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Reseach Article

Practical biology mock examination as a predictor of secondary school students' academic performance in biology theory in Nnewi education zone

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ABSTRACT

This study investigated the predictive value of students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone. Five research questions and five null hypotheses, tested at the 0.05 level of significance, guided the research. A correlational survey research design was adopted for the study. The population consisted of 13604 (public: 1918 males and 2049 females; private: 4332 males and 4765 females) Senior Secondary Sschool three (SS 3) students in the public and private secondary schools in Nnewi Education Zone, from which a sample of 727 (390 males and 337 females) SS 3 students was drawn using a multistage sampling procedure. The performance scores of students in the Biology practical and theory mock examination for the 2024/2025 academic session, from the selected schools, were used to collect data for the study. There was no need for instrument validation and reliability tests, since the performance scores were obtained from already existing standardized examination questions. Data were retrieved from the academic records of selected schools after due permission had been sought and obtained from the school authorities. The collected data were analyzed using simple linear and ANOVA regression analyses. The study found that practical mock Biology examination scores are not significant predictors of students' theory performance. The findings of the study also showed that while gender was not a significant moderator of this predictive relationship, school type was. Based on the findings, it was recommended that while students should adopt study habits that integrate the practical and theoretical aspects in their learning of Biology, Biology teachers should deploy teaching methods in the classroom to facilitate this integration.

1. Introduction

Science is the powerhouse of any significant development at individual and national levels. It plays a significant role in equipping students with the necessary confidence and competence to solve societal problems. According to Abanikannda (2018), science is the systematic acquisition of organized knowledge regarding the natural and physical world, established through predictions, observations, and experiments. Similarly, Ugwuoti, Nnoli, and Oguezue (2022) described Science as an accumulated and systematized body of knowledge about natural phenomena that is subject to verification using empirical evidence. The future economic viability of Nigeria rests on its ability to strengthen its science and technology programs in content, teaching, and learning of science subjects. These subjects include Chemistry, Physics, and Biology.

Biology deals with the study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy. Enebechi and Nzewi (2017) described Biology as the science of life because it deals with the study of living and non-living components of the environment. Biology can be defined as the science of life, enabling the understanding of oneself and the environment. According to Jandrić (2021), Biology is critical for solving societal problems such as disease outbreaks, overpopulation, and climate change, among others. Adegboye, Bello, and Isaac (2018) asserted that Biology is composed mainly of two fields: functional and historical Biology.

Historical Biology is often referred to as evolutionary Biology and requires a sound knowledge of history for the explanation of all aspects of the living world. Thus, the historical narrative methodology is useful for providing explanations in this field of Biology. Functional

Biology, on the other hand, deals with physiological processes in living things, explained using the natural laws of physical sciences, especially at the cellular-molecular level (Adegboye, Bello, and Isaac, 2018). These researchers further posited that the most frequently asked question in the field of functional biology is how and why? This field of Biology requires experimental procedures to provide answers to these questions. From the aforementioned assertions, biological knowledge can be considered to be both theoretical and practical, necessitating the adoption of theoretical knowledge and practical/experimental procedures for the effective teaching and learning of Biology.

Theoretical Biology entails the mere presentation of biological knowledge to students. Falemu and Akinwumi (2021) described it as the presentation of facts, principles, and concepts of Biology that are often abstract in context and used to abstractly to explain the behaviour of objects, concepts, or processes in Biology. However, they form the basis for practical Biology. Practical Biology, on the other hand, entails using practical activities that incorporate hands-on and minds-on activities to make students do Biology, rather than just learning about it. These practical activities are often conducted in school laboratories that provide a conducive environment for practical work. Ezra and Agah (2019) posited that these activities foster students' positive attitudes toward Biology and maintain their interest in learning the subject. Practical Biology helps students understand the theories, ideas, principles and concepts of Biology that were taught theoretically. These practical activities also help students acquire science process skills. In buttressing the complementary nature of these two aspects of Biology, Kambaila, Kasali, and Kayamba (2019) posited that these two aspects need not be isolated but taught as segments or portions of Biology and not as a different entity. From the foregoing, it can be deduced that both components of biological knowledge are complementary and important in the teaching and learning of Biology and in assessing students' performance in the subject.

