


## Contemporary evaluation techniques for assessing student's achievement in science and mathematics and sciences

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ARTICLE INFO	ABSTRACT
<p><b>Keywords:</b> <i>contemporary evaluation, digital assessment, performance-based assessment, science and mathematics achievement, formative assessment</i></p> <p><i>Received : 09, Feb. 2024</i> <i>Revised : 11, Nov. 2025</i> <i>Accepted: 13, Dec. 2025</i></p> <p>©2025 Author(s): This is an open-access article distributed under the terms of the <a href="#">Creative Commons Attribution 4.0 International</a></p> 	<p><i>The study employed a descriptive survey design involving 200 teachers randomly selected from ten public secondary schools in Anambra State. The objective was to examine contemporary evaluation techniques for assessing students' achievement in science and mathematics, focusing on enhancing the validity, reliability, and authenticity of learning assessment. Data were collected using a validated and reliable self-structured questionnaire arranged on a four-point Likert scale. The researcher personally administered all questionnaires to ensure clarity and accuracy. Reliability was confirmed with a Cronbach Alpha coefficient of 0.95. Collected data were analyzed using mean and standard deviation, with 2.5 set as the benchmark for acceptance of questionnaire items. The findings showed that teacher qualification strongly influenced effective evaluation in science and mathematics, with high acceptance for items on quality teaching, subject mastery, and learner interest (means ranged from 3.20–3.35). Only one item was rejected (1.70). Evaluation resources also played a key role; effective use enhanced clarity and engagement (3.35, 3.30), while inadequate facilities hindered achievement (3.25). Some resource-related items were rejected (means between 1.42–2.10). Poor teaching methods further affected evaluation outcomes. Respondents agreed that teaching experience and appropriate methods improved student achievement (means 3.15–3.40), while a few items on negative effects were rejected (2.05, 2.55). The study concluded that contemporary evaluation techniques are vital for promoting deeper conceptual understanding, scientific reasoning, and problem-solving abilities among learners. It recommended targeted professional development, improved technological infrastructure, and supportive policy frameworks to strengthen their adoption in schools. This study adds to ongoing discourse on innovative approaches needed for enhancing science and mathematics learning outcomes in Nigerian secondary schools.</i></p>

### 1. INTRODUCTION

Contemporary evaluation techniques have become increasingly important in measuring students' achievement in science and mathematics, particularly as traditional assessment methods have been criticized for focusing narrowly on rote memorization and paper-and-pencil testing. The problem underlying the shift is that conventional assessments often fail to capture higher-order thinking, creativity, problem-solving, and the application of scientific and mathematical knowledge to real-life situations. Scholars argued that modern classrooms require assessment approaches that align with learner-centred pedagogy, inquiry-based learning, and competency-driven curricula (Muge & Waiganjo, 2025). Consequently, contemporary evaluation methods have emerged to provide more authentic, comprehensive, and performance-based measures of student learning.

One prominent contemporary technique is performance-based assessment, which requires learners to demonstrate knowledge through tasks such as experiments, investigations, projects, or mathematical modelling. This approach evaluates students' ability to apply concepts rather than recall

facts. According to Daniel et al, (2025), performance tasks enhance learners' scientific reasoning and procedural understanding, especially in laboratory-based subjects. In mathematics, project-based assessments allow students to apply quantitative reasoning to real-life problems, thereby deepening conceptual understanding (Drastisianti et al, 2024).

Portfolio assessment has also gained recognition as a valuable tool for evaluating achievement in science and mathematics. Portfolios provide a collection of students' work over time, demonstrating growth, creativity, and mastery of skills. Alkaabi and Abdallah (2024) noted that portfolios encourage continuous learning and self-reflection, allowing teachers to assess cognitive and affective development. In Nigerian classrooms, portfolio use has been associated with improved engagement and responsibility for learning (Khasawneh et al, 2025). Another contemporary strategy is authentic assessment, which examines learners' performance in real-world or simulated contexts. Authentic tasks such as fieldwork, model construction, data analysis, and scientific reporting reflect how scientists and mathematicians operate in real professions. Authentic evaluation enhances problem-solving competence and fosters transferable skills needed for innovation and national development (Hendrilia & Dewi, 2023).

