

## **Effect of Senior Secondary School Students' Exposure to Formative Testing On Performance in Biology in Ekiti State, Nigeria**

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### **Abstract**

This is a pretest-posttest, quasi experimental study of the effects of formative testing procedures on Biology performance of senior secondary school students. Attempt was made to find out whether formative testing with remediation and without remediation across gender would affect the Biology performance of senior secondary school students. The  $3 \times 2$  factorial design was adopted and a sample of 90 senior secondary school two (SSS 2) students consisting of forty-nine males and forty-one females was drawn. The science class of SS2 in each of the selected schools was included in the study. Six tests were developed and used for data collection. Data collected for the study were analyzed with the analysis of covariance. Findings showed that the students in experimental group one (formative testing with remediation) performed better in Biology than students in experimental group two and control group (formative testing without remediation and no formative testing). It also revealed that gender has no significant effect on Biology performance of students but there was a significant interactive effect of gender and formative testing on their performance. Based on these findings, formative testing with remediation was recommended as an alternative assessment technique to enhance students' performance in Biology at secondary level.

**Keywords:** Formative Testing, Senior Secondary Students, Performance, Biology

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## **Introduction**

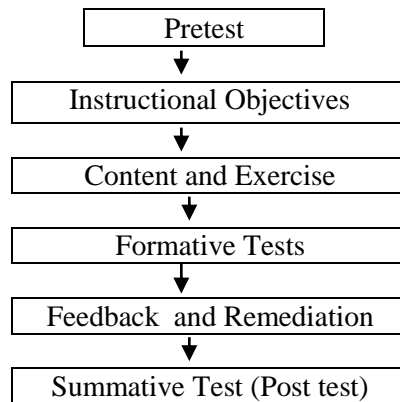
Assessment is part and parcel of the school system. It is an important aspect of teaching/learning processes that educationists could hardly achieve their objectives without engaging in it. Educational assessment is an indispensable element in educational planning, curriculum development, innovation and other routine activities in the school system (Nuhfer, 1996). Its outcomes could be a source of motivation for both teachers and learners and provides feedback data to both the teachers, learners as well as other stakeholders in education (Owolabi, 2004).

Assessments to a large extent determine what, when and how students study. Teachers use it to discover the extent to which students have actually acquired knowledge and skills they are expected and for diagnosing learners' problems. Through assessment, teachers ascertain whether their teaching objectives were achieved and also appraise the performance of their students for the purpose of certification. Assessment could either be formative or summative. Formative assessment is designed to monitor learning progress during the course of instruction. Due to the fact that formative assessment is conducted when the programme activities are ongoing, it deals with the process (Bhola, 1990). Its purpose is to provide continuous feedback to both the pupil and the teacher concerning successes and failures in such a way that the processes would lead to high quality product.

Formative assessment comprises mostly teacher made tests and other techniques that produce comprehensive results on the competence and skill acquired by the learner (Alonge, 2003). Teachers also use summative assessment at the end of each term or session for meeting their objectives. Though summative assessment has its own roles in education, formative assessment should be complementary to it in many ways. On the other hand, formative assessment is used to achieve the objectives of the mastery learning strategy

Mastery learning strategy, found to be a highly effective for imparting knowledge, involves the use of formative tests with corrective feedback and remediation (Bloom, Hastings & Madaus, 1971). Corrective feedback places a heavy demand on the time of the teacher who has to prepare, teach, diagnose and adopt appropriate corrective measures for re-teaching to bring the students to mastery (Owolabi, 2000). Block (1971) stated that remediation involves re-testing and re-teaching for bringing learners to mastery. Although, Bloom's format was modified to make remediation limited and prescriptive, time is still taken by the corrective feedback system affects progress and extent of syllabus

coverage in the regular school system. An alternative formative testing model proposed by Glasser and Nitko (1971) suggested a combination of formative with feedback, remediation and summative tests. The model is as presented below:



*Source: Glasser and Nitko's Model (1971)*

The model uses feedback and remedial instruction involving diagnosing learning difficulties and identifying strengths and weaknesses in group performances for the purposes of improving the students' academic performance and achieving instructional objectives. It could be inferred that problems of mass failure of students, especially at the senior secondary school level could be addressed with the use of formative assessment procedures with corrective feedback.

Biology is one of the science subjects offered by students at the Senior School Certificate Examination level by more than a yearly average of 80%. Despite the large number of candidates registering for this subject, the candidates' performances over years were neither encouraging nor stable as no particular trend was identified. The problems of student's low performance in biology have been observed by many researchers. Owino et al. (2014) noted that the problem with inadequate supply of teaching and learning resources such as chemicals, charts, apparatus, models, local specimens, laboratories, textbooks, and libraries led to poor performance in Biology. Also, the apparent failure of continuous assessment (C.A) for improving students' performance in our schools needs also to be addressed. Okwilagwe (2000) established that there were doubts as to the adequate implementation of the C.A. process in Nigerian schools.

