The impact of teachers' assessment practices on students' acquisition of process skills and performance in basic science

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ABSTRACT

The purpose of this study is to examine impact of teachers' assessment practices on students' acquisition of process skills and performance in basic science in Kogi State, Nigeria, utilizing a cross-sectional survey research design. The sample comprises 393 Basic Eight students from a population of 20,885 in the study area using the multi-stage sampling procedure. Ten Basic Science teachers were observed in class. Data collection instruments include the Basic Science Process Skill Acquisition Test (BSPSAT), the Basic Science Performance Test (BSPT), and the Basic Science Teachers' Assessment Practices Observation Scale (BSTAPOS). The reliability coefficients were 0.71 for BSPSAT, 0.86 for BSPT using Kuder–Richardson Formula 21, and the BSTAPOS value was 0.66 using Spearman's rank correlation. The descriptive statistics of mean and standard deviation as well as an independent t-test and analysis of variance (ANOVA) were used for analysis. Significant differences were found regarding the impact of teachers' low, moderate, and high classroom assessment practices on the mean process skills acquisition scores and the mean performance scores of students in basic science. Students' gender did not show a significant difference regarding the impact of teachers' low, moderate, and high assessment practices on process skills acquisition and performance scores in basic science. It is recommended that teachers of basic science should use assessment guides and workbooks to acquaint themselves with the appropriate assessment practices.

Keywords: *Basic Science, Critical thinking, Gender, Performance, Process-skill-acquisition, Teachers' assessment practices.*

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Highlights of this paper

- The purpose of the study was to examine impact of teachers' assessment practices on students' acquisition of process skills and performance in basic science in Kogi State, Nigeria, using a cross-sectional survey research design.
- Teachers' assessment practices were the independent variable whose impact on the dependent variables (acquisition of process skills and performance) was measured by administration of the instruments to a sample of 411 students and 10 teachers.
- A significant difference was found in the impact of teachers' low, moderate, and high classroom assessment practices on the mean process skills acquisition scores [$F(2,392) = 174.961$; $p = 0.000 < 0.05$] and the mean performance scores [$F(2,392) = 59.872$; $p = 0.000 < 0.05$] of students in basic science.

1. INTRODUCTION

Basic science, as part of Nigeria's Basic Education Programme, introduces pupils and students to the foundational principles of science. According to the educational policy in Nigeria (FRN, 2013), the subject is defined as structured science content taught to develop practical and applied scientific knowledge. The goal of teaching basic science is to broaden students' understanding and foster an appreciation for the interconnectedness of scientific disciplines (Nwafor, 2014). This understanding can influence students' choices of science-related careers, ultimately contributing to the scientific development of the nation. Danjuma (2019) opined that learners could gain a strategy for solving problems of a scientific nature, thereby enhancing the scientific development of the nation.

As noted by Ode, Ayua, and Alagwu (2019), the basic science curriculum was intended to provide learners with an opportunity to develop an interest in science, acquire foundational knowledge and skills, and apply these to address societal needs. Additionally, the curriculum encourages students to explore the career opportunities that science offers and prepare them for further studies in the field. Despite these attractive objectives, the performance of students is continuously poor. This status of performance is hinged on the fact that the teaching of science in Nigerian secondary schools is below expectations due to inappropriate and ineffective instructional strategies and assessment techniques used by science teachers (Ajayi, 2019). For the objectives of any school subject to be effectively achieved, the assessment techniques employed by teachers require research attention. Achor, Odoh, and Abakpa (2018) posit that assessment is the organized collection, deep examination, and use of information in relation to a learning programme to bring about improvement in students' learning and development. Therefore, assessment is an organized basis for making inferences concerning students' achievement. This entails making a judgment, noting the strengths and weaknesses, and the dos and don'ts of an educational programme.

It is widely recognized that the impact of feedback is significantly greater when it is provided immediately and communicated clearly, as this helps to guide the learning process and address any potential areas of weakness (Umar, 2018). Teachers' assessment practices should be all-encompassing, involving series of activities or actions which include what the individual can do, how the individual can do it, and what the individual cannot do. The practice of assessing students' learning outcomes can be carried out at different levels due to the fact that no single assessment practice can be comprehensive enough to take into cognizance the three domains of educational objectives (Ifeakor, Akujieze, & Erutujiro, 2022).

The categorization of assessment practices among teachers as low, moderate, or high carries significant implications for student learning outcomes and instructional effectiveness. Low assessment practices in science often involve limited use of diverse assessment methods and an inadequate feedback mechanism, which can hinder the accurate measurement of student understanding and the effective adjustment of teaching strategies (Ifeakor et al., 2022). Moderate assessment practices in science often involve a balanced approach using both formative and summative assessments. While these practices provide useful insights into students' understanding, there is a need

for a more systematic application and integration with instructional goals to maximize their effectiveness (Karaman, 2021). High-quality assessment practices in science are characterized by the use of varied assessment types, alignment with learning goals, and an emphasis on feedback that guides student learning. These practices help in effectively tracking students' progress and enhancing science process skills.