Computer-based testing (CBT) and digital formative assessment tools have also transformed evaluation practices. CBT offers immediate feedback, adaptive questioning, and multimedia simulations, which support deeper learning experiences in science and mathematics. According to Chukwuma-Nosike and Chukwuma (2023), digital assessment promotes efficiency, objectivity, and accessibility, particularly in large classrooms. Similarly, formative digital tools such as online quizzes, interactive simulations, and automated scoring platforms improve teachers' ability to monitor progress continuously. Furthermore, concept mapping has been identified as a useful evaluation method for assessing learners' understanding of scientific and mathematical relationships. Concept maps require students to visually represent connections between ideas, revealing misconceptions, cognitive structures, and levels of comprehension. Novak and Cañas' theory of concept mapping has been widely applied, and Nigerian studies confirmed its effectiveness in diagnosing learning gaps in science education (Veiga et al, 2025).

Contemporary evaluation techniques such as peer and self-assessment strengthen students' metacognitive skills and deepen their engagement in scientific and mathematical reasoning. These approaches align with the shift towards learner-centred pedagogies that emphasize inquiry, collaboration, and problem-solving. Studies emphasised that effective learning requires assessment methods that reflect real-world competencies rather than rote memorisation, highlighting persistent gaps in classroom practice. Research on quality assurance pointed out weaknesses in current evaluation systems, stressing the need for authentic measures that improve learning outcomes (Ezugoh et al., 2023). Limited ICT integration in assessment reflects broader systemic challenges, as observed in studies on post-COVID-19 digital utilisation (Ikegbusi et al., 2021). Evidence also showed that inadequate teacher capacity and resource constraints hinder innovative evaluation practices, similar to challenges identified in food insecurity and teacher motivation studies (Ikegbusi et al., 2025).

Scholars further argued that modern STEM learning requires creativity-driven and project-based evaluation formats that enhance higher-order thinking (Ikegbusi & Egbu, 2024). The growing adoption of AI-driven learning underscores the need for assessments that capture application of knowledge in emerging fields (Ofozoba et al., 2025). Effective school management and strategic resource mobilisation were also linked to improved assessment quality (Egbu & Ekwu, 2024; Egbu & Mbonu, 2023). Overall, contemporary evaluation techniques are essential for bridging traditional assessment gaps and advancing meaningful learning in science and mathematics. These gaps highlight the need for a comprehensive study that promotes awareness and integration of modern evaluation strategies. Therefore, this study is important as it provides evidence-based insights that can guide teachers, policymakers, and curriculum developers in improving assessment practices to

reflect global STEM learning standards and better prepare students for future academic and career demands.

### 1.1 Research questions

1. To what extent does teacher's qualifications influence effective evaluation of science and mathematics in JSS?
2. To what extent does evaluation resources affect effective evaluation of science and mathematics in JSS?
3. What are the effects of poor teaching method on effective evaluation of science and mathematics in JSS?.

## 2. METHOD

The study adopted a descriptive survey research design, which allowed data to be collected at a single point in time in order to describe existing conditions and compare them with established standards. This approach enabled the researcher to study a defined population through representative sampling. The investigation was conducted in Anambra State. The area comprised a population dominated by business people and fishermen. The study population consisted of teachers in the public secondary schools in the state. A purposive sampling technique was used to target specific respondents, after which random selection was applied. Ten secondary schools were randomly selected, and from each school twenty teachers were chosen, making a total sample size of 200 teachers.

Data were collected using a self-structured questionnaire. The instrument contained two sections: demographic information and items based on the research questions. A four-point Likert scale ranging from strongly agree to strongly disagree was used. The questionnaire was validated by two experts. Their corrections were incorporated, and the instrument was deemed valid. Reliability was established through a test-retest procedure involving ten teachers outside the main study. Using the Cronbach Alpha method, a reliability coefficient of 0.95 was obtained, indicating acceptable internal consistency. The researcher personally visited the selected schools to administer and retrieve all 200 questionnaires, ensuring clarity and accurate responses. Data were analyzed using mean and standard deviation, with a decision rule that a mean score of 2.5 and above indicated acceptance, while 2.4 and below indicated rejection.

