

# Effect of Problem Based-Solving Technique on Secondary School Students Achievement in Biology

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**Abstract** - The study investigated the effect of problem based-solving technique on secondary school students achievement in biology in Onitsha North Local Government Area of Anambra State, Nigeria. The design of the study was quasi-experimental, specifically, pre-test, post-test non randomized equivalent control group design. The sample consist of 150 SSI students drawn from two co-educational Government owned secondary schools out of 16 public secondary schools in Onitsha North L.G. A. of Anambra State. Intact classes were randomly assigned to one experimental group and one control group. The experimental groups were taught biology using problem based-solving technique, the control group were taught using the conventional method. Two research questions and two hypotheses were formulated to guide the study. Biology Achievement Test (BAT) of 20 items was developed and used to collect data. The instrument was validated and the reliability coefficient was 0.79. The data were analyzed using mean and standard deviation to answer the research questions while Analysis of Covariance ANCOVA was used to test the hypotheses of 0.05 level of significance. The results revealed that students taught using problem-based solving technique performed significantly better than those taught using conventional method. Also, there was a significant effect of method and gender on students' achievement in biology. Male students performed better than the female students in biology achievement test. Based on the findings, recommendations were proffered.

**Keywords:** Achievement, Biology, Effect, Problem based, School, Solving technique, Student

## INTRODUCTION

Science is the hall mark of technological advancement. Knowledge of science helps man to understand the working of the planets of the universe. Learning science in the 21<sup>st</sup> century is aim at training students to be able to understand concepts, develop process skills and also develop thinking abilities to be able to transfer knowledge (Aidoo, Boateng, Kissi & Ofori, 2016). Science comprises of basic discipline such as physics, chemistry and biology.

Biology is one of the core science subjects offered in senior secondary school in Nigeria. Biology gives students a glimpse of scientific exploration and opportunity that are needed for discovering. Biology have contributed immensely towards improved quality of human life by providing information on drug abuse, biotechnology, genetic engineering and molecular biology. Various researchers have observed that there is an increasing yearly enrolment in senior secondary school examination in biology, but each year candidate achieve poorly in the examination (Nnorom, 2015; Okoye, 2010). Also, West Africa Examination Council annual report 2015 - 2017 shows that only 26 percent of the candidates who

wrote the 2017 senior secondary certificate examination SSCE had five credits including biology, Maths and English representing a sharp drop in the results recorded in 2016. The percentage of candidate in this category in 2015 and 2016 examination were 28.59 percent and 38.50 percent respectively. This has become a worry to school principals, teachers, stakeholders as to the real cause of the problem and strategies of advisory them.

The West Africa Examination Chief Examiner report 2015 – 2017 reported that the persistent decline in students performance in science was as a result of lack of resources such as teaching aids, lack of content knowledge by teachers. Other factors include large class size, materials for the practical lesson, and ineffective teaching method (Okeke, 2011).

Moreover, to improve the performance of students in science especially biology, a more engaging teaching method should be employed by teachers. Teaching methods refers to the general principle, pedagogy and management techniques used for classroom instruction (Kolawole, 2007). They include discussion method, collaborative, expository, project method, problem based solving technique among others.

Researchers have shown that most teachers continue to use ineffective and teacher centered method such as conventional method in teaching (Chukwuemeka, 2016; Ogbu, 2011). Conventional method of teaching refers to teaching using chalk and board for teachers, pen and paper for students (Nnorom, 2015). Teaching should be based on the student's previous knowledge and connection between the experience of student and biological concept (Chukwuemeka, 2016). Berkeley (2015) noted that the teacher centered method does not promote skill acquisition, objectivity and critical thinking ability among students. There is the need for more activity oriented, students centered and innovative method that can develop in the students science process skills, which include problem based solving method.