Biological knowledge is critical to several science-related fields. For example, Chukwu and Arokoyu (2017) posited that the knowledge is applied in Medicine, Biochemistry, Pharmacy, Microbiology and Agriculture, among others. Thus, Biology is a necessity for any prospective student who wishes to study medical and health sciences in any higher institution of learning in Nigeria. They maintained that the significance of Biology, and its perceived simplicity, is reflected in the number of students who enroll for the subject in external examinations like the West African Senior School Certificate Examination (WASSCE) conducted by the West African Examination Council. However, students' underperformance in the subject has been noted.

The suggestions made by the WAEC Chief Examiner corroborate the assertions of Abdussemiu (2022) on the essentiality of practical activities in the teaching and learning of Biology, the use of the practical activities approach to teaching and learning Biology concepts should be mandatory if Nigeria hopes to produce students who can acquire the necessary knowledge, skills, and competence needed to meet the nation's demands. The remedies suggested by the WAEC Chief Examiner also underscore the proposition made earlier that biological knowledge has both theoretical and practical components, and that these components are complementary. Thus, students' performances in these components could be related and interdependent, and assessing their academic performance in both components provides a comprehensive understanding of their overall competence in Biology.

Academic performance is a student's level of performance in any given field of study. Okwuduba, Nwosu, Okigbo, Samuel, and Achugbu (2021) defined academic performance as the knowledge gained by students in a given subject area, often assessed by the marks given or educational goals set by students and teachers to be achieved over a specific time. Okwuduba et al. further posited that these goals are measured using students' continuous assessment or examination results. According to Nnoli and Ibeh (2026), academic performance is the measure of a student's success in a particular subject or in school generally. In the context of the present study, students'

academic performance in both theoretical and practical Biology was measured using their mock examination results.

Mock examinations are preparatory assessments leading to the main examination. Progress and Ikeanumba (2024) state that the mock is an examination in practice for future examinations, where the marks may or may not count. They further posited that the examination is formative, selective, predictive and diagnostic of students' strengths and weaknesses, and is useful in boosting their confidence about the main examination. Mock examination is expected to reveal how successfully the teacher's instructions have been mastered and which students will succeed in future academic endeavours. According to Bosson-Amedenu (2017), the mock examination is a standardized test that prepares final year students for their final examinations, like the WASSCE. It is often taken when the syllabi for the said examination must have been covered.

Gender is a cultural construct that dichotomizes between males and females. According to Musa and Mohammed (2019), this construct uses cultural perceptions to delineate the roles, behaviours, and mental and emotional characteristics associated with males and females. Regarding gender variation in the relationship between students' performance in theoretical and practical Biology components, Ebuoh (2014) observed that gender is not a significant factor. The findings imply that none of the examination types discriminated against any particular gender. However, Musa and Mohammed observed that gender is a significant factor in the aforementioned relationship. According to them, the male students achieved more in Biology examinations than their female counterparts. Contrariwise, a more recent finding by Kaifi, Alshamrani, Al-Nasser, Omair, and Althaqafy (2024) show that female students have taken the lead, achieving more than their male counterparts in both the theoretical and practical components of examinations.

Statement of the Problem

Despite the acknowledged significance of both theoretical and practical components of Biology in its teaching and learning, students' academic performance in the subject remains inconsistent across these components. These inconsistencies are indicated by the trend of students' performance in external examinations like WASSCE. The reports from the WAEC Chief Examiner indicate ongoing deficiencies in students' capacities to articulate theoretical concepts and accurately perform or report practical procedures in Biology. These issues, among other things, indicate potential deficiencies in the integration of the theoretical and practical components of Biology within the teaching and learning process, establishing the case that performance in one component could predict performance in the other.