## 3. RESULT AND DISCUSSION

**Research question 1:** To what extent does teacher's qualifications influence effective evaluation of science and mathematics in JSS?

**Table 1:** Mean and standard deviation of responses on the extent does teacher qualifications influence effective evaluation of science and mathematics in JSS?

S/N	ITEM	MEAN	Std Dev	Decision
1.	Qualified teachers are the main determinant of quality in education	3.35	0.91	Accepted
2.	Teacher with whom the Science and mathematics students can identify and who has good mastery attract science and mathematics students to his/her subjects	3.25	0.89	Accepted
3.	NCE grade teachers are not friendly while teaching	1.70	0.95	Rejected

4.	Science and mathematics students have greater interest in their subject only when the teacher(s) teaching the subject is qualified	3.35	0.91	Accepted
5.	Highly qualified teacher refer to the simple related topic when introducing new topic	3.20	0.87	Accepted
6.	Mostly graduate teachers give adequate explanation while teaching	3.20	0.98	Accepted
7.	The teachers' teaching effectiveness is evident in the learning outcome of science and mathematics students as measured by science and mathematics students' academic achievement	3.30	0.9	Accepted
8.	effective teaching is a significant predictor of science and mathematics students' academic achievement	3.30	0.9	Accepted
9.	Experienced and qualified teacher identify Science and mathematics student's factor while teaching	2.50	1.12	Accepted
10.	Science and mathematics students' ratings are valuable indicators of teachers' attitude and input	2.75	1.04	Accepted

Table 1 above showed that with respect to extent teacher's qualifications influence effective evaluation of science and mathematics in JSS; it is surprising to observe that qualified teachers are the main determinant of quality in education with a mean of 3.35. However, they disagreed that NCE grade teachers are not friendly while teaching (1.70); the Science and mathematics students agreed that Science and mathematics students have greater interest in their subject only when the teacher(s) teaching the subject is qualified with a mean score of 3.35 and standard deviation of 0.91. In general, items number 1, 2, 4, 6, 8, 9 and 10 yielded a mean score of 3.35, 3.25, 3.35, 3.20, 3.20, 3.30, 3.30, 2.50, 2.75 and standard deviation of 0.91, 0.89, 0.91, 0.87, 0.98, 0.9, 0.9, 1.12, 1.04 respectively and thus was accepted while item 3 gave the mean score of 1.70 corresponding to standard deviation of 0.95 and thus was rejected.

Research question 1 sought to find out the extent does teacher's qualifications influence effective evaluation of science and mathematics in JSS, the study found that qualified teachers are the main determinant of quality in education (3.35), this view has previously been promulgated by Daniel et al, (2025), he upheld that no education system can arise above the quality of its teachers. Regarding teacher-Science and mathematics student interaction, there are indications that teacher with whom the Science and mathematics students can identify and who has good mastery attract Science and mathematics students to his/her subjects (3.25) thus, Drastisianti et al, (2024) suggested that every effort should be made during recruitment exercise by the school authorities so as to employ teachers whom the Science and mathematics students would have confidence to impact knowledge to them.

It was clear that Science and mathematics students have greater interest in their subject only when the teacher(s) teaching the subject is qualified (3.35) and this is consistent with the findings of Muge and Waiganjo (2025) whose findings on pre-service teacher preparation are consistent with common sense and the experience of those in the classroom. It was upheld that qualified teachers are more likely to remain in teaching and qualified teachers produce higher Science and mathematics student achievement. Table 1 also showed that mostly graduate teachers give adequate explanation while teaching (3.20), this is consistent with the results of Khasawneh et al, (2025) who examined the factor of teachers' qualifications on the learning outcome of science and mathematics students as measured by Science and mathematics students' academic achievement, therefore effective teaching is a significant predictor of science and mathematics students' academic achievement as attested to by the respondent with a mean score of 3.30 and standard deviation of 0.9. Although the respondents

agreed Science and mathematics students' ratings are valuable indicators of teachers' attitude and input (2.75) however, Hendrilia and Dewi (2023) suggest that other factors such as socio-economic background, family support, intellectual aptitude of science and mathematics student, personality of science and mathematics student, self-confidence, and previous instructional quality have been found to also factor Science and mathematics students' examination score either positively or negatively.