Each time we look at a problem, generate hypotheses, make predictions, define variables, test assumptions by conducting experiments, initiate a data collection procedure, carry out analyses, and project findings, we are already involved in science process skills (Önder et al., 2022). Process skills includes the ability to develop skills in intellectual, social, and physical dimensions that are the sources of a student's standing (Atmojo, 2012). Process skills are essential skills that every student needs to possess, as they are used in daily life and therefore affect personal and social lives (Siregar, Rajagukguk, Sinulingga, Rajagukguk, & Sinulingga, 2020); they cannot be separated from the conceptual understanding of learning and its application to science in practice. Thus, students can reproduce, examine, experiment, and research the problem and the subject (Choirunnisa, Prabowo, & Suryanti, 2018). Process skills in science can be categorized into cognitive, affective, and psychomotor skills that scientists engage for problem identification, inquiry, gathering information, transformation, assigning meaning, and communication for students' enhanced performance.

Students' performance is certainly a key factor for personal advancement. The urge to perform well in the course usually translates to tension for learners, teachers, school administrators, and the system of education in practice. The academic performance of students is defined as their level of attainment in the subject. Often, higher scores are interpreted as better academic performance (Achor, Agogo, & Duguryil, 2015). The concept of academic performance is also seen as the ability to execute a given task effectively. It is equally seen as a good but demanding task that is executed successfully (Danjuma, 2019).

Despite the fact that there is ample evidence that basic science is very important for youths and national development, there are still indications that the performance of students in the subject is below expectations (Musa, Achor, & Ellah, 2021). Available records from the Ministry of Education, Statistics Department, Lokoja, Kogi State, on the Basic Education Certificate Examination (BECE) (2012–2021) and the Chief Examiner's reports show that students' performance is poor and inconsistent at the upper basic level in Kogi State. Students failed to pass seven out of ten areas, and this is evidence of poor foundations. In line with this, Achor et al. (2015) opined that the persistent poor performance in science, skills, and knowledge levels among students is an indication of weak or inappropriate teaching.

Generally, a poor performer or an underachiever is someone whose performance is persistently below average (Danjuma, 2015). The quest for academic performance for national development is one of the reasons schools are set up. The curriculum is implemented in schools to achieve the educational goals and objectives of the nation. Teaching and learning activities may or may not take cognizance of students' gender.

Concerning the gender of students in secondary schools, Achor et al. (2018) opined that gender dictates how people behave, how they interact socially, and how they reflect on themselves. Ajayi (2019) states that gender is a social construct deployed for allotting power, duties, responsibilities, position, and contributions in any social framework. Matters related to gender are commonplace in Nigerian society, as reported by Ewumi (2012), including academic performance. The difference in basic science performance due to gender is a source of concern for educationists (Okoye, 2014).

There has been research on whether or not gender has any impact on students' attitude, critical thinking, science process skills acquisition, and performance in science. Yet no consistent conclusion has emerged. For instance, Olasehinde and Olatoye (2014) reported in their joint study that females lag behind males in science because they

possess low analytical and visual spatial skills that are engaged in higher-order thinking in science. The authors, on the other hand, countered their earlier report, as they stated that girls performed better than boys. The inconsistent results suggest that research related to the impact of assessment practices on students' attitude, critical thinking, process skills acquisition, and academic performance is still inconclusive. Therefore, this study determined how teachers' assessment practices impact students' acquisition of science process skills and performance in basic science in Kogi State, Nigeria. The specific objectives are to:

i. Determine the impact of different levels of teachers' classroom assessment practices on students' science process skills acquisition in basic science.
ii. Determine the impact of different levels of teachers' classroom assessment practices on students' performance in basic science.
iii. Determine the impact of different levels of teachers' classroom assessment practices among male and female students' acquisition of process skills in basic science.
iv. Determine the different levels of teachers' classroom assessment practices among male and female students' performance in basic science.

1.1. Research Questions

The questions answered in the study are as follows:

1. What is the impact of teachers' low, moderate, and high classroom assessment practices on students' mean process skills acquisition scores in basic science?
2. What is the impact of teachers' low, moderate, and high classroom assessment practices on students' mean performance scores in basic science?
3. What is the impact of teachers' low, moderate, and high classroom assessment practices among male and female students' mean process skills acquisition scores in basic science?
4. What is the impact of teachers' low, moderate, and high classroom assessment practices among male and female students' mean performance scores in basic science?

1.2. Hypotheses

The null hypotheses tested at the 0.05 level of significance include:

1. There is no significant difference in the impact of teachers' low, moderate, and high classroom assessment practices on the mean process skills acquisition scores of students in basic science.
2. There is no significant difference in the impact of teachers of low, moderate, and high classroom assessment practices on mean performance scores of students in basic science.
3. There is no significant difference in the impact of teachers of low classroom assessment practices on male and female students' mean process skills acquisition scores in basic science.
4. There is no significant difference in the impact of teachers of moderate classroom assessment practices on male and female students' mean process skills acquisition scores in basic science.
5. There is no significant difference in the impact of teachers of high classroom assessment practices on male and female students' mean process skills acquisition scores in basic science.
6. There is no significant difference in the impact of teachers of low classroom assessment practices on male and female students' mean performance scores in basic science.
7. There is no significant difference in the impact of teachers of moderate classroom assessment practices on male and female students' mean performance scores in basic science.