Only a few studies in Nigeria have examined the connection between students' performances in practical and theoretical Biology; however, these studies are constrained both in scope and geographical context. Moreover, the few findings have shown inconsistency, with some studies indicating a significant relationship between the two components, while others suggest disparities that may arise from unequal emphasis by teachers or insufficient practical exposure. Furthermore, there are also disparities in research findings with respect to the moderating effect of students' gender and school type on this relationship, and no studies have been specifically conducted in the Nnewi Education Zone, where educational challenges may vary due to contextual factors including the locational identity of the zone as a business-inclined area that may distract students' attention from school, school resources, teacher quality, and instructional methods.

Considering the significance of mock examinations as a preparatory examination for external examinations like WASSCE, and the essentiality of Biology in science-related fields, it is crucial to examine the performance of students in both the theoretical and practical components of the Biology mock examination. It is also pertinent to investigate how performance in one component predicts the other in the Nnewi Education Zone.

Purpose of the Study

The purpose of the study is to investigate the predictive value of students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone. Specifically, the study sought to determine the:

1. predictive value of students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone
2. predictive value of male students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone
3. predictive value of female students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone.

Research Questions

The study sought answers to the following research questions:

1. What is the predictive value of students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone?
2. What is the predictive value of male students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone?
3. What is the predictive value of female students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone

Hypotheses

The following null hypotheses (H_o) were tested at 0.05 level of significance

1. Students' practical Biology mock examination scores do not significantly predict their theory performance in Nnewi Education Zone
2. Male students' practical Biology mock examination scores do not significantly predict their theory performance in Nnewi Education Zone
3. Female students' practical Biology mock examination scores do not significantly predict their theory performance in Nnewi Education Zone

Methods

The research design is a correlational survey. Creswell and Creswell (2017) described this research design as one employed to determine the relationship among two or more variables in a study. The study was conducted in the Nnewi Education Zone of Anambra State

The population of the study consists of 13604 (public: 1918 males and 2049 females; private: 4332 males and 4765 females) senior secondary school three (SS 3) students in the public and private secondary schools in Nnewi Education Zone (Source: Statistics and Planning Unit of Post Primary Schools Service Commission of Anambra State. The sample of the study comprised 727 (public: 182 males and 135 females; private: 208 males and 199 females) SS 3 students. The performance scores of students in the Biology practical and theory mock examination for the 2024/2025 academic session, from the selected schools, were used to collect data for this study. There was no need for instrument validation and reliability in this study, since the performance scores of students in practical and theoretical mock Biology examinations were obtained from already existing standardised examination questions. The data for this study were the performance scores of students in the 2024/2025 theoretical and practical mock Biology examination. These scores were retrieved from the academic records of selected schools after due permission had been sought and obtained from the school authorities of the concerned schools. In analysing the data, the simple linear regression analysis was used to answer the research questions. For hypothesis testing, ANOVA regression analysis was used to test for the significance at a 0.05 level of significance. The interpretations were as follows: for research questions, a score of .80 and above was considered a high prediction, .31 -

.79 was considered a moderate prediction, while .30 and below was considered a low prediction. For the hypotheses, in taking a decision where the P-value is less than or equal to a significant value of .05 ($P \leq .05$), the null hypothesis was rejected, but if otherwise, the null hypothesis was not rejected.

Results

Research Question One: What is the predictive value of students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone?

Table 1: Simple Linear Regression Analysis of Practical Biology Mock Examination Scores on Theory Performance

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.063[a]	.004	.003	6.11734	.004	2.844	1	725	.092

a. Predictors: (Constant), Practical Scores

Table 1 reveals the prediction of students' practical Biology mock examination scores from their theory performance scores. The Pearson correlation coefficient (R = -.063) indicates a low positive predictive relationship between practical and theory performance scores in mock Biology. The coefficient of determination ($R^2 = .004$) implies that practical Biology mock examination scores predict 0.4% of the change observed in students' theory performance scores in the Biology mock examination in the Nnewi Education Zone.