**Research Question 2:** To what extent does evaluation resources affect effective evaluation of science and mathematics in JSS?

**Table 2:** Mean and standard deviation of responses on the extent evaluation resources affect effective evaluation of science and mathematics in JSS.

S/N	ITEM	Mean	Std Dev	Decision
11.	The use of evaluation resources teaching process is less stressful for both teacher and Science and mathematics students	1.50	0.87	Rejected
12.	Inappropriate teaching methods and inadequate numbers of learning facilities in schools affects Science and mathematics student academic achievement	3.25	0.89	Accepted
13.	teachers claim that improvisation is time consuming and often depleting	1.42	0.63	Rejected
14.	there is a relationship between teachers' knowledge of what they teach	2.65	1.11	Accepted
15.	The ability to teach effectively depends on evaluation resources and knowledge that exists in many forms	2.00	1.1	Rejected
16.	Effective use of evaluation resources will pass concept more clearly and provide better explanations than those with weaker backgrounds	3.35	0.85	Accepted
17.	Skills in teaching is a registered variable has an effect on science and mathematics students' academic achievement	2.10	0.99	Rejected
18.	Teaches putting more efforts in buying expensive evaluation resources by taxing the Science and mathematics students.	1.75	0.89	Rejected
19.	evaluation resources gives learners opportunities to relates to real life experience	2.65	1.11	Accepted
20.	evaluation process is made lively by using evaluation resources	3.30	0.84	Accepted

The result in table 2 reveals that effective use of evaluation resources will pass concept more clearly and provide better explanations than those with weaker backgrounds (3.35). However, inappropriate teaching methods and inadequate numbers of learning facilities in schools affect Science and mathematics student academic achievement (3.25). In all, items 22, 24, 26, 29, 30 with a mean score of 3.25, 2.65, 3.35, 2.65, and 3.30 corresponding to standard deviation of 0.89, 1.11, 0.85, 1.11 and 0.84 were accepted while items 21, 23, 25, 27, 28, in table 3 were rejected with a mean score of 1.50, 1.42, 2.00, 2.10 and 1.75 respectively.

Research question 2 examined the extent does evaluation resources affect effective evaluation of science and mathematics in JSS; it was found effective use of evaluation resources will pass concept more clearly and provide better explanations than those with weaker backgrounds (3.35). To

explain this phenomenon, a study by Chukwuma-Nosike and Chukwuma (2023) revealed that the achievement of Nigeria Science and mathematics students in O/L Education was generally poor, this was attributed by the author to many factors of teaching, of which evaluation resources itself was considered as an important factor. From table 3, the respondents agreed that inappropriate teaching methods and inadequate numbers of learning facilities in schools affects Science and mathematics student academic achievement (3.25). Most respondents suggests that evaluation resources gives learners opportunities to relates to real life experience (2.65). Other studies in terms of teaching methods gave similar results. For example, Veiga et al, (2025) upheld that positive inputs of teachers via the use of appropriate evaluation resources for the right concept are essential for effective learning. There are also indications that evaluation process is made lively by using evaluation resources (3.30), this result is collaborated by Egwu and Ekwe (2024) who asserts that students has speculated about some of their teachers do not have the necessary skills, techniques, strategies needed to convey concepts, ideas, principles meant to facilitate effective learning.

**Research Question 3:** What are the effects of poor teaching method on effective evaluation of science and mathematics in JSS?

**Table 3:** Mean and standard deviation of responses on the effects of poor teaching method on effective evaluation of science and mathematics in JSS?