8. There is no significant difference in the impact of teachers of high classroom assessment practices on male and female students' mean performance scores in basic science.

2. LITERATURE REVIEW

This study is anchored on Sadler's theory of assessment (Sadler, 1983), Gagné's theory of instruction (Gagné, 1965), and Piaget's cognitive development theory (Piaget, 1956). According to Sadler (1983), academic learning occurs when an individual understands the goal to be achieved, actively works toward accomplishing it, and is able to recognize progress along the way. Students often perceive assessment as difficult and threatening, and for assessment to be congenial, it should take place in an open environment where the teacher considers the difficulty that the students face during the assessment and where the student appreciates the need for assessment in a teaching and learning situation. Assessment is the process of determining the gap between learner knowledge and skills and the intended learning outcome. A good assessment presents a positive image of the teacher as the unquestionable authority, and it recognizes the importance of creative discourse among teachers and students.

Gagné's theory of instruction, propounded in 1965, states that learning is a lasting change in human disposition or a capability that endures over time and cannot be solely attributed to natural growth. The theory emphasizes the importance of different types of learning outcomes, including intellectual skills in the context of assessing process skills acquisition. The theory of instruction, often known as the conditions of learning, outlines the process of learning and the indices of effective instruction. The theory has been influential in guiding educators in creating effective learning experiences. For basic science process skills, educators can align assessment with Gagné's nine events of instruction, ensuring that students acquire knowledge and demonstrate their ability to apply it in practical situations, which might involve designing an assessment that focuses on problem solving, experimental critical thinking, and other higher-order cognitive skills.

Piaget asserts that the advancement of children is through four distinct stages of cognitive development, each marked by a specific way of reasoning and comprehending the world. This theory, known as the developmental stage theory, addresses the nature of knowledge and how it is gradually acquired, constructed, and utilized. It posits that the human mind develops cognitive structures that interpret, transform, and organize external sensory input. Piaget adds that cognitive development involves a progressive reorganization of mental processes driven by both biological maturation and environmental experiences. Behavior, or adaptation to the environment, is regulated through mental frameworks called schemata, which individuals use to represent the world and determine actions. This process of adaptation is propelled by a biological drive to achieve equilibrium between schemata and the environment, a phenomenon known as equilibration.

Piaget's theory about the development of cognition is relevant to this study because it emphasizes the stages of intellectual development in children. Teachers can apply his stages (that is, sensory motor, pre-operational, concrete operational, and formal operational) to tailor assessments to students' cognitive abilities. For basic science, assessment should align with a student's current cognitive stage, ensuring that they can grasp and apply fundamental scientific concepts effectively. Piaget's theory of cognitive development informs assessment practices by emphasizing the need to tailor assessment to a student's cognitive stages. For Basic Eight students, this means creating assessments that align with their developmental stage, ensuring they are appropriate for their level of cognitive understanding and effectively measure their grasp of scientific concepts and their performance.

Conceptual reviews have addressed concepts of assessment practices, process skills acquisition, and academic performance. Other sub-headings captured in this section include teachers' assessment practices, process skills acquisition, and gender. For example, Achor and Ejeh (2019) explored the effects of the Cognitive Acceleration

Training Programme (CATP) on Nigerian home economics students and demonstrated that students participating in the CATP, along with traditional teaching methods, achieved higher outcomes. The finding that students with lower cognitive abilities benefited more from the CATP suggests that such interventions can effectively support struggling learners and potentially close achievement gaps. However, the lack of significant differences in mean gains across varying cognitive ability levels indicates that while the CATP is beneficial, it may not sufficiently differentiate learning outcomes among all ability groups. This raises questions about the need for tailored interventions that cater specifically to the diverse cognitive needs of students.

Supporting this theme of cognitive ability, Achor et al. (2015) found that students with higher reasoning abilities significantly outperformed their peers with lower reasoning abilities. This finding emphasizes the importance of fostering critical thinking skills early in education, as they play a pivotal role in academic success. Yaduvanshi and Singh (2019) echoed this sentiment, revealing that students across various achievement levels in the experimental group outperformed those in the control group, underscoring the effectiveness of targeted instructional strategies in enhancing student performance.

In the realm of assessment, Yusuf and Mahmut (2021) highlighted the significant impact of formative assessment practices on students' mathematics achievement. This aligns with the growing body of literature advocating for formative assessments as a means to enhance learning outcomes by providing ongoing feedback and opportunities for improvement.