Moreover, the students' poor performance has affected the popularity of Biology among students. This has given rise to the need to develop teaching and learning methods that could transform the performance of candidates enrolled for Biology in certificate examinations. In view of this, this study investigated effect of senior secondary school students' exposure to formative testing on performance in biology in Ekiti State, Nigeria

### **Statement of the Problem**

Evidence from Senior School Certificate Examination results indicate that a large proportion of Nigerian senior secondary school students have difficulty performing well Biology. Review of literature has shown that teaching methods could account for poor performance. Other key factors isolated by Kareem (2003) as causes of poor performance in SSCE Biology include ineffective teaching, failure to use continuous assessment to direct learning, lack of bio-statistical knowledge, inability to make good drawings and so on. It has been established that poor implementation of Continuous Assessment, which was designed to revolutionarily improve students' performance, may also account for the high failure rates observed. Educationists and Biologists have concerned themselves with the search for approaches capable of making teaching of Biology more meaningful to the learners and an intervention strategy that will turn students' performances round (Adepoju, 2003). It could be inferred however that formative assessment with corrective feedback may bring about an improvement in Biology performance of the students.

This study therefore investigated the effect of formative testing in achieving mastery among secondary school students. The study aimed at investigating the effect of senior secondary school students' exposure to formative testing on performance in biology in Ekiti State, Nigeria. It designed to examine whether formative testing with or without remediation will affect students' performance in Biology.

### **Research Hypotheses**

Three hypotheses were formulated for the study.

1. There is no significant effect of formative testing on Biology performance of senior secondary school students'.
2. There is no significant effect of gender on Biology performance of senior secondary school students'.
3. There is no significant interactive effect of formative testing and gender on Biology performance of senior secondary school students'.

## **Methodology**

The researchers adopted quasi-experimental research design for the study. This design is suitable for use when researchers have no intention of tampering with intact groups to avoid likely negative effects on research outcomes. Out of four senior secondary schools in Three Ilejemeje Local Government Area of Ekiti State, the researchers randomly selected three senior secondary schools. The science arm of SS2 in each of the sampled schools participated in the study. The sample for the study is made up of 49 males and 41 females which were randomly assigned into two experimental groups and one control group by the researchers. The sampled classes were treated as intact groups for the purpose of this study. In addition, a 3 X 2 factorial model with factors includes teaching method at three levels (Formative Testing with Remediation, Formative Testing without Remediation and Control Group) and Gender at 2 levels (male and female).

Instructional modules were developed from the SSCE syllabus on four topics - Homeostasis: Regulation of Internal Environment, the Mammalian Liver, the Mammalian Skin and Hormonal System. These four topics were broken into 12 modules with each topic taught in three periods of 45 minutes each per week in the 8th, 9th, 10th and 11th weeks of the term as indicated by the schools' scheme of work. This was carefully planned to agree with the academic calendar of sampled schools during the four weeks that the experiment lasted. Treatment was randomly assigned to two experimental groups and placebo to the control group.

Pretest and posttest were administered to the two groups (experimental and control groups) and the criterion of mastery was set at 80% in line with guidelines by Bloom, Hastings and Madaus (1971). The first experimental group, which was exposed to formative tests with remediation, took the tests and was later given their answer scripts after learning problems associated with their performances were used to diagnose and remediation procedures executed through re-teaching. Experimental group two took formative tests only and were not exposed to remediation. Though they were informed of their performance, no attempt was made to revise and re-teach them. The third group, which is the control group, did not receive formative tests at all, but went through conventional instruction.

Six multiple choice tests in Biology were developed and used for data collection. These comprised a pretest made up of 20 items, four formative tests with 22, 23, 15 and 20 items respectively and a posttest made up of 35 items. The researchers validated the instruments to make sure that all multiple choice items were developed from the topics chosen

from Senior School Certificate Examination syllabus and scheme of work contents used by the schools for teaching their students. Both the face and content validities of the tests were established by the three Biology teachers in the sampled schools. The reliability of each of these instruments was found to be 0.75, 0.72, 0.71, 0.75, 0.78 and 0.76 respectively. The three hypotheses generated in this study were tested by using the Analysis of Co-variance (ANCOVA) with pretest scores as covariate.

## Results

The summaries of Analysis of Covariance and post hoc tests are presented on Tables 1 to 3 with respect to the hypotheses tested. The Duncan's Multiple Range Test (DMRT) was used to identify the sources of variation in cases where significant differences were observed in students' performance.

**H<sub>01</sub>: There is no significant effect of formative testing on Biology performance of senior secondary school students'.**

On Table 1 are the results of the performances of experimental and control groups subjected to Analysis of Covariance.

