



Enhancing Assessment Literacy for Effective Teaching and Learning of Chemistry in Senior Secondary Schools in Rivers State

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Abstract

Effective teaching and learning of chemistry requires not only a sound curriculum and teaching strategies but also appropriate assessment practices. This study investigated how enhancing assessment literacy can improve teaching and learning outcomes in chemistry, focusing on senior secondary schools in Rivers State. A descriptive survey research design was adopted for this study, using stratified random sampling technique a sample size of 212 was selected as the respondents. A 4-point Likert scale questionnaire titled “Chemistry Teachers’ Assessment Literacy Questionnaire (CTALQ)” was used to obtain data from the respondents for the four research questions and two hypotheses that guided the study. The questionnaire was face validated and trial tested. Cronbach Alpha reliability coefficient of .854 was obtained. The results obtained were analyzed using mean, standard deviation and t-test. The study revealed a moderate level of assessment literacy, utilization of assessments, challenges and strategies employed to improve assessment literacy among chemistry teachers in Rivers State. It was also revealed that there is a statistical significant difference between urban and rural chemistry teachers’ assessment literacy and utilization of assessment in favour of urban chemistry teachers. Thus, the findings emphasized the need for targeted training programs and professional development for teachers, as well as the importance of incorporating a variety of assessment methods to foster deeper student understanding of chemistry concepts.

Keywords: Assessment literacy, chemistry teacher, summative, formative, utilization, data interpretation

Introduction

Assessment literacy plays a crucial role in enhancing the teaching and learning process, particularly in subjects like chemistry, which require students to understand abstract concepts. The concept of assessment literacy refers to the ability of both teachers and students to design, interpret, and use assessments effectively, leading to improved educational outcomes (DeLuca, 2012). In chemistry education, promoting assessment literacy ensures that chemistry students are evaluated comprehensively, considering both their cognitive abilities and their ability to apply chemistry concepts to real-world situations (Bernal-Ballen, & Ladino-Ospina, 2019)

In recent years, the importance of assessment literacy has gained increasing recognition in the field of education. Traditionally, assessments in chemistry education often focused on summative measures, such as end-of-term exams, which primarily evaluated students’ memorization of facts and formulas (Popham, 2013). Though, such assessments do not capture the full range of a student’s abilities, given that subject like chemistry involves not only knowledge retention but also the ability to apply such knowledge in problem-solving tasks, practical experiments, and real-world situations (Volante & Fazio, 2007; Abell, & Sevan, 2020). One significant challenge in chemistry education is the abstract nature of the subject matter, which spans theoretical concepts, laboratory works, and mathematical computations as well as problem-



solving skills. Traditional methods of assessment, often focuses solely on theoretical knowledge, which may not be adequate to capture students' proficiency in applying their knowledge in practical tasks, such as carrying-out experiments or analyzing data. In this context, enhancing assessment literacy involves moving beyond the reliance on standardized tests and incorporating more diverse assessment tools, such as formative assessments, peer reviews, self-assessments, and authentic tasks that require students to engage actively with chemistry concepts (Brookhart, 2011). Moreover, assessment literacy also involves understanding how assessments can be utilized as feedback tools rather than simply as final judgments of student performance.

Research has shown that students who receive timely, constructive feedback are more than likely to succeed in abstract subjects like chemistry (DeLuca & Klinger, 2010; Babinčáková, et al., 2023). Feedback enables students to identify areas of weakness, correct misconceptions and refine their understanding of chemical principles. In this sense, enhancing assessment literacy is vital for both teachers and students, as it provides them with the tools to engage with assessments as part of the ongoing learning process, rather than seeing them as isolated events. Furthermore, the shift towards a more student-centered approach to learning emphasizes the need for assessment literacy. In present-day educational paradigms, students are increasingly motivated to take ownership of their learning process. This includes being able to self-assess their progress, set personal learning goals, and reflect on their strengths and weakness. For chemistry teachers, developing assessment literacy enables them to better understand the performance level of the chemistry students, and further provides them with insight on how performance can be improved (Zimmerman, 2002).

In Rivers State, Nigeria, like many other regions of the worlds, secondary school teachers often face challenges related to assessment literacy. While chemistry teaching and learning is essential in preparing chemistry students for further studies in science and other related fields, research has shown that many teachers lack a deep understanding of how to design and interpret assessments that truly reflect students' learning and achievement (Oloyede & Olorundare, 2021). Chemistry teachers may rely deeply on summative assessments and rote memorization, like exams, which do not actually capture the full range of students' abilities and skills or

enhance critical thinking skills (Adekola & Olayemi, 2019). As a result, students may not develop the need skills to excel in both their academic works and in real-world situations where the knowledge of chemistry is applied.

The existing literature suggests that chemistry teachers' preparation in assessment is time and again inadequate. While there are training programs for teachers, they tend to focus on content knowledge rather than pedagogical methods, including effective assessment practices (Nicol & Macfarlane-Dick, 2006). In addition, the introduction of assessment policies and practices by education authorities is often not accompanied by sufficient professional development program to equip the chemistry teacher. This results in a mismatch between what is expected in assessments and what chemistry teachers are really capable of implementing in the teaching and learning of chemistry in senior secondary schools in Rivers State.

