# Students' Lived Experiences of Assessment Methods in Chemistry Learning

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**Abstract**

The purpose of this study was to explore how students perceive their experience when exposed to both traditional (pen-and-paper) and performance-based assessments (PBA) in Chemistry. Ten Grade 10 students who had participated in either type of assessment were asked to reflect on their lived experiences as students, including the challenges they encountered while participating in assessments, and what strategies or tools they used to cope. This qualitative transcendental phenomenological design included conducting semi-structured interviews using an interview guide to elicit participants' responses, followed by thematic analysis as defined by Moustakas. While participants believed that traditional paper/pencil-based testing increased their ability to think logically and solve problems theoretically, they also felt that PBAs promoted more authentic collaboration among peers, developed more robust conceptual understanding of Chemistry, and enabled students to see abstract ideas applied to everyday situations. Ultimately, the two assessment approaches worked well together, as they provided students with both cognitive discipline through a traditional pen-and-paper test and creative and practical applications through a PBA. Therefore, providing students with opportunities to participate in both types of assessments will create a complete learning environment where they can grow cognitively, creatively, and practically. Educators need to incorporate innovative ways to help reduce or eliminate test-related anxiety when utilizing both forms of assessments. Examples include providing pre-test review sessions, formative feedback, and establishing positive classroom climates to help shift the focus from anxiety being a hindrance to it becoming a motivator. By continuing to create diversity through promoting mastery, and creating balance within the level of challenge versus rewards, teachers are able to increase learner engagement, promote confidence, and ultimately lead to increased levels of resilience - creating a dynamic and holistic chemistry learning environment.

*Keywords:* Pen-and-paper assessments; Performance-based tasks; Chemistry education; Student engagement; Skills developments

## 1. Introduction

Chemistry is viewed by many as difficult to learn due to its abstract nature and the assessment techniques used. The dominant form of student assessment remains pencil-and-paper exams. There has been an increasing trend toward more authentic and performance-based assessments across the globe that focus on inquiry, collaboration,

and application to real-world problems, all of which are examples of what educators refer to as 21st-century skills. In comparison, although there have been changes in classroom practices in some Asian countries, such as Japan and South Korea, they still rely heavily on high-stakes written exams, particularly those required for university admission. The purpose of the written exams is to determine whether students can recall and apply what they have learned from the theoretical aspects. Each nation is currently undergoing changes to its methods of assessing students in addition to the previously mentioned theoretical applications, i.e., practical experimentation, collaborative project work, and inquiry-based tasks. Thus, while globally there is a movement away from "hands-on" assessment methods and toward more team-oriented assessments of chemistry, Japan and Korea remain exam-focused; however, they are opening opportunities for students to experience chemistry through more tangible means and connections to their daily lives. Therefore, this contrast provides a clear example of how assessment practices influence students' experiences -- either as a formula-based discipline that exists on paper or as an active science that sparks interest and further understanding.

In addition to being given more opportunities to complete experiments, projects, and demonstration activities, in which students can show how well they have learned through practical and creative means, students in many Philippine classrooms continue to spend most of their class time memorizing formulas and definitions. The kinds of assessments students are exposed to shape how they think about chemistry: whether it is as an area of study from which they will draw material for tests, or as an important science related to everyday life (Bautista, 2018). This is why assessment practices were selected as the focus of this study, as they reflect how students construct meaning in chemistry, in line with the principles of Constructivist Learning Theory (Piaget, 1972). To guide this study's discussion of assessment practices and their effect on student motivation, coping mechanisms, and classroom behavior, Kolb's Experiential Learning Theory (Kolb, 1984), Assessment Theory (Black & Wiliam, 1998), and Self-Determination Theory (Deci & Ryan, 1985) were also used. Theoretical frameworks have been tested for use in the Philippines as well. For example, Vega (2024) showed that when students had opportunities to engage in meaningful and authentic assessments instead of assessments traditionally used for grading, they became engaged in the learning process and developed new ways of thinking about learning. In another example, Sayre et al. (2025) found significant competency gaps that indicated rote testing was limited. Lastly, Sugano & Nabua (2020) found that the way students perform and feel confident in their abilities is impacted significantly by the methodologically applied approach and type of assessments employed in class. These findings are consistent with the goals set forth by the Department of Education's EDCOM 2 (2023): to end grade level mass promotion; to establish foundational academic skills, e.g., reading by Grade 3; and to promote authentic learning through initiatives such as ARAL. Therefore, with this context considered, this present study addresses three major research questions: (1) What are students' experiences of using various assessment approaches for learning chemistry? (2) What barriers do students experience when using these approaches? And (3) how do they overcome them?

