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Science Process Skills and Academic Performance of Students in Cross River State Colleges

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Abstract
The study examines the science process skills acquisition and academic achievement of Chemistry/ Biology students in colleges of education in Cross Rivers State, Nigeria. A null hypothesis was formulated to guide the study. Observing, inferring, measuring and classifying skills are not significant predictors of a student's academic performance in biology. The research design adopted for this study was ex post facto. A census study of 134 NCE 2 students of Akamkpa and Obudu Colleges of Education was used for the study. Two Biology Performance Tests (BPT) and a science process skill acquisition test (SPSAT). These instruments were validated in the Departments of Biology Education and Measurement and Evaluation. Kuder Richardson 20 (KR20) and Cronbach alpha reliability methods were used to estimate the reliability indices for biology performance tests. One-way analysis of variance and multiple regression analysis were used to test the null hypothesis. The result revealed that observing, informing, measuring and classifying skills are significant predictors of student's performance in biology. Based on the finding, it was concluded that observing, inferring measuring and classifying science process skills are significant predictors of student's performance in biology. It was recommended among others that science teachers should encourage the use of science process skills in other to facilitate the learning of science concepts as well as provide a good spirit of science among learners.

Keywords: Process Skills, Skills Acquisition, Academic Performance, Science students, Biology learning

Introduction

Science processes are the collection of aptitudes used for science activities. Science students with good procedural skills are more interested in their studies. Suppose teachers designed the learning stage in such a manner. In that case, students will have chances to actively engage in learning. (Safaah et al., 2017). The American Association for the Advancement of Science (AAAS, 1967) classified the science process skills into fifteen. These are observing, measuring, classifying, communicating, predicting, inferring, using numbers, using space/time relationships, questioning, controlling variables, hypothesizing, defining operationally, formulating models, designing experiments and interpreting data. According to Ango (2011), science process skills can be classified into two categories basic and integrated process skills. The basic (simpler) process skills provide a foundation for learning the integrated (more complex) skills. Basic science processes are vital for science learning and concept formation at the primary and junior secondary school levels. More hard and integrated science process skills are more suitable at the senior secondary and tertiary school levels for the formation of models, experimenting and inferring. Therefore, both basic and integrated science process skills are pertinent and suitable at the senior secondary school level in Nigeria. Ugwuanyi and Nwafor (2021) identified a level of acquisition of seven (7) out of the fifteen (15) science process skills. These comprised five (5) basic science process skills (observation, measuring, recording, communication and inferring skills) and two (2) integrated science process skills (controlling variables and experimenting). Each scientific processability is a skill that students use in several circumstances throughout their lives. There are lots more than simply "science". (Dourham et al 2017).

In inquiry based hands-on science learning "doing" science involves putting the process into action. In general, the definition of science process skills is basically a formation of transferable abilities appropriate for the scientific field. Students apply these process skills to understand better how scientists explore and answer their questions. There are two types of science process skills (SPS) which are classified into fundamental and integrated processes. The fundamental actions necessary in scientific inquiry are known as basic processes. These include observing, communicating, measuring, classifying, inferring and predicting. They are the core abilities that underpin all

scientific inquiries. On the other hand, integrated process skills involve the control of variables, operational definition, data interpretation and experimentation. These skills are essential for students to design and conduct scientific investigations. (Widyaningsih,et al, 2020) SPS is an important aspect of teaching to achieve good knowledge. Hikmah et al. (2018) affirm that SPS skill in the learning process is not only served as the basis of scientific methods but also learning about the characteristics of knowledge. The purpose of science education is to enable individuals to use scientific skills, in other words, to be able to define problems around them, to observe, analyze, experiment, conclude, generalize and apply the information they have with the necessary skills known as science process skills.

Science process skills are an integrated part of the teaching of science. In school's science curriculum focuses upon the science process skills as essential tools that support the students in constructing knowledge . These skills, therefore, affect the personal, social and global lives of individuals. For the student to comprehend the science concepts laws, principals, theories etc, it becomes essential to develop the ability to link the constructed knowledge and developed skills. Science process skills nurture critical thinking as by nature they are investigative (Ostlund, 1992, in (Ahuja, 2016). The science process skills are an integral part of the teaching of science. Science as a discipline evolved because of those process skills namely, collection of information and interpretation of data, identifying the variables, defining the variables, describing the relationship between the variables, hypotheses information, designing experiments, data analysis, drawing conclusions, generalization etc. Science process skills simplify the learning of science, motivate students, foster a sense of responsibility among them with respect to learning, and enhance the permanency of learning (Ahuja, 2016).

