



Assessment of Selected Science Process Skills Acquisition among Senior Secondary Schools Students in Calabar Education Zone of Cross River State, Nigeria

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Abstract

This study assessed selected science process skills acquisition among senior secondary students in Calabar Education Zone of Cross River State, Nigeria. To achieve this, three hypotheses were formulated to guide the study. Survey research design was adopted for the study. Using stratified random sampling techniques, a sample of 413 science students was selected from a population of 4212 science students for the study. The questionnaire was the main instrument for data collection. The instrument was subjected to both face and content validation. The reliability estimates of the sub-components of the instrument were established through the Cronbach coefficient alpha method that showed indices that ranged from .73 to .91. Population t-test statistical analysis technique was used to test the three null hypotheses at .05 alpha level. The results of the statistical analysis revealed that students' science process skills acquisition, with respect to computation, problem-solving, and making of inference were significantly high. Based on the findings of the study, it was recommended that proper training and re-training of science teachers should be made to ensure that they are equipped with pedagogical competence in identifying students' process skills acquisition.

Keywords: Science process, Skills acquisition, Computation skill, Problem-solving skills, Inference making skills, Assessment.

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INTRODUCTION

As science and technology become increasingly complex and more integrated into the contemporary social fabric in the 21st century, there is a great emphasis placed on science education because science and technology is seen as the basic tool for the growth and development of any nation. Individual and group exclusion from science learning can lead to barriers that present their full participation in the society. It is on this note that the Federal Republic of Nigeria (2004) in her National Policy on Education emphasizes the teaching and learning of science process and principles. Thus, it is hoped that this will lead to fundamental and applied research in science at all levels of education.

One of the guiding principles of the National Science Education Standards (NSES) is simply science for all students (Sheridam, 2001). This principle underscores the belief that all students, regardless of race, gender, or disability, should have the opportunity to learn and understand the essential science content described in the standards. Despite these efforts, poor performance in science in general has become the primary worry of all serious minded stakeholders in the educational system at all levels. There have been incessant reports of general poor performance of students in sciences in public examinations in the school system. Some educators and parents are wary of aspects of the new standards and inclusion practices, which they see as potentially placing higher expectations on students without providing necessary support (Stock, Desoete & Roeyers, 2006). Similarly, Salau (2006) maintains that statistics abound to show that massive failure in science examinations is real and the trend of students' performance has been on the decline.

Science as used here entails major foundational science subjects like mathematics, biology, chemistry and physics. There are areas or skills of science that prepare students for scientific explorations and endeavours. One of such areas or skills is science process skills acquisition. Edem (2009) has traced the root cause of these problems in science education to; acute shortage of qualified science teachers; overcrowded science classroom; adherence to old teaching methods inspite of exposure to more viable alternatives, students' attitude towards science; and undue emphasis on syllabus coverage at the expense of meaningful learning of science concepts, to mention but a few. Little or no emphasis has been placed on the difficulty of learning science concept as well as individual differences with respect to students' science process skills acquisition.

Science process skills acquisition refers to a variety of abilities that affect the acquisition, retention, understanding, organisation or use of verbal and/or non-verbal information. Science process skills acquisition in a generic term refers to a heterogeneous group ability manifested in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities, or of social skills (Hallahan & Mercer, 20002). Among school-aged children, science process skills acquisition may be seen as deficient skills in computation, making inferences, problem-solving, and short attention span. These forms of skills may impede and/or promote science learning outcomes in one way or the other.

Computation skills refers to abilities to calculate basic addition, subtraction, multiplication, and division problems quickly and accurately using mental methods, paper-and-pen, and other tools, such as calculator. Computation skill required the selection of the appropriate arithmetic operation. It requires the execution of the steps to calculate the solution. Computation skills can be carried out only by humans, but with the aid of calculators or computers, as well (Lyon, 2008). Computation skills are important because they will enable students to easily navigate everyday life tasks such as finding the price of marked down merchandise, figuring out which size of item provides the best value for their money and accurately doubling or halving cooking recipes, to mention a few.

Galleto and Refugio (2011) conducted a study to find out the students' skills in mathematical computation using graphic calculator in teaching mathematics among freshmen of the College of Education of Jose Rizal Memorial State University, Philippines. It was an experimental study. The skills that the students possessed in both the control and the experimental groups on the topics included in this experiment is equivalent or comparable before the intervention. The study revealed that there is a significant variation in the students' skills in mathematical computation between the control group with the traditional method of teaching and the experimental group with the use of graphing calculator in teaching and learning mathematics. This concludes that students' in the experimental group performed skilfully better than their counterparts in the control group.