The goal of this study is to fill a void in the Literature concerning the Teaching of Chemistry in the Philippines. As most studies before, have shown that the use of paper and pencil assessments has been used for many years to assess the level of knowledge by students. However, more recently there has been a movement toward using assessments that are more experiential and authentic in terms of students learning. While Bautista (2018), studied senior high school students from the Metro Manila area, and determined that traditional assessment practices were one of the main barriers to student development and understanding of science concepts; however, while Bautista

highlighted the tension between memorization-based exams and authentic learning, she did not study or explain how students, themselves, experience, and cope with different types of assessment methods. This study examines how grade ten chemistry students, who are at a developmental age when their attitudes about science are developing, personally experience and handle both paper/pencil-based assessments and performance-based assessments. By placing student voice at the forefront of this study, it will provide new information regarding how assessment methods impact students' motivation, resilience, and views of chemistry—two areas not studied previously.

## 2. Methods

### *2.1 Research Design*

The use of a transcendental phenomenological methodology (one form of qualitative research) was employed by the researcher for this study to explore how students make sense of and perceive assessments in their chemistry classes. The researchers' focus was on how students assign meaning to assessments through the use of performance based assessments as well as paper-and-pen assessments. Instead of focusing on the numbers from the assessments, the study's focus was on students' individual perspectives related to the assessments. For the purpose of selecting participants for this study, students were selected using a purposive sampling strategy so that all of the participants were currently enrolled in grade ten chemistry. All of the students who participated in the study had been exposed to both types of assessments; therefore, they were eligible to participate in the study. Due to the fact that the researcher is attempting to create rich, authentic descriptions of students' perceptions and interpretations of assessments, a relatively small sample size of about 10 students would be sufficient to produce data saturation. Data collection will be primarily through semi-structured interviews. During the interviews, students will be asked to provide detailed descriptions of their thoughts, feelings and perceptions concerning their emotional responses, difficulties, and learning experiences when completing both types of assessments. As needed, follow up conversations may occur between the researcher and the students to clarify or validate the statements made by them. Themes developed throughout the data analysis process will have been created by identifying patterns present in the descriptions provided by the students. The researcher will also summarize the essential elements associated with being a student experiencing two different formats of assessments. Member checking, thick description, and maintaining an audit trail are methods that can assist in increasing the validity of the findings produced by this study.

### *2.2 Research Locale*

The study was conducted in one of the Public Secondary Schools in Leyte. A school site provides an example of a typical public education environment in which learners experience both traditional pen-and-paper assessments and performance-based assessments (e.g., experiments/projects) in daily practice. The site is important because it mirrors the day-to-day experiences of most Philippine students, who struggle to balance rote memorization with hands-on learning, providing a unique context for assessing the impact of different assessment types on students' comprehension of chemistry. Although this research has a limited scope, as it includes only a single school and grade level, the findings may provide insight into broader issues and opportunities in Science Education across multiple subjects.