Table 1

*Summary of ANCOVA Table on Treatment and Students' Performance in Biology*

Source of Variation	Sum of Square (SS)	DF	Mean Square (MS)	Calculated F- Ratio	Sig. of F (P)	Remark
Corrected model	976.08	6	162.68	5.21	.00	
Intercept	3511.26	1	3511.26	112.61	.00	
Covariate	168.10	1	168.10	5.39	.02	
Gender	119.62	1	119.62	3.83	.05	s
Formative Testing Interactions	375.76	2	187.88	6.02	.00	s
Gender* Formative Testing	319.33	2	159.66	5.12	.00	s
Error	2587.91	83	31.18			
Total	21204.00	90				
Corrected Total	3564.00	89				

\* Interactive Effect; S = Significant

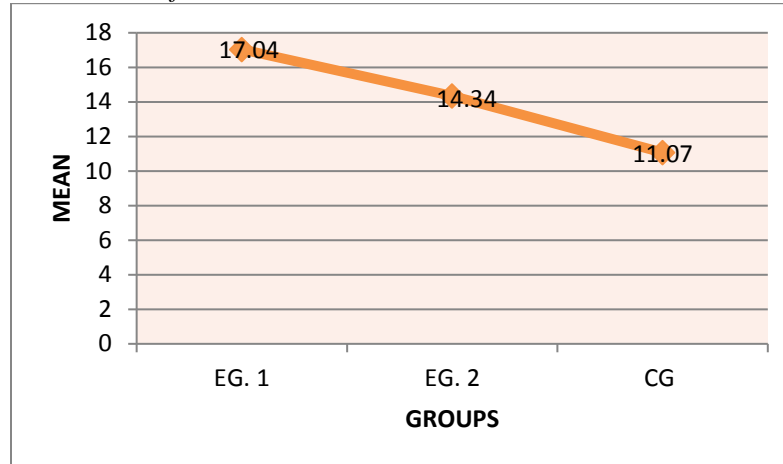
For hypothesis one, results on Table 1 reveals the calculated F-ratio of 6.026 which is significant at 0.05 alpha level ( $F(p)$  value= 0.00) , thus the null hypothesis was rejected. This means formative testing significantly had effect on Biology performance on senior secondary school students' performance. Duncan's Multiple Range Test (DMRT) was used to trace the source of observed variation as presented on Table 2 below:

Table 2  
*Post Doc Analysis (Duncan's Multiple Range Test) on Treatment and Students' Performance*

<b>Duncan's Grouping</b>	<b>Mean</b>	<b>Treatment</b>
A	17.04	Formative Testing with Remediation
B	14.34	Formative Testing without Remediation
C	11.07	No Formative Treatment

The Duncan's Multiple Range Test (DMRT) post-hoc analysis indicated that the highest mean performance was shown in the group subjected to formative test with remediation with 17.04 followed by the group exposed to formative test without remediation with 14.34. The control group had the least mean performance of 11.07. The experimental groups which were exposed to formative test with remediation and formative test without remediation performed significantly better in Biology than those in the control group.

**Graph 1**  
**Mean Graph Showing the Duncan's Grouping on Treatment and Students' Performance**



**Key:** EG. 1: Experimental Group 1 (Formative Testing with Remediation)

EG 2: Experimental Group 2 (Formative Testing without Remediation)

CG: Control Group (No Formative Treatment)

Graph 1 reveals that the mean scores of the subjects in experimental and control groups are significantly different based on Duncan's analysis table. Therefore, hypothesis one is not upheld.

**H<sub>02</sub>: There is no significant effect of gender on Biology performance of senior secondary school students.**

For hypothesis two, Table 1 shows that the calculated F-ratio of 3.837 which is significant at 0.05 alpha level of significance ((F (p) value = 0.05). Therefore, we do not accept the null hypothesis two. This result indicates that gender has significant effect on Biology performance of senior secondary school students'.

**H<sub>03</sub>: There is no significant interactive effect of formative testing and gender on Biology performance of senior secondary school students'.**

Table 1, reveals a calculated F-ratio of 5.12 with a p value of 0.00 which is significance at 0.05 alpha levels. It shows that there is a significant interactive effect of gender and formative testing on Biology performance of senior secondary school students'.



