gender difference in the achievement of students in genetics when taught using researchers' structured order?

Research Hypotheses

- H_{01} There is no significant difference in the achievement of students taught genetics using the arrangement in the syllabus and those taught with a researcher's reordered genetics topics.

11. There is no significant difference in the achievement of male and female students taught genetics using a researchers restructured genetics topics.

Literature Review

Olorundare & Oni (2007) analyzed teachers' of difficult biology concepts, factors and reasons for their perceived difficulties. Fifty six biology teachers randomly selected from secondary schools in Akure South and North Local Government Areas of Ondo State constituted the sample for the study. Five research questions were formulated and tested at 0.05 significance levels. The instrument used was a researchers-designed questionnaire containing 30 biology concepts. The instrument was face-validated and tested for reliability with the reliability coefficient being 0.66.

Findings from the study revealed that teachers' academic qualifications & teaching experience each had a significant influence on teachers' perception of the difficult biology concepts and factors responsible for such perception. Teachers' reasons for their perceptions were also ranked and analyzed. Acquisition of appropriate teaching qualifications, attending specialized workshops and seminars, and use of relevant instructional materials to simplify teaching and learning of specific isolated difficult biology concepts were recommended in the study.

The effectiveness of Problem Based Learning (PBL) on academic performance in genetics was explored by Araz & Sungur (2007). A total of 217 students were involved and randomly assigned to intact classes of two different teachers. Each teacher had both PBL and traditional classes. The PBL group was exposed to researcher restructured contents cooperatively with the guidance of the teachers. Students in the traditional classes received instruction based on teachers' explanations, discussions and textbooks. The two groups were exposed to Genetics Achievement Test (GAT) developed by the researcher to determine the academic achievement and performance skills. Multivariate Analysis of Variance conducted showed that PBL students had higher academic achievement and performance skills than those in the traditional classes. This implies that PBL students acquire scientific concepts related to genetics better, and are able to integrate and organize knowledge more than students in traditional classes.

Studies have been conducted on influence of sequencing of topics on achievement of students in science and non-science courses. Ilori (2002) conducted a research on assessment of teachers' sequencing of topics from the secondary school mathematics curriculum using Piagetian theory. A total of 143 senior school mathematics teachers constituted the sample. The subjects were sampled using purposive and stratified sampling techniques. As such, teachers were selected based on their qualifications, experience and areas of specialization. Each of the teachers prepared a scheme and the schemes prepared by them were used as bases to determine each of the teacher's cognitive view of the topic. The prepared schemes were compared with one another and later with the model scheme. The data collected from the comparison was analyzed using percentages, frequency counts and inferential statistics and Kruskal Wallis Analysis of Variance by rank. The study found that 86.7% of all the selected practising senior school mathematics teachers did not apply Piagetian theory of cognitive development in drawing their scheme of work from the curriculum. Experience and qualification positively affected the schemes prepared by the various teachers concerned.

Salami (2002) explored the influence of teachers' sequencing and coverage of the secondary school physics curriculum on student achievement in Kwara State, Nigeria. Three hundred and twenty physics students in 10 senior secondary schools of Kwara State were involved.

Data was collected using multiple choice physics performance test. The data collected was analyzed using Pearson Product Moment Correlation Coefficient. The study revealed that students whose teachers followed the prescribed sequence performed better than their counterparts whose teachers did not follow the sequence. It was also found that sequence without coverage and coverage without sequence often produced the same result and that sequence with coverage usually produced better result than non-sequence and no coverage of curriculum content.

Adeyemi (2014) investigated the influence of gender on secondary school students' achievement in map work. A total of 164 SSII Geography students were randomly drawn from Ilesa East and West Local Government Areas of Osun State. Four instruments were used to source for data. The data went through parametric and non-parametric analysis using mean, standard deviation, ANCOVA and Multiple Classifications Analysis (MCA). It was revealed that significant main gain effect of gender occurred in Declarative Knowledge Achievement Test (DKAT) and Procedural Knowledge Achievement Test (PKAT). However, there was no significant difference in Map Reading and Interpretation Achievement Test (MARIAT), though the males performed better than the females in map work.

The effect of gender, age and mathematics anxiety on college students' achievement in algebra was examined by (Owolabi & Etuk-iren, 2014). The study adopted an expo-facto design. The participants were mathematics teacher trainees drawn from Federal College of Education, Lagos and Ogun States. Questionnaire was used to elicit information on gender and age of the respondents while mathematics anxiety scale and participant achievement score in an algebra course were used to gather information on their achievement. The collected data was analyzed using mean, standard deviation, independent *t*-test and one-way ANOVA. The result showed that there was average performance in the algebra course. It was also found that gender, age and mathematics anxiety grouping were all non-significant.

Methodology

The study was a 2 x 2 quasi-experimental design involving pre-test, post-test, non-randomized, control and non-equivalent intact group. The sequencing occurring at two levels (officially prescribed order as found in the syllabus, and a researcher reordered sequence) students' gender at two levels (male and female). The study was conducted in Ilorin metropolis. The study involved 107 SSIII students purposively selected from two co-educational schools in the area. The study was conducted in schools in their intact classes of which one of the schools was used as the experimental while the other served as the control group.

