INTERNATIONAL JOURNAL OF RESEARCH AND INNOVATION IN SOCIAL SCIENCE (IJRISS)
ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue II February 2025

Least Mastered Competencies in Grade 10 Chemistry and their Motivation Levels: A Basis for Pedagogical Intervention

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DOI: https://dx.doi.org/10.47772/IJRISS.2025.9020081

Received: 19 January 2025; Accepted: 29 January 2025; Published: 04 March 2025

ABSTRACT

The existing literature and studies prompted the researchers to conduct this study to identify what is/are the least mastered competencies of Grade 10 Fourth Quarter Topics in Chemistry, through achievement tests. Researchers also seek to examine the Grade 10 learners level of Motivation in Chemistry who has undergone chemistry in their junior year. The study used a descriptive-survey research design using a test questionnaire as the primary data collection tool to describe mastery level of Grade 11 General Academic Strand (GAS) students. The pilot testing phase of the assessment tool was done at the public high school. The pilot testing was participated in by a total one hundred twenty-one - (121) learners. After reviewing all items that passed the evaluation criteria of the pilot testing based on difficulty and discrimination indices, another 37 grade 11 General Academic Strand learners were the source of the implementation of the validated test instrument in Grade 10 Fourth Quarter Topic in Chemistry. The findings indicate that many Grade 11 General Academic Strand learners are still struggling to master key chemistry competencies outlined from their previous the Fourth Quarter Topics in Chemistry in their junior year, with several areas showing a response rate below 50%, with many competencies falling in the "not mastered" category, with only one in the "least mastered" and in the nearly mastered competency. Notably, areas like classifying reactions, identifying factors that affect reaction rates, and recognizing biomolecules show particularly low mastery, underscoring persistent gaps in foundational chemistry knowledge. This lack of mastery highlights the need for enhanced teaching strategies, targeted interventions, and instructional materials designed to address these gaps.

Keywords: Mastery level, least mastered competencies, Grade 10 Chemistry Competencies, motivation in chemistry, mastery level, grade 10 and grade 11

INTRODUCTION

Chemistry, as a fundamental branch of science, plays a crucial role in developing students' understanding of the natural world and laying the foundation for various scientific and technological fields. In the Philippine education system, the Grade 10 Chemistry curriculum is designed to introduce students to basic scientific concepts, skills, and critical thinking strategies that are essential for their academic progression in the sciences. Among the core subjects covered, the Fourth Quarter topics in Chemistry are pivotal in deepening students' understanding of chemical reactions, stoichiometry, acids and bases, and the properties of different chemical substances. These topics are fundamental not only for mastering Chemistry but also for fostering scientific literacy that students will rely on as they progress through higher education and into professional careers.

However, despite the importance of these topics, studies and classroom observations suggest that some competencies within the Fourth Quarter Chemistry curriculum remain less understood or inadequately mastered by students. This gap in learning can hinder learners' ability to fully grasp more advanced scientific principles, which may affect their academic performance and future interest in science and technology fields. Identifying these least mastered competencies is crucial for educators, curriculum developers, and policymakers to enhance Chemistry teaching methods, develop more effective intervention strategies, and ultimately improve student achievement in Chemistry.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue II February 2025

The learning challenges faced by learners in mastering these competencies have been further compounded by the impact of the COVID-19 pandemic. The shift to online and remote learning as a result of the pandemic has disrupted traditional classroom instruction, limiting opportunities for hands-on learning, laboratory experiments, and interactive teaching approaches that are essential for subjects like Chemistry. In the Philippines, the transition to online learning posed significant challenges, particularly in rural areas where access to technology and reliable internet connections was limited (Sanchez, 2017). As a result, many students have struggled to grasp complex concepts in Chemistry, especially those that require practical application and real-time feedback.

Science education in the Philippines is structured around the K-12 curriculum, which aims to improve learners' scientific literacy and foster interest in science and technology. According to Bautista (2021), the K-12 curriculum introduces science subjects as early as elementary school and continues to emphasize these subjects at the high school level. At the Grade 10 level, the curriculum includes subjects such as General Science and Chemistry, aiming to provide students with foundational knowledge in various scientific disciplines. It is crucial to acknowledge that advanced learning depends on a strong grasp of the knowledge and skills gained during basic education (Lapitan et al., 2021). A weak foundation in basic chemistry can pose significant challenges for students and may lead to misconceptions (Omiko, 2017).

Despite the well-established framework, studies have pointed out several challenges. Sanchez et al. (2017) highlighted that students in the Philippines often struggle with conceptualizing abstract scientific concepts, particularly in subjects like chemistry, physics, and biology, which require both theoretical understanding and practical application. This difficulty is compounded by the lack of resources and infrastructure in many schools, particularly in rural areas, where hands-on laboratory activities and access to quality teaching materials are limited.