In another study, Achor et al. (2018) found that laboratory strategies significantly improved students' acquisition of science process skills compared to traditional expository methods. This emphasizes the value of inquiry-based learning in fostering essential skills, suggesting that students benefit more from hands-on experiences that allow them to actively engage with scientific concepts. The lack of significant gender differences in achievement further indicates that effective teaching strategies can benefit all students equally, regardless of gender. Similarly, Orheruata and Oyakhirome (2019) found that formative classroom assessments positively impacted student achievement, with improvements noted from pre-test to post-test scores. Their findings reinforce the idea that ongoing assessments can foster a culture of continuous improvement and learning, benefiting all students irrespective of gender.

Finally, Agwagah and Ezieke (2023) confirmed that there were no significant gender differences in academic achievement among students exposed to formative assessment practices. In contrast, Karaman (2021) reported significant advantages for students taught through formative assessments compared to traditional methods. This highlights the potential for formative assessments to level the playing field and promote equity in educational outcomes.

These studies collectively underscore the importance of tailored instructional strategies and assessment practices in enhancing student achievement across diverse cognitive abilities and gender. The emphasis on experiential learning, cognitive acceleration, and formative assessments provides a roadmap for educators seeking to improve learning outcomes and address students' diverse needs, especially in Nigeria's educational landscape.

3. MATERIALS AND METHODS

3.1. Design, Sample and Sampling

A cross-sectional survey design was employed in this work. This design enables the collection of data per time from a representative sample, therefore using minimal time and resources. The study population comprised 20,885 students from 531 schools in the study area for the 2023/2024 academic session. year. The sample for this study comprised 411 students, obtained using Taro Yamane's formula. The multi-stage sampling procedure was employed because this procedure allows the researcher to use various sampling techniques at different levels in a study. In the

first phase, nine local government areas (LGAs) were randomly chosen via the simple random sampling technique through the use of slips of paper without replacement. The names of all the LGAs in the Kogi East education zone were written on a piece of paper, folded, and shuffled in a container, then a neutral person was asked to pick one at a time. This process was repeated five times. This technique was chosen because it gave all the LGAs an equal chance of being represented.

In the second stage, 18 teachers were selected out of the 30 teachers of basic science in 18 schools using the purposive sampling technique. This technique was selected to eliminate schools without university graduates as teachers in basic science. Also, the criteria for selection are that the schools must have a record of coverage of the curriculum for Basic Science I and Basic Science II for the previous years, and they must have a functional science laboratory with basic equipment and tools.

In the third stage, 18 teachers of basic science were again selected using the purposive sampling technique. The choice of purposive sampling was to ensure that only teachers with five years' teaching experience and above were included. In the fourth stage, the student population was stratified along gender sensitivity, and using proportionate stratified random sampling, a sample of 393 students was obtained.

The proportionate stratified random sampling technique was deemed suitable because it ensures a higher degree of representativeness of the sample compared to the total student population in the study area as well as guaranteeing minority constituents of the students are equally represented in the sample. Depending on the number of students available in the 18 schools and their representation by gender system, 22 students were chosen from each of the 17 schools, while 19 students were selected from the 18th school, making a total of 393 students.

3.2. Instrument, Validation and Reliability

Data were collected with the Basic Science Teachers' Assessment Practice Observation Scale (BSTAPOS), the Basic Science Process Skill Acquisition Test (BSPSAT), and the Basic Science Performance Test (BSPT). The BSTAPOS was adapted for this study from the Benue State University Makurdi Student Teaching Practice Evaluation Form and the National Commission for Colleges of Education (NCCE) Teaching Practice Form. The BSTAPOS has two parts, A and B. Part A sought information about the respondents, while part B contained 20 items that measure the assessment practices used by teachers of basic science.

The BSPSAT was designed for this study by the researchers and has two parts, A and B; part A gathered information from the respondents, and part B comprises a 12-item essay test that measures the extent of their understanding of the concepts in basic science.

The BSPT also has two parts. Part A addressed information on the students, and part B comprised 40 multiple-choice questions. The items were adapted from the BECE examination questions for 2012. The development of the BSPT was guided by Bloom's Taxonomy of Educational Objectives. The 40 multiple-choice questions allowed a possible total of 40 marks.

Face validation was carried out for the BSTAPOS, BSPSAT, and BSPT by three experts. Content validation was carried out for the BSPT. The validators were requested to check whether or not the items conformed to the subject matter, were clear, readable, and free from ambiguity, and can assess the basic area of the study. Psychometric analysis was carried out in the BSPT to discern the quality, difficulty, discrimination, and the distracting power of the test item options (Nworgu, 2015). The items with distracter indices of zero were modified and selected. Items that scale through the analysis were featured in the BSPT, while the items that failed were discarded. In all, 36 items survived.

The BSPSAT and BSPT instruments were trialed on 40 Basic Eight science students in two schools, while the BSTAPOS was trial tested on 10 teachers of basic science in five schools that were not sampled for the study to

determine the internal consistencies, or reliability coefficient. The internal consistency of the BSPSAT and BSPT were analyzed using Kuder–Richardson Formula 21 and the values were found to be 0.71 and 0.86, respectively, while that of the BSTAPOS was analyzed using Spearman's rank correlation and was found to be 0.66.