In Rivers State, despite several efforts to improve chemistry education, there is still limited studies' specifically addressing how assessment literacy can be improved for chemistry teachers in senior secondary schools. As such, a gap exists in understanding the relationship between chemistry teachers' assessment literacy and their ability to effectively teach chemistry for students understanding. Empirical studies on this topic could significantly inform chemistry teacher development programs and policy initiatives targeted towards effective teaching strategies in chemistry education, with particular attention given to assessment practices. This study intends to fill this gap by exploring ways to enhance assessment literacy among chemistry teachers in senior secondary schools in Rivers State. It will investigate chemistry teachers' current understanding of assessment practices, identify specific challenges faced by chemistry teachers in implementing assessments effectively, and provide strategies for improving their assessment literacy in Rivers State. Eventually, the goal is to empower chemistry teachers to utilize assessments more efficiently to promote deeper student understanding and thus, improve their academic performance, leading to better students' preparation for future scientific endeavors.

Literature Review

The Concept of Assessment Literacy

Assessment literacy simply refers to the knowledge of the various assessment methods, their



purposes, and how to effectively design, interpret, and utilize assessments to bring about learning. It incorporates the knowledge of both formal and informal assessment techniques and their alignment with learning outcomes (DeLuca, 2012; Bernal-Ballen, & Ladino-Ospina, 2019). Assessment literacy is essential for those in the educational system to make informed decisions that enhances student learning and achievement.

An assessment-literate teacher is not only knowledgeable about the various kinds of assessments but also have an in-depth understanding on how to interpret and use the results so obtained to guide instructional practices. For instance, formative assessments are utilized to monitor student progress and adjust teaching methods, while summative assessments measure the overall performance at the end of the learning period (Brookhart, 2011; Bernal-Ballen, & Ladino-Ospina, 2019). Both forms of assessment require an understanding of how to design them effectively, ensuring that they are aligned with learning goals and objectives.

The concept of assessment literacy also involves the ethical use of assessment data. Teachers must be able to analyze results accurately, avoiding biases or misinterpretations that could affect students' learning experiences. Moreover, teachers need to communicate assessment results transparently to students as well as parents, explaining how these results inform instructional practices and student progress (Popham, 2011; Babinčáková, et al., 2023). In today's educational system, where data-driven decision-making plays a critical role, assessment literacy has become increasingly pivotal. Teachers must develop a deep understanding of assessment processes to ensure fair, valid, and reliable evaluation of student performance.

The Role of Assessment in Chemistry Education

Assessment plays a vital role in the educational system. As an essential component of teaching and learning, assessment serves not only to evaluate students' understanding but also guide instruction, enhance learning outcomes, and ensure that the curriculum is effective. In chemistry education, assessment provides the chemistry students with adequate knowledge to develop vital skills needed to understand the abstract nature of chemistry. Some of the roles that assessment plays in chemistry education include the following;

Guiding Student learning: assessment provides chemistry students with valuable feedback, helping them understand their areas of weakness that needs improvement and their areas of strength too. In chemistry, where understanding abstract concepts like atomic structure, chemical reactions, and thermodynamics is crucial, assessments help students identify gaps in their knowledge. Regular quizzes test and assignments serve as tools to reinforce key idea, making sure that student grasp fundamental concepts before progressing to more advance topics (DeLuca & Klinger, 2010; Abell, & Sevian, 2020). For instance, in practical lab settings, assessments such as lab reports or performance evaluations allow students to assess their ability to apply theoretical knowledge in real-world experiments. These assessments not only test recall but also encourage critical thinking and problem-solving skills, which are key skills in chemistry. Additionally, assessment promotes active learning. In response to assessment, students are often motivated to engage more deeply with the learning material, seeking clarification on areas of difficulty and thus, making challenging concepts clear. This active engagement fosters a deeper understanding of the subject matter, leading to better retention and the ability to apply knowledge in various contexts.

Supporting Effective Teaching: for teachers, assessment is an important tool for measuring the effectiveness of their methodology and identifying areas where students may be struggling. Chemistry, with its emphasis on both theoretical and practical elements, requires vivid and effective teaching methods. Through assessments, teachers can ascertain whether or not their instruction method has successfully conveyed the necessary information for the chemistry student to master key skills (Department of Education and Training, 2020; Abell, & Sevian, 2021). If a large portion of the class performs poorly on a specific topic, it can inform the teacher that the material was not effectively communicated and may need to be re-explained or approached using a different method or from a different angle. Moreover, assessments provide chemistry teachers with insight into individual student needs, allowing for targeted support to be given. For example, if a student is struggling with understanding chemical bonding, a teacher can provide additional support like one-on-one guidance. This personalized approach ensures that no student is left behind, and helps maintain the overall quality of teaching and learning in the classroom.

Informing Curriculum Development: assessment also plays a vital role in the development and restructuring of chemistry curricula. By analyzing student performance on various assessments, teachers and curriculum developers can determine whether the course content is adequately aligned with the learning objectives. If certain topics are consistently difficult for students to understand, it may indicate that those topics require modification or different teaching method (Pastore & Gillespie, 2019; Babinčáková, et al., 2020). Similarly, assessments can help identify emerging trends in student performance, highlighting areas where the curriculum needs updating or expanding to accommodate new scientific developments or new methodology. In addition to helping teachers adjust their instructional methods, assessments can also ensure that the curriculum is preparing students for future endeavors in chemistry (Penney et. al., 2009; Abell, & Sevia, 2021). For example, assessments in advanced chemistry courses should conform with expectations of professional or academic institutions, ensuring that chemistry students are adequately prepared for further education or work in the field.

