



## Effects of Problem-Solving Strategy on Academic Performance of Senior Secondary Students in Biology in Kaduna State Nigeria

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### ABSTRACT

*This study investigated the Effects of Problem-solving strategy on attitude and academic performance in biology among Senior Secondary Students of varied ability in Zaria Educational Zone, Kaduna State Nigeria. All the six co-educational senior secondary schools in Zaria Educational Zone understudy with a total number of one thousand six hundred (1600) students formed the population for the study. Two out of the six co-educational SSII in the area with a total number of one hundred and eighty-five (185) i.e. (113male and 72 female) students were selected as the sample of the study using simple random sampling technique involving balloting method. One school formed the experimental group that received treatment via problem-solving strategy while the second school was used as the control group. High, average and low ability levels were determined using their classwork, continuous assessment result and pre-test scores. The top 25% were ranked as high, middle 50% were the average while the bottom 25% were low ability group. The intact classes of the two schools were used to take care of the issue of gender. The experimental group was taught using a problem-solving strategy while the control group was taught using the lecture method. Two instruments were developed and used for this study i.e. Biology Performance Test (BPT) and Student Attitude Questionnaire, (SAQ). These instruments were used for data collection. Three research questions and three null hypotheses were formulated and tested at 0.05 level of significance. The data collected were analyzed using t-test and ANOVA statistics to determine the significant difference between the two groups, at P 0.05. The findings of the study showed that problem-solving had significant effects on the academic performance of the students of low ability. Low ability students that were taught biology using problem-solving strategy improved in academic performance and retained the learnt concepts better than those taught using the lecture method. Neither male nor female in the two groups performed significantly better than the other in biology after treatment thus, the strategy is gender-friendly. Based on the findings of the study, appropriate recommendations were advanced.*

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### INTRODUCTION

Science is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and

knowledge that can be rationally explained and reliably applied to everyday life. The field of science education includes work in science content, science process (scientific



Skill) some social science and some teaching pedagogy (Yeung, 2006). Bichi, (2008) stated that the purpose of education is not just making a learner literate, but adds rationale thinking, knowledge, skills, self-efficiency and self-independent. Thus, in every human society, education is meant to pass onto new generations the existing knowledge of their physical environment, to introduce them to the organization of the society and teach them skills for performing their daily jobs with ease and as such boost the manpower development and economic growth of the country.

Egbunonu and Ugbaja (2011), observed that the education standards call for more than science as a process in which students learn such skills as observing, inferring, experimenting, etc. In this way students actively develop their understanding of science, combining scientific knowledge with reasoning and thinking skills. To achieve these goals as desired, it is highly required of teachers at all levels to have a high sense of self-confidence for the enhancement of teaching and learning of scientific concepts and principles that can lead to positive scientific and technological development.

Biology is one of the core science subjects taught in Nigerian secondary schools. It is the backbone of science as it is the study of life and therefore plays an essential role in harnessing interaction between living things and its environment. Thompson (2006) observed that no science subject forms a binding force among various science courses like biochemistry, pharmacy, veterinary medicine etc. as biology. Biology allows students to relate to some of the most important environmental issues affecting the environment. (Nwagbo and Chukelu, 2011; Anyanwu, Obochi and Isa 2015).

The senior secondary school biology curriculum is designed to serve the needs and interest of the students of different abilities. Consequently, upon the introduction of the 6-3-3-4 and Basic

science system of education, the curriculum recommended among others that experimentation, demonstration, problem-solving and even field trip resting on practical activities of the students should be used in the teaching of science subjects (FME, 2005 in NPE, 2013). The expectation could be that a successful implementation of the curriculum objectives can be based on the recommended teaching techniques. The learner would be equipped with adequate knowledge, positive attitude and science process skills that would enhance his performance, sustain his interest and also serve as a springboard for the nation's scientific, economic growth, and technological breakthrough. Contrary to these expectations, the level of performance among secondary school biology students has not been encouraging. The objectives of biology education curriculum as provided in the National Policy of Education (NPE, 2013) include the following among others.

Adequate laboratory and field skills in biology; inculcate in the learners' meaningful and relevant knowledge in biology and functional scientific attitudes. However, despite these objectives and numerous efforts aimed at improving students' performance in biology, the subject has continued to witness low rate of academic performance. The poor performance has been attributed to the methods the teachers use in teaching the subject. Researchers like Moore, (2006), Uza, (2014) stated that the lecture method is the most commonly used method by science teachers. If the Nigerian child is to be of any use to their society they must be taught using methods that would encourage the acquisition of attitude that would encourage the economic growth of the nation.

