
IMPACT OF PROBLEM-SOLVING AND DISCOVERY STRATEGIES ON THE ACADEMIC PERFORMANCE, ATTITUDE AND RETENTION
IN GENETIC CONCEPT AMONG SENIOR SECONDARY SCHOOLS IN ZARIA METROPOLIS, NIGERIA

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ABSTRACT

This study investigated the impact of problem-solving and discovery strategies on attitude, retention and academic performance in genetic concepts among secondary school students in Zaria, Nigeria. The research design for the study is Quasi-experimental with control group involving pretest and posttest. The population of the study consists of 527, (264 male and 263 female) students. Simple random sampling technique paper ballot was used to select three schools out of five co-educational schools. A sample of three hundred and forty-five (345) secondary school students consisting of 182 male and 163 female students were randomly selected and used for the study. The sample was divided into two groups – experimental and control groups. Both groups underwent pre-test, treatment and post-test. Two instruments were used for gathering data, Genetic Performance Test (GPT) with reliability co-efficient of $r=0.87$ and Students' Attitude to Genetics Questionnaire (SAGQ) with reliability co-efficient of $r=0.79$. Kruskal-wallis statistic were used for analysing the data gathered at $P<0.05$ level of significance. Findings reveal that students taught by problem-solving and discovery strategies performed better than those taught by conventional lecture method. This implies that problem-solving and discovery strategies actually enhance attitude of students towards teaching and learning of Genetics at senior secondary schools. Problem solving also enhances students academic performance in genetics. The same result was obtained in their retention ability and attitude change. However, gender did not show any difference in performance in all the two teaching strategies. Based on the findings recommendations were made one of which urge biology teachers to use problem solving and discovery strategies to improved students academic performance in genetics.

INTRODUCTION

Science education is an indispensable tool for national development because the economic, political strength of a nation is always assist in terms of her performance in science and technology (Olarinoye, 2001, Otuka, 2006, & Wasagu, 2007). The importance of science education to nation building, cannot be over emphasized the federal government of Nigeria emphasized the teaching of science and teaching science and technology at all level of education in the country, (Eze, 2001) and in the National Policy on Education (FRN, 2013). This advocacy is consistent with various reformed initiatives and the globe for both science and mathematics curricular and classroom practices, for instance, the need to develop students

understanding and scientific literacy and using inquiry and problems solving experiences and skills acquisition, has been emphasized in the United State reform document of the American Association for Advancement of Science (A. A. S, 2006) and National Research Council (NRC, 2006).

Biology is a branch of science that deals with the systematic study of life. Biology as a science subjects, has many branches notably zoology, study of animal is Botany. The study of plant. Biology has other concept such as ecology microbiology, evaluation, genetics and many others. Biology serve as a pre-requisite or a core subject to many science discipline notably human medicine, food technology, Agriculture, Pharmacy, veterinary based courses and universities,

colleges of education, Polytechnics and other tertiary institutions.

In spite of this important position of Biology among other science and science related discipline student performance has consistently been below expectation for the low performance in genetics Oloyode (2008) observed other student's low performance in genetic aspect. Contributes to the failure rate in O'level Biology examination. Several researchers indicated that (Lawal, 2009, Abuze, 2009)

students have differently in the learning genetic due to it obstruct which lead to their poor performance in Biology. Biology is one of the physical science that affect by level of order performance by learner. The performances of students in science reflect how well they understand science concept and a reflection of how good is the strategies used Sabir (2001). The performance of Biology students in SSCE examination in Kaduna state have been declining over years as presented in Table I.

Table 1: Students' Performance in Biology in Kaduna State WAEC May/June, 2012-2015

Years	Total Sat for Exam	% Per	% Failure
2012	26,821	47.04	52.96
2013	34,852	41.95	58.05
2014	30,653	42.98	57.02
2015	50,896	47.83	52.17

Source: West African Examination Council Chief Examiners Report 2012-2015

The need to find solution to students with low performance is therefore an obvious factor as Damide (2000), Oloyede (2008) and Zayum (2008) Opined that several factors have been advanced for the low performance of students in Biology. This include, insufficient teaching and learning materials, abstract nature of genetics concepts, poor language skills. These seems to note about that Biology students encounter difficulties in Biology at senior secondary school level due to lack of enough time to teach genetic concepts evolution and ecology effectively as they formed in the aspect of curriculum at secondary schools as no specific time is allocated to them, Oke and Orimogunle (2010) state that lack of appropriate teaching strategy usually affects students' academic performance adversely in science subject due to the facts that most of science subjects are all abstract or difficult to learn. How these problems of poor performance can be alleviated so as to enable students perform better in biology. This study is aimed at providing strategies and techniques of imparting knowledge which may probably reduce the poor performance of students in genetics

such as problem solving and discovery teaching strategies.