Challenges of Assessment Practices

Assessment is a vital tool in education, measuring students' overall progress. However, despite its enormous importance, various challenges hinder effective assessment practices, making it a complex and evolving area. These challenges amongst others include bias in assessment, issues in implementation as well as evolving educational needs.

One significant challenge is the presence of bias in assessment practice. Assessment tools, whether practical test or written exam, may unintentionally favor certain groups of students over others. This bias can be in the form of cultural, linguistic or socioeconomic factors, which goes to disadvantage students from different backgrounds. According to Brookhart (2011), standardized tests have been criticized for not been able to account for cultural differences, thus leading to skewed results. Such biases undermine the fairness of assessments and can affect a student's academic journey, often leading to inaccurate representations of their abilities.

Another challenge is the over-reliance on standardized testing. While these tests offer a uniform system of evaluating students, they fail to take into account the full spectrum of a student's learning and development. Critics argue that standardized

assessments force students to focus heavily on rote memorization and fail to reflect student's practical skills or critical thinking abilities (Popham, 2017; Abell, & Sevia, 2021). This narrow focus neglects the multifaceted nature of learning, consequently overlooking student's creativity, problem-solving abilities and social interaction which are equally important for success. Additionally, technological advancements have introduced challenges related to online assessments. The rapid shifts towards digital assessments, especially during the COVID-19 pandemic, have raised concerns over students' accessibility and security. Many students lack the necessary technology and internet access, therefore, creating differences in the assessment process (Weller, 2020; Abell, & Sevia, 2020). Moreover, online exams are susceptible to cheating, requiring constant adaption of new measures to ensure academic integrity.

Enhancing Assessment Literacy

The understanding of assessment principles and practices is important for both teachers and students to ensure that assessments are effectively designed, implemented and as well interpreted. In educational contexts, enhancing assessment literacy advances the quality of teaching and learning. It also helps teachers design fair and informative assessments while empowering students to understand their progress and areas for improvement. One significant approach to enhancing assessment literacy is professional development for teachers. Teachers who are well-read in assessment strategies can utilize a range of assessment tools, including formative, summative, and diagnostic assessments, to better understand and give respond to students' learning needs (Stignis, 2002; Babinčáková, et al., 2020). Teachers trained in assessment literacy are more likely to utilize assessments that are aligned with learning objectives and standards, giving a more precise measure of student performance. Furthermore, when teachers understand adequately how to interpret assessment data, they can change the teaching methodologies to meet students' needs, improving overall student performance (Brookhart, 2011).

Another important aspect of enhancing assessment literacy is including students in the assessment process. Students who understand the purpose, use and interpretation of assessments, are more likely to engage meaningfully with their learning (Andrade, 2013; Bernal-Ballen, & Ladino-Ospina, 2019). For instance, students can be taught on how to



set learning goals and carry-out self-assess to understand how assessments can be used to inform their progress. This process helps students become more actively engaged in their learning, fostering a sense of ownership and motivation. Moreover, integrating technology into assessment can further enhance assessment literacy. Digital tools allow for more personalized and efficient assessment practices. It also enables real-time feedback and greater accessibility for all students (Torrance & Pryor, 2001; Babinčáková, et al., 2020). By familiarizing both teachers and students with these tools, assessment literacy can be enhanced in modern classroom, ensuring that assessments are fair, accurate and inclusive.

Assessment Literacy and Location (Urban & Rural)

While assessment literacy is an essential tool for both teachers and students, location is an important factor that influences it (assessment literacy). Location, specifically whether a school is located in an urban or rural area is significant to assessment literacy. The difference between urban and rural settings includes resource availability, teacher training, and access to professional development programs, which have significant implication for the development of assessment literacy.

Urban areas, with their larger student populations and better funding, often have more access to diverse assessment tools and technologies. Research by Wyse et. al., (2017) highlights that urban teachers are more likely to receive specialized training on contemporary assessment practices, such as formative assessments, data-driven decision-making, and the use of digital tools for assessment. In urban schools, there is often a greater emphasis on differentiated assessments due to the diverse needs of students, pushing teachers to enhance their assessment skills (DeLuca et. al., 2016; Bernal-Ballen, & Ladino-Ospina, 2019). This wealth of resources and professional support enables urban teachers to develop a higher level of assessment literacy compared to their rural counterparts.

In contrast, rural schools are often faced with challenges that hinder the development of assessment literacy. A study by Hargreaves et. al., (2018) found that rural teachers tend to have limited access to professional development opportunities due to geographic isolation and financial constraints. This lack of ongoing training makes it difficult for rural

teachers to stay current with latest assessment strategies, such as those that incorporate digital tools or advanced data analysis techniques. Additionally, the smaller student populations in rural areas often result in less diversity, leading teachers to rely more on traditional assessment methods, rather than tailoring approaches to individual student needs (Hutchison & Reinking, 2011; Babinčáková, et al., 2020).

Overall, while urban schools have more opportunities for developing assessment literacy through resources and professional development, rural schools face systemic barriers that limit their ability to enhance assessment practices. Addressing these disparities is essential for ensuring that all teachers, regardless of location, have the tools and knowledge to implement effective assessments.

Theoretical Framework

Theoretical framework for enhancing assessment literacy in chemistry teaching and learning can be grounded in several educational theories, such as constructivism, Formative Assessment Theory and Feedback Theory. These theories provide a comprehensive foundation for improving assessment literacy, ensuring that assessments foster deeper learning and facilitate meaningful learning.