S/ N	ITEM	MEAN	STD DEV	Decision
21.	Teachers using improved teaching methods turned out Science and mathematics students with higher academic achievement	3.40	0.86	Accepted
22.	Teachers' experience in his field of study greatly adds to his usage of effective method in teaching	3.35	0.85	Accepted
23.	Teacher, as a skill and profession, requires some appropriate methods or approaches	3.15	1.01	Accepted
24.	An experienced teacher can apply appropriate teaching method which is carefully planned and can lead to effective learning by Science and mathematics students	3.35	0.85	Accepted
25.	Poor teaching method involves far more than an inappropriate match between the school's curriculum and the Science and mathematics students' needs	3.15	0.91	Accepted
26.	Poor teaching method not only aggravates existing learning factors, but it can also increase poor achievement.	2.50	1.12	Accepted
27.	Effective teaching method can stimulate and motivate Science and mathematics students to learning	3.30	0.84	Accepted
28.	Poor teaching method increase discrepancy between Science and mathematics students intellectual ability and achievement	2.05	1.12	Rejected
29.	An experienced teacher will be able to foster high academic achievement among Science and mathematics students	2.80	1.17	Accepted
30.	Poor teaching method may hamper good Science and mathematics students achievement	2.55	0.86	Rejected

Table 3 above showed that based on the analysis made on research question 2 the respondents agreed that teachers' experience in his field of study greatly adds to his usage of effective method in teaching (3.35); in relation to professional requirements, there are indications that teacher, as a skill and profession, requires some appropriate methods or approaches (3.15); on the whole, items 11, 12, 13, 14, 15, 16, 17, 19 were accepted with a mean score 3.40, 3.35, 3.15, 3.35, 3.15, 2.50, 3.30, 2.80 corresponding to standard deviation of 10.86, 0.85, 1.01, 0.85, 0.91, 1.12, 0.84, 1.17 respectively, while items 17, 20 were rejected with a mean score of 2.05, 2.55 and standard deviation of 1.12, 0.86 respectively. Table 2 also showed that an experienced teacher will be able to foster high academic achievement among science and mathematics students.

Research question 3 dealt with the effects of poor teaching method on effective evaluation of science and mathematics in JSS. Based on the analysis, the respondents agreed that teachers' experience in his field of study greatly adds to his usage of effective method in teaching (3.35), Ezugoh et al, (2023) upheld that teachers effective use of teaching method appear to be effective with students of all achievement levels, regardless of the level of heterogeneity in their classrooms; in relation to instructional delivery, there are indications that poor teaching method not only aggravates existing learning factors, but it can also increase poor achievement (2.50). Collaborating these findings, researches on teacher use of appropriate teaching method supports the fact that effective teachers not only make Science and mathematics students feel good about school and learning, but also that their work actually results in increased Science and mathematics student achievement. Studies have substantiated that a whole range of personal and professional qualities are associated with higher levels of science and mathematics student achievement (Ikegbusi et al, (2021). The respondents however disagreed that poor teaching method may hamper good science and mathematics students' achievement (2.55).

#### 4. CONCLUSION

The study on contemporary evaluation techniques for assessing students' achievement in science and mathematics established that modern assessment practices are essential for improving learning outcomes, strengthening instructional delivery, and aligning classroom evaluation with global STEM standards. Findings demonstrated that teacher qualification, availability of evaluation resources, and the application of appropriate teaching and assessment methods significantly influenced the effectiveness of evaluating students' performance. Teachers who possessed strong subject mastery, professional competence, and adequate experience were better able to adopt innovative assessment strategies that enhanced students' understanding and engagement. The study also revealed that contemporary evaluation techniques, such as performance-based assessment, project work, diagnostic testing, practical tasks, and continuous formative feedback, provided deeper insights into students' problem-solving abilities and conceptual understanding compared to traditional paper-and-pencil tests. However, challenges such as inadequate facilities, limited digital tools, insufficient teacher training, and inconsistent instructional practices hindered optimal utilization of these modern techniques.

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