*2.3 Participants*

Participants for the study consisted of ten (n=10) grade 10 junior high school students who are enrolled in chemistry. These students were selected using a Purposive Sampling approach. These students were an optimal source of information on the use of both traditional Pen/Paper tests and Performance Tasks, as they had first-hand knowledge of each type of test from their chemistry classes. For the purposes of this research, the inclusion criteria included being a current Grade 10 student enrolled in chemistry, having experienced both types of assessments, and being willing to provide responses to the Survey Questionnaire and subsequent discussion. Exclusion Criteria eliminated students who were not enrolled in chemistry; students without prior experience with both Pen/Paper and Performance Tests; and students who were either unwilling or unable to respond meaningfully to the questions. As such, it was ensured that the Data collected for this research were genuine and relevant to the Phenomenon Under Investigation. This would provide a useful illustration of the influence of Assessment Methodology on Students' Learning Experience within a Real Classroom Environment.

*2.4 Research Instrument*

The survey used in this study is an interview guide designed to capture students' lived experiences with assessment practices in chemistry (pen-and-paper testing and performance tasks). This survey included both closed and open-ended questions that could be completed as an individual response. The student responses during the initial section of this survey would reflect their experiences based on their own personal emotional responses to either struggling with or experiencing positive ("aha") moments while completing a paper based test or performance task. Since open-ended question responses allowed for students to speak freely regarding their opinions on the fairness of each assessment type and how they feel about their desire to continue learning about the subject matter, students were able to share their perspectives from a personal perspective. The review by three content area experts served as evidence to validate the survey. The experts evaluated the survey for clarity and determined if there were any areas where the survey did not align with the objective of the study. Although many different types of surveys can be used to collect large amounts of quantitative data, the questions in this survey were developed to elicit reflective and targeted responses; therefore, the survey elicited a vast amount of qualitative data related to students perceptions and understanding of the two assessments types (paper-based vs. performance) and provided authentic and genuine feedback related to how each assessment impacted the students chemistry learning journey.

*2.5 Data Gathering Procedure*

The first stage of this study's research methodology involved securing a signed Informed Consent form from each participant prior to collecting data on them. Prior to data collection, each participant signed a consent form, ensuring that their contribution would be kept confidential. Thus, this methodological approach demonstrated respect for participants' rights and ethical treatment of their input. The next step was to complete the administration of the interview guide (i.e., asking students to share their thoughts on their experiences with both paper-and-pencil assessments and performance tasks) in Chemistry. Additionally, follow-up interviews and group interviews enhanced the depth of the data collection. In these follow-up and group interviews,

additional information was obtained from the participants, allowing them to elaborate and provide examples related to the collected data. Finally, the last step included organizing, categorizing, and analyzing the collected data. Specifically, the researcher transcribed all questionnaire responses, interview and discussion comments, and analyzed their content; additionally, he/she used a rubric to assess the quality of student outputs from performance tasks to determine common skill applications among students. Reliability was achieved through the researcher consistently comparing respondents' replies throughout his/her analysis and consulting with co-teachers relative to assessing student work. Through this systematic design, it was ensured that the data reflected actual student experience and established a solid basis for subsequent thematic analyses. Furthermore, member checking was completed by verifying participant statements.

### *2.6 Data Analysis*

The researcher used the same methodology as Moustakas (1994), which is intended to help the researcher understand the essence of students' lived experience of assessing methods in chemistry. Since this instrument was based on student interviews conducted by the researcher with ten Grade 10 students, the following procedures took place: Epoché (Bracketing): the researcher employed epoché, or bracketing, by setting aside his/her own biases so that he/she could view the students' responses without being swayed by the students' views. All students' reflection papers were reviewed in detail, and the most important comments were extracted to identify both the emotional and cognitive aspects of their experiences with paper-and-pencil testing and performance-based assessment. These comments were grouped into themes, such as perceived fairness of assessments, motivation for taking assessments, anxiety related to taking assessments, and the relationship between assessment types and students' conceptual development. Imaginative Variation: The researcher used imaginative variation to determine how other circumstances would have affected the students' perceptions of their experiences with chemistry assessments. Finally, the results were synthesized into a rich descriptive summary of the essence of students' lived experiences with chemistry assessments.