3.3. Data Collection and Analysis

A letter seeking permission to carry out the research was submitted and approved before commencement. The instruments were personally administered to the respondents by the researcher with the assistance of the science teachers to ensure a high rate of return. Where two schools within the same locality were involved, they were required to respond to the instruments on the same day. Three days were used in each school for instrument administration. On day 1, the students were asked to respond to the BSPSAT and the BSPT, and the BSTAPOS was administered personally by the researcher and a research assistant on day 2. The research assistant was briefed on the administration of the instrument and essence of the study.

The mean and standard deviation statistics addressed all the research questions. The ANOVA and the t-test of independence were deployed to test the null hypotheses at the 0.05 level of significance. The ANOVA was chosen as the statistical technique because there were more than two groups whose means were to be compared statistically. The independent t-test is considered appropriate when only comparing two groups—male and female students.

4. RESULTS

In line with the earlier stated questions and hypotheses, the results are hereby presented.

Table 1. Mean process skills acquisition of students based on teachers' low, moderate, and high classroom assessment practices.

Classroom assessment practices	N	$\overline{X}$	σ	Std. error
Low assessment practices	80	2.78	2.80	0.31
Moderate assessment practices	213	2.85	2.77	0.19
High assessment practices	100	13.40	8.42	0.84

Note: $\overline{X}$ = Mean; σ = Standard deviation.

Table 1 shows that there were low classroom assessment practices with 80 students, moderate classroom assessment practices with 213 students, and high classroom assessment practices with 100 students. The table further shows that students with low classroom assessment practices had mean process skills acquisition scores of 2.78 and a standard deviation of 2.80, students with moderate classroom assessment practices had a mean process skills acquisition score of 2.84 and a standard deviation of 2.77, and students with high classroom assessment practices had a mean process skills acquisition score of 13.40 and a standard deviation of 8.42.

Table 2. Mean performance of students based on teachers' low, moderate, and high classroom assessment practices.

Classroom assessment practices	N	$\overline{X}$	σ	Std. error
Low assessment practices	80	17.00	6.12	0.68
Moderate assessment practices	213	17.95	5.88	0.40
High assessment practices	100	26.41	9.17	0.91

Note: $\overline{X}$ = Mean; σ = Standard deviation.

Table 2 shows that there were low classroom assessment practices with 80 students, moderate classroom assessment practices with 213 students, and high classroom assessment practices with 100 students. Students with

low classroom assessment practices had a mean performance score of 17.00 and a standard deviation of 6.12, students with moderate classroom assessment practices had a mean of 17.95 and a standard deviation of 5.88, and students with high classroom assessment practices had a mean of 26.41 and a standard deviation of 9.17.

Table 3. Mean process skills acquisition by gender based on teachers' low, moderate, and high classroom assessment practices.

Students' process skills acquisition scores	Classroom assessment practices								
	Low			Moderate			High		
	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ
Male	43	2.81	3.03	118	3.12	3.16	55	14.55	7.00
Female	37	2.65	2.49	95	2.57	2.15	45	13.80	8.13
$\overline{x}$ differ	-	0.16	-	-	0.55	-	-	0.75	-

Table 3 shows that there were low classroom assessment practices with 43 male and 37 female students, moderate classroom assessment practices with 118 male and 95 female students, and high classroom assessment practices with 55 male and 45 female students. The table further shows that male students with low classroom assessment practices had a mean process skills acquisition score of 2.81 with a standard deviation of 3.03, and female students with low classroom assessment practices had a mean process skills acquisition score of 2.65 with a standard deviation of 2.49. Similarly, male students with moderate classroom assessment practices had a mean process skills acquisition score of 3.12 with a standard deviation of 3.16, and female students with moderate classroom assessment practices had a mean process skills acquisition score of 2.57 with a standard deviation of 2.56. Male students with high classroom assessment practices had a mean process skills acquisition score of 14.55 with a standard deviation of 7.00, and female students with high classroom assessment practices had a mean process skills acquisition score of 13.80 with a standard deviation of 8.13.

Table 4. Mean performance of male and female students based on teachers' low, moderate, and high classroom assessment practices.

Students' performance scores in basic science	Classroom assessment practices								
	Low			Moderate			High		
	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ
Male	43	17.05	5.97	118	18.63	5.95	55	24.70	6.75
Female	37	17.06	6.45	95	17.35	5.79	45	25.30	6.81
$\overline{x}$ differ	-	-0.01	-	-	1.31	-	-	-060	-

Table 4 shows that there were low classroom assessment practices with 43 male and 37 female students, moderate classroom assessment practices with 118 male and 95 female students, and high classroom assessment practices with 55 male and 45 female students. The table further shows that male students with low classroom assessment practices had a mean performance score of 17.05 with a standard deviation of 5.97, and female students with low classroom assessment practices had a mean performance score of 17.06 with a standard deviation of 6.45. Male students with moderate classroom assessment practices had a mean performance score of 18.63 with a standard deviation of 5.95, and female students with moderate classroom assessment practices had a mean performance score of 17.35 with a standard deviation of 5.79. Male students with high classroom assessment practices had a mean performance score of 24.70 with a standard deviation of 6.75, and female students with high classroom assessment practices had a mean performance score of 25.30 with a standard deviation of 6.81.