Constructivist Learning Theory

The constructivist approach, rooted in the works of Piaget and Vygotsky, emphasizes the importance of active learning, where students construct their knowledge through experiences and interactions. In chemistry, this approach suggests that assessments should not merely evaluate memorization of facts but instead focus on students' ability to apply concepts, analyze data, and engage in problem-solving (Brookhart, 2011). By enhancing assessment literacy, teachers can design assessments that align with active hands-on learning process, using tools such as laboratory works, problem-based assessments, and collaborative projects. These assessment types enable students to demonstrate higher-critical thinking and analysis as well as the ability to apply information to real-world situations, which are central to learning chemistry effectively.

Formative Assessment Theory

Formative assessment, put forward by Black and William, focuses on the ongoing nature of assessment during the learning process, rather than as a summative judgment at the end of instruction. This

theory posits that assessment should inform teaching by providing regular feedback to teachers and students on their progress. In chemistry education, formative assessments can be employed in the form of quizzes, concept maps, in class discussions and peer assessments (Popham, 2017). These practices help students identify gaps in their understanding, allowing them to actively engage with the material and improve their performance before final exams. For teachers, fostering assessment literacy through formative assessment encourages continuous reflection on student progress, enabling timely interventions and adjustments to instruction to support individual students' learning needs.

Feedback Theory

Feedback is a central component of assessment literacy. Hattie and Timperley (2007) identified that effective feedback significantly enhances student learning outcomes by clarifying learning goals, providing specific information about performance, and suggesting ways for improvements. In chemistry education, feedback should go beyond just identifying correct or incorrect answers, it should focus on guiding students through their thought processes, helping them understand why a concept or answer given is correct or incorrect. By enhancing feedback literacy, teachers can foster a growth mindset in students, enriching them to view mistakes as opportunities for learning rather than failures.

Statement of the Problem

Despite the importance of effective assessment practices in the teaching and learning of chemistry, many secondary school chemistry teachers in Rivers State lack the necessary skills to design and utilize assessment tools that enhance meaningful teaching and learning of chemistry. This lack of assessment literacy may result in ineffective teaching methodologies, poor student performance, and in general, hindered academic development in the field of chemistry. It is on this premise that the study seeks to investigate how enhancing assessment literacy can improve teaching and learning outcomes in chemistry, focusing on senior secondary schools in Rivers State.

Purpose of the Study

The purpose of the study is to investigate how enhancing assessment literacy can improve teaching and learning of chemistry in senior secondary schools

in Rivers State. The study also seeks to achieve the following objectives;

1. To investigate the level of assessment literacy among chemistry teachers in senior secondary schools in Rivers State.
2. To determine the level of utilization of assessments in enhancing students' learning in chemistry.
3. To ascertain the challenges chemistry teachers face in using assessments to support teaching and learning in senior secondary schools in Rivers State.
4. To discover strategies that can be employed to improve assessment literacy among chemistry teachers in Rivers State.

Research Questions

The following research questions were posed the study;

1. What is the level of assessment literacy among chemistry teachers in senior secondary schools in Rivers State?
2. What is the level of utilization of assessments in enhancing students' learning in chemistry?
3. What challenges do chemistry teachers face in using assessments to support teaching and learning in senior secondary schools in Rivers State?
4. What strategies can be employed to improve assessment literacy among chemistry teachers in Rivers State?

Hypotheses

H₀₁: There is no significant difference in the level of assessment literacy among urban and rural chemistry teachers in senior secondary schools in Rivers State.

H₀₂: There is no significant difference in the level of urban and rural chemistry teachers' utilization of assessments in enhancing students' learning.

Methodology

A descriptive survey research design was utilized for the study. The study was carried-out in Rivers State, South-South, Nigeria. The state is made up of 23 Local Government Areas (LGAs), information obtained from Rivers State Post-primary Schools Board reveals the total number of chemistry teachers as 469. A stratified random sampling technique was used to obtain a sample size of 212 (using Yamane's formula at 95% confidence level and

5% margin of error). The sample size consisted of 106 urban chemistry teachers and 106 rural chemistry teachers with three years and above teaching experience, totaling 212 respondents used for the study. The research instrument for the study was a 4-point Likert scale questionnaire titled “Chemistry Teachers’ Assessment Literacy Questionnaire (CTALQ)” adapted from Alkharusi (2010) and modified by the researcher. The questionnaire was divided into two sections; section A contained the demographic information of the respondents (name, sex, age, name of school, school location, qualification and years of experience), while section B was subdivided into four sections, addressing each research question. The research questionnaire was face and content validated by two chemistry education lecturers and two experts in measurement and evaluation. Subjecting the research instrument to a reliability test

using Cronbach Alpha returned a reliability coefficient of .854 and on the basis of high reliability index, it was deemed suitable for the study. The method utilized by the research to administer the questionnaire to the respondents was through a one-on-one method, e-mails and Google Forms. The ones sent through e-mails and google forms were received within the interval of 7 weeks, while the ones administered one-on-one were retrieved at the point of administration. The data acquired from the questionnaires were analyzed using Arithmetic Mean, Standard Deviation and t-test. Decision making was based on accept mean score of 2.70 and above as high, 2.50 to 2.69 as moderate and 2.49 and below as low for research questions while decision making for the hypotheses were based on reject the null hypothesis if the p-value was smaller than the set alpha value of 0.05, otherwise do not reject.