The major aim of Nigerian education is to produce productive citizens (Okoli, 2019). In teaching the process of science, emphasis must be placed on the active participation of learners in the learning process. They should have ample opportunity to handle materials, manipulate simple equipment and test their ideas experimentally by so doing, they will be more involved in acquiring suck skills. These activities have a lasting effect on their minds and thus make for their easy transfer of knowledge to related situations. When little or no process skills acquisition and development is encouraged in the learners, it could limit the options available for a nation striving toward sustainable development. Realizing the importance of science process skills on students' academic performance, the federal government among other things, stated as one of the national goals of education in Nigeria that; education should aim at helping a child to acquire appropriate skills, abilities and competencies, both mental and physical as equipment for the individual to live in and contribute to the development of the society (FRN, 2014). According to Peter (2013), a number of factors have been linked to the non-acquisition of skills by students which invariably leads to poor academic performance in biology, especially its practical aspect.

Limba (2012) posted that students tend to understand and recall what they see more than what they hear as a result of using labs in teaching and learning of sciences. In every biology examination, students are required to observe, infer, measure and classify specimens, such questions reinforce observing, inferring, measuring and classifying skills in students, primarily as a means of demonstrating their content of biology knowledge. He suggested that students might be missing valuable learning opportunities if teachers are not prepared to take advantage of the rich evidence in students' thinking that comes from the ability to observe, infer, measure and classify strategy in science and biology in particular. By observing specimens, asking questions, making interpretations, measuring and classifying during biology practical sessions, students get involved in the learning process. This makes learning effective apart from promoting the development of other science process skills (Eric 2013). Process skills of observing, informing, measuring and classifying are the essential basic science process skills that are applicable to many sciences. The acquisition of these basic process skills facilitates learning in physical sciences, ensures active students' participation, helps students develop a sense of understanding responsibility in their own learning, increases the performance of learning and also increases students' skills of observing, inferring, measuring and classifying are the building blocks of critical thinking and acquiring in science (Ostlound, 1992) in Okoli 2019).

The acquisition of this basic approach to processes and its effective application by the learners act as a predictor to their performance in sciences and biology in particular. Science process skills abilities are associated with student's achievement. Its purpose is to address issues and come up with effective answers. (Dannaji,et al 2020). Dakabesi and Louise (2019) opined that science process abilities will influence students to take environmental challenges realistically. A significant amount of work is required to develop excellent process skills and critical thinking. In the case of academic achievement, its development together with the child's cognitive abilities is crucial. (Peng and Klevit, 2020). The teacher's professional development influences classroom instructions, hence, the academic achievement of the students as well. (Fisher et al, 2018). In addition, Mirana (2019) disclosed that students have a positive attitude toward science. However, their science process skills are not well developed. The same finding by Bete (2020) study revealed poor process skills in one science class in grade 8 students.

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Barantes and Tamoria (2021) also reveal the effectiveness of a learning technique to help improve basic science process skills acquisition.

Akinbobola (2007) in Okoli 2019 conducted a study to analyze the science process skills of observation inference, measurement and classification in junior secondary school practical examinations in Ondo State for a period of 10 years (1998-2007). The ex-post facto design was adapted for the study. The result shows a high percentage rate of performance by the students. The result indicates that basic science process skills determine student's performance in biology. Collective sub-variables such as observing, informing, measuring and classifying are basic process skills which have not received due emphasis and yet, are very fundamental for effective instructions Eric (2013) noted that teachers do a great deal of telling and demonstrating at the expense of engaging learners in activities which will foster and even make the process enjoyable. Eric (2013) while investigating strategies by teachers to improve students' mastery of observing and inferring skills and academic performance in the biology west district of Kenya using the simple size of 360 reported that the proportion of respondents who reported having problems in observing and inferring was 68%, while 12% of the respondents were effective in observing and inferring in practical biology. Eric also stated that those who were able to observe and infer in the practical biology work performed better academically than those who could not.

Timba (2013) surveyed mastering observing and inferring skills as a factor affecting the academic performance of students in biology in Bungoma West District of Kenya Schools and students were sampled through a simple random sampling technique. Temba reported that 80.15% of students sampled out of 100% lack observing and inferring skills, while 14.85% of students sampled out of 100% acquired observing and inferring skills. Afif, (2015) conducted a study on science process skills and attitudes toward science among Palestinian secondary school students and reported that there is a significant difference in science process skills due to gender favouring females. While Feyzioglu (2011) conducted a study on investigating on the relationship between science process skills of observing, inferring, measuring and classifying with efficient laboratory use and academic performance in Biology. The result shows that a significant and positive linear relationship was found between the report prepared by the students at the end of the laboratory class and basic and high-level science process skills dealt with during the laboratory application.