Research Question Two: What is the predictive value of male students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone?

Table 2: Simple Linear Regression Analysis of Practical Biology Mock Examination Scores on Male Students' Theory Performance

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
Male	.031[a]	.001	-.002	5.94971	.001	.368	1	388	.545

a. Predictors: (Constant), Practical Scores

Table 2 reveals the prediction of male students' theory performance in mock Biology by their practical examination scores. The Pearson Correlation coefficient (R = .031) indicates a low positive predictive relationship between practical and theory examination scores in mock Biology. The coefficient of determination ($R^2 = .001$) implies that practical mock Biology examination scores predict 0.1% of the change observed in male students' theory performance in Biology in the Nnewi Education Zone.

Research Question Three: What is the predictive value of female students' practical Biology mock examination scores on their theory performance in Nnewi Education Zone?

Table 3: Simple Linear Regression Analysis of Practical Biology Mock Examination Scores on Female Students' Theory Performance

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
Female	.094[a]	.009	.006	6.29469	.009	3.015	1	335	.083

a. Predictors: (Constant), Practical Scores

Table 3 reveals the prediction of female students' theory performance in mock Biology by their practical examination scores. The Pearson Correlation coefficient (R = .094) indicates a low positive predictive relationship between practical and theory examination scores in mock Biology. The coefficient of determination (R^2 = .009) implies that practical mock Biology examination scores predict 0.9% of the change observed in female students' theory performance in Biology in the Nnewi Education Zone.

Hypothesis

Hypothesis 1: Students' practical Biology mock examination scores do not significantly predict their theory performance in Nnewi Education Zone.

Table 4: ANOVA Regression Analysis of the Prediction of Students' Practical Biology Mock Examination Scores on Theory Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	106.440	1	106.440	2.844	.092[b]
	Residual	27130.834	725	37.422		
	Total	27237.274	726			

a. Dependent Variable: Theory Scores

b. Predictors: (Constant), Practical Scores

The result of the ANOVA regression analysis from Table 4 shows a non-statistically significant prediction of practical Biology mock examination scores on students' theory performance, $F(1, 725) = 2.844$, $p > 0.05$. Since the p-value (.092) is greater than the 0.05 level of significance, the null hypothesis was not rejected. This decision indicates that practical Biology mock examination scores do not significantly predict students' theory performance in the Nnewi Education Zone.

Hypothesis 2: Male students' practical Biology mock examination scores do not significantly predict their theory performance in Nnewi Education Zone.

Table 5: ANOVA Regression Analysis of the Prediction of Male Students' Practical Biology Mock Examination Scores on Theory Performance

Gender	Model		Sum of Squares	Df	Mean Square	F	Sig.
Male	1	Regression	13.019	1	13.019	.368	.545[b]
		Residual	13734.850	388	35.399		
		Total	13747.869	389			

a. Dependent Variable: Theory Scores

b. Predictors: (Constant), Practical Scores

Table 5 shows the results of the ANOVA regression analysis for the prediction of male students' practical Biology mock examination scores from theory performance. The analysis showed a non-statistically significant prediction, $F(1, 388) = .368$, $p > 0.05$. Since the p-value (.545) is greater than the 0.05 level of significance, the null hypothesis was not rejected. This non-rejection indicates that practical Biology mock examination scores do not significantly predict male students' theory performance in Biology in the Nnewi Education Zone.

Hypothesis 3: Female students' practical Biology mock examination scores do not significantly predict their theory performance in Nnewi Education Zone.