It can be seen in Table 5 that $F(2,392) = 174.961$; $p = 0.000 < 0.05$. Therefore, the null hypothesis is rejected. This means that there is a significant difference in the impacts of teachers' low, moderate, and high classroom assessment practices on the mean process skills acquisition scores of students in basic science.

Table 5. ANOVA of the impact of teachers' low, moderate, and high classroom assessment practices on process skills acquisition scores.

Students' mean process skills acquisition scores					
	Sum of squares	df	Mean square	F	Sig.
Between groups	8330.964	2	4165.482	174.961	0.000
Within groups	9285.142	390	23.808		
Total	17616.107	392			

Table 6. Multiple comparisons of the impact of teachers' low, moderate, and high classroom assessment practices on process skills acquisition scores.

Scheffé Test						
(I) Low, moderate, and high classroom assessment practices	(J) Low, moderate, and high classroom assessment practices	Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Low assessment practices	Moderate assessment practices	-0.075	0.640	0.993	-1.647	1.497
	High assessment practices	-10.625*	0.732	0.000	-12.423	-8.827
Moderate assessment practices	High assessment practices	-10.550*	0.591	0.000	-1.497	1.647

Note: * The mean difference is significant at the 0.05 level.

The comparison in Table 6 shows that $p = 0.993 > 0.05$ for teachers' low and moderate classroom assessment practices, $p = 0.000 < 0.05$ for teachers' low and high classroom assessment practices, and $p = 0.000 < 0.05$ for teachers' high and moderate classroom assessment practices. We therefore uphold the rejected null hypothesis. This means that there is a significant difference in the impacts of teachers' low, moderate, and high classroom assessment practices on the students' mean scores of process skills acquisition in basic science.

Table 7. ANOVA of the impact of teachers' low, moderate, and high classroom assessment practices on the performance scores of students in basic science.

Students' mean performance scores					
	Sum of squares	df	Mean square	F	Sig.
Between groups	5722.080	2	2861.040	59.872	0.000
Within groups	18636.622	390	47.786		
Total	24358.702	392			

In Table 7, $F(2,392) = 59.872$; $p = 0.000 < 0.05$. We therefore reject the null hypothesis. This means that there is a significant difference in the impact of teachers' low, moderate, and high classroom assessment practices on the mean performance scores of students in basic science.

Table 8. Multiple comparisons of the impact of teachers' low, moderate, and high classroom assessment practices on the performance scores of students in basic science.

Scheffé Test						
(I) Low, moderate, and high classroom assessment practices	(J) Low, moderate, and high classroom assessment practices	I-J	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Low assessment practices	Moderate assessment practices	-0.948	0.90646	0.579	-1.647	1.497
	High assessment practices	-9.410*	1.037	0.000	-12.423	-8.827
Moderate assessment practices	High assessment practices	-8.465*	0.838	0.000	-1.497	1.647

Note: * The mean difference is significant at the 0.05 level.

The comparison in Table 8 shows that p = 0.579 > 0.05 for teachers' low and moderate classroom assessment practices, p = 0.000 < 0.05 for teachers' low and high classroom assessment practices, and p = 0.000 < 0.05 for teachers' high and moderate classroom assessment practices. Therefore, the rejected null hypothesis is upheld.

Table 9. T-test of the differences in the impact of teachers' low classroom assessment practices on male and female students' process skills acquisition.

Gender	N	$\overline{X}$	σ	t	df	Sig. (2-tailed)	Remark
Male	43	2.81	3.03	0.263	78	0.793	NS
Female	37	2.65	2.49				

Note: NS = Not significant.

In Table 9, t = 0.263 at df = 78; p = 0.793 > 0.05; therefore, we do not reject the null hypothesis. This means that there is no significant difference in the impact of teachers' low classroom assessment practices between male and female students' mean process skills acquisition scores in basic science.

Table 10. T-test of the differences in the impact of teachers' moderate classroom assessment practices on male and female students' process skills acquisition.

Gender	N	$\overline{X}$	σ	t	df	Sig. (2-tailed)	Remark
Male	118	3.12	3.16	1.440	21	0.151	NS
Female	95	2.57	2.15		1		

Table 10 reveals that t = 1.440 at df = 211; p = 0.151 > 0.05. We therefore do not reject the null hypothesis. This means that there is no significant difference in the impact of teachers' moderate classroom assessment practices on male and female students' mean process skills acquisition scores in basic science.

Table 11. T-test of the difference in the impact of teachers' high classroom assessment practices on male and female students' process skills acquisition.

Gender	N	$\overline{X}$	σ	t	df	Sig. (2-tailed)	Remark
Male	55	14.55	7.00	0.500	98	0.618	NS
Female	45	13.80	8.13				

From Table 11, t = 0.500 at df = 98; p = 0.618 > 0.05. We do not reject the null hypothesis. Therefore, there is no significant difference in the impact of teachers' high classroom assessment practices on male and female students' mean process skills acquisition scores in basic science.

