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Influence of teacher-related factors on junior secondary school students' acquisition and application of science process skills in Basic Science in Ondo City, Nigeria

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Abstract

The study assessed the influence of teachers' year of experience on students' level of acquisition and application of science process skills (SPS) in junior secondary schools Basic Science in Ondo city, Nigeria. It also determined the influence of teachers' educational qualifications on students' level of acquisition and application of science process skills in Basic Science. These were with a view to providing empirical information on the position of teacher-related factors in improving students' acquisition and application of science process skills in Basic Science. The study adopted the correlational research design. The population comprised Junior Secondary three (JS 3) Basic Science teachers and students in Ondo State. The sample consisted of 20 JSS 3 Basic Science teachers and 432 students from Ondo West and East Local Government Areas (LGAs). Two instruments were used for data collection, which are: Basic Science Teachers' Observation Rating Scale (BSTORS), and Students' Science Process Skills Observation Rating Scale (SSPSORS). Data collected were analysed using the Pearson product-moment correlation coefficient and ANOVA.

The results showed that there was no significant influence of teachers' year of experience on students' level of acquisition and application of SPS ($F_{3,16} = 1.629, p > 0.05$). Also, there was no significant influence of teachers' educational qualification on students' level of acquisition and application of SPS ($F_{1,18} = 0.002, p > 0.05$).

The study therefore concluded that teachers' years of experience and their educational qualifications have no significant influence on students' level of acquisition and application of SPS in Basic Science.

Keywords: Science Process Skills; Acquisition; Application; Years of Experience; And Educational Qualifications

1. Introduction

The study of science and technology is crucial because it is vital for scientific progress and the economic sustainability of any country. A nation's growth in technology, industrialisation, and knowledge for economic sustainability cannot happen without science education. Science education equips learners with the knowledge, skills, and attitudes necessary to comprehend the natural world and apply scientific principles in their daily lives. The National Research Council of the United States of America [11] stated that science education is a tool that helps students develop the abilities they need for their personal lives and civic responsibilities in this technologically advanced and scientifically complex world. Science education focuses on developing cognitive and manipulative skills that enable learners to explore, investigate, and actively construct scientific knowledge, known as Science Process Skills (SPS).

Science process skills (SPS) are a set of generally applicable abilities that apply to various kinds of scientific fields and mirror the actions of scientists. They involve gathering information using the senses and scientific tools, including skills such as observing, classifying, measuring, inferring, predicting, experimenting, and communicating. They have been referred to as critical thinking, scientific thinking, and the scientific method at different times. Mutlu and Tmiz [9] described Science process skills as the foundation for scientific thinking and research. Science process skills are typically

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grouped into basic process skills and integrated process skills based on learners' developmental stages. Basic process skills support early science learning at the primary and junior secondary levels, while integrated process skills build upon basic skills and are essential at the senior secondary level. Together, they facilitate learners' ability to engage meaningfully with scientific tasks and construct scientific knowledge.

Globally, science process skills (SPS) are recognized as fundamental competencies for 21st-century scientific literacy, and their importance has gained increasing attention within science education programmes. International frameworks such as the Next Generation Science Standards (NGSS) [12], the Programme for International Student Assessment (PISA) [17], and UNESCO's science education reforms [18], highlight SPS as crucial for scientific inquiry, problem-solving, and innovation. In today's world, where science and technology continue to advance rapidly, and access to knowledge is expanding, understanding the nature of science, producing scientific knowledge, interpreting and solving problems, and applying scientific reasoning have become essential goals of science education. The rationale for teaching SPS is rooted in the principle of learning transferability: once a skill is acquired, it can be applied across new contexts and domains, and real-world situations

In Nigeria, the curriculum emphasizes hands-on investigation, problem-solving, and real-life application of scientific principles. The Basic Science and Technology Curriculum was originally introduced in 2007 as part of the 9-Year Basic Education Curriculum. It was subsequently revised in 2012 by the Nigerian Educational Research and Development Council [13]. The revised curriculum explicitly promotes guided inquiry and activity-based teaching and learning using locally sourced materials [13]. Basic Science is strategically designed to lay the foundation for future scientific understanding and develop attitudes, values, and competencies essential for national development. However, despite these curriculum expectations, reports from various empirical studies and national assessment bodies have indicated the persistent low academic achievement in science among Nigerian junior secondary school students. These low outcomes are often associated with weak science process skills, limited exposure to practical activities, poor performance in science-related tasks, and inadequate application of scientific reasoning in problem-solving situations. Ibiyengibo [7] observed that a significant problem in Nigerian science education is that science is often presented dogmatically in most schools as a collection of fragmented facts and concepts, which students find difficult to link to real-world experiences.