Genetics is a branch of Biology that deals with the study of heredity and variations, the principle that account for the diversity of organism (Kala, 2012). According to Kala (2012) the understanding of genetics at colleges of educations and universities very much depend on the pre-requisite of understanding of genetic concepts like the cell it structures and function among others. A good knowledge of genetics is very important to students of Biology and related courses most especially in their later years of study (Okebukola, 2002) however, many students avoid genetics related questions in Biology at early secondary.

Previous studies such as Lawal (2005), Umah (2006), Araz (2007) and Lawal (2010) showed that, students have difficulties, and confusion in genetic and also this makes students have hate the topics and the situation lead to poor performance of students in Biology especially at SSS level (WAEC 2015). Moreover, genetics is becoming more and more important in the societies (Banet & Ayuso, 2003). For example, the rapid advancement of genetics science, field by the human

project and other related initiatives, promises a new kind of public health practice based on the pre-dictation of disease in relation to calculations of genetics risk or curing virulent disease by gene therapy (Bunton, 2001). Attitude is the most important and frequently research variable in science teaching Ibraheem (2008) defined attitude as a learner disposition to respond in a consistently or unfavorable manner with respect to a given objects, attitude of students towards science forms an aspect of this study is establish the differences if (any).

Retention ability is also a very important factor in learning science in general and Biology in particular. Hornby (2010) defined retention as the ability to remember things. Lakpini (2006) defined retention as the ability of the memory to store information which can be recalled after interval of weeks when exposed to a series of instructions and trainings. Bichi, (2002) viewed problem-solving as the process of moving towards a goal when the path to that goal uncertain. They added to solve a problem is to find a way around an obstacle and attain a desired end that is not attainable by appropriate mean. Adamu, (2014) problem-solving being an activity based where students learn by themselves through in which students acquire meaningful learning.

Bruner, (1968) and Mahmud (2009) viewed discovery strategy as the process of science teaching was postulated by using mental processes and manipulating scientific equipment and material and also allows students to carry activities by themselves to observed. (2000) viewed discovery strategy is the activity-based method among other which allows students to actively participate in learning activities and this make students to gain meaningful learning through discovery of certain concept on their own. Attitude is one of the most important and frequent researched variable in science teaching Ibraheem (2008) defined attitude as a learner disposition to respond on a consistently favourable manner with respect to a given object. Attitude of students towards science form an aspect of this study so as to establish

the difference (if any) in the attitude of students before and after exposure to constructivist instructional strategies.

Another variable of this study is the issue of retention ability a learner to recall remember and recollect a body knowledge through instruction at given time duration.

Objective of the Study

The objective of the study is to:

- ✓ Determine if problem-solving and discovery strategies will enhance SS II student's attitudes towards Genetics concepts.

Research Question

- ✓ What is the different in the attitudinal change of senior secondary school SS II students towards Genetic concepts when exposed to problem-solving and discovery strategies and those taught with lecture method?

Null Hypothesis

H₀: There is no significant difference in attitudinal change between students taught genetics concept using problem solving, and discovery strategies and those taught Genetic concept using lecture method.

METHODOLOGY

The research design for this study is pretest, posttest and post posttest, quasi-experimental and control group, design using intact classes which does not allow for randomization of the subject (Kerlinger, 1975 & Sambo, 2008). The experimental group was given treatment that is be taught the genetic concept using model of Bruner (1961) and Jensen (1996). The control group taught the same genetic concepts using the lecture method at the end of the treatment period, a post-test (O₂) was be administered to both the group of students in order to evaluate the effectiveness or otherwise of the treatment for enhancing the learning of genetics of concepts among SS II students. The research design illustration is presented in Fig 1

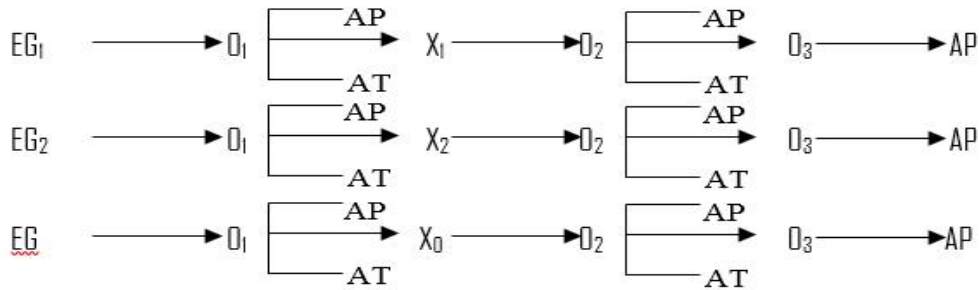


Figure 1 research design

Adopted from (Kerlinger, 1975 and Sambo 2008)