Table 6: ANOVA Regression Analysis of the Prediction of Female Students' Practical Biology Mock Examination Scores on Theory Performance

Gender	Model		Sum of Squares	Df	Mean Square	F	Sig.
Female	1	Regression	119.446	1	119.446	3.015	.083[b]
		Residual	13273.741	335	39.623		
		Total	13393.187	336			

a. Dependent Variable: Theory Scores

b. Predictors: (Constant), Practical Scores

Table 6 shows the results of the ANOVA regression analysis for the prediction of female students' Biology mock theory performance by their practical examination scores. The analysis showed a non-statistically significant prediction, $F(1, 335) = 3.015$, $p > 0.05$. Since the p-value (.083) is greater than the 0.05 level of significance, the null hypothesis was not rejected. This non-rejection indicates that practical Biology mock examination scores do not significantly predict female students' performance in theory in Biology in the Nnewi Education Zone.

Discussion

The result of the ANOVA regression analysis shows a non-statistically significant prediction of practical Biology mock examination scores on students' theory performance, $F(1, 725) = 2.844$, $p > 0.05$. Since the p-value (.092) is greater than the 0.05 level of significance, the null hypothesis was not rejected.

The prediction of male students' theory performance in mock Biology by their practical examination scores indicates a low positive predictive relationship between practical and theory examination scores in mock Biology. Male students' practical Biology mock examination scores do not significantly predict their theory performance in Nnewi Education Zone.Therefore, the null hypothesis was not rejected.

The prediction of female students' theory performance in mock Biology by their practical examination scores indicates a low positive predictive relationship between practical and theory examination scores in mock Biology. Female students' practical Biology mock examination scores do not significantly predict their theory performance in Nnewi Education Zone. Therefore, the null hypothesis was not rejected.

Thus, a student may be meticulous with laboratory experiments, leading to a high practical score, but may struggle with abstract reasoning and the written articulation of biological concepts required for theory examinations. Conversely, a student with a deep theoretical understanding of biological concepts might lack the fine psychomotor skills or practical experience to excel in the practical mock examination.

The findings of this study diverge from the findings of Ebuoh (2014), who observed a significant relationship between essay and practical mock Biology examination scores in Ezeagu LGA of Enugu State. The recent study's findings also contradicted Galadanci and Mukhtar (2017), who observed, from their findings, a statistically significant and strong positive relationship between students' theoretical and practical scores in computer application courses at Bayero University, Kano. Furthermore, the findings of the study differ from those of Ramakrishnan and Abukari (2019), who similarly observed a moderate positive correlation between undergraduate physiotherapy students' performance in theoretical and practical examinations in the UAE.

The findings of this study agree with Musa and Mohammed (2019), who observed from their findings that female students achieved significantly better than their male counterparts in both theoretical and practical aspects of Biology in Edu Educational Zone of Kwara State.

Conclusion

The study concluded that performance in practical and theoretical mock Biology examinations represents two distinct, though related, domains of competence. The overall absence of a significant predictive relationship between these components suggests that proficiency in one does not guarantee success in the other. This disconnect is attributed to fundamental differences in the skills each examination format assesses and the pedagogical practices that often treat these aspects of Biology in isolation, particularly in the Nnewi Education Zone. Furthermore, while gender did not moderate this predictive relationship, school type emerged as a significant moderating factor, with public school students demonstrating an integrated understanding of practical and theoretical Biology concepts, which is absent in their private school counterparts, likely due to more consistent curricular delivery and resource-informed teaching strategies that necessitate conceptual connections.

Recommendation

Based on the findings of the study, the following recommendations were made:

1. Secondary school students should approach the learning of Biology from a holistic standpoint. They must adopt study habits that deliberately connect hands-on laboratory activities with underlying biological principles for comprehensive understanding and performance in Biology.
2. Biology teachers should be encouraged to integrate the practical and theoretical aspects of Biology in teaching the subject. They should be trained on using effective teaching methods to integrate these two aspects of Biology in their teaching.
3. School administrators should ensure that laboratory resources are available and utilized for laboratory sessions. They must ensure that their teachers do not replace practical sessions with theoretical explanations of biological concepts.
4. Examination bodies like WAEC and NECO should explore new assessment formats that would require students to integrate their practical and theoretical competencies to answer. With these formats, the students would not focus completely on a particular aspect of Biology.

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