### *2.7 Ethics*

Before participating in this study, all students were fully advised as to what this study involved. Prior to participation, each student gave consent, assuring that all students fully understood and agreed to take part. Students participated on a voluntary basis and could end their participation at any time without negatively affecting their grade. Each student's response was made anonymously through a coded number or name. Only the researcher had access to the collected information. Participating in the study did not impact the student's overall academic performance. The risk of harm to each participant was kept to a minimum because the researcher conducted all conversations with respect and fairness. Equal opportunity was granted to every student to provide their experiences. No deception occurred. Students were aware of how their responses would be used. The researcher had no conflicting interests. In other words, the study was completely honest and objective from start to finish.

### *2.8 Trustworthiness*

The research integrity of this study was confirmed via procedures designed to ensure its validity and reliability. Prior to collecting data from students, each data instrument (questionnaire, interview protocol,

rubric) was peer-reviewed by at least three expert professionals in chemistry education. The review process established whether each tool clearly measured what it claimed to measure, whether the questions/tasks were relevant to the study's purpose, and whether the task(s) assessed student learning in a manner consistent with the study's goals. Feedback from reviewers on these topics led to revisions to the tools so they could be used to assess authentic student experiences. Pilot testing supported the reliability of the collected data by allowing researchers to identify ambiguous items and develop response patterns. Further, the use of a rubric to evaluate student performance enabled an assessment of inter-rater reliability, as multiple teachers would have applied the rubric to identical student work products and compared their ratings. The final step to support the study's validity was to conduct peer debriefings with other teachers who had access to all teacher-student interactions during the study. During these debriefings, teachers validated the researcher's interpretations and minimized possible researcher bias. Collectively, these validation procedures enabled researchers to assert that their data reflected students' true opinions and perspectives, thereby providing a valid basis for conducting thematic analyses.

2.9 *Reflexivity*

To ensure that the researcher's interpretation of the data was unbiased, the researcher remained objective throughout the entire research process. In order to maintain participants' authenticity and to retain their own unique voice/perspective, the participants' original stories/narratives from which the findings were derived were kept intact with no editing or changes made by researchers. This helped maintain the overall integrity of the research study because the researcher's interpretations were based on what the participant experienced (lived experience) rather than what the researcher assumed. Maintaining a transparent and credible approach fostered an environment of trust, thereby supporting the validity of the study's conclusions.

## 3. Results and Discussion

These research results illustrated what students experienced during their time as Grade 10 chemistry students when they had to complete paper-based test (and) performance task assessments; these research results also identified several common themes that described students' perceptions about how different types of chemistry assessment affected their perception of content, their level of confidence, and their interest in learning chemistry.

### Experiences of the assessment method in Chemistry learning

#### *Theme 1: Engagement and Excitement in Performance-Based Tasks*

There have been many studies that have used participant accounts to evaluate student responses to performance-based classroom tasks; however, many have found that students' views on these tasks vary widely. The majority of students who completed performance-based classroom tasks described their experiences as being "fun", "exciting," "intriguing," or "engaging." Participants noted how enjoyable they found using lab equipment, conducting experiments, watching chemical reactions unfold before their eyes, working with classmates, and participating in other collaborative activities.

Hands-on activities can make a school day feel like a part of one's everyday life and also allow students to

demonstrate their knowledge through action rather than just reading from a textbook. Students reported experiencing an adventure while completing their hands-on activities, which further deepened their understanding of topics beyond textbooks (Reyes, 2025). The following participant accounts provide a better description of participants' experiences and perceptions in their own words.

