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AN ASSESSMENT OF SCIENCE PROCESS SKILLS AMONG SCIENCE STUDENTS IN RIVER STATE, NIGERIA

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Abstract

The present study assessed junior secondary school students' basic and integrated science process skills. The study was conducted during the 2021/2022 academic year in the post-primary education zones of River state, Nigeria. The participants completed a self-report measure of the SPS. A descriptive research method was adopted in the study. The percentage analysis conducted on the data revealed that most respondents (66.2%) were more familiar with the concept of basic science process skills than (33.8%) of their counterparts. Conversely, the result revealed high unfamiliarity with integrated science process skills among the students (84.4%). The finding revealed a gap in science teaching and learning in River state's post-primary education system. It is recommended that teachers improve their pedagogical strategies in the science classroom. The result has implications for developing science education.

Keywords: *science process skills, science students, basic, integrated, junior students*

INTRODUCTION

Science education is essential for 21st-century education (Kalogiannakis et al., 2021) and should begin at a young age (Tavares et al., 2021). The growing number of global, technological, and scientific advancements have necessitated adequate performance in science education at all levels of education (Taştan et al., 2018). Science education is a field concerned with imparting scientific knowledge and methods to students who do not have a scientific background (Ohunene & Ebele, 2014). Science education entails teaching students critical thinking, fundamental scientific skills, practical steps, creativity, and originality in scientific explorations. According to Olayinka (2019), science is the study of knowledge that can be transformed into a system based on evaluative facts. Individuals and nations need science education to survive and meet global economic goals. A substantial body of literature has linked science education to human, national, and economic development (Agarkar, 2017; Alam, 2009; Clement et al., 2017; Dovgyi et al., 2020; Drori, 2000; Helen., 2019; Jacob, 2013; Kyle, 2020; Sugimoto, 2019). It is widely acknowledged that exposing young learners to the fundamental knowledge of investigating concepts in their environment may be critical to the advancement of our society.

Science education is based on reasoning, problem-solving, and processes. Hence, one possible way to impact students' science skills is to expose them to science process skills (Hernawati et al., 2018). Science process skills refer to learning abilities that need to be embedded, practiced, and owned by students (Wahyuni et al., 2017). It is the procedural skills, experimental and investigative science habits of mind, or scientific inquiry abilities expected of science learners. Thus, the vital role of science education is to equip the learners with science process skills (Ekici & Erdem, 2020). Science process skills denote critical indicators of teaching objective accomplishment (Gunawan et al., 2019). Moreover, science process skills entail integrating scientific skills, knowledge, and favorable attitudes to advance a better understanding of scientific concepts. The science process skills are embedded in scientific thinking and decision-making (Yumusak, 2016). Hence, instructors must use facts, concepts, and theories to guide students through scientific investigation.

One of the most crucial science education goals is to teach students how to get involved in inquiries. This is possible through training students in the science process skills (Hernawati et al., 2018). Science process skills (SPS) describe procedural skills, experimental and investigating science habits of mind, or scientific inquiry abilities. Several disparate studies have underscored the concept of SPS (Arifullah et al., 2020; Duda & Susilo, 2019; Inayah et al., 2020; Irwanto et al., 2017; Laksono et al., 2017; Langtang, 2018; Maison et al., 2020; Nuraini & Muliawan, 2020; Prabowo, 2015; Rahayu & Syarifudin, 2019; Rahayu Ariffin et al., 2014; Savitri et al., 2017; Sukarmin et al., 2018; Wardani & Djukri, 2019; Yunianti et al., 2019). The studies linked science process skills with attitudes toward science, concluding that the better an individual performs on science process skills, the better their attitudes toward science. Research continues to point out the impact of positive attitudes on teaching science. Thus, the education ecosystem should emphasize science process skills.

Science process skills include observing, measuring, classifying, communicating, predicting, inferring, using numbers, questioning, controlling variables, hypothesizing, defining operationally, formulating models, designing an experiment, and interpreting data (Asy'ari et al., 2019). Similarly, SPS has been widely studied in two categories, including basic and integrated science process skills (Duda & Susilo, 2019; Mohd Al-junaidi & Ong, 2013; Romadona et al., 2021). The basic (simpler) process skill (classifying, predicting, inferring, measuring, observing, and communicating) provides a foundation for scientific learning. The integrated (more complex) skills (interpreting, experimenting, hypothesizing, formulating methods, and identifying variables) describe improved scientific knowledge.

Basic science processes are critical for science learning and promote affective reactions to science concept formulation at the primary and junior secondary school levels. More complex and integrated science are more appropriate at the secondary and tertiary school levels to form models. However, there are intimations about poor science orientations in Nigeria's educational ecosystem. For instance, Akinbobola and Afolabi (2010) analyzed the science process skills in Nigeria's West African senior secondary school certificate physics practical examinations. The findings revealed a high percentage rate of basic (lower order) science process skills (62.80%) as compared to the integrated (higher-order) science process skills (37.20%). The results also indicated that the number of basic process skills is significantly higher than the integrated process skills in Nigeria's West African senior secondary school certificate examinations. Similarly, Ezeudu et al. (2019) found a low science process skill in secondary school students on volumetric analysis. Studies show that most students are not conversant in science process skills. Accordingly, little is known about students' familiarity with the basic and integrated science process skills in the River state post-primary education zones. As such, this study assessed science process skills (basic/integrated) in secondary school students in River state, Nigeria.