Table 12. T-test of the difference in the impact of teachers' low classroom assessment practices on male and female students' performance.

Gender	N	$\overline{X}$	σ	t	Df	Sig. (2-tailed)	Remark
Male	43	17.05	5.97	0.004	78	0.997	NS
Female	37	17.05	6.45				

Table 12 reveals that t = 0.004 at df = 78; p = 0.997 > 0.05. Therefore, the null hypothesis is not rejected. This means that no significant difference exists in the impact of teachers' low classroom assessment practices on male and female students' means performance scores in basic science.

Table 13 shows that t = 1.578 at df = 211; p = 0.116 > 0.05. We therefore do not reject the null hypothesis. This means that no significant difference exists in the impact of teachers' moderate classroom assessment practices on male and female students' means performance scores in basic science.

Table 13. T-test of the difference in the impact of teachers' moderate classroom assessment practices on male and female students' performance.

Gender	N	$\overline{X}$	σ	t	df	Sig. (2-tailed)	Remark
Male	118	18.63	5.95	1.578	211	0.116	NS
Female	95	17.35	5.79				

Table 14. T-test of the difference in the impact of teachers' high classroom assessment practices on male and female students' performance.

Gender	N	$\overline{X}$	σ	t	Df	Sig. (2-tailed)	Remark
Male	55	24.70	6.75	0.438	98	0.662	NS
Female	45	25.30	6.81				

Table 14 displays that t = 0.438 at df = 98; p = 0.662 > 0.05. Therefore, the null hypothesis is not rejected. This means that there is no significant difference in the impact of teachers' high classroom assessment practices on male and female students' means performance scores in basic science.

5. DISCUSSION

The findings show that teachers with low, moderate, and high classroom assessment practices have a significant impact on students' process skills acquisition. The multiple comparisons of the impact of teachers' low, moderate, and high classroom assessment practices on the students' process acquisition scores upheld the rejected null hypothesis. This connotes that the difference in the impact of teachers' low, moderate, and high classroom assessment practices on the students' mean process skills acquisition scores was statistically significant. The present study disagrees with that of Anyanwu, Ezenwa, and Gambari (2014), who found that no significant difference exists in the post-test mean scores of high, medium, and low ability students exposed to mathematics content via an animation test.

Teachers' classroom assessment practices provided quality feedback to students before, during, and after learning and were found to significantly impact their acquisition of science process skills. The teachers' classroom assessment practices reflected real-world scientific practices and context and prepared students for better future scientific endeavors. The assessment practices aligned the assessment's instructional objectives and curriculum standards to support students' acquisition of the process skills and to promote meaningful learning outcomes. This could explain the statistically significant impact of teachers' low, moderate, and high classroom assessment practices on the students' mean scores of process skills acquisition. The impact of teachers' classroom assessment practices on the students' mean performance score was found to be significant. The multiple comparisons of the impact of teachers' assessment practices on the students' performance scores upheld the rejected null hypothesis. The finding agrees with Achor et al. (2015), who found that the achievement levels of students with high and low reasoning abilities differ significantly, favoring those with higher abilities. This finding also aligns with Yaduvanshi and Singh (2019), who reported that low, average, and high achievers in the treatment group performed better than those in the control group. Similarly, Yusuf and Mahmut (2021) noted a statistically significant effect of formative assessment practices on students' mathematics achievement. However, this finding contrasts with Achor and Ejeh (2019), who reported no significant differences in the mean gains of cognitive ability and achievement scores among low, moderate, and high cognitive ability students exposed to content through a cognitive acceleration training program. The teachers' classroom assessment practices reflect the content and skills taught in class, accurately measure students understanding, and lead to improved performance. The assessment practices used by the teachers in the present study entail high-quality, timely, and specific feedback provided during learning process to help students understand their strengths and weaknesses, allowing them to make necessary adjustments to improve their learning and performance. The way teachers understand assessment principles and practices plays a crucial role in students' performance. The

classroom assessment practices involve regular appraisals that inform instruction and guide students' progress, leading to better academic outcomes. This may explain why the difference in the impact of teachers' classroom assessment practices on the mean performance scores of students was significant.

The impact of teachers' low classroom assessment practices on the male and female students' mean scores for process skills acquisition was not significant. The finding agrees with Remziye et al. (2011), who found that gender had no significant influence on science process skills acquired by learners. The findings showed that the impact of teachers' moderate classroom assessment practices on the mean scores for the process skills acquisition of male and female students was not significant. The agrees with Nworgu and Otum (2013), who also found no gender difference. It similarly agrees with Ekon and Eni (2015), who stated that the acquisition of science process skills at the upper basic level of Universal Basic Education (UBE) was not significantly influenced by gender.

Another finding is that the impact of teachers' high classroom assessment practices on male and female students' means scores for process skills acquisition was not significant. This implies that the impact of teachers' high classroom assessment practices on students' process skills acquisition was not significantly influenced by gender. The finding agrees with Obialor, Osuafor, and Nnadi (2017), who found that students' science process skills acquisition in biology was not significantly influenced by gender. The finding also collaborates with Achor et al. (2018), who found that the difference between the mean scores for the acquisition of science process skills ($p = 0.09 > 0.05$) for male and female students exposed to biology content via a laboratory strategy was not significant.