- EG₁ = Experimental group 1
- EG₂ = Experimental group 2
- CG = Control group
- X₁ = Pretest
- AP = Academic performance
- AT = Attitude
- O₂ = Posttest
- O₃ = Postposttest
- X₁ Problem-solving
- X₂ Discovery-strategy
- X₀ Control group

The population of the study comprised of all SSII students in five co-educational public secondary schools; G.S.S Aminu, G.S.S Magajiya, G.S.S Kofan Kuyanbana, G.S.S Dakace, G.S.S Tudun Jukun, in Zaria metropolis. The reason for using co-educational school is because gender is involved in this study. The co-educational schools are located in two local government areas; Sabon Gari and Zaria, Sabon Gari has one school G.S.S Aminu, while Zaria has four schools G.S.S Kofan Kuyanbana, G.G.S.S Dakace, G.S.S Tudun Jukun, making a total of five co-educational schools. The no of students is 264 males and 263 females making a total of 527 students procedure.

The sample for the study was selected from the population of the study in the following ways: the 5 co-educational schools were given pretest and analysis of variance (ANOVA) was used to determine the schools that do not differ significantly in their performance before the treatment. The results show that there is significant difference scheffe’s test was carried out. Three schools were used, two experimental and one control consists of 163 male students 182 female students making a total number of 345. The detail of the same size is presented in Table 2.

Table 2: Sample for the Study

School	Group	M	F	Total
G.S.S. Dakace	Experimental I	47	61	108
G.S.S Magajiya	Experimental II	53	69	122
G.S.S T/Jukun	Control	63	52	115
Total		163	182	345

The treatment of the study involves exposing SS II students to genetic concepts using problem-

solving strategy and discovery strategy as well two experimental groups. The experimental group was

taught for six weeks with 80 minutes per period by the researcher. The concepts taught were cell structure, function of cell, cell division and difference between mitosis and meiosis. The control group was then taught the same concepts using lecture method for the same period of time. Treatment administration was carried out using the selected genetic concepts.

RESULTS

Table 3: Mean Rank Scores of attitudinal of students exposed to problem-solving and discovery strategies and lecture method in Genetics.

Group	Attitude	N	Mean Rank	Mean Rank gain
EG1	Pretest	108	359.93	
EG1	Pretest	108	404.91	44.98
EG2	Pretest	122	436.15	
EG2	Pretest	122	449.94	13.79
CG	Pretest	115	165.51	
CG	Pretest	115	169.58	4.07

Significant at P< 0.05

In Table 3 the result revealed that the mean rank of students' attitude before exposed to problem was 359.93 while after exposure to problem-solving it was 404.91 with mean rank gain of 44.98 for those exposed to discovery strategy the mean rank before exposure was 346.15 after exposure it was 449.94 with the mean rank gain of 13.75 while those in the Control group recorded the mean rank of 165.57 before and after was 169.58 with mean rank gain of 4.07. This shows that the students exposed to problem-solving retain more than those exposed to discovery strategy

Research Question: what is the difference in the attitudinal change of senior secondary school SSII students towards Genetics concept when exposed to problem-solving and discovery strategies and those taught with lecture method.

To answer research question 3, the mean rank of EG1, EG2 and CG were computed using kruskal-wallis statistics and result is presented in Table 3

while those in the control group retain very little. To test for significant for different null hypotheses was tested.

Null hypothesis 1: There is no significant difference in attitudinal change between strategies and those taught genetics with lecture method.

To test the hypothesis, at P< 0.05 post test data EG1, EG2, and CG were subjected to kruskal-wallis summary of analysis and the results is shown in Table 3

Table 4a: of Kruskal-Wallis Analysis Problem-Solving and Discovery Strategies and Lecture Method.

Variable	Attitude	N	Mean Rank	Df	Chi-square	P	R
Expt I	Pretest	108	359.93				
Expt I	Pretest	108	404.91				
Expt II	Pretest	122	436.15	5	101.085	0.001	S
Expt II	Pretest	122	449.94				
CG	Pretest	115	165.51				
CG	Pretest	115	169.58				

The result from Table 4a show chi square value $p=0.001$ at Df 5 and Hoc test 101.085. the obtain $p= 0.001$ which is less than $P<0.05$ in favour of

experimental group. This implies that the difference was significant. the null hypothesis which stated that there is no significant difference is therefore rejected.

Table 4b: Dunn Bonferari Post hoc Test of Attitude of genetics students exposed to Problem-Solving and Discovery Strategies and Lecture Method.