Significant Response 1: *"I think I'd say it was intriguing, unpredictable, fun, and exciting. In my chemistry class, I had to follow all the safety precautions and take care so I wouldn't get hurt." [P1, L13-15].*

Significant Response 2: *"Because I am able to use the information I've gained and create something in a way that I enjoy and find interesting, I think it allows me to learn about the material at a greater depth." [P3, L24-25].*

Significant Response 3: *"Both of those experiences were fantastic." [P9, L42].*

***Theme 2: Mixed Emotions in Assessment Experiences***

Students experienced varying levels of difficulty and emotion across assessment types (Wass et al., 2018). Many students stated they struggled to understand some aspects of chemistry, such as being confused by many concepts or finding it stressful due to the amount of memorization or the speed at which they had to complete the test, whereas some students were comfortable with assessments that included memorization and timed testing. Other students felt excited because they had never completed performance-based tasks before, but also felt frustrated either from performing the task themselves or from feeling nervous about making a presentation. Below are the student's accounts of their experiences and thoughts on this matter.

Significant Response 1: *"At times, it becomes difficult to learn all of the material, just memorize formulas and solve chemistry equations, so there will be less chance of getting the correct solution. [P4, L27-29]*

Significant Response 2: *"When I am faced with something new, I find it difficult to learn and to get an understanding of the new vocabulary." [P6, L35-36]*

Significant Response 3: *"In addition to the challenges associated with performance-based assessments in chemistry, I must be honest about the difficulties I have with completing performance-based assessments as compared to taking paper/pencil exams. As an example, I was given a performance-based task assignment by my teacher, which included conducting a demonstration and presenting, and I became anxious about it, something I did not experience during pencil-and-paper exams. [P10, L51-54]*

***Theme 3: Varied Experiences of Assessment***

Students' views were consistent: both assessment types have positive effects on students' educational paths. Students perceived that pen-and-paper testing provides an opportunity to develop foundational knowledge and cognitive skills, whereas the performance task allows them to be creative, work in groups, and apply learned concepts (Ismail & Osman, 2024). Together these two assessments create a complete educational experience for students by challenging them in terms of academics while creating a sense of enthusiasm and curiosity for

chemistry. Each participant has provided personal accounts of their involvement in this research project below.

Significant Response 1: "*Both assessments (pen-and-paper and performance-based tasks) I used to evaluate myself are very beneficial" [P4, L25].*

Significant Response 2: *"They are simple to use; I find both paper-and-pen assessments and performance-based tasks simple to understand and use in my Chemistry Class because my instructors teach well." [P8, L38-39].*

Significant Response 3. *"It is amazing to participate in both activities" [P9, L41].*

**Challenges in the assessment method in Chemistry learning**

***Theme 1: Understanding and Conceptual Clarity***

Learners stated that they often find that writing information down on paper allows them to apply their analytical reasoning, memory, and methodical approach to problems. Learners also stated that writing down equations, balancing chemical reactions, and remembering formulae helped them understand why certain chemical processes occurred. Paper-based assessments were seen by learners as structured and unambiguous, enabling them to visualize what was happening at the molecular level and to establish a strong theoretical base. Furthermore, a chemically thinking approach to issues enables students to develop all the ideas required for a paper-based assessment. Below are the learner's accounts of their experiences with paper-based assessments:

Significant Response 1: *"I feel it is better for learning chemistry concepts because they are very well organized, make sense, and are easy to follow; this way, complex concepts can be understood much more clearly." [P5, L54-55]*

Significant Responses 2: "*This will help me determine whether I have learned chemistry concepts, equations, and problem-solving, and I think it is good for assessing my theoretical and calculation skills." [P5, L69-70]*

Significant Responses 3*: "Helps me learn many more Chemistry concepts, such as gas laws, atoms, and elements." [P8, L75-76]*

**Theme 2: Deepening Understanding through Hands-On Performance Tasks**

Using performance-based assessments allowed students to connect the theory of chemistry with what they could see and do. Iyamuremye et al. (2023) reported that student respondents described how using experiments, projects, and real-world examples made chemistry more relevant to them and therefore easier to remember. Student respondents indicated that being able to directly participate in chemical reactions, operate lab equipment, and be considered "scientists" made chemistry more enjoyable and interesting. The following quotes will illustrate the

student respondent's personal experiences.