The economic growth of any nation depends largely on the success of education and development of manpower of such nation. Education is a backbone for economic growth and technological advancement of any nation. As one of the



oldest industry, education is the main instrument used by the society to preserve, update, upgrade and maintain the social heritage to an equilibrium. According to the Federal Ministry of Education, (2013), the purpose of education is not just making a learner literate but adds rationale thinking, knowledge, skill, self-efficiency and self-independent. Uza (2014) stated that one of the major goals of education in Nigeria is the acquisition of appropriate skills, development of mental, physical and social ability that houses human and individual endeavour to live and contributes to the development of the society. By and large, knowledge creation via science education and its application for development in Nigeria, in particular, is the key to the nation's economic growth, global competitiveness and meaningful job creation in a global context where there are significant shifts in knowledge production accompanied by shifts in global wealth economy.

Lecture method is a method of teaching which involves verbal presentation where the teacher delivers the lesson to the students with little or no active participation by the students. It is a teacher-centred approach involving largely a one-way form of communication from the teacher to the students. Lawal, (2009) maintained that when learning is augmented by a method such as a laboratory via practical experience, demonstrations and visual presentation, teaching becomes more appropriate and meaningful learning and positive attitude takes place.

Attitude is one of the major factors that interfere with the academic performance of students. Attitude, however, is defined by Lawal, (2009) as the predisposition to react positively or negatively towards object, ideas, institution or people. Thus, if students hold a positive attitude towards a particular course or subject, it is relatively easy to lead them towards desirable objectives which will, in turn, enhance their

performance and also improve the national economic growth.

In a normal class, students are found to have different levels of learning abilities. This applies to any science class for the entire population of the students have varieties of learning abilities. Their abilities are referred to as varied abilities, thus, while some students may find a learning task easy to complete, others may find it difficult to understand. The weakness of candidates in biology generally was linked to the fact that candidates lack basic concepts and not able to link biological concepts to the real-life situation (Lakpini, 2006, Lakpini and Atadoga 2012). According to Lakpini, (2006) varied ability can be determined in three levels (i) High achievers, (ii) middle/average achievers and (iii) low achievers. The low achievers who usually perform poorly are the focus of this paper. These group of learners are usually found in Nigerian science classes. Getting away to improve their attitude and performance will go a long way to also improve the economy of the country.

Gender is also another factor interacting with performance, Erinosh, (2005) and Obochi, (2016) in their studies has observed that gender issues both on the part of the teacher and the students have been documented to affect academic performance and some other learning outcomes. Abdulrahman (2012) observed that gender inequalities are interwoven with social class, ethnicity, sexuality, disability and other factors identified as influencing attainment. Also, Adebajo (2014), also linked gender and academic achievement with patterns of behaviour. He noted that there are signs of boys being vulnerable to becoming disaffected. He stated further that boys tend to be less careful about rules and more indifferent to being reprimanded. This study is concerned with the alarming crisis about students' attitude and academic performance in science subjects and especially biology. The poor performance of students in the subject has been a major

concern to many stakeholders in the subject. Like any other science subject, the syllabus of this activity-based subject emphasizes the use of the activity-based method of instruction. Unfortunately, as reported by researchers such as Lakpini (2006) and Lawal, (2009) teachers shy away from activity-based teaching method and rely mostly on easy go lecture method which in most cases are often inadequate and inappropriate for meaningful learning to take place. It is on this note that the study investigated the effects of problem-solving teaching strategy on the attitude and academic performance in biology among senior secondary school students of low ability level.

#### **The Objectives of the Study**

The objectives of this study are as follows:

1. Examine the effects of problem-solving teaching strategy on academic performance in biology among students of varied ability.
2. Determine the effects of problem-solving teaching strategy on the performance of varied ability students in biology.
3. Examine the effects of problem-solving teaching strategy on the academic performance of male and female students of varied ability in biology.

#### **Research Questions**

The study investigated the following research questions:

1. Are there differences in the mean performance scores of students of varied ability level taught biology using problem-solving teaching strategies and their counterparts taught using lecture method?
2. What are the differences in the mean academic performance scores of male and female students taught biology using problem-solving teaching strategy?

#### **Null Hypotheses**

HO<sub>1</sub>: There is no significant difference in the mean academic performance scores of varied ability students taught biology using problem-solving strategies and those taught using lecture methods.

HO<sub>2</sub>: There is no significant difference in the mean academic performance scores of male and female students taught biology using problem-solving teaching strategy.

#### **METHODOLOGY**

The research design was quasi-experimental design using pre-test and post-test control group design in which two intact classes were involved and assigned to two different treatments. The experimental group (EG) received six weeks' biology lessons using Problem-solving teaching strategy while the control group was taught the same topics using traditional lecture method. Pre-test O<sub>1</sub> was used to determine the equivalence of the two groups before the experiment, while the post-test O<sub>2</sub> was used to find out whether or not the problem-solving teaching strategy had any impact on academic performance of the students of varied ability.