Findings

Table 1: Showing Level of Assessment Literacy among Chemistry Teachers in Senior Secondary Schools in Rivers State.

S/N	Statement	\bar{x}	SD
1.	I understand the different types of assessments (formative, summative and diagnostic) and their purposes in the chemistry curriculum.	2.85	0.92
2.	I regularly use formative assessments (e.g. quizzes, discussions, peer reviews) to monitor students’ understanding during the chemistry lessons.	2.60	1.04
3.	I can effectively interpret the results of assessments to identify gaps in students’ understanding of chemistry concepts.	2.73	0.97
4.	I provide timely and constructive feedback to students after their chemistry assessments, helping them understand how to improve.	2.75	0.99
5.	I involve students in self-assessment and peer assessment activities to encourage their understanding of chemistry content and skills.	2.50	1.04
6.	I align my assessments with the learning objectives and outcomes of the chemistry curriculum to ensure relevance and accuracy.	2.63	0.99
7.	I use a variety of assessment methods (e.g. written tests, practical exams, laboratory reports, project work) to evaluate students’ knowledge and skills in chemistry.	2.63	1.05
8.	I am aware of the potential biases that may affect the fairness of assessments, such as cultural bias or the difficulty level of the questions.	2.60	1.02
9.	I encourage students to reflect on their assessment results to set personal learning goals and improve their understanding of chemistry.	2.71	0.97
10.	I am confident in using assessment data to adjust my teaching methods and strategies to meet the diverse learning needs of my chemistry students.	2.68	1.03
Overall Mean and Standard Deviation		2.67	1.00

Data displayed in table 1 shows items 1, 3, 4, and 9, having a high mean value of 2.85, 2.73, 2.75 and 2.71, while items 2, 5, 6, 7, 8, and 10 a moderate mean values of 2.60, 2.50, 2.63, 2.63, 2.60 and 2.68. However, the study showed an overall mean value of

2.67 and SD of 1.00 for assessment literacy among chemistry teachers in Rivers State, suggesting a moderate level of assessment literacy. In the context of this study, a mean value of 2.67 indicates that the chemistry teachers in question are somewhat familiar

with assessments but may have significant room for improvement in their practices. The SD of 1.00 implies variability in the assessment literacy levels among the

teachers, with some likely being more knowledgeable than others.

Table 2: Showing Level of Utilization of Assessment in Enhancing Students' Learning in Chemistry.

S/N	Statement	\bar{x}	SD
1.	I use formative assessments regularly in my chemistry lessons to track students' progress and adjust my teaching strategies.	2.58	1.07
2.	I encourage students to reflect on their assessment results to identify areas where they need improvement and make learning adjustments.	2.61	1.02
3.	I use assessment results to group students according to their learning needs, providing targeted support where necessary in chemistry.	2.49	1.04
4.	After each major assessment, I provide personalized feedback to help students understand their mistakes and improve their chemistry skills.	2.71	0.98
5.	I create assessments that require students to apply chemistry concepts in real-life contexts, helping them see the relevance of the subject.	2.45	1.03
6.	I design assessments that assess both students' theoretical understanding and practical laboratory skills in chemistry.	2.61	1.01
7.	I involve students in peer assessment activities, allowing them to review and learn from each other's work in chemistry.	2.45	1.03
8.	I use quizzes, assignments, and other assessments to diagnose misconceptions early, ensuring that students' understanding of key chemistry concepts is correct.	2.66	1.01
9.	I provide opportunities for students to revise and retake assessments to demonstrate their improvement and mastery of chemistry content.	2.67	0.98
10.	I incorporate a variety of assessment types (e.g. written, oral, practical, project-based) to give students multiple ways to demonstrate their understanding of chemistry.	2.61	1.01
Overall Mean and Standard Deviation		2.58	1.02

Table 2 reveals the level of utilization of assessment in enhancing students' learning in chemistry. Only item 4 showed a high mean value of 2.71, indicating that personalized feedback is provided to students to improve their understanding of

chemistry concepts. Meanwhile, items 3, 5 and 7 revealed low mean values of 2.49, 2.45 and 2.45. While items 1, 2, 6, 8, 9, and 10 reveal moderate mean values of 2.58, 2.61, 2.61, 2.66, 2.67 and 2.61.

Table 3: Showing Challenges Chemistry Teachers face in Using Assessments to Support Teaching and Learning in Senior Secondary Schools in Rivers State.

S/N	Statement	\bar{x}	SD
1.	I face challenges in designing assessments that accurately measure students' understanding of complex chemistry concepts.	2.53	1.01
2.	Limited time during lessons makes it difficult to implement frequent formative assessments and provide meaningful feedback to students.	2.64	1.00
3.	I find it challenging to balance between assessing theoretical knowledge and practical laboratory skills in chemistry.	2.58	0.99
4.	The lack of resources (e.g. lab equipment, technology) makes it difficult to create effective assessments that test students' practical chemistry skills.	2.67	1.02
5.	Some students struggle to understand the purpose of assessments, making it hard to motivate them to take assessment seriously.	2.55	1.00
6.	I face difficulties in interpreting and using assessment data effectively to improve my teaching and support student learning in chemistry.	2.57	1.02