Variable	Attitude	N	Mean Rank	Sig	R
Expt I	Pretest	108	359.93	0.001	S
Expt I	Pretest	108	404.91		
Expt II	Pretest	122	436.15	0.032	S
Expt II	Pretest	122	499.94		
CG	Pretest	115	165.51	0.065	S
CG	Pretest	115	169.58		

Significant at $P<0.05$

Table 4b the result revealed that for experimental group I problem-solving the P value recorded is 0.001 which is less than $P<0.05$ meaning that there is significance difference between attitudes of genetic students before exposure to problem-solving. Also, those exposed to discovery strategy, the P value recorded is 0.032 which is less than $P<0.05$ showing that there is significant difference in the attitude after exposure to treatment. This shows that both problem-solving and discovery strategies enhance genetics students attitude in their learning of genetics as observed from their mean scores. The p value recorded was $p<0.05$ meaning that there is no significant difference with attitude of genetics students before and after exposure to lecture method. This implies that problem-solving and discovery strategy equally enhance attitude of students towards learning of genetics at the senior secondary school.

DISCUSSION OF THE RESULT

This study investigating the impact problem-solving, discovery strategies on attitude, retention and academic performance in genetic concepts among secondary school students in Zaria. From the Table 3 the results show that students taught genetics concept using problem-solving has the means score of 25.86 & Standard deviation 30.11 while discovery strategy has

26.08 mean score and standard deviation 26.31 which discovery strategy has more impact on students than others strategy. The result from Table 4 the results shows that P value is 0.001 which is less than 0.05 at df 2, since the P value observed 0.001 which is less than $P<0.05$. Therefore, the bull hypothesis is rejected at $P<0.05$ level of significant. There is significant difference in academic performance in the mean score between students taught genetic concepts using problem-solving and discovery strategies and those exposed to lecture method in Senior Secondary School.

Result from Table 4b shows that there is no significant difference in the academic performance mean scores between students in the experimental groups. 1 & 2 with $P=0.92$ which is greater than 0.05, however, significant difference was found between the control & EG₁ with P value of 0.04 which is less than 0.05 similarly no significant difference was found between the control group & EG₂ with P value 0.09 which is greater than the statistically P value of 0.05 while experimental group 2 and shows P value of 0.09 which indicate no significant difference because of the P value observed is higher than the $P<0.05$. It can be concluded that both discovery and problem-solving strategies are effective in improving the performance of students in genetic concepts compared to control group and

discovery strategy has more significant impact than the problem-solving strategy.

There is significant difference found between the three groups is likely to be due to use of problem-solving and discovery strategies (activity oriented method) on the experimental groups since two experimental groups performed significantly better than the control group. Problem-solving and discovery strategies have significant impact on academic performance in genetic concept among secondary school students improved their performance.

The result agrees with the earlier findings of Bichi (2002) reported the effectiveness of problem-solving investigated instructional strategy on academic achievement and retention of Biology concept taught at Senior Secondary School Students. The findings further suggest that the impact of problem solving strategy on attitude, retention on academic performance led to better performance by students in genetic concepts. Nwafor, (2007) used problem-solving and inquiry strategies on attitude, retention in genetic concepts among Secondary School Students which enhance the teaching and learning genetic concepts and thus better in academic performance by the students.

Galadima, (2001) conducted his study using problem-solving and lecture method in Mathematics and the study revealed that those taught with problem solving strategy performed better than those taught using the lecture method.

Bunkure, (2012) investigated the constructivist instructional strategy on academic performance retention, attitude in Physics among Secondary School Students. The findings suggested that constructivist instructional strategy led to more effective learning and higher retention than the traditional method. The two strategies i.e Problem-Solving and Discovery Strategies are performed better than the lecture (i.e control group).

CONCLUSION

From the findings of the study, the following conclusion are drawn. Student taught using problem solving and

discovery strategies performed better in attitude, retention and academic performance in genetics concept among secondary school and also use of problem solving and discovery strategies potentially of enhancing academic performance in genetics concept as well as improving attitude and retention ability of the students.

RECOMMENDATIONS

The following recommendations are made:

1. The teaching of biology especially genetic should be conducted in such a way that students learn meaningful and develop positive attitude, retention towards the subject. The use impacts problem-solving and discovery strategies seem to appropriate in that respect, it should therefore be incorporated into the main strategies of teaching and learning genetics
2. The use of Problem-solving and discovery strategies in teaching has been found to be more effective than the lecture method in order to enhance teaching and learning genetic concept.
3. In service training for science teachers in form of seminar/workshop, conference should focus more on how to use impact of problem-solving and discovery strategies on attitude, relation and performance in genetic concept. The government or relevant professional bodies like science teachers, association of Nigeria (STAN) could do this.
4. Professional association such as Science Teachers Association (STAN), Mathematics Association of Nigeria (MAN) and Nigerian Educational Research Development Council (NERDC) should organize workshops on training and retraining of teachers on the use of problem solving and discovery strategies.

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