The population for the study comprised all the SS2 Biology students in Public Secondary Schools in Zaria Educational Zone. The total number of students in the population is 1600 made up of 791 males and 809 female students. Simple randomize technique in balloting method was employed to select the two (2) co-education schools used for the study. Two out of the six co-educational schools in the population were selected by using simple random techniques by balloting system. The two co-educational schools used in the study consists of 113 males and 72 female given a total number of 185 students. The sample size of 185 is in line with the Central Limit Theory of Tuckman (1975). The instrument for the study was validated by three senior lecturers from Ahmadu Bello University Zaria. The test scores for CA were used to

classify the subjects into the various levels of abilities, the two groups were then taught for six weeks. They were each post-tested, the scripts were marked and the scores subjected to analysis to answer the research questions and test the null hypothesis stated.

## RESULTS

**Research Question 1:** Are there differences in the mean academic

performance scores of students of varied ability level taught biology using problem-solving teaching strategies and their counterparts taught using lecture method?

To answer research question one, Post-test data generated through BPT were subjected to descriptive statistics to calculate the mean and standard deviation.

**Table 1:** Means and Standard Deviation of Post-test Scores of Varied Ability Students for EG and Control Groups

Variability Level	Treatment	Mean	Std. Error	Mean diff.
Low	Laboratory	77.87	0.37	0.40
	Problem-solving	77.47	0.38	
Middle	Laboratory	78.14	0.30	1.23
	Problem-solving	76.90	0.28	
High	Laboratory	78.39	0.54	0.50
	Problem-solving	77.89	0.49	

Table 1 revealed that among the low ability levels the mean difference between problem-solving and lecture is (= 1.99) in favour of problem-solving strategy which shows that students of low ability performed better when taught using a problem-solving approach.

To test the Post-test scores of the Experimental Group and Control Groups were subjected to Analysis of Covariance (ANCOVA).

The Table also, revealed that the mean difference between problem-solving strategy and control group is (= 1.09) in favour of problem-solving.

To find out whether there is a significant difference in the groups, the data were subjected to a 2-Way Analysis of Covariate (ANCOVA).

**Research Question 2:** What are the differences in the mean academic performance scores of male and female students taught biology using problem-solving teaching strategy?

To answer this research question, the Post-test scores of Experimental Group was used and subjected to descriptive statistics. Means and Standard Deviation (SD) were computed/calculated. Summary of the analyses is presented in Table 3.

**Table2:** Mean and Standard Deviation of Post-Test Scores of Male and Female Students Taught biology using Problem-Solving Strategy.

Treatment	Gender	Mean	Std. Error	Mean difference
Problem-solving	Male	14.81 <sup>a</sup>	.31	.89
	Female	15.50 <sup>a</sup>	.32	



To determine whether gender is statistically significant, a 2-Way Analysis of Covariance (ANCOVA) was conducted as shown in Table above. Result from Table 2: shows the summary of Analysis of Covariance (ANCOVA) of male and female students' Performance in biology after Treatment in experimental group (problem-solving) and (Control group). The Table revealed that gender is not

statistically significant,  $F_{(1,120)} = 1.81, p > 0.05$ . Also, a 2-Way ANCOVA showed that gender and treatments are not statistically significant,  $F_{(1,120)} = 1.39, p > 0.05$ . Therefore, the null hypothesis is retained, neither the males nor the females performed significantly better than the other in the two groups. This implies that sex does not determine the academic performance of students.

**Table 3:** Means and Standard Deviation of Post-Test Scores of Male and Female Students of Varied Ability Levels Taught Biology Using Problem-Solving.

Gender	Mean	Std. Error	Mean diff	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	12.363 <sup>a</sup>	.296	.453	11.777	12.949
Female	12.816 <sup>a</sup>	.264		12.293	13.339
Male	15.166 <sup>a</sup>	.342	.112	14.489	15.842
Female	15.054 <sup>a</sup>	.358		14.345	15.763
Male	17.919 <sup>a</sup>	.666	2.358	16.599	19.238
Female	20.277 <sup>a</sup>	.719		18.854	21.701

Result in Table 3: shows that differences exist in the mean scores of male and female students taught biology using problem-solving teaching strategy and those taught using lecture methods. The difference between male and female in the problem-solving group is .89 in favour of female students. The table also revealed that female students performed better than male in the control group with a mean difference of .07. The Table also indicated that female students with low ability level had a higher mean score than the male with the mean differences of 2.36.