At the first week, all the students in the two groups were pretested prior to the experiment. This was used to determine the status of the students before the commencement of the experiment. The experiment lasted for six weeks. The instrument used for the study was a researchers-developed 20 item, short-structured test tagged Biology Performance Test on Genetics (BPTG). The instrument was validated by two lecturers from the Department of Science Education, University of Ilorin. The reliability was determined using Pearson Product Moment Correlation Coefficient and 0.82 was obtained.

The experimental group was taught genetics using a researcher reordered sequence designed by the researchers and a control group was taught using an officially arranged sequence in the curriculum. The teaching in the two groups lasted for four weeks. The two groups were post-tested. The data collected from pre- and post-tests was analyzed using *t*-test statistics.

Results

Research Question 1. Does sequencing affect students' achievement in genetics?

Table 1 illustrates a close pre-test mean scores of 36.61 and 35.86 for the researcher reordered structured and officially prescribed groups, respectively. After the administration of the treatment, the experimental group, i.e. those taught with the researcher-reordered sequence had a higher mean gain score of 18.6 than their counterparts taught with official prescribed order with a mean gain score of 17.71. This implies that sequencing affects the achievement of students in genetics.

Research Hypothesis 1.

There is no significant difference in the achievement of students taught genetics using the researcher-structured sequential order of genetics and those taught using the officially prescribed order of genetics curriculum.

Table 2 reveals the performance of students in the BATG by the experimental and control groups. It could be deduced from the table value (2.00) which is greater than the t calculated (0.93) at 0.05 level of significance that there is no significant difference in the performance of students taught genetics using the researcher-structured sequential order of genetics and those taught using the officially prescribed order of genetics curriculum. Therefore, the hypothesis is not rejected.

Table 1: Description of the Differences in the Performance of Experimental and Control Groups

Group	N	pre-test Mean	Post-test Mean	Mean Gain Score
Experimental (Researcher structured)	56	36.61	55.21	18.6
Control (Officially prescribed order)	51	35.86	52.96	17.1

Table 2: The t -test Analysis of Post-test of Experimental and Control Groups

Group	N	$\sum x$	$\bar{x}$	SD	df	t cal	t -table
Experimental (Researcher structured)	56	3092	55.21	13.36	105	0.93	2.00
Control (Officially prescribed order)	51	2701	52.96	11.41			

Research Question 2.

Is there a gender difference in the achievement of students in genetics when taught using researchers reorder structured order?

Table 3 shows that male students had slightly higher mean of 55.35 than their female counterparts whose mean as 55.07, hence, there was a slight difference in the achievement of male and female taught genetics using a researcher-structured order.

Research Hypothesis 2.

There is no significant difference in the achievement of male and female students taught genetics using a researchers reordered genetics topics.

It is evident from table 3 that the t -table value is 2.00 which is greater than the t -calculated 0.08 at 0.05 level of significance, since t -calculated is less than the t -table value, the hypothesis which states that there is no significant difference in the achievement of male and female students taught genetics using a researchers reordered genetics topic is therefore not rejected. The study was however contrary to the findings of Adeyemi (2014) who found that male students achieved significantly better than their female counterparts.

Table 3: The t-test Analysis of Posttest Scores of Male and Female in Experimental Group

Group	N	$\sum x$	$\bar{x}$	SD	df	t cal	t-table
Male	29	1605	55.35	13.58	54	0.08	2.00
Female	27	1487	55.07	13.37			

Summary of Major Finding

The following findings were obtained from the analysis and interpretation of the collected data.

- i. Students taught with researcher- sequence benefited better than those taught using the teacher structured sequence although the difference was not significant
- ii. There was no difference in the performance of male and female students taught using the teacher -structured sequence.

Discussion

Findings revealed that students taught genetics using researchers' structured order did not achieve better than those taught using officially prescribed order of the curriculum. Hence, researcher's structured sequence did not enhance students' achievement in genetics. This agrees with the finding of Johnson (1977) who submitted that any item in the curriculum may be learnt first, irrespective of the order it was presented in the curriculum. However, the study is at variance with the findings of Salami (2002) who found that students whose teachers followed the sequence performed better than their counterparts whose teachers did not follow the sequence.

The study also found that gender had no influence on students' achievement. This implies that being male or female has nothing to do with the order of presentation of instruction to learners. The result agrees with the finding of Owolabi & Etuk-iren (2014) who found that gender was not a determining factor in sequencing of genetics topics.

The study found that researcher- structured order of genetics topics did not determine students' achievement in genetics. Likewise, gender had no significant role when genetics topics were taught with researcher-structured order of genetics topics.

Recommendations

- i. Concepts in genetics should be taught independently as learning of one concept does not affect the other; it was also recommended that other manner of structuring should be delved into to allow for a better conception of information presented to students.
- ii. Both male and female students could be given equal consideration as far as genetics teaching is concerned, since gender had no influence on their achievement. Students should also be encouraged to work collaboratively irrespective of their gender to ensure equality among them.

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