Problem-solving skills refer to mathematical tasks that have the potential to provide intellectual challenges for enhancing students' mathematical understanding and development (Lester & Charles, 2003). Problem-solving is one of major aspects in mathematics/science curriculum which requires students to apply and integrate many mathematical/scientific concepts and skills as well as making decisions. Many students struggled to accomplish mathematics especially problem-solving (Ibrahim, 1997; Tarzimah, 2005; Garderon, 2006). However, they still need to learn mathematics because of its importance in daily life (Meese, 2001; Aziz, 2002; Berch & Mazzocca, 2007; Kaufman, 2008). They must be able to solve problems because problem solving is important for the development of human competences (Subahan, 2007). In real life, students need to solve problems because that is a basic way to survive in our daily living. The primary and secondary mathematics curriculum emphasized on arithmetic; problem-solving, communication, mantic-thinking, connection-building and technology application skills (Curriculum Development Centre, Ministry of Education, 2003). Problem-solving is an integral part of science learning. Students learn and understand mathematics (and other science subjects) through solving mathematically rich problems and problem-solving skills are developed through learning and understanding mathematics concepts and procedures (Lester & Charles, 2003).

Lack of many mathematics skills caused difficulties in making inference and solving problem. Students are required to apply and integrate many mathematical concepts and skills during the process of making decision and problem-solving. Garderen (2006) stated that deficiency in visual-spatial skill might cause difficulty in differentiating, relating and organising information meaningfully as well as drawing inferences. However, the lack of mathematics skills among students varied (Hill, 2008; Kaufman, 2008).

Science process skills acquisitions are by far the most common needed elements among children of school-age (Hallahan & Mercer, 2002). In terms of science based subjects', students with science process skills acquisition need computation, making of inferences, and problem-solving skills. Without these skills, they often have problem in sustaining attention to task remembering procedures, deadlines, among others. Disability in computation impedes the child's ability to apply mathematical principles that are essential in the teaching and learning of sciences. Effective earning of sciences also revolves around problem solving as well as making of inference from observations.

According to Sinha (2003), in mathematics and science, students with science process skills acquisition often do not have problems in computation, problem-solving, making inferences, and integrating new and prior knowledge. Memory, motor, and attention deficits are also not common among them. Students associated with poor science process skills acquisition have challenges characterised by poor performance in computing and solving basic science problems. They may also have problem of making inferences. It is from this backdrop that this study was conducted on the assessment of science process skills acquisition among senior secondary school students in Calabar Education Zone of Cross River State, Nigeria. Therefore, the study assessed science process skills acquisition of senior

secondary two (SS₂) science students in; computation, problem-solving, and making inference.

Hypotheses

The following hypotheses were formulated to guide the study:

- The science process skills acquisition of senior secondary two SS₂ science students in computation is not significantly high.
- The science process skills acquisition of SS₂ science students in problem-solving is not significantly high
- The science process skills acquisition of SS₂ science students in making inferences is not significantly high.

METHODS

Survey research design was adopted for the study. This was considered most appropriate because it allows the researchers to make inference and generalisation of the population by selecting and studying the sample for the study. The research area for this study is Calabar Education Zone of Cross River State, Nigeria. It comprises seven local government areas, namely: Akamkpa, Akpabuyo, Bakassi, Biase, Calabar Municipality, Calabar south, and Odukpani. The population of this study consisted to all the SS₂ Science students in the zone, numbering 4,212 in the 2015/2016 school year (Post Primary School Board, Calabar, 2016). Stratified random sampling technique was used to select, based on local government areas (LGAs), 421 from 4,212 SS₂ science students as the sample for the study.

A 30-item instrument titled: “Science Students’ Process Skills Acquisition Test (SSPSAT)” constructed by the researchers was used for data collection. The instrument was designed to respondents’ ability in computation, problem solving and inference making skills. The test was developed with the help of the table of specification shown in Table 1.

Table 1: Table of specification for science students’ process skills acquisition test

Content (skills)	Comprehension (30%)	Application (46.7%)	Analysis (23.3%)	Total (100%)
Computation skills (33.3%)	2	3	5	10
Problem solving skills (33.30%)	3	6	1	10
Inference making skills (33.3%)	4	5	1	10
Total (100%)	9	14	7	30

Ten (10) questions were developed to test respondents’ skills acquisition level in each of the three skills. The test was designed to ensure that respondents show clear working to reveal how well they acquire the respective skills. The instrument was both face and content validated. Using Cronbach Alpha method, the reliability estimates that ranged from .73 to .91 were established.

Out of the 421 copies of the instrument administered to the respondents, only 413 were correctly filled. The other eight copies were invalidated because they were either not correctly filled or not returned to the researchers. The 413 retrieved copies of the instrument were duly coded and collated for statistical analysis.

RESULTS

Hypothesis 1: The science process skills acquisition of SS₂ science students in computation is not significantly high.

The only one variable in this hypothesis is the science process skills acquisition of science in computation. To test this hypothesis, we need to compare sample mean with the population mean. Population t-test statistical analysis was employed to test this hypothesis as shown in Table 2.

Table 2: Population t-test analysis of the science process skills acquisition of science students in computation (N = 413)

Computation skills	N	Mean	SD	t-value	p-value
Sample mean	413	18.75	1.41	97.22*	.000
Population mean		10.00	0.00		

* Significant at .05; critical t = 1.960; df = 412

The results of the analysis presented in Table 2 shows that the calculated t-value of 97.22 is greater than the critical t-value of 1.96 at .05 level of significance with 412 degrees of freedom. With these results, the null hypothesis 1 was rejected and its alternative retained. This implies that the science process skills acquisition of science students in computation is significantly high in the research area.