**Discussion of the Findings**

This study investigated the effect of problem-solving teaching strategy on academic performance among SSS II biology Students of varied ability in Zaria Educational Zone Kaduna State, Nigeria. The result of testing hypothesis one shows that there is a significant difference in the mean scores performances of students of different abilities taught biology using problem-solving teaching strategy compared with their counterparts taught

with lecture method. Thus, the finding is in agreement with the study conducted by Afolabi and Akinbobola (2009) who recorded a significant difference among SSII physics students with low ability level taught using problem-based learning technique when compared with those taught with conventional lecture method. The finding is also in line with the work of Osafor and Okigbo (2013) who reported a significant difference in the achievement of SSI students taught biology with different instructional strategies and also that of Ojediran, Oludipe and Ehindero (2014) who also reported that there was a significant difference in the achievement in physics of low performing students exposed to the laboratory-based instructional intervention (LBII) when compared with those exposed to conventional teaching method (CTM).

The ANCOVA of students' performance in biology by treatments and low ability level was calculated. The result of the analysis indicates that the effect of treatments on students' performance in biology is statistically significant,  $F_{2, 18} = 27.75$ , where  $p < 0.05$ . Consequently, the

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null hypothesis which states that there is no significant difference in the mean scores of students of varied ability taught biology using problem-solving strategy and those taught using the lecture method is therefore rejected. The findings of this study are as per that of Bichi, (2002 and 2008) who investigated the effects of problem-solving strategy and enriched biology curriculum on senior secondary school students in Zaria. His result revealed that there was a significant difference in the mean scores of students exposed to problem-solving when compared with those taught with the conventional method. The present study is also in agreement with the findings of Obeka, (2010), Ajaja, (2013); Ibe, (2013) and Seyhan, (2015) who worked with different instructional strategies (i.e. laboratory, problem-solving, inquiry, demonstration and discovery) in their studies and reported that problem-solving and laboratory strategies have a positive effect on academic performance of students when compared with lecture method.

The finding is also in agreement with the study conducted by Afolabi and Akinbobola (2009) who recorded a significant difference among SSII physics students with low ability level taught using problem-based learning technique when compared with those taught with conventional lecture method. The finding is also in line with the work of Osuafor and Okigbo (2013) who reported a significant difference in the achievement of SSI students taught biology with different instructional strategy.

The results of the study indicated that there was a significant difference in the performance of students taught using problem-solving strategies and lecture method with a problem-solving strategy having the highest scores 83.45, while the control group had the lowest scores 80.24. The finding also confirms the work of Osuafor and Okigbo (2013) who conducted a similar study in Akwa Anambra State and observed that problem-solving strategy

improved the performance of SSII biology students. The result is in agreement with that of Ojediran, Oludipe and Ehindero (2014), who also conducted a similar study in physics in Oshun State and reported that laboratory strategy improved the academic performance and attitude of students in physics.

The finding of this study confirms that of Lakpini (2006) which reported that using PIPS and CCIS Model to teach genetics concepts improved the academic performance and attitude of low ability SSII students in Zaria. Results from the study also indicate that gender and treatments are not statistically significant, thus the treatment is gender-friendly hence gender does not influence the understanding of students in the experimental and control groups. Therefore, the null hypothesis is retained. The finding of this study is in agreement with those of Mari, (2002), Njoku, (2012) Adu and Sheyin (2013) and Amedu, (2015) which in their studies reported no significant difference in the mean scores of male and female students taught with different instructional methods. The finding of this study is not in line with that of Abduraheem, (2012) who worked on gender differences and academic achievement in integrated science in Junior Secondary Schools. He confirmed that males performed better than females and affirmed that males demonstrated significantly more positive attitudes towards science than females. Owuamanam and Babatunde (2007) also noted that females exhibit more positive attitudes towards Biology and males towards Physics. The result of this study is however different from that of Ibe, (2013) who reported that female students outperformed the males in RMBT when taught biology using the guided-inquiry method.

## CONCLUSION

Based on the findings of the study, the following conclusions were made



1. Problem-solving teaching strategy has the potentials of enhancing and improving the academic performance of students in the biology subject of SSII level. This could be because students were involved and exposed more to realities by hand-on minds-on, hence they participated fully in the class unlike in the lecture method of teaching, where the students remained passive.
2. Since neither the male nor the female in the experimental group performed significantly better than the other in the test, it means that gender does not influence the students' academic performance thus, the instructional strategy is gender-friendly.
3. In a nutshell, the findings of this study indicate that if students are well taught with problem-solving teaching strategy, is better than teacher-centred learning in promoting the academic performance of learned concept in biology subject among SSII students of low ability.

#### RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. The use of problem-solving teaching strategy should be encouraged among secondary school biology teachers by school administrators and education agencies. This will enhance their performance and help them develop a positive attitude to biology
2. Government agencies such as Federal and State Ministry of Education and other stakeholders in the educational sector should provide adequate and relevant instructional materials for effective utilization of problem-solving strategy to enhance meaningful learning.
3. Biology students at SS level should be given the opportunity

and guided on how to handle and manipulate some materials and equipment in biology laboratory to improve their psychomotor skills.

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