Science Process Skills, Attitude and Students' Academic Performance in Practical Biology in Secondary Schools in Etinan Local Government Area

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Abstract

This study sought to determine the prediction of science process skills, attitudes and students' academic performance in practical Biology in secondary schools in Etinan Local Government Area. Three specific objectives, three research questions and three null hypotheses were formulated to guide the study. The correlational survey design was used in this study. The population of the study comprised all the 2460 senior secondary two (SS2) students offering Biology in the 11 public secondary schools in Etinan Local Government Area in the 2024/2025 academic session. The sample consisted of all the 344 SS2 students offering Biology obtained through Taro Yamane formula. Simple random sampling technique was adopted for this study. Three instruments titled "Science Process Skills Questionnaire (SPSQ)", "Students' Attitude Questionnaire (SAQ)" and "Biology Practical Test (BPT)" was used for data collection in the study. The instruments were face validated by three experts from the Department of Science Education, Akwa Ibom State University. Cronbach's Alpha technique was used in determining the reliability coefficient of the instruments and coefficients index of .73, .92, and .72 were obtained respectively. Regression analysis was used to answer all the research questions as well as testing all the null hypotheses at 0.05 level of significance using Statistical Package for Social Science (SPSS). The findings of this study indicated that there is very high and significant prediction of science process skills and attitudes on students' academic performance in practical Biology in secondary schools in Etinan Local Government Area. Based on the findings, it could be concluded that science process skills and attitude significantly predict students' academic performance in practical Biology irrespective of gender. Therefore, it was recommended among others that Government through State Secondary Education Board should regularly organize conferences, workshops and seminar for teachers and students on the relevance of science process skills especially observing skills on students' academic performance in practical Biology in secondary schools.

Keywords: Science Process Skills, Attitude, Performance, Biology

Introduction

Education has been widely acknowledged as a critical factor for the development of individuals, society and nation. This cannot occur without a functional secondary school. Secondary school is an institution or human industry established for refining human beings at their youthful age in terms of skills, behaviour and all-around developments in order to fit into the society where they live. Secondary school is the stage in the educational system that comes immediately after primary education. Solomon (2018) revealed that the future of any nation depends quite considerably on the quality of secondary education provided for its citizenry. It aims at preparing students for higher education and useful living in the society (Federal Republic of Nigeria [FRN], 2014). The specific objectives of secondary education are: acquire necessary knowledge, skills and attitude for the development of self and the nation; build a firm foundation for further studies and training; develop ability for inquiry, critical thinking and national development; and build a foundation for technology and industrial development.

Secondary schools also provide trained manpower in the applied science, technology, and commerce at sub-professional grades; develop and promote Nigerian languages, art and culture in the context of the world's

cultural heritage; inspire students with a desire for self-improvement and achievement of excellence; foster National unity with an emphasis on the common ties that unite people in diversity; raise a generation of people who can think for themselves, respect the views and feelings of others, respect the dignity of labour, appreciate those values specified under the broad national goals and live as good citizens. Secondary schools provide technical knowledge and vocational skills necessary for agricultural, industrial, commercial, and economic development. Attaining these core objectives is anchored on the worthwhile school subjects such as Biology.

Biology aims at equipping students with appropriate scientific skills, attitudes, competences and ability to apply scientific knowledge to every challenges of life. Yilshik *et al*. (2020) opined that Biology excites intellectual curiosity, increases awareness of fragile ecosystem and stimulates critical thinking. It ensures acquisition of necessary scientific skills for observing, classifying, and interpreting biological data. The basic relevant knowledge in Biology is needed for future advanced studies in biological sciences, problem-solving, personal, social, environmental, community health and economic problems as well as interrelationships between biology and other scientific disciplines. Therefore, it is not an overstatement that the subject biology is very significant in the proper understanding of some courses in the tertiary institution.

Biology is a prerequisite subject for many fields of learning in the tertiary institution such as Medicine, Pharmacy, Nursing, Agriculture, Forestry, Biotechnology, Nutrition, Food technology, among others. This culminated from the fact that biology involves the study of living things as well as the study of physiology, biochemistry, anatomy, systems, genetics, evolution and ecology of plants and animals that contribute immensely to the scientific growth of the world and specifically, Nigeria which has relevance to man's existence. Contrarily, the knowledge of biology is not limited to pursue a career in academic alone, but also pivotal in health, well-being, and care of households.