Hypothesis 2: Science process skills acquisition in problem solving among science students is not significantly high.

The only one variable in this hypothesis is science process skills acquisition in problem solving. Population t-test statistical analysis was employed to test the null hypothesis 2 at .05 alpha level. The results are presented in Table 3.

Table 3: Population t-test analysis of the science process skills acquisition of science students in computation (N = 413)

Problem solving skills	N	Mean	SD	t-value	p-value
Sample mean	413	18.75	1.31	140.00*	.000
Population mean		10.00	0.00		

* Significant at .05; critical t = 1.96; df = 412

The results of the analysis presented in Table 3 shows that the calculated t-value of 140.00 is greater than the critical t-value of 1.96 at .05 alpha level with 412 degrees of freedom. With those results, the null hypothesis 2 was rejected, and its alternative retained. This implies that the science process skills acquisition of science in problem solving among science students is significantly high in the research area.

Hypothesis 3: The science process skills acquisition of science students in making inference is not significantly high.

There is only one variable in this hypothesis, which is the science process skills acquisition of science students in making inference. Population t-test analysis was employed to test this hypothesis at .05 level of significance. The results of the statistical analysis are as presented in Table 4.

Table 4: Population t-test analysis of the science process skills acquisition of science students in making inference (N = 413)

Problem solving skills	N	Mean	SD	t-value	p-value
Sample mean		16.53	2.17		
	413			59.27*	.000
Population mean		10.00	0.00		

* Significant at .05; critical t = 1.96; df = 412

The results of the analysis presented in Table 4 shows that the calculated t-value of 59.27 is greater than the critical t-value of 1.96 at .05 alpha level with 412 degrees of freedom. With this results, the null hypothesis 3 was rejected. This implies that the science process skills acquisition of science students in making inference is significantly high in the research area.

DISCUSSION OF FINDINGS

The result of the hypothesis 1 revealed that the learning science process skills acquisition of science students in computation is significantly high in the research area. The finding of this study is somewhat in consonant with the view of Galleto and Refugio (2011) who deduced that there is a significant variation in the students' skills in mathematical computation between the control group with the traditional method of teaching and the experimental group with the use of graphing calculator in teaching and learning mathematics. This means that students performed skilfully better during the post-test than during the pretest. They concluded that the treatment given to the science students by their teachers had significant effect on their computation skills. Computation skills remain an integral part of students' science education because they lay the foundation for success in future mathematical learning such as algebra, geometry, trigonometry, calculus, in particular, and science, generally. Hence, efforts at improving the skills by both the teachers and the science students should be encouraged.

The result of the hypothesis 2 revealed that science process skills acquisition in problem solving among science students' is significantly high in the research area. The finding of this study agreed with Lester and Charles (2003) who noted that the problem-solving skills have value in many areas of life. Employers of labour value employees who can solve problems without the need to always find a supervisor or monitoring team. Entrepreneurs may need to think outside the box to create a business that thrives and stands out from other similar businesses. Similarly, a student who excels in problem-solving can earn higher grades in science related subjects like mathematics, chemistry and physics. This skill set for problem solving in all these areas have the same components.

In real life, students need to solve problems because that is a basic way to survive in our daily life and problem-solving is seen as the language for daily living. Many students struggled to accomplish mathematics and science in problem-solving. However, they still need to learn mathematics because of its importance in daily life. They must be able to solve problems because problem-solving is important for the development of human competencies.

The result of the hypothesis 3 revealed that science process skills acquisition of science students in making inference is significantly high in the research area. The finding of

this study seems to agree with Garderen (2006) who stated that deficiency in visual-spatial skill might cause difficulty in differentiating, relating and organising information meaningfully as well as drawing inferences. However, the lack of mathematics and indeed making inference skills among students vary. Incomplete mastery of number facts, weakness in computation, inability to connect conceptual aspects of mathematics, inefficiency to transfer knowledge, difficulty to make meaningful connection among information, incompetency to transform information mathematically, incomplete mastery of mathematical terms, incomplete understanding of mathematical language and difficulty to comprehend and visualise mathematical concept might result in science process skills acquisition in inference making.

The basis for understanding how meaningful learning can occur in terms of the importance of being able to infer and/or to link new knowledge on to the network of concepts, already exist in the learner's mind. The ability to link these network of concepts properly and appropriately will call for making of inference skills. Concepts developed as new ideas are linked together through making inference, and the learner, and indeed science student, who does not always correctly make such links would have misconceptions-where students possess knowledge without understanding. Therefore, correct inference making is a basis for proper understanding.

CONCLUSION

The findings of this study revealed that science students possessed or have acquired high science process skills in computation, problem-solving and making of inference. Therefore, if science students in the area of the study were found wanting in science process skills acquisition, then something other than computation skills, problem-solving skills, and making of inference skills, were responsible.

Recommendations

- Proper training and re-training of science teachers should be made to ensure that they are qualified and equipped with pedagogical skills and impact same to students.
- The government/proprietors of schools should give priority to equipping the science laboratories and improving the teaching and learning environment.
- Practical work should be emphasized for the proper acquisition of science process skills.

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