Boyo (2010) also determined the effect of measuring skills on students' performance in biology in Lagos State, using a descriptive survey research design and selected 15% of the schools in the area using a stratified random sampling technique which was 33% of the targeted population was selected using simple random sample technique. In mixed schools, the subjects were obtained using a stratified sampling technique to ensure gender equality. The teachers for the study were selected using a purposive sampling technique. Three instruments were used to collect data, the teachers' questionnaire (TQ), students' questionnaire (SQ) and students test (ST). Data obtained was analyzed using both descriptive and inferential statistics using SPSS computer software. The study found that the strategies used in helping students to master measuring and classifying skills were adequate; moreover, the problem students encountered in measurement and classification and strategies used by teachers to develop measuring and classifying skills in students, had a significant effect on performance in biology.

Ugwuanyi and Nwafor (2021) The study was aimed at ascertaining the science process skills acquired by senior secondary school Chemistry students in qualitative analysis in Enugu Education Zone. The sample was made up of sixty (60) secondary school students (SSS III) from six (6) secondary schools. The study adopted a descriptive survey design. The science process skills examined were observing, experimenting, controlling variables, measuring, recording, communicating and inference using qualitative analysis. The tool for data gathering was the qualitative analysis skills rating scale (QASRS) modified by the researchers and authenticated by the science educators at the University of Nigeria, Nsukka. The tool contained twenty-seven (27) qualitative analysis items (QLA). Kendall's coefficient of concordance was used to establish the inter-rater reliability index of 0.803. The internal consistency reliability coefficient of the instrument was 0.732 via Cronbach's alpha. Data collected were analyzed using mean, standard deviation, Z-test and ANOVA. The result of the study shows that students had a low level of achievement in controlling variables, recording, communication and inference. Gender and school type had no significant influence; school location had a significant influence in favour of Urban, it was recommended among others that pedagogical inspectors, principals and school administrators should be firm on the use of the science laboratory by science teachers

The background provided so far shows that although there is an endorsement that students of colleges of education, as well as other students, perform low in science and biology inclusive, it is not clear whether observation, inferring, measurement and classifying among other science processes skills have any influence on student's academic performance in biology. This, therefore, brings about the need for the present study which sick to

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investigate the influence of science process skills acquisition on students' academic performance in biology, in colleges of education, Cross Rivers State, Nigeria.

Research questions

1 To what extent does the acquisition of observation skills influence the performance of students in biology?
2 To what extent does the acquisition of science process skills of observation, inference, measurement and classification predict students' performance in biology?

Hypotheses

1 There is no significant influence of the acquisition of observational skills on students' performance in biology.
2 Observing, inferring, measuring and classifying in science process skills are not significant predictors of students' performance in biology.

Methodology

The research design adopted for this study was ex post facto. The population of the respondents comprised 134 NCE II Chemistry/ Biology students from the two institutions selected for the study. That is Cross River State College of Education Akamkpa 63 and federal college of education Obudu 71. The whole population was used for the study. Two instruments were used for the study, i.e. Biology Performance Test (BPT) and the Science Process Skills Acquisition Test (SPSAT) The instrument was developed by the researchers and subjected to face and content validity by two lecturers in the Departments of Biology and Measurement and Evaluation. Kuder Richardson 20 (KR20) and Cronbach alpha reliability methods were used to estimate the reliability indices for the biology performance test Biology Performance Test (BPT) and Science Process Skills Acquisition Test (SPSAT) The reliability coefficient of the instruments was 0.76 and 0.86 respectively. The research questions were answered using mean and standard deviation while the hypotheses were tested using Analysis of Covariance (ANCOVA), Analysis of variance (ANOVA) and multiple regression. The hypothesis was accepted when the calculated value of t is less than the p-value and accepted when the calculated value of t is greater than the p-value.

Results

Research question 1: To what extent does the acquisition of observation skills influence the performance of students in biology?

Hypothesis 1 There is no significant influence of the acquisition of observational skills on students' performance in biology.

To test the hypothesis of the significant influence of observational skill on students' performance in biology, the one-way analysis of variance (ANCOVA) was used with the result as shown below.

Table 1 Summary data of one-way analysis of variance (ANCOVA) of influence of observational skills on students' performance in biology.

Variable	N	X	SD
High	44	44.7609	5.2374
Midrate	52	36.3943	6.3943
Low	38	38.3056	5.615
Total	**134**	**37.2388**	**8.63215**

ANCOVA

Source of Varian	sum of square	df	mean square	F	Sig
Between-group	5487.119	2	2743.559	81.254	.0000
Within group	4423.239	131	533.765		
Total	**9910**	**133**			

P> 0.05 critical $F_{(2,131)}$ =133.00

In Table One, since the calculated F-ratio of 81.254 is greater than the critical F-ratio of 3.00 at 0.5 level of significance and $F_{(2,131)}$ degree of freedom for the two-tailed tests, it follows that there is a significant influence

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of observational skills as (categorized) on students' performance in biology. The null hypothesis of "no significance influence" is therefore rejected but the alternative hypothesis is accepted.