The existing literature and studies have laid a strong foundation for this research, inspiring the researchers to identify the least mastered competencies in Grade 10 Chemistry, especially within the Fourth Quarter topics, through achievement tests. This focus aims to identify the most challenging concepts for students, uncovering knowledge gaps that may hinder their overall learning and understanding.

Alongside identifying these competencies, the study also seeks to examine the motivation in learning Chemistry among Grade 11 General Academic Strand (GAS) learners who have undergone Grade 10 Chemistry lesson during their junior year, as motivation plays a significant role in student performance and learning outcomes. Gaining insight into students' motivation levels is crucial for understanding why they may struggle with certain topics and evaluating the effectiveness of current teaching strategies.

The results of this research are intended to form the foundation for creating educational interventions specifically designed to address the needs of Grade 10 learners. For teachers, this study provides important insights into the areas where learners face difficulties, offering guidance for refining teaching strategies. These insights will help educators adopt more evidence-based practices, tailored to the needs of their students, ensuring a more effective and responsive approach that tackles common challenges in Chemistry education.

For curriculum developers, the study highlights critical areas within the Grade 10 Chemistry curriculum, particularly the Fourth Quarter topics, that may need strengthening or restructuring. By examining the least mastered competencies and students' motivation, curriculum designers can create more relevant and practical learning materials and activities that address these gaps. This approach can lead to a curriculum better suited to students' needs and provide a more comprehensive and engaging learning experience.

The study’s main purpose was to determine the least mastered competencies in Grade10 Fourth Quarter Chemistry Topics in a public high school as a basis for educational intervention. Their performance on gas laws, chemical reactions and biomolecules competencies will be evaluated and from the result the least mastered competencies will be identified. The researcher also seeks to examine the Grade 11 General Academic Strand learners who have taken up Grade 10 Chemistry lessons during their junior year, level of motivation in Chemistry.

METHODS

The study employed a descriptive-survey research design, using a test questionnaire as the main tool for gathering data to describe the competencies related to Grade 10 Fourth Quarter Topics in Chemistry. A descriptive research design aims to explain what, how, or why something occurs, while a survey research design involves collecting data primarily through surveys. In this approach, researchers use surveys to gain a deeper understanding of individuals' or groups' perspectives on a specific concept or issue. Additionally, the Level of Motivation in Chemistry questionnaire was used to explore how learners' motivation in the subject influences their attitude toward learning Chemistry.

The research employed purposive sampling to select appropriate participants, focusing specifically on senior high school grade 11 learners under the General Academic Strand from a public high school. The pilot testing of the assessment tool was conducted in one of the public high schools in Northern Mindanao, Philippines, with One Hundred Twenty-One (121) learners participating. After reviewing the items that met the evaluation criteria based on difficulty and discrimination indices, additional Thirty-Seven (37) Grade 11 General Academic Strand (GAS) students were selected to implement the validated test instrument. All assessment activities were carried out using traditional pen-and-paper methods. The participants voluntarily agreed to take part after providing informed consent. They were chosen based on their grade level and willingness to participate, ensuring that ethical standards were maintained throughout the study.

The researcher designed a multiple-choice achievement test consisting of Fifty (50) items to assess the key competencies in Grade 10 Chemistry, specifically covering gas laws, biomolecules, and chemical reactions. To ensure a well-structured approach, a Table of Specifications (TOS) was developed (Michael, 2017; Lei et al., 2015; Smith and Holloway, 2020), based on Bloom’s Taxonomy. This TOS included cognitive levels, knowledge domains, and scientific literacy competencies (Makieiev, 2023; Hartono and Siahaan, 2023). A rubric was also created to evaluate both the internal and external qualities of the test instrument, focusing on its validity and construct.

To validate the test items, the researcher consulted with three experts in pure chemistry and chemistry education. Their feedback, including suggestions and corrections, was incorporated into the refinement of the test. As a result, the TOS was adjusted to match the revised components of the test.

The evaluation of the test was based on several key criteria. The "level of difficulty" was an important consideration, ensuring the questions were aligned with the table of specifications and categorized according to varying difficulty levels. This approach aimed to comprehensively assess students' scientific literacy. The "directions" for the test were crafted to be clear and suited to the students' grade level, reducing the risk of confusion. The "length of the test" was also considered, ensuring the number of items was appropriate for reliable results and matched students' grade-level capabilities. In terms of "structure," evaluators checked for grammatical accuracy and appropriate distractors to challenge students effectively. Finally, the "content" was thoroughly reviewed to ensure alignment with the chemistry curriculum standards, ensuring the test provided an accurate measure of students' understanding and achievement in the subject (Munkh-Erdene et al., 2022; Lowmaster, 2023).

This research adopted a descriptive analysis approach, where each item on the questionnaire was carefully reviewed by experts using a rubric based on Bloom's Taxonomy. This process ensured a thorough evaluation of each item for construct and content validity. The experts assessed the clarity, relevance, and alignment of each item with the intended constructs, classifying them into three categories: acceptance, revision, or rejection. Items that were accepted directly supported the framework, while those requiring revision were modified to better align with the research goals and validity criteria. Items that did not meet the necessary standards were discarded. This meticulous analysis provided a systematic approach to refining the assessment tool, ensuring each item was robust, valid, and effectively measured the intended constructs.