Problem based-solving technique is a student centered method where the teacher and students play equal active role in teaching and learning process. The teachers primary role is to coach and facilitates student learning and overall comprehension of material while the students construct new ideals and concept based on their past knowledge. Brooks and Brooks (2011) stressed that in problem based solving technique students are in charge of the learning process while the teacher provides student with suitable environment to construct knowledge. Problem based solving technique is a type of learning which involve problems that give students opportunity to design an investigative activity using problem-solving to arrive at conclusion (Thomas, 1999). It involves an experimental learning process that composed of data collection, experiment, observation, explanation and drawing conclusions (Bell, 2010). The use of problem based-solving technique in teaching helps to stimulate students' understanding on how to find information that are linked to problem, and this increase their thinking ability. Various researchers have reported successful implementation of problem based learning in the classroom, and students problem solving skills and thinking ability were improved (Aidoo, Boateng, Kissi and Ofori, 2016). Zhou, Huang and Tian (2013) also concluded that task based learning improved students analytic skills and ability to personalized learning. Also Akinolu & Fandogan (2012) exposed science students to problem based solving techniques and their findings improve academic achievement of student, but there were contradiction in their findings on the influence of gender.

Gender is a socially constructed definition of male and female. Gender related issues in science education has continued to receive serious attention. Okoye & Nnorom (2016) explained that many parents do not want to spend much on female

education as that of male children because of their social or cultural environment. However, Awoniyi (2011) found out that female students perform better than male counterpart in science. While Okeke (2011) noted that there is no significance difference in the achievement score of male and female students in both chemistry and biology examinations. This shows a contradiction in the findings of researchers on science achievement. Jegede & Fatoke (2014) pointed out that there is no gender difference in the achievement of male and female students in science subjects, however, a good teaching strategy may be gender friendly to ensure that both boys and girls benefit equally from the teaching strategy. Therefore there is need to determine the effect of problem based solving techniques on students achievement in biology.

### **Purpose of the Study**

The main purpose of this study is to find out the effect of problem based-solving technique (PBST) on secondary school students achievement in biology. Specifically, the study will determine:

- The mean achievement scores of students taught biology with problem based solving techniques and those taught with conventional method.
- The effect of gender on student achievement when taught biology with problem based solving technique.

### **Research question**

The following research questions guided the study:

- What are the mean achievement scores of student taught biology with PBST and those taught with conventional method.
- What is the mean achievement scores of male and female students taught biology using problem based solving technique.

### **Hypotheses**

The following null hypotheses were formulated at 0.05 level of significance.

There is no significant difference in the mean achievement scores of biology students taught with PBST and those taught with conventional method.

There is no significant difference between the achievement scores of male and female students when taught biology with PBST

### **Method**

The study was carried out in Onitsha North Local Government Area of Anambra State, Nigeria. The design of the study was quasi experimental using

pre-test – post test non-equivalent control group. The sample consist of 150 SSI students drawn from two co-educational Government owned secondary schools out of 16 public secondary schools in Onitsha North L.G. A. of Anambra State. The instrument for data collection was biology achievement test (BAT) which was made up of 20 items test. The items were generated from the topic excretion Selected from the SSI biology curriculum. The instrument was validated by two experts in science education and measurement and evaluation, from Chuwkuemeka Odumegwu Ojukwu University, Nigeria. The reliability of the BAT was determined using Kuder Richardson formular and the reliability coefficient was 0.79.

### Experimental Procedure

The regular biology teachers were used for the study in both experimental and control group. Before the treatment began orientation was given to the biology teachers of the experimental group on how to use the problem based-solving technique. The biology teacher of the control group uses the conventional method. Since intact stream was used, the experimental stream teacher was given lesson plan prepared by the researcher, while the researcher vetted the lesson plan prepared by the biology teacher in the control group. A pretest was given to the two groups before the actual treatment, to access their problem solving, critical thinking skills and also their prior knowledge on the concept. The scripts were marked and the scores obtained before the actual treatment.

The main treatment was teaching of excretion to experimental group using the lesson package PBST developed by the researcher. All the necessary information about the concept were given and explained to the students. The students in the experimental group were guided to construct new ideas and concept that is their own knowledge during and after the lesson with the teacher acting as a facilitator, by asking students probing questions that will enable them be on the track, monitoring the process, and making resources available.