Method

This descriptive research examined the profile of science process skills in the post-primary education system of River state, Nigeria. The participants included 126 science students in the junior class in ten public and private secondary schools. The study was conducted during the 2021/2022 academic year. In the post-primary education system in River state, students at the junior level are exposed to science and non-science subjects in preparation for their transition to a specified academic direction at the senior level. This means that all the students in the category can develop a scientific mindset. Thus, they are considered appropriate for the present study.

Measures

Basic and integrated science process skills were assessed using the 48-item multiple-choice Science Process Skills Performance Test designed to assess performance on the science process skills studied in this study. The instrument contains a multiple-choice format, with each item having four possible options. Of the 48 questions, 19 (39.6%) focused on the six basic process skills, and 29 (60.4%) focused on the seven integrated process skills. The reliability of the scale was determined following a pilot study. A Cronbach's alpha value of 0.78 was obtained for the scale. Thus, the values represent an acceptable measure of reliability.

Result

Table 1: Description of the basic science process skills

Science process skills	
Classifying	The practice of categorizing objects or occurrences based on traits, attributes, criteria, or a predefined scheme.
Predicting	the result of a future occurrence based on data from past observation or experience.
Inferring	Based on observation and evidence, the process of making ideas, conclusions, hypotheses, or explanations regarding a specific event.
Measuring	The process of describing the dimensions of an object, substance, or event in quantitative terms utilizing standard and nonstandard measures or estimations and their associated instruments.
Communicating	The process of describing and exchanging information, such as an action, item, or event, from one person or system to another using words, symbols, pictures, and other written or vocal representations.
Observing	The collecting of information about an object or event through the use of one's five senses.

Table 2: Description of the integrated science process skills.

Science Process Skills	
Data interpretation	the process of manipulating or altering data in order to make it relevant and derive conclusions from it by identifying patterns, graphs, or tables.
Experimenting	The process of deciding on and carrying out suitable procedures to test an idea or hypothesis by observing, identifying, and controlling variables, collecting, and analyzing data, and measuring and manipulating materials.
Hypothesizing	In an experiment, stating a provable relationship between variables and their intended outcome.
Formulating	Making a conceptual, graphical, textual, or physical representation to explain an idea, item, or event.
Identification	Identifying the variables that can influence an experiment.
Controlling variables	Identifying any factors other than the manipulated variable that may influence an event's result and holding those elements constant in order to ascertain causality.

Table 3 Description of percentage score on basic and integrated science process skills

science process skills	familiar	unfamiliar
Basic science process skills	66.2%	33.8%
Integrated science process skills	15.6%	84.4%

The study was conducted to understand better students' familiarity with science process skills in junior secondary school. The percentage analysis performed on the data revealed that most respondents (66.2%) were more familiar with the concept of basic science process skills than (33.8%) of their counterparts. On the other hand, the result revealed a high level of unfamiliarity with integrated science process skills among the students (84.4%).

Discussion

The present study assessed junior secondary school students' basic and integrated science process skills in the post-primary education zones of River state, Nigeria. One hundred and twenty-six junior students conveniently pooled from public and private secondary schools responded to the study's questionnaire. A descriptive method was used to describe the level of familiarity with basic and integrated science process skills in the junior class. Results show that junior secondary school students in River state teachers reported high familiarity with basic science process skills based on the percentage response to the measurement scale. The basic science process skills reflect the lower concepts in science education that entails primary knowledge in education. From the early elementary stage, students are exposed to the basic understanding of classifying objects and observing and measuring concepts. The result indicates a significant level of basic scientific knowledge in the students. However, they demonstrated low conceptual knowledge of the integrated science process skills. The result corroborates previous findings (Ezeudu et al., 2019). The result suggests they expressed high disinterest in learning more about science process skills. In particular, students rated the science process skills that they were least familiar with as the ones that are more complex and difficult to comprehend. Thus, they were most interested in the basic aspect of science learning. The probable explanation of this outcome might be attributed to poor science instructional strategy and lack of adequate scientific infrastructure in the learning process.

Conclusions and recommendations

The results suggest that the student's basic science process skills score is acceptable, while their average integrated science process skills score is abysmal. Overall, this research has found a significant gap in the student's progression in science education. Equally important, there appears to be a gap in the teaching and learning of science in the post-primary education system of River state. It is suggested that teachers determine their students' science process skills to plan so that they can assist in raising their students' current basic and integrated SPS by designing science lab activities or methods to the desired level that they view as satisfactory. In other words, teachers must implement effective teaching strategies that promote students' science process skills in River state. These strategies include inquiry-based laboratory projects, problem-solving, project-based learning, and other scientific-related hands-on instruction. Consequently, students must be given more challenging tasks to solve complex problems through research-based activities. Regarding further research, researchers are encouraged to expand this research by adding more participants from different learning environments and socio-cultural backgrounds.

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