Significant Response 1: *"This also allows me to be more active and watchful as I can visualize, have personally participated, and have hands-on experience." [P1, L58-60]*

Significant Response 2: *"This has assisted me as well as other students to recall and relate theoretical chemistry concepts to practical uses, such as how chemicals react and the application of chemical equation usage." [P9, L80-81]*

Significant Response 3: *"Using performance-based assessments provided me with an opportunity to have direct experiences." [P10, L88-89]*

***Theme 3: Complementary Roles of Both Assessments***

The most significant observation was that both testing methods complement each other. In other words, the paper-and-pencil tests gave them clarity, structure, and confidence. On the other hand, the performance tasks were engaging, creative, and applicable to real life (Chi et al., 2024). Moreover, students identified having both test-taking preferences. For example, some students liked taking pen-and-paper tests because they were familiar with them, while others were excited about hands-on performance tasks. Overall, these two approaches to assessing student knowledge and understanding reinforced the same concept through multiple means, allowing students to gain a more complete understanding. Below are the participants' stories detailing their perceptions of their experiences.

Significant Response 1: *"It is helpful to me in understanding chemistry concepts because it allows me to write down my own thoughts/feelings/reflections on what I learned. This makes the concepts stick better in my mind. Additionally, writing down my concerns or struggles with certain topics gives me insight into what I need to focus on." [P7, L75-76]*

Significant Response 2: *"I believe they help me learn more about chemistry, including gas laws, atoms, and elements, etc." [P8, L78-79]*

Significant Response 3: *"Both of these assessment tools work well when used together as a way to meet the needs of the various learning styles; however, when used together, they also enhance our understanding as learners/students participating in this process." [P9, L82-83]*

**Coping with the challenges in the assessment method in Chemistry learning**

***Theme 1: Confidence Building through Achievement***

Students expressed that both paper-and-pencil and performance assessments help them stay engaged. Paper/pencil testing makes students focus and think on their feet. Performance assessments help stimulate curiosity and give students a sense of being "alive" during the learning process (Kibga et al., 2021). Students also said they often navigate assessment challenges by celebrating their successes. They may be a high grade on a test,

successfully completing an experiment, or even successfully resolving difficult problems. Such successes will help build student confidence and motivate them to take on other challenges with courage and tenacity. Using different types of assessments keeps students from becoming bored and encourages all students to become involved. As such, Chemistry is presented as dynamic and interactive. Participants' stories are listed below for further insight into each participant's experience and perspective.

Significant Response 1: *"It affects how I am engaged, confident, and learn about Chemistry in ways which allow me to take part in experiments, share my curiosity, and demonstrate my knowledge" [P1, L93-94].*

Significant Response 2: *"The assessment methods used in this class greatly enhance my level of engagement since there are so many different avenues to display what I know!" [P4, L103-104].*

Significant Response 3: *"Assessment methods affect my level of engagement, confidence, and learning in Chemistry by allowing me to assess where I need to improve; and when I complete difficult assignments/problems, I feel much better than before" [P7, L111-112].*

***Theme 2: Engagement and Motivation through Variety***

Variety in the way you assess is an important factor in keeping students interested and motivated. When we experience both paper-and-pencil testing and hands-on, performance-based assessments, we learn about chemistry in a much more exciting way. This variety helps eliminate the boredom of being tested, increases our active involvement, and creates opportunities for meaningful involvement. Below are the participants' stories, experiences, and views of the assessments.

Significant Response 1: *"I was able to participate, experiment with ideas and questions, and express my own curiosity. That gets me excited about the subject matter and makes the process of learning fun, versus boring or uninteresting." [P1, 89-91]*

Significant Response 2: *"They give many different ways of showing what I have learned. When I am successful at doing a difficult task related to science, I become more confident." [P4, 99-101]*

Significant Response 3: *"The different types of assessment definitely affect my level of engagement, confidence, and ultimately my learning of chemistry." [P10, 120-121]*

***Theme 3: Overall Learning through Skills Development***

Students understand that written exams serve not only as an assessment of their knowledge but also as a means of developing their problem-solving, critical thinking, and innovation skills (Raslan, 2023). Written exams are intended to improve a student's self-discipline and ability to reason logically. Performance assessments are intended to help educators evaluate how well a student applies what they have learned in school to real-world situations, particularly through their ability to work with others. When combined, the two types of assessments give students a balanced educational experience that provides them with both theoretical and applied knowledge.