The conventional methods was used to teach the control group. However, it involve the use of talk and chalk method on board style, in which the teacher dominate the teaching and learning encounter. The teaching of both experimental and control group was done during the normal school biology periods.

After the treatment the post BAT was administered after reshuffled to the students in experimental and control group. The samples were marked by the researcher and the students score were recorded. Mean and standard deviation was used to answer

the research questions while analysis of covariance (ANCOVA) was used to test the hypotheses.

**Table 1: Mean Achievement Scores of students taught biology with problem based-solving technique and those taught with conventional method**

Groups	N	Pretest Mean	SD	Posttest Mean	SD	Mean gain
<b>Experimental</b> (project base learning)	90	10.92	0.68	14.92	0.88	4.0
<b>Control</b> (lecture method)	60	9.55	0.58	10.60	0.67	1.02
<b>Differences</b>	150	0.63	0.10	4.32	0.21	2.98

From the table (1) above, the experimental group obtained higher mean achievement scores of 14.92 with a standard deviation of 0.88. The control group obtained a mean achievement score of 10.60 with a standard deviation of 0.67. This shows that the experimental group perform better than the control group in biology achievement test. Therefore problem based solving technique enhanced students performance in biology.

**Table 2: Mean achievement scores of male and female students taught biology with problem based solving technique (PBST).**

Gender	N	Pretest Mean	SD	Posttest Mean	SD	Mean gain
Female	80	10.02	0.61	13.70	0.66	3.68
Male	70	10.08	0.73	14.77	0.80	4.50

Table 2 result shows that the mean achievement scores of female students taught with PBST was 13.70 with standard deviation of 0.66 and that of male was 14.77 with standard deviation of 0.80. This shows that male students achieved more than female students in BAT when exposed to PBST.

**Table 3: Summary of ANCOVA Result**

Sources	Type III sum of squares	DF	Mean square	F	Significance
Corrected model	727.691	6	60.641	5.901	.000
Intercept	1143.130	1	114.130	111.245	.000
Pre-test	137.874	1	137.874	13.147	.000
Treatment	428.702	2	214.351	20.860	.000
Gender	.579	1	.579	0.56	.031
Treatment x gender	10.143	2	5.072	.494	.021
Error	1407.782	137	10.276		
Total	25623.000	150			
Corrected total	2135.473	149			

Significant (p<0.05)

Table 3 result shows that  $f_{cal}$  (20.860) has a probability value of 0.00, since this value is less than 0.05 level of significance, the null hypothesis was rejected. Hence, there is a significance

difference in the mean achievement scores of students taught biology with problem based solving technique and those taught with conventional method.

Also, from table 3 result  $F_{cal}$  (0.494) has a probability value of 0.012, since this value is less than 0.05 the null hypothesis is rejected. Therefore, there is a significance difference in the mean achievement scores of male and female students when taught with PBST.

### Discussion of Result

Result from research question one shows that students taught biology with PBST have higher achievement score than those taught with the conventional method. This shows that the students problem solving skills and thinking ability had improved when exposed to PBST in biology test. This result is in line with Aidoo, Boating, Kissi and Ofori (2015) who also found out that students taught chemistry with problem based learning perform better than those students taught with traditional instructional strategy.

On the other hand, the result also revealed that male students perform better than the female students when exposed to PBST. This result contradict the findings of Jegede & Fatoke (2014) who stressed that gender composition have no significant impact on group interaction and individual learning. Although Awoniyi (2011) assert that gender difference may exist but a good method should be capable of neutralizing the difference.

### Conclusion

The study has proved that the use of problem based solving technique has helped students to develop process skills thinking ability and a positive attitude towards science (biology). PBST is a students centered approach which help the students to relate scientific concepts to real life situation.

### Educational Implication

The findings of this study have implication for teachers, students, school teachers have to adopt the use of PBST to encourage students centered learning in science (biology) classroom. Also, students will learn better and achieve higher when PBST is used in teaching and learning.

### Recommendations

The following recommendations were made:

- Government should organize workshop and seminar for biology teachers on the

use of PBST in teaching and learning of science in schools.

- Science teachers should ensure that they employ this innovation method in teaching science.

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