Research question 2: To what extent does the acquisition of science process skills of observation, inference, measurement and classification predict students' performance in biology?
Hypothesis 2 Observing, inferring, measuring and classifying in science process skills are not significant predictors of students' performance in biology.

The null hypothesis stated that inferring, observing, measuring and classifying science process skills are not significant predictors of students, performance in biology was tested with multiple regression analysis.

The intercorrelation among the variables in the hypothesis is shown in Table 1 while the regression analysis results are shown in Table 2.

Biology Performance Observing, Informing Measuring and Classifying Skills.
Table 2

Variables	BPT	OS	INS	MS	CS
BPT	1.000	.714	.631	.667	.695
Observing skills (OS	.741	1.000	.722	.771	.781
Inferring skills (IN)	.631	.722	1.000	.679	.751
Measuring skills (MS)	.667	.771	.679	1.000	.828
Classifying skills (CS)	.695	.784	.751	.828	.100

Multiple correlation R = 754; R^2 = 569

This table shows that all bivariate person's coefficient is significant at 0.05. The multiple correlation variables are .754 which is significant at 0.05 level of significant. The percentage of variance in the predicted variable accounted for by the predictors is .569 which is very moderate.

Table 3
Multiple regression analysis of the prediction of biology performance from observation, inference, measurement and classification
ANOVA

Source of variables	Sum of square	Df	Mean square	F	Sig
Regression	4160.351	4	1040.088		0.000
Residual	3152.108	93	33.894	30.687	
Total	**7312.459**	**97**			

Model	Regression Weight	Standard Error	t-value	Sig
Constant	17.636	2.305	7.650	.000
Observation	.651	.224	2.905	.005
Inference	.215	.188	1.140	.257
Measuring	.197	.195	1.005	.317
Classification	.281	.186	1.517	.133

P<0.05 shows the multiple regression result

It shows regression weights of independent variable and t-value that tested the significance of the regression weight or the predictive ability of the independent variables. It implies that biology performance can be significantly predicted by observation skills (t=2.905; P = .005 P = .224), inference skills (t = 1.140; P = .257; B = .195); classification skill (t = .517; P =133; B = 186). Observational skills, inferring skills, measuring process skill and classification skills are significant predictors of students' biology performance hence the null hypothesis is rejected.

Discussion

The result of hypothesis 1 in Table 1 showed that there is a significant influence of the acquisition of observation skills on students' performance. This means that students who acquired high observational skills perform better than those who have low observational skills. That is students' performance in biology is a function of acquiring observational skills. The finding of this hypothesis is in agreement with Ahuja(2016); and Feyzloghu (2011). The finding also agrees with Afif (2015) who shows that significant and positively linear relationship between the report prepared by the students at the end of the laboratory class and basic and high-level science process skills dealt with during the laboratory application.

The finding of hypothesis 2 in Tables 2 and 3 revealed that process skills acquisition (observing, inferring, measuring and classifying) are significant predictors of students' performance in biology. This means that process skills (observing, inferring, measuring and classifying are the building block of critical thinking and inquiring in science.

The finding of this hypothesis is in consonant with Akinbola (2007); Eric (2013) and Boyo (2010) who found that the strategies used in helping students to master measuring and classifying skills were adequate; moreover, the problem students encountered in measurement and classification and strategies used by teachers to develop measuring and classifying skills in students, had a significant effect on performance in biology.

The findings of this hypothesis teach the educational stakeholders that process skills of observing, measuring inferring and classifying are the essential basic science process skills that are applicable to many sciences the result of the study disagrees with Ugwuanyi and Nwafor (2021) that shows that students had a low level of achievement in controlling variables, recording, communication and inference.

Conclusion

The study investigated the science process skills acquisition and academic achievement of Chemistry/ Biology students in colleges of education in Cross Rivers State, Nigeria. Science process skills simplify the learning of science, motivate students, foster a sense of responsibility among them with respect to learning, and enhance the permanency of learning Based on the findings of the study, it was concluded that; observing, inferring, measuring and classifying science process skills are significant predators of students' performance in biology.

Recommendations

The following recommendations were made on the basis of the findings obtained from the study.

1. Science teachers should encourage students at all levels to properly use of basic science process skills in other to facilitate the learning of science concept as well as promote the good spirit of science among learners.
2. Science process skills should be encouraged by WAEC, NECO as well as colleges of education and other educational institutions in science practical examinations to enable learners to acquire creativity, problem-solving skills, reflecting thinking, congeniality and methods which are vital ingredients for scientific and technological development of the nation.

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