The participants' narratives were provided to better show how each student experienced the various aspects of their educational process and to convey each student's perspective.

Significant Response 1: *"Also, this is beneficial for the development of innovation, critical thinking, and total understanding of all sectors of learning education." [P1, L95-96]*

Significant Response 2: *"This makes me think critically, and I see it." [P7, L112]*

**Theme 4: Balancing Anxiety and Reward**

Although some students acknowledged feelings of anxiety when taking paper-and-pencil-based testing, many also stated that this type of assessment motivated them to put forth the effort required to master the subject matter (Alkan, 2021). As students explained, both achieving success with paper-based examinations and laboratory experiments were considered motivating and rewarding, further solidifying their commitment to studying chemistry. The students' stories are illustrated below to convey details of their overall experience and perspective on assessing chemistry through paper-and-pencil testing.

Significant Response 1: *"Paper-and-Pencil Assessments sometimes produce an initial level of anxiety, yet for the most part, the paper-and-pen assessments push me to understand the material." [P3, L100-101]*

Significant Response Two: *"Paper-and-Pencil Tests will boost confidence if I am ready for it. If I do not have time to prepare, then it may create an element of anxiety." [P9, L116-117]*

## 4. Conclusion

The study found that paper-and-pencil tests (written assessments) and performance-based activities were two distinct types of assessment tools, which served two unique purposes in terms of how students learn and understand chemistry. Students indicated that written assessments may be difficult to complete due to the cognitive load associated with completing such exams; however, the vast majority of students perceive these assessments as critical for building foundational theoretical knowledge and skills for logical reasoning. In contrast, students perceive performance-based activities (assessments where a student demonstrates and applies knowledge) as fun, cooperative, and relevant to real-world applications of abstract chemical principles. Together, the use of both written and performance-based assessment activities created an optimal combination of novel and traditional assessment experiences for students. This balance allowed for a cohesive learning experience, in which students could build upon each other's experiences. Overall, these various assessment strategies contributed to changes in students' engagement, confidence, and resilience. The variety of assessment tools fostered curiosity and interest among students; therefore, the anxiety experienced by students was transformed into motivation when students felt confident that they would succeed. Thus, through using multiple assessment methods within the classroom, educators can create a vibrant and balanced educational environment that encourages students to excel in all areas of the subject matter. Furthermore, educators who incorporate both assessment methods into their instructional practices will create an atmosphere that fosters inquiry and exploration regarding the material being studied,

creates opportunities for students to feel confident in their abilities, and fosters an appreciation for chemistry as both an intellectual theory and an applied scientific field.

## 5. Recommendations

Based on these study findings, it is recommended that the chemistry teacher use both the written/paper-and-pencil test format and various types of performance assessments (to take full advantage of the learning potential) by combining them. The written/test format of the assessment is intended to enhance students' memory skills in recalling the content and their logic application skills in applying this recalled chemical information; the written/test format also provides an opportunity for students to develop their basic knowledge base. The performance task will allow students to develop a deeper understanding of chemistry concepts, foster teamwork/collaboration among peers, and demonstrate how these concepts relate to real-world issues. If the educator develops a balanced assessment program that combines performance and written/pen-and-paper tasks, it may appeal to different types of learners, promote engagement, and stimulate interest in chemistry. In addition to promoting a balance between theory and practice in assessing student learning, providing strategies to reduce test anxiety, such as study groups, early and constructive feedback, and creating a comfortable classroom environment, can assist in transforming what might otherwise become anxiety into motivation, increase students' confidence, and promote long-term interest in chemistry.

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