Despite the worthwhile and rich contents in Biology among the senior secondary school subjects, Sandy (2018) observed that there has been an unending sequence of poor achievement of Biology students in almost all examinations conducted across the country in recent years. The students' achievement plays an important role in producing the best quality school leavers who will man the society in various positions. Hijazi and Naqvi (2016) maintained that academic achievement is a multidimensional construct composed of the skills, attitudes, and behaviours of students which contribute to academic success in the classroom. It is a satisfactory and superior level of performance of students as they progress through and complete the school experiences. Academic performance is the assessment of how much students have learnt or attained after a learning period. It is an important indicator of adjustment of learning and also serves as an important variable in school system as it provides the yardstick for measuring academic progress (Ezekiel *et al*., 2021). The implication of this phenomenon is underscored by research which repeatedly demonstrates that the vast majority of students who withdraw from school do so for no reason other than poor academic performance. This is the performance of the examinee that is adjudged by the examiner as falling below an expected standard. It has been observed in subjects especially Biology in secondary school students.

However, students' academic performance in Biology at the Senior School Certificate Examination has been unsatisfactory over the years. Only few students got the grade above pass level which can qualify them for admission into higher institution to study Biology and other Biology-related disciplines. Raiyegbemi *et al.* (2020) observed that students are increasingly finding it difficult to pass the subject at both the West African Examinations Certificate (WAEC) and the National Examination Council (NECO). These inconsistencies can be

linked to the learning strategies of the students. The academic failure is not only frustrating to the students and the parents, its effects are correspondingly grave on the society in terms of dearth of manpower in all spheres of the economy.

Stakeholders in education are concerned about why the system is turning out school leavers with poor results. Udoukpong *et al.* (2020) lamented that the academic performance of students in Biology in competitive examinations conducted by West African Senior School Certificate Examination (WASSCE) and National Examination Council (NECO), Unified Tertiary Matriculation Examination (UTME) and other reputable examination bodies have shown shocking failure rate year in-year out in Akwa Ibom State. This situation has made many students in Etinan Local Government Area to repeat SSCE as well as UTME many times, drop out of school or resort to examination malpractices and other desperate measures to meet the admission requirement.

According to Ekanem (2021) the foregone issue has been blamed on several factors ranging from poor learning environment, poor teaching methods, poor choice of instructional materials, teachers' unprofessionalism, among others. Some underlining factors may be responsible for this trend, and these factors may be multifaceted, ranging from the students' or teachers' attitudes, inadequate instructional materials and lack of laboratories to mention a few (Akpan, 2022). Similarly, Akpan and Akpan (2017), Akpan (2018), Ereh and Thomas (2018) showed that several factors are responsible for the poor performance of students in Biology and other science subjects such as adhering to instructions, crossing of guidelines in drawings, labeling, handling of equipment like pipettes, burettes, identification and labeling of specimen, reporting of experiments, among others. Raiyegbemi *et al*. (2020) also revealed that the nonchalant attitude of students and teachers in senior secondary schools towards certain concepts in the Biology curriculum also accounts for poor performance in the subject. The Federal Republic of Nigeria [FRN] (2014) stipulated that teaching and learning of science, which includes Biology should be process-oriented to promote students' understanding of science concepts and application of knowledge, likewise the learning of biology does not only requires knowledge in the form of facts, concepts, and or principles but also requires a scientific process approach.

Science process skills are vital skills possessed by students in conducting scientific activities. Science process skills are to improve scientific literacy, help students understand Biology concepts easily and correctly. During the learning process, students are required to be active in discovering the main concepts of Biology material through observation, experimentation, drawing pictures, graphs, tables, and communicating the results to others (Inayah *et al*., 2020; Akpan, et al., 2019). The most important aspect of studying science is by developing in the learner the skills needed for acquiring scientific attitudes, which are the science process skills.

The processes of science take account attitudes and methods of inquiry. Attitudes consist of both emotional attitudes like curiosity, humility, determination, open mindedness, while intellectual attitudes include objectivity, skepticism and rationality. The methods of inquiry are observing, hypothesizing, analyzing, inferring, extrapolating, reasoning and synthesizing, among others. The attitudes develop concurrently with science process skills (Sadhana, 2017; Thomas & Inyang, 2021). Hence, science process skills become eminent in the learning of biology subject. Therefore, Ekon and Eni (2015) mentioned that the science process skills suitable for students' academic performance in Biology in secondary schools include: predicting, inferring, analyzing skills, among others.