The effectiveness of SPS instruction depends considerably on the teacher, who serves as a facilitator of scientific inquiry. Teachers' competence, pedagogical content knowledge, academic qualifications, and years of teaching experience largely determine the extent to which students engage meaningfully in investigative activities and develop SPS. Teachers with longer teaching experience often demonstrate stronger classroom management, deeper practical expertise, and greater confidence in conducting hands-on or inquiry-based science lessons. Research has shown that teachers with adequate academic qualifications and more years of teaching experience are generally more effective in promoting learners' understanding of scientific concepts and processes. Oludipe and Oludipe [15] reported that Nigerian teachers with longer teaching experience demonstrated higher effectiveness in facilitating students' knowledge of Basic Science concepts.

Despite the well-recognized importance of teacher quality and curriculum expectations, Basic Science teaching in many Nigerian classrooms remains predominantly theoretical, with minimal emphasis on experimentation, active exploration, and inquiry. This suggests a gap between the inquiry-oriented intentions of the curriculum and teachers' actual classroom practices. Previous studies have explored students' performance in SPS and the challenges in teaching Basic Science; however, there is limited empirical research that specifically examines how teacher-related factors, such as year of teaching experience and educational qualifications, influence students' acquisition and application of SPS in Basic Science in junior secondary schools in Ondo City. This study, therefore, investigates the influence of teachers' years of teaching experience and educational qualifications on students' acquisition and application of science process skills in Basic Science in Ondo City, Nigeria. The findings aim to contribute to science education research and provide insights that can inform policies and interventions directed toward improving instructional quality and student learning outcomes.

1.1. Statement of the Research Problem

Despite the importance of science process skills (SPS) for meaningful science learning and preparing students to solve problems in real-life contexts, studies have shown that there is low level of acquisition and application of science process skills by junior secondary school (JSS) students in Basic science in Nigeria, as reflected in their limited engagement with practical science tasks and their persistent underperformance in standardized science assessments. One critical factor influencing students' acquisition and application of SPS is the teacher. Research has shown that teachers' professional background (years of teaching experience and academic qualifications) shapes the quality of instruction and the extent

to which learners engage with science meaningfully. It is observed that Basic Science is still often taught dogmatically, with limited emphasis on hands-on, inquiry-based approaches that foster SPS. Variations in teachers' experience and qualifications may contribute to this situation. Few studies have examined teachers' qualifications and years of teaching experience, with most focusing on their relationship to students' academic performance in Basic Science (Oludipe & Oludipe [15]; Okose & Obiunu [14]. However, there is limited empirical evidence linking these teacher-related factors to students' SPS outcomes in Basic Science.

Therefore, this study investigates the influence of teacher-related factors, specifically years of teaching experience and educational qualifications, on junior secondary school students' acquisition and application of science process skills in Basic Science in Ondo City, Nigeria.

The specific objectives of the study are to:

- assess the influence of teachers' years of teaching experience on students' level of acquisition and application of science process skills in Basic Science.
- determine the influence of teachers' educational qualifications on students' level of acquisition and application of science process skills in Basic Science.

1.2. Hypotheses

H₀1: There is no significant difference in students' level of acquisition and application of science process skills in Basic Science based on teachers' years of teaching experience (less, moderate, substantial, and high).

H₀2: There is no significant difference in students' level of acquisition and application of the science process in Basic Science based on teachers' qualification (low, moderate, and high)

1.3. Research methodology

The study employed an ex post facto research design. The study's population consisted of all Basic Science teachers and students in junior secondary schools II (JSS 2) classes. The sample consisted of 20 Basic Science teachers and 432 JSS 2 students, selected from Ondo West and Ondo East Local Government Areas, using a purposive sampling technique (based on the schools having a laboratory). Two instruments were used for data collection: Basic Science Teacher (BSTQ) and Students' Science Process Skills Observation Rating Scale (SSPSORS).

BSTQ was used to determine teachers' years of teaching experience and educational qualifications based on the level of students' acquisition and application of science process skills. Then, the level of students' acquisition and application of Science Process Skills (SPS) was assessed using the Students' Science Process Skills Observation Rating Scale (SSPSORS). All instruments were pilot-tested with respondents outside the study area to establish reliability. Pearson product-moment correlation yielded reliability coefficients of 0.73 for BSTQ and 0.83 for SSPSORS. The data collected were analyzed using ANOVA to test the two hypotheses.