7.	The diverse learning abilities in my classroom make it challenging to create assessments that are fair and accessible for all students.	2.74	0.97
8.	I find it hard to provide timely and individualized feedback on assessments due to a heavy workload and large class sizes.	2.72	0.97
9.	There is limited professional development or training on how to effectively use assessments to enhance teaching and learning in chemistry.	2.68	1.01
10.	I struggle to align my assessments with the curriculum standards and learning objectives while maintaining students' engagement in chemistry lessons.	2.67	0.98
Overall Mean and Standard Deviation		2.63	1.00

Table 3 shows the responses to the challenges faced by chemistry teachers in using assessments. Items 7 and 8 shows a high mean value of 2.74 and 2.72, indicating that the chemistry teachers experience major challenge in using assessment as a result of diverse learning abilities in their classroom and as a result of heavy workload and class size makes it difficult for them to provide timely and individualized feedback to the students. All other items reveal a

moderate level of challenges experienced by the chemistry teachers in Rivers State. Going forward, table 3 also shows an overall mean value of 2.63 and SD of 1.00. The mean value of 2.63 implies that chemistry teachers experience a moderate level of challenges, while the SD of 1.00 indicates significant variability in how different chemistry teachers perceive or experience these challenges.

Table 4: Showing Strategies that can be employed to Improve Assessment Literacy among Chemistry Teachers in Rivers State.

S/N	Statement	\bar{x}	SD
1.	Providing professional development workshops focused on effective assessment design and interpretation would help improve my assessment literacy in chemistry.	3.01	0.91
2.	Regular collaboration with colleagues to share assessment strategies and resources would enhance my ability to use assessments effectively in my chemistry teaching.	2.74	1.00
3.	Access to clear guidelines and frameworks on how to align assessments with chemistry curriculum objectives would help improve my assessment practices.	2.76	0.99
4.	Incorporating more practical, hands-on assessment training (e.g. lab assessments, project-based assessment) into professional development programs would improve my assessment literacy in chemistry.	2.84	0.95
5.	Engaging in regular reflective practice, such as reviewing past assessment and considering how to improve them, would help me become more assessment literate in my chemistry teaching.	2.56	1.01
6.	Accessing and utilizing digital tools and resources for creating and analyzing assessments would support my efforts to improve assessment literacy in chemistry.	2.70	0.97
7.	Encouraging students to participate in discussions about assessment criteria and self-assessment practices would improve both mine and my students' understanding of assessments in chemistry.	2.48	1.04
8.	Creating a system of formative assessments, with ongoing feedback, would help me develop a better understanding of how to support student learning in chemistry through assessments.	2.54	1.00
9.	Attending conferences or webinars on assessment practices specific to science education would improve my knowledge and skills in assessment literacy in chemistry.	2.72	1.02
10.	Encouraging peer observation and feedback on assessment practices among chemistry teachers would provide opportunities for sharing best practices and improving assessment literacy.	2.52	0.96
Overall Mean and Standard Deviation		2.69	0.98

Date displayed in table 4 shows strategies that can be employed to improve assessment literacy among chemistry teachers in Rivers State. Item 1 shows a very high mean value of 3.01, indicating that providing professional development workshops focused on effective assessment would help improve the assessment literacy of chemistry teachers, while

item 7 showed a low mean value of 2.48 suggesting that encouraging students to participate in discussions about assessment criteria and self-assessment practices was not seen as improving chemistry teachers assessment literacy. Items 2, 3, 4, 6, and 9 also showed a high mean values, while items 5, 8, and 10 revealed a moderate mean values of 2.56, 2.54, and 2.52.

Table 5: Showing Independent Sample t-test of Significant between Level of Assessment Literacy among Chemistry Teachers in Urban and Rural Senior Secondary Schools in Rivers State.

Variable	(\bar{x})	SD	N	df	P - Value	t – Crit.	Result
Urban	29.70	10.53	106	208	.0012	1.9714	Rejected
Rural	25.16	9.45	106				

The hypothesis test reveals that urban teachers have a higher mean value of assessment literacy (29.70 with SD of 10.53) as compared to rural teachers (25.16 with SD of 9.45), with a p-value of 0.0012. This

indicates a statistically significant difference between the two groups, meaning that the difference in assessment literacy levels between urban and rural teachers is unlikely to have occurred by chance.

Table 6: Showing Independent Sample t-test of Significant between Level of Utilization of Assessments in Enhancing Students' Learning in Chemistry among Chemistry Teachers in Urban and Rural Senior Secondary Schools in Rivers State.

Variable	(\bar{x})	SD	N	Df	P - Value	t – Crit.	Result
Urban	28.19	10.47	106	208	.0000	1.9721	Rejected
Rural	22.25	8.00	106				

The hypothesis test in table 6 compares the level of utilization of assessment literacy among chemistry teachers in urban and rural areas of Rivers State. The test reveals that urban chemistry teachers had a mean value of 28.19 and SD of 10.47 as against a mean value of 22.25 and SD of 8.00 for rural chemistry teachers, with p-value of .0000 indicating a highly statistically significant difference, thus the result was rejected.

Discussion

Findings from this study showed a moderate level of assessment literacy among chemistry teachers in Rives State. In the context of this study, it was shown that the chemistry teachers in question are somewhat familiar with assessments but may have significant room for improvement in their practices. This implies that there is a variability in the assessment literacy levels among the teachers, with some likely being more knowledgeable than others.