High levels of learning occur and learners feel good about themselves and the materials they are learning when teachers instructional period is interesting. The way teachers interact with students influences their attitude toward school and their academic performance. How students perceive their teacher attitudes to teach in the classroom is highly essential and related to students' academic performance. Nevertheless, these could be moderated by certain construct like gender.

Gender entails the social attributes associated with being male and female and the relationships between women and men; girls and boys, as well as the relations between women and those between men. It is widely proven and reported by researchers that the variation in male and female has created gender disparity in the academic performance of students (Umoetuk and Akpan, 2023). Globally, promoting gender equality in science currently used as developmental strategy for socio-economic development of any nation. Some researchers found that male students perform than females (Ukpai & Fonsi, 2023). Olatunde-Aiyedun (2021) stated that males are more likely to take difficult subject areas and challenging problem-solving situations, while females prefer simple subjects and less difficult tasks. Itighise and Umanah (2019), Akpan (2022), Akpan and Akpan (2017) reported that gender had no significant effect on students' performance.

However, the researcher observed that despites the benefits of science process skills and attitude in the students' academic performance in Biology, yet those in secondary schools in Etinan Local Government Area remained poor, which has led to students' inability to achieve the stated goals of secondary schools. Then, it seems that the students of the public secondary schools are deficient in the said skills or failed to embrace or they are ignorant of these skills and the place of attitude to overcome their academic problems. It is against this background that this study sought to address science process skills, attitudes and students' academic performance in practical biology in secondary schools in Etinan Local Government Area.

Statement of the Problem

The academic performance of students in Biology in competitive examinations conducted by West African Senior School Certificate Examination (WASSCE) and National Examination Council (NECO), Unified Tertiary Matriculation Examination (UTME) and other reputable examination bodies have shown shocking failure rates over the years. Likewise, researchers have observed an increasing decline in student's academic achievement at secondary school level over the years. This could be responsible for truncating the ambition of most prospecting students as well as poor enrolment.

Concerted efforts have been made by education stakeholders to ameliorate the situation through the organization of conferences, workshops and seminar for teachers, as well as science quiz, and other competitions among students, yet the problem have persisted. Similarly, reports from research findings concurred that Akwa Ibom State government has made efforts to encourage the study of science, through organizing science quiz competitions for students and seminars and workshops for Biology, and other Science, Technology, Engineering, and Mathematics (STEM) teachers. The Science Teachers Association of Nigeria (STAN) works assiduously towards Science Education in Nigeria. Despite these efforts, students' achievement in Biology at the Senior School Certificate Examination (SSCE) has not been encouraging. Since students' achievement could be used to assess the efficacy of teaching learning process in schools, this could be an indication of the existence of missing link in science process and attitude in secondary schools in Akwa Ibom State.

Despite these efforts students' achievement in biology at the SSCE has not been encouraging. This issue has been blamed on many factors such as teachers' unprofessionalism, poor attitude of students and teachers, lack of teaching learning facilities, poor knowledge of science process skills by students and teachers, poor learning environment, poor selection of instructional strategy, among others. Researches revealed that Biology subject as an embodiment of science activities cannot be handled with negligence by mere talking, attention must be given to the innovative skills available for its effective teaching and learning. It is therefore on this note that this study sought to determine science process skills, attitudes and students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.

Purpose of the Study

The purpose of the study was to determine the prediction of science process skills, attitudes and students' academic performance in practical Biology in secondary schools in Etinan Local Government Area. Specifically, the study sought to:

1. Ascertain the prediction of science process skills on students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.
2. Ascertain the prediction of attitude of students on students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.
3. Determine the prediction of science process skills on students' academic performance in practical Biology in secondary schools in Etinan Local Government Area as moderated by gender.

Research Questions

The following research questions guided the study:

1. How do science process skills predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area?
2. How does attitude of students predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area?
3. To what extent does science process skills and gender jointly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area?

Hypotheses

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

1. Science process skills does not significantly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.
2. Attitude of students does not significantly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.
3. Science process skills and gender does not significantly jointly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.