2. Presentation of results

2.1. Hypothesis one

There is no significant difference in students' level of acquisition and application of science process skills in Basic Science based on teachers' years of teaching experience (less, moderate, substantial, and high).

The distribution of teachers' years of teaching experience is presented in Table 1

Table 1 Distribution of Teachers' Years of Teaching Experience

Years of Experience	Frequency	Percentage	Experience Level
1 – 4 years	5	25.0	Low Experience
5 – 14 years	9	45.0	Moderate Experience
15 – 24 years	3	15.0	Substantial Experience
25 years and above	3	15.0	High Experience
Total	20	100.0	

The results in Table 1 showed that teachers with moderate teaching experience (45%) had the highest percentage, followed by those with low teaching experience (25%), and then those with substantial and high teaching experience (15%). Therefore, the results suggested that teachers with moderate experience, between five and 14 years, had the highest number of years of teaching experience, while teachers with high experience had the lowest frequency.

In a bid to test the hypothesis, data on teachers' years of experience in relation to students' level of acquisition and application of science process skills in Basic Science were analysed using analysis of variance (ANOVA). The results are presented in Table 2

Table 2 ANOVA of teachers' year of experience and students' level of SPS

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. of F
Between Groups	347.661	3	115.887	1.629	.222
Within Groups	1138.089	16	71.131		
Total	1485.750	19			

*Significant at $p < .05$

Results in Table 2 indicated no significant difference in students' level of acquisition and application of science process skills in Basic Science based on teachers' years of teaching experience, $F(3,16) = 1.629$, $p > .05$. Accordingly, the null hypothesis was not rejected, indicating that teachers' years of teaching experience did not significantly influence students' acquisition and application of science process skills in Basic Science.

2.2. Hypothesis Two

There is no significant difference in students' level of acquisition and application of the science process skills in Basic Science based on teachers' qualifications (low, moderate, and high)

The distribution of teachers' educational qualifications is presented in **Table 3**

Table 3 Distribution of Teachers' Educational Qualifications

Educational Qualification	Frequency	Frequency (%)	Qualification Level
Nigeria Certificate in Education (NCE)	3	15.0	Low
First Degree	17	85.0	Moderate
Higher Degree	0	0.0	High
Total	20	100.0	

Table 3 showed that 17 teachers (85%) possessed a first degree, while three teachers (15%) held the Nigeria Certificate in Education (NCE). None of the teachers had a higher degree qualification. This indicates that all participating teachers met the minimum qualification requirement for teaching at the basic education level, which is consistent with the National Policy on Education [10] stipulation that teachers under the Universal Basic Education (UBE) programme should possess at least the NCE qualification.

Although teachers' educational qualifications were categorized as low, moderate, and high, no teacher held a higher degree; therefore, the analysis compared only the low and moderate qualification groups.

The overall mean score for students' acquisition and application of science process skills was 80.30 (SD = 8.84), based on data from 432 students taught by 20 teachers. The influence of teachers' educational qualifications on students' acquisition and application of science process skills in Basic Science was examined using one-way analysis of variance (ANOVA). The results are presented in Table 4

Table 4 ANOVA of Teachers' Educational Qualifications on Students' Level of Science Process Skills

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. of F
Between Groups	0.139	1	0.139	0.002	0.968
Within Groups	1485.611	18	82.534		
Total	1485.750	19			

*Significant at $p < .05$

The results in Table 4 indicated no significant difference in students' level of acquisition and application of the science process in Basic Science based on teachers' educational qualifications, $F(1, 18) = 0.002, p > .05$. Therefore, hypothesis two is not rejected, indicating that teachers' educational qualifications did not significantly influence students' acquisition and application of science process skills in Basic Science.

3. Discussion of the findings

The findings of this study revealed that there was no significant difference in students' level of acquisition and application of science process skills (SPS) in Basic Science based on teachers' years of teaching experience, whether less, moderate, substantial, or high. The results suggested that the length of teaching experience alone may not be sufficient to influence students' SPS acquisition and application. These findings contrast with the earlier report of Nwosu, cited in Ibe [6], who maintained that science process skills are competencies that can be developed through experience and applied in both mental and physical operations. It also contradicts the findings of Ene et al. [4] and Agharuwhe [1], who reported that teaching effectiveness, influenced by years of teaching experience, positively impacts students' academic achievement. Similarly, Bamidele and Adekola [3] found that students' achievement differed significantly depending on whether long-term experienced teachers or short-term experienced teachers taught them. The disparity between the present findings and earlier studies may be attributed to uniform curriculum implementation, examination-oriented instructional practices, and limited opportunities for sustained practical engagement in Basic Science classrooms.