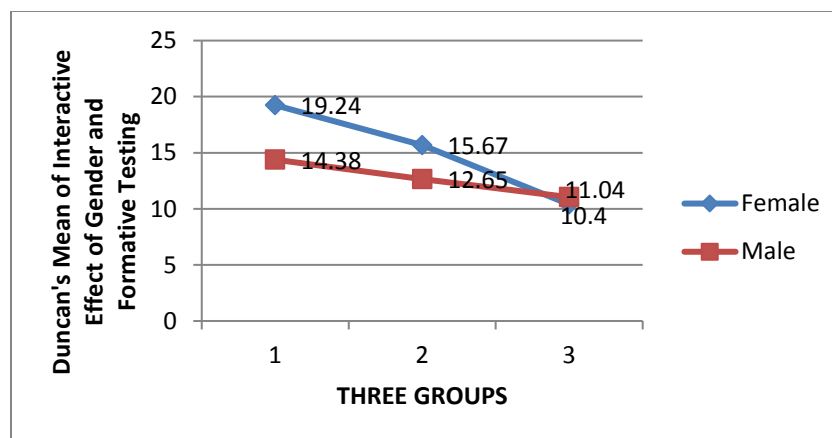
Table 3  
*Post-hoc Analysis (Duncan's Multiple Range Test) on Effect of Treatment and Gender on Students' Performance*

<b>Grouping</b>	<b>A</b>	<b>B</b>	<b>C</b>
Formative Testing	Formative Testing with Remediation	Formative Testing without Remediation	No Formative Testing
Female	19.24	15.67	10.40
Male	14.38	12.65	11.04

Different letters indicate that there is a significant interactive effect of gender and formative testing on Biology performance of secondary school students'. DMRT indicated that the mean of the male and female were 19.24 and 14.38 in formative testing with remediation group, that of male and female were 15.67 and 12.65 in formative testing without remediation group and the means of male and female in group without formative testing (control group) are 10.40 and 11.04 respectively. Therefore, the interactive effect of formative testing and gender on students' performance in Biology is positive since the means of students' vary from one method of testing to another and differ from male and female students.

Graph 2

*Mean Graph Showing the Duncan's Grouping of Interactive Effect of Gender and Treatment on Students' Performance in Biology*



**Key:** 1. Experimental Group 1 (Formative Testing with Remediation)

2. Experimental Group 2 (Formative Testing without Remediation)
3. Control Group (No Formative Treatment)

Graph 2 shows that the mean scores of interactive effect of formative testing and gender on students' performance in Biology is significantly positive. Therefore, hypothesis we do not accept hypothesis three.

### **Discussion of Findings**

The results obtained in this study indicate that formative test with remediation is a better method of assessment that can improve students' performance in Biology. This finding indicated that students exposed to formative test with remediation and formative test without remediation had significantly better performance in Biology when compared with the control group. King (2003) study supported the findings of this study, he concluded in his study that teachers accepted formative assessment as a valuable teaching strategy, and they thought that it improved science teaching. The findings from this study support the work of Afemikhe (1985) who found that when formative test was used in teaching Mathematics, the students so exposed were found to be significantly better than students not exposed to it. Similarly, Okpala and Onocha (1990) observed that students performed better when they are systematically assessed. In addition, Yin et al. (2008) did not support the finding of this study; they found that formative assessment did not lead to a significant influence on students' achievement.

It was discovered from this study that students' gender has significant effect on their performance in Biology. However, the observation that male students performed equally well as their female counterparts is against the findings of the study. Akande's (2001) study in which it was observed that gender has no significant effect on academic performance did not support the result of hypothesis two. Moreover, Olasehinde and Olatoye (2014) result also disagree with the findings of this study; they reported that there is no significant difference between male and female students in science achievement.

It was also found in this study that there is significant interactive effect of gender and formative testing on students' performance in Biology. Students' academic performance can therefore be attributed to the interaction of gender and treatment conditions. This study further showed that formative test with remediation is a better method of assessment than formative testing without remediation and that it could be used to improve students' performance in Biology. Also, from the

findings of this study, it could be concluded that formative tests with remediation could be used to improve learning of Biology among secondary school students.

### **Conclusion**

The results of this study indicate that formative test with remediation and formative test without remediation are effective in improving academic performance of students in Biology. It also showed that students exposed to formative test with remediation performed better than those exposed to formative test without remediation. Though gender differences were established in students' performance in Biology, significant interactive effects of formative testing and gender on performance in Biology were also observed.

### **Recommendations**

Based on the findings of this study, the researchers conclude that testing could be used to institute educational reform in Nigerian secondary education. Thus, it is recommended that continuous assessment, currently being used at this level, should be replaced with formative test with remediation and mastery standards observed. This may help to overcome perennial failure in school certificate examinations at the end of their programmes. Teachers should thus be exposed to training that would foster adoption of formative testing procedures while executing the secondary school curriculum. This study was conducted in secondary schools, further study may be conducted in primary schools and tertiary institutions to further ascertain the relative effectiveness of the assessment techniques: formative testing with remediation and formative testing without remediation. Research is also required in other school subjects while experts in educational measurement should ensure that standardized formative tests are produced and made available for use in schools.

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