Methods

The study employed correlational survey design. Correlational design provides insights concerning the current status of the phenomenon and to describe what exists with respect to variables or conditions in a situation. Therefore, the design was chosen because the researcher aimed at determining how science process skills, attitude predict students' academic performance in practical biology. The study was conducted in Etinan

Local Government Area. The population of the study comprised of 2460 senior secondary two (SS2) students offering Biology in 11 public secondary schools in the study Area in the 2024/25 academic session. The sample size for this study consisted of 344 senior secondary two (SS2) students offering Biology obtained statistically using Taro Yamane formula. Three instruments titled "Science Process Skills Questionnaire (SPSQ)", "Students' Attitude Questionnaire (SAQ)" and "Biology Practical Test (BPT)" were used for data collection in the study. The (SPSQ) contained 3 sections (A-C) namely; predicting, inferring, and analyzing skills. The (SAQ) was adapted instrument of Russell and Hollander (1975) with 14 structured items. Again, the instrument (BPT) embedded with 3 questions. Questions on Biology Practical Test (BPT) were extracted from National Examination Council (NECO) Biology I past questions that were already standardized. For the (SPSQ) and (SAQ), a 4-point rating scale was used for response options mode as shown below:

Strongly Agree (SA) - 4 points
Agree (A) - 3 points
Disagree (D) - 2 points
Strongly Disagree (SD) - 1 point

The instruments were face validated by three experts, two from the Biology Unit and one from Measurement and Evaluation all from the Department of Science Education, Akwa Ibom State University. Cronbach Alpha statistics was used to determine the internal consistency of the instruments; "Science Process Skills Questionnaire (SPSQ)", "Students' Attitude Questionnaire (SAQ)" and "Biology Practical Test (BPT)" and coefficients index of 0.73, 0.92, and 0.72 were obtained respectively which showed that the instruments are reliable for this study. Each question on "Biology Practical Test (BPT)" was tag with specific mark, summed up as follows: question 1 – 30 marks, 2 – 25 marks, and 3 – 25 marks resulting in 80 marks on the whole. Regression analysis was used to answer research questions 1 to 6, as well as testing the null hypotheses 1 to 3 at 0.05 level of significance, while mean and standard deviation were used in answering research questions7 and 8, while two-way Analysis of Variance (ANOVA) was used in testing null hypotheses 7 and 8 at 0.05 level of significance using Statistical Package for Social Science (SPSS).

Results

Hypothesis one: Science process skills do not significantly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.

In testing this hypothesis, multiple regression analysis statistics was used to predict the relationship between the independent factors of science process skills on students' academic performance in practical biology.

Table 1: Regression analysis on the science process skills and students' academic performance in practical Biology in secondary schools in Etinan Local Government Area

Model	Sum of Squares	df	Mean Square	F	P-value	Decision
Regression	39080.490	3	13026.830	506.710	.000[b]	
Residual	8586.694	334	25.709			Reject H_0
Total	47667.183	337				

a. Dependent Variable: Students' Academic Performance in Practical Biology

b. Predictors: (Constant), Observing Skills, Communication Skills, Measuring Skills.

* Significant at the 0.05 level of significance

Table 1 shows the regression analysis on the science process skills and students' academic performance in practical Biology in secondary schools in Etinan Local Government Area. The Table revealed the F-value as 506.710 and the P-value of .000 which is less than 0.05 level of significance. The prediction is significant. Therefore, the null hypothesis one which stated that science process skills do not significantly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area is rejected. This shows that science process skills significantly predict students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.

Hypothesis two: Attitude of students do not significantly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.

In testing this hypothesis, multiple regression analysis statistics was used to predict the relationship between the independent variable attitudes of students on academic performance in practical biology.

Table 2: Regression analysis on the attitude of students and students' academic performance in practical Biology in secondary schools in Etinan Local Government Area

Model	Sum of Squares	df	Mean Square	F	P-value	Decision
Regression	39512.413	1	39512.413	1628.025	.000[b]	
Residual	8154.771	336	24.270			Reject H_0
Total	47667.183	337				

a. Dependent Variable: Students' Academic Performance in Practical Biology

b. Predictors: (Constant), Attitudes.

* Significant at the 0.05 level of significance

Table 2 represents the regression analysis on the attitude of students and students' academic performance in practical Biology in secondary schools in Etinan Local Government Area. The Table revealed the F-value as 1628.025 and the P-value of .000 which is less than .05 level of significance. The prediction is significant. Therefore, the null hypothesis two which stated that attitude of students does not significantly predict students' academic performance in practical Biology in secondary schools in Etinan Local Government Area is rejected. This shows that attitude of students significantly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.

Hypothesis three: Science process skills do not significantly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area as moderated by gender.