Moreover, the results revealed no significant difference in students' level of acquisition and application of science process skills in Basic Science based on teachers' educational qualifications (low, moderate, and high). These findings indicated that higher academic qualifications alone may not necessarily translate into improved SPS outcomes among students. The results contradict the findings of Greenberg, Rhodes, and Stancavage [5], who observed that teachers holding a master's degree or higher have a more pronounced impact on students' academic achievement. In addition, the results are also inconsistent with Omaliko and Okpala [16], who reported a significant difference in students' performance between those taught by professional and non-professional teachers. However, the findings of this study corroborate Akpo's [2] findings, which reported no significant relationship between teacher educational qualification and students' academic achievement.

In terms of teachers' qualifications, the majority of the teachers (85%) had first-degree certificates, while only 15% held the Nigeria Certificate in Education (NCE). The findings corroborate the earlier findings of the National Policy on Education [10], which states that all the Universal Basic Education (UBE) teachers have a minimum qualification of NCE. This distribution aligns with the National Policy on Education [10], which stipulates NCE as the minimum qualification for teachers at the Universal Basic Education (UBE) level. However, the findings differ from Ishola's [8] report, which asserted that none of the teachers had a professional qualification. The dominance of first-degree holders in this study suggests an improvement in teacher qualification levels, although this improvement did not translate into significant differences in students' SPS acquisition and application.

4. Conclusion

This study examined how teacher-related factors, specifically years of teaching experience and educational qualifications, influence junior secondary school students' acquisition and application of science process skills (SPS) in Basic Science in Ondo City, Nigeria. The findings showed that neither teachers' years of teaching experience nor their educational qualifications had a statistically significant effect on students' acquisition and application of SPS. These results suggest that students' development of science process skills may not be solely dependent on teachers' professional background variables, such as experience and qualifications. Rather, other factors, including instructional strategies, availability and use of practical resources, classroom practices, and opportunities for inquiry-based learning, may play a more critical role in shaping students' SPS acquisition and application.

The findings have important implications for science education practice and policy in Nigeria. While teachers' qualifications and experience remain essential for professional standards, emphasis should also be placed on continuous professional development that strengthens teachers' pedagogical approaches to inquiry-based and activity-oriented science instruction. Such efforts may better support the effective development of science process skills among junior secondary school students.

4.1. Recommendations

Based on the findings of this study, the following recommendations were considered relevant:

- State and Federal Ministries of Education should strengthen science components of teacher education programmes (NCE and first degree) by increasing opportunities for practical, laboratory-based, and inquiry-oriented activities. Adequate provision of laboratory equipment, materials, and chemicals should also be ensured to support effective teaching and learning of science process skills.
- Since teachers' years of experience and educational qualifications did not significantly influence students' acquisition and application of science process skills, attention should be directed toward continuous professional development. Regular workshops, seminars, and retraining programmes should be organized to equip science teachers with effective strategies for teaching science process skills.
- Basic Science teachers should identify specific science process skills in which students demonstrate weaknesses and deliberately design classroom and laboratory activities to address such deficiencies. This targeted approach may enhance students' mastery and application of science process skills.
- Governments and school authorities should ensure the availability of qualified laboratory technologists and technicians to support practical science instruction. Effective laboratory management and supervision will enhance students' engagement in hands-on and inquiry-based learning activities.
- Orientation programmes should be organized for newly employed science teachers, while regular in-service training should be provided for serving teachers to update their pedagogical skills, particularly in the use of science process skills-based instructional approaches.
- Curriculum planners and educational stakeholders should explicitly integrate science process skills as core instructional strategies in the Basic Science curriculum at the junior secondary school level. This will ensure that the teaching of science process skills is systematic, intentional, and consistently implemented across schools.

Compliance with ethical standards

Disclosure of conflict of interest

I, Dr Oyagbile Abosede Adenike declares that there is no possible conflict of interest/ Competing Interests I have with the publication of the manuscript or secondary schools mentioned in the manuscript. I also declare that there is no conflict of interest in the study.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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