Gender stereotypes exist in relation to students' process skills acquisition in basic science when teachers practiced classroom assessments. The present study found an insignificant impact of teachers' low, moderate, and high classroom assessment practices on male and female students' mean process skills acquisition. This implies that teachers' classroom assessment practices are gender-friendly with respect to students' process skills acquisition in science. This is because of the integration of technology into teachers' classroom assessment practices that encourage collaboration and peer interaction and promote students' development of process skills, such as communication and teamwork, irrespective of gender. Another finding showed that the difference in the impact of teachers' low classroom assessment practices on male and female students' means performance scores did not differ significantly. This means that the impact of teachers' high classroom assessment practices on students' mean performance scores by gender was not significant. This finding agrees with Orheruata and Oyakhirome (2019), who also found that gender was not a significant factor when students were exposed to formative classroom assessment.

It was also found that the impact of teachers' moderate classroom assessment practices on students' mean performance scores by gender was not significant. This is in agreement with Agwagah and Ezieke (2023), who found that the mean academic achievement of students exposed to formative assessment practice was not significant by gender. However, the finding disagrees with Karaman (2021), who found that a significant difference exists ($p < 0.05$) between the average score of students taught by the formative assessment and the average score of those taught via the traditional method. Another finding revealed that the impact of teachers' high classroom assessment practices on male and female students' means performance scores was not significant. This connotes that the difference in the impact of teachers' high classroom assessment practices on male and female students' mean performance scores was not significant. This is in agreement with Karaman (2021), who found no significant difference in relation to students' gender between the effects of formative assessment-based strategy on the higher basic students' general science achievement. The finding also agrees with Achor et al. (2015), who found that the gender of basic science students exposed to content prior to instruction did not significantly differ in their mean achievement scores.

Gender stereotypes exist in relation to students' performance in basic science when teachers practiced classroom assessments. This study found that the impact of teachers' low, moderate, and high classroom assessment practices

on students' mean performance scores by gender was not significant. This implies that teachers' classroom assessment practices are not gender sensitive with respect to students' performance. This can be adduced to the fact that teachers' classroom assessment practices enhance male and female students' self-efficacy in science and lead to greater confidence in their abilities. The teachers' tailored their classroom assessments to accommodate students' diverse learning needs and abilities to advance performance irrespective of gender.

6. IMPLICATIONS

The essence of every teaching activity in science is to bring about the improved acquisition of process skills and performance. Before now, the focus has been on teaching strategies, leading to teachers neglecting of some major teaching activities in the classroom such as the type of assessment they practice. Some assessment types are more engaging both in activities and in reasoning than others. This study has brought to the fore the inherent benefits of assessment practices and where to place emphasis. For instance, four out of twenty items on the instrument read:

5. The teacher sets a task to find out students' imaginative and innovative solutions to problems.

14. The teacher facilitates group discussions where students can explain their scientific reasoning and share their findings.

15. The teacher conducts hands-on experiments or demonstrations to assess the students' understanding of scientific concepts.

20. The teacher assigns students to teach a concept or topic to their peers and observes the peer teaching sessions.

These items are highly engaging and could possibly expose students to critical thinking, abstract reasoning, or higher-order thinking, resulting in a good grasp of process skills in science and improved performance. It is instructive to note that for both process skills and performance, the students' mean scores increase from low to moderate to high assessment practices, though the difference between low and moderate was minimal. This implies that if some of these notable practices, such as the four items listed, are put on high frequency in basic science classrooms, process skills and academic performance will improve.

7. LIMITATION OF THE STUDY

As this study uses a cross-sectional survey design, the students were not taught for the purpose of the study but depended on the knowledge acquired within the term/session (4–10 months before the data were collected). Though this was same period for all the students in the study sample and the content covered was ensured to be the same, their retentive ability of the knowledge acquired would not be the same. Some may have forgotten more concepts than others, and this could have created a difference in the results obtained and on which decisions were hinged. This calls for replication of the study to guarantee far-reaching decisions.

8. CONCLUSION AND RECOMMENDATIONS

The study concluded that teachers' assessment practices have a great impact on students' process skills acquisition and performance in basic science. It was also concluded that the assessment practices of teachers are gender friendly with reference to students' science process skills acquisition and performance in basic science. It is therefore recommended that:

1. Teachers of basic science are encouraged to use assessment guides and workbooks to acquaint themselves with appropriate assessment practices. This will help them to enhance their assessment practices and boost their students' performance in basic science.

2. In-service training in the form of seminars, workshops, and symposia are expected to be organized by the Basic Education unit of the state's Ministry of Education to inculcate in teachers effective assessment practices in their teaching subjects irrespective of gender.
3. Teachers of basic science need to be mindful of the assessment practices they employ in the classroom in order to enhance students' acquisition of science process skills.

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