Table 3: Regression analysis on the Science process skills and students' academic performance in practical Biology in secondary schools in Etinan Local Government Area as moderated by gender N = 338

Model	Sum of Squares	df	Mean Square	F	P-value	Decision
Regression	39104.092	4	9776.023	380.168*	.000[b]	
Residual	8563.092	333	25.715			Reject H_0
Total	47667.183	337				

a. Dependent Variable: Students' Academic Performance in Practical Biology

b. Predictors: (Constant), measuring skill_c, communication skill_c, observing skill_c, gender_c.

* Significant at the 0.05 level of significance

Table 3 shows the regression analysis on how science process skills predict students' academic performance in practical Biology in secondary schools as moderated by gender. The Table revealed the F-value as 380.168 and the P-value of .000 which is less than 0.05 level of significance. The prediction is significant. Therefore, the null hypothesis three which stated that science process skills interacting with gender does not significantly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area is rejected. This shows that science process skills and gender significantly jointly predicts students' academic performance in practical Biology in secondary schools in Etinan Local Government Area.

Discussion of Findings

The analysis of the result of research question one using regression analysis regarding science process skills and students' academic performance in practical Biology revealed that science process skills is very highly predict students' academic performance in practical Biology. This may be upheld from the fact that science process skills such as observing skill are the very foundation of the hierarchy of those science skills. Thus, the ability to make scientific observations affects students' ability to formulate testable questions, to record accurate and relevant data in an inquiry. This is in consonance with Sahnaz *et al.* (2018) who maintained that observing skill is one of the fundamental science process skills that should be acquired by students at the elementary school. This finding supported that of Awolere (2015) who posited that these skills are special skills that students and teachers use in carrying out mental operation of and physical activities in the field of science.

The finding of hypothesis one through regression analysis indicated that science process skills significantly predict students' academic performance in practical Biology. This is in line with Amoah *et al.* (2018) who found that students from the private schools performed significantly better than the students from the public school on the science process skills. This supported the finding of Asyari *et al.* (2022) who found that the obstacles encountered when using learning tools are that students are unfamiliar with communication skills, making some students less active participants in the learning process. Therefore, students respond positively to the learning process after participating in the teaching and learning process. Moreover, the finding of Edikpo *et al.* (2024) showed a significant difference in the mean achievement scores of Biology students taught the concept of classification of animals using concept mapping, field trip and expository method.

The analysis of the result of research question two using regression analysis revealed that attitude of students very highly predict students' academic performance in practical Biology. Attitude helps students to carry out scientific activities or scientific procedures. This is in line with Owoeye and Agbaje (2016) who showed a significant relationship in the students' attitude to Biology and students' academic performance in Biology. The finding of hypothesis two using regression analysis showed that attitude significantly predicts students' academic performance in practical Biology. This is in consonance with Akpan (2022) who found that a negative, moderate significant relationship between teacher's skills and students' attitude to Biology. Hence, there is therefore a correlation between teachers' skills and students' attitudes in biology. The analysis of the result of research question three using regression analysis revealed weak prediction of science process skills on students' academic performance in practical Biology in secondary schools in Etinan Local Government Area as moderated by gender. This is in line with Bassey and Amanso (2017) who showed that various biological differences in human make-up such as are differently inherent in male and female students may be responsible for some disparities in school performance of the two groups. The finding of hypothesis three using regression analysis showed that science process significantly predicts students' academic performance in practical Biology as moderated by gender. This is contrary with the finding of Akpan (2022) who showed no significant gender difference in students' academic achievement and retention in various subjects. The finding of Ogbogu and Osuafor (2021) also showed a significant positive relationship between science process skills acquisition and achievement in biology, and male students' science process skills correlated significantly with their biology achievement.

Conclusion

Based on the findings of this study, it could be concluded that science process skills and attitude significantly predict students' academic performance in practical Biology irrespective of gender.

Recommendations

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

1. Government through State Secondary Education Board should regularly organize conferences, workshops and seminar for teachers and students on the relevance of science process skills especially observing skills on students' academic performance in practical Biology in secondary schools.
2. Biology teachers should always consider the use of Biology laboratories during practical Biology class for students to exhibit the communication skills so as to improve their academic performances.
3. Government through State Secondary Education Board should always collaborate with private individuals to ensure the availability of relevant science apparatus and equipment in secondary schools for effective teaching and learning of practical Biology by students.
4. School Counselors and Curriculum planners for senior secondary school should work cooperatively to ensure that the basic contents of science processes and attitude is integrated into school curriculum for proper implementation by teachers.

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