Several studies have highlighted those teachers, including those in chemistry, often lack deep assessment literacy. For instance, McMillan (2014) in

his review of assessment literacy found out that many teachers are not adequately trained to create and interpret valid assessments, leading to suboptimal teaching outcomes. His work suggests that assessment literacy is an area where secondary school chemistry teachers often struggle. In a study by Liu et. al., (2019), teachers were found to have a positive self-perception of their assessment literacy, but their actual ability to develop reliable and valid assessments was often inadequate. The study suggested that while chemistry teachers report confidence in their assessment abilities, they often lack the deep pedagogical and theoretical understanding of assessments. This gap between self-reported knowledge and actual capability explains the moderate mean score of the present study. Similarly, research by Broadfoot et al., (2006) found out that chemistry teachers on the average are not always offered systematic, formal training on assessment practices. This absence of professional development could lead to inconsistent assessment literacy levels, which is reflected in the SD as found by this present study. It also suggests that, while some chemistry teachers may

have high assessment literacy, others may struggle due to lack of training and support.

In contrast to the moderate score of as revealed by this study, some studies suggest that chemistry teachers may possess a higher level of assessment literacy, especially in more developed educational systems. For example, Stiggins (2008) has argued that teachers in the U.S. are increasingly well trained in assessment literacy, with many districts offering significant professional development programs in this area. In such an educational system, one might expect a mean score significantly higher than the one in the present study, suggesting that chemistry teacher's competence in assessments could be higher than suggested by the study. Also, Bennett (2014) disputes that modern teaching practices often integrate technological tools to support assessments. Chemistry teachers who use such tools effectively might demonstrate higher level of assessment literacy than found by the present study.

Furthermore, the study found that an average level of utilization of assessment by chemistry teachers in enhancing students' learning in chemistry is on a moderate level, implying that while assessments are used, their application in enhancing student learning is not fully optimized. The SD from the study indicates variability, suggesting that while some teachers may be more skilled in using assessments effectively, others may under utilized or even misapply assessment strategies.

Assessment for learning refers to the practices of utilizing assessments not just for grading but as a tool to enhance students' understanding and improve their learning through feedback, reflection, and adaptation of teaching methods. This study suggests that utilization of assessments in chemistry teaching may not yet be reaching its full potential, which has implication for improving student's outcomes. Many studies indicate that teachers tend to focus more on summative assessment (tests and exams) rather than formative assessments, which are more directly linked to enhancing learning. According to Evans (2013), many secondary school chemistry teachers prioritize summative assessments that measure knowledge acquisition, instead of using assessments that help guide learning throughout the learning process. This explains the moderate utilization score as it suggests that while assessments are used, their primary purposes is likely more focused on evaluating than on enhancing learning. Liu et. al., (2019) argues that teachers often lack the necessary training in

assessment literacy, which includes understanding how to utilize assessments to promote student learning rather than just evaluate it. On the other hand, Stiggins (2008) argues that when teachers receive adequate professional training on assessment for learning, they are more likely to use assessments effectively to support and enhance learning. Meanwhile, Bennett (2014) highlights that the use of digital formative assessments and learning analytics can significantly improve how assessments are used to support student learning. This modern approach could result in higher levels of utilization of assessments compared to the one found in the present study.

Findings from s study also suggest that while some chemistry teachers face considerable difficulties in using assessments effectively, others may not face such pronounced challenges.

One of the key challenges reported by many chemistry teachers is insufficient training in assessment practices. Broadfoot et al., (2006) highlighted that due to lack of training, chemistry teachers may struggle with creating assessments that not only evaluate knowledge but also foster deeper understanding, which could explain the moderate mean score as revealed by the present study. Broadfoot et al., (2006) also noted that chemistry teachers face significant time constraints, which can hinder their ability to use assessments effectively in teaching and learning of chemistry. Often, pressure from curriculum demands high-stakes testing, which leads them to prioritize summative assessment over formative assessments. The pressure to cover extensive content, limit the time available for creating and using assessments that support students learning. Also, Liu et. al., (2019) found that many teachers struggle to balance traditional content-focused assessments with those that assess higher-order thinking, such as problem-solving and critical analysis. This struggle could explain why chemistry teachers face challenges in using assessments effectively, learning to a moderate level of difficulty.

In contrast to the present finding, some research suggests that technology can significantly alleviate the challenges chemistry teachers face in using assessments. Bennett (2014) argued that the integration of digital tools, such as online quizzes, simulations, and learning management systems, can make assessment more dynamic and accessible for both students and teachers. In educational systems where technology is integrated effectively, teachers may experience fewer challenges in using assessments



to support learning, potentially leading to a higher utilization score than the one found in the study. Another study by Stiggnis (2008) and Zhao (2018) pointed out that in many developed educational systems; there has been a concerted effort to provide chemistry teachers with the necessary professional development to improve their assessment practices. When chemistry teachers are properly trained, the challenges they face in using assessments are often reduced, and they are better able to integrate assessments into their teaching.

Also found by this study is a moderate level of strategies employed to improve assessment literacy among chemistry teachers in Rivers State which provides valuable insight into the current state of assessment literacy in this context. Assessment literacy is crucial for teachers, as it directly affects how they design, administer, and evaluate student assessments, which in turn influences students' learning outcomes. This implies that the strategies employed may be seen as somewhat effective but could likely be improved. The SD from the study also indicates a moderate level of variability in how these strategies are perceived by the teachers, suggesting that not all participants in the study had the same experiences. A study by Stiggins et al., (2006) discussed how assessment literacy is a critical component in developing effective teachers. They argue that teachers who understand assessment principles are better equipped to design assessments that truly measure students' learning. This is particularly relevant in chemistry, where conceptual understanding and practical skills need to be accurately assessed. According to Bennett (2011), global trends emphasize improving assessment literacy for teachers to enhance their ability to use assessments effectively. This includes helping teachers understand the purpose of assessment, designing assessments, interpreting results and providing constructive feedback. Such initiatives align with the findings of the present study, suggesting that there is an ongoing effort to improve assessment literacy, although the mean value from this study may indicate room for growth.

According to Popham (2009), one of the significant challenges in improving assessment literacy among teachers is the lack of sustained professional development. He argued that one-off workshops or short-term programs may not have long-lasting effects on teachers' assessment practices. This could explain the moderate effectiveness of the strategies in the present study, as teachers might need more continuous

support and training to implement assessments effectively. Schildkamp et al., (2015) conducted a review of various teacher training programs aimed at improving assessment literacy and found that many programs had limited impact. This finding aligns with the relatively moderate mean value in the present study, suggesting that even though there are efforts to improve assessment literacy, the effect may be less substantial than expected.

The hypothesis test reveals that urban teachers have a higher mean value of assessment literacy as compared to rural teachers. This indicates a statistically significant difference between the two groups, meaning that the difference in assessment literacy levels between urban and rural teachers is unlikely to have occurred by chance. Several studies indicate that teachers in urban areas tend to have greater access to professional development programs and resources compared to their rural counterparts. According to Darling-Hammond (2010), urban schools access are more likely to have better access to continuous professional development (CPD) opportunities, including those focused on assessment literacy. Urban teachers may have access to more training, workshops, and seminars, which could explain their higher levels of assessment literacy. Similarly, Choi and Lee (2015) found that teachers in urban schools benefit from better infrastructure, administrative support, and teaching resources, which often lead to more effective teaching practices, including assessment literacy. Rural teachers, on the other hand, often struggle with little or no resources and less professional support, which may hinder their development in areas like assessment literacy. Also, according to Vanghn et al., (2017), rural teachers often have less access to high quality teacher preparation programs, especially in specialized areas such as assessment literacy. This gap in teacher preparation could explain why rural teachers have lower levels of assessment literacy compared to their urban counterparts. However, Guskey (2003) suggested that rural teachers may develop unique adaptive strategies due to the constraints they face in terms of resources. Rural teachers might be able to work around these limitations and create their own effective assessment strategies despite lower access to formal training. Thus, while the statistical significance is clear, the practical impact of this difference may be more nuanced than the study suggests.

The test of hypothesis also reveals that there is a significant difference in the level of urban and rural

chemistry teachers' utilization of assessments in enhancing students' learning in favour of urban chemistry teachers, thus the null hypothesis was rejected. This suggests that the observed difference in the utilization of assessment literacy between urban and rural teachers is unlikely to have just occurred. This truly implies that urban teachers are more proficient in applying assessment literacy to enhance students' learning in chemistry compared to their rural counterparts. One of the prominent factors that explain why urban teachers often have a higher utilization of assessment literacy is better access to professional development programs. Darling-Hammond (2010) found that teachers in urban areas are more likely to have access to training programs that focus on assessment strategies, which could enhance their ability to implement assessment practices in their classrooms. Urban schools often have more resources, including workshops, seminars, and mentorship opportunities, which might explain the higher utilization of assessment literacy. Meanwhile, Popham (2009) argues that the effective use of assessment literacy is not solely dependent on training and resources but also on how teachers perceive and integrate assessment into their daily practices. Teachers' beliefs about the importance of assessment and their willingness to engage with new strategies can influence how they use assessment literacy in their classrooms. Rural teachers may be equally capable of utilizing assessment literacy, but other contextual factors (e.g. motivation, support from colleagues or administrators) could affect its practical application.

Conclusion

This study concludes that enhancing assessment literacy among chemistry teachers is essential for improving the quality of teaching and learning in senior secondary schools in Rivers State. The study found out a moderate level of assessment literacy, moderate level of utilization of assessments, moderate level of challenges and moderate level of strategies employed to improve assessment literacy among chemistry teachers in Rivers State. This result is consistent with several studies that highlighted gaps in teachers understanding and use of assessments, particularly in secondary education. However, other research points to the possibility that teachers, especially in well-supported educational systems, could possess a higher level of competence in assessment practices. Also, the study revealed different level of assessment literacy and utilization of

assessment based on location (urban and rural). It was obvious that the difference found between urban and rural chemistry teachers was not by chance, thus, the findings emphasized the need for targeted training programs and professional development for teachers, as well as the importance of incorporating a variety of assessment methods to foster deeper student understanding of chemistry concepts. While the study's findings are not universally supported, they are consistent with broader trends in educational research regarding assessment literacy.

Recommendations

The following recommendations are put forward based on the findings of the study;

1. **Professional Development Program:** chemistry teachers in Rivers State should undergo continuous training in assessment practices, focusing on formative assessments and data interpretation.
2. **Diverse Assessment Strategies:** chemistry teachers in Rivers State should be encouraged to use a range of assessment types, including quizzes, assignments, and project-based assessments, in addition to traditional exams.
3. **Collaborative learning:** schools in Rivers State should promote collaborative learning among chemistry teachers, allowing them to share best practices and improve their assessment literacy collectively.
4. **Policy Support:** Ministry of Education in Rivers State should develop policies that support the integration of effective assessment practices into the curriculum, ensuring that teachers have access to the necessary resources.

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