An item analysis was performed on the responses from the pilot group to evaluate the performance of individual questions. Cronbach's alpha was calculated to measure the internal consistency of the items, a crucial metric for assessing the coherence and reliability of the assessment tool. This also helped identify any items that might be removed to improve the overall reliability. In addition, the discrimination index and percentage of correct answers were analyzed to determine the difficulty level of each item, which was then visually represented. This comprehensive data analysis confirmed the reliability and validity of the test, ensuring that the items consistently measured the intended constructs and provided insight into how well the items correlated with one another and the overall score.

Visual summaries in tabular form were used to present the results, clearly showing the percentage outcomes for each answer choice from the pilot group. These tables included metrics such as frequency counts, the percentage of correct responses, and the percentage of incorrect answers. This analysis helped identify specific organic chemistry concepts that students struggled with, highlighting areas where they lacked proficiency. By presenting the data in a visual format, the study provided a clearer understanding of students' strengths and weaknesses, offering valuable insights for targeted improvements in instruction. Once the questionnaires were collected and reviewed, the results were tallied, organized, analyzed, and interpreted. The scores, along with their corresponding interpretations, were used to assess the overall performance, mastery level, and competency in each area.

The Level of Motivation questionnaire consists of 25 question items with five components, namely: *intrinsic motivation (IM), career motivation (CM), self-determination (SD), self-efficacy (SE), and grade motivation (GM).* The Level of Motivation questionnaire, is designed to assess and measure the different factors that influence a student's motivation in learning. The questionnaire helps to gauge how these specific components contribute to students' attitudes, behaviors, and overall engagement with their studies, particularly in the context of learning chemistry. It provides insights into the internal and external motivations that drive students' academic performance, understanding, and persistence in their educational journey.

The questionnaire was given to 37 Grade 11 General Academic Strand learners who were also selected to implement the validated test instrument. After the questionnaire was completed, the responses were gathered, organized, and analyzed to identify trends and patterns in the students' confidence and motivation regarding their understanding of the Fourth Quarter Topics in Chemistry (Taber 2018). The summarized results offer a thorough overview of the students' motivation levels in chemistry and provide valuable insights into areas that require targeted interventions to improve their understanding and performance in Chemistry.

Table 2. Interpretation on Level of Motivation in Chemistry

Scale Range	Remarks
0	Never
1	Rarely
2	Sometimes
3	Often
4	Always

Interpretation adapted from the study of Glynn et al., 2011

Table 3. Interpretation on Leaners Performance on the Achievement Test

Percentage	Remarks
90-100	Passed
85-89	Passed

80-84	Passed
75-79	Passed
Below 75	Failed

Reference: DepEd Order No. 8 s, 2015

Table 4. Mastery Level and Percentage equivalent

Mastery Level	Percentage Equivalent
Mastered	80-100
Nearly Mastered	75-79
Least Mastered	51-54
Not Mastered	50 and below

Reference: DepEd PPST- Module 11

RESULTS

The result of the level of motivation questionnaire revealed varying levels of motivation in chemistry among 37 Grade 11 General Academic Strand students. The table provided illustrates the respondents' levels of motivation in chemistry across five dimensions: Intrinsic Motivation, Career Motivation, Self-Determination, Self-Efficacy, and Grade Motivation. Below is an analysis of each dimension based on the data:

Table 5. Level of Motivation in Chemistry summary of results (N=37)

Statement					
Intrinsic Motivation	***0- Never (%)***	***1- Rarely (%)***	***2- Sometimes (%)***	***3- Often (%)***	***4- Always (%)***
1. I enjoy learning chemistry.	5(13.5%)	7(18.9%)	13(35.1%)	7(18.9%)	5(13.5%)
2. I am curious about discoveries in chemistry.	0 %	12(32.4%)	11(29.7%)	11(29.7%)	3 (8.1%)
3. Learning chemistry makes my life more meaningful.	2 (5.4%)	9(24.3%)	10(27%)	8(21.6%)	8(21.6%)
4. Learning chemistry is interesting.	2(5.4%)	9(24.3%)	8(21.6%)	10 (27%)	8(21.6%)
5. The chemistry I learn is relevant to my life.	1 (2.7%)	11(29.7%)	13(35.1%)	7(18.9%)	5(13.5%)
Career Motivation	***0- Never***	***1- Rarely (%)***	***2- Sometimes (%)***	***3- Often (%)***	***4- Always***

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	(%)				*(%)*
1. I will use chemistry problem-solving skills in my career.	0%	7(18.4%)	15(39.5%)	13(34.2%)	3(7.9%)
2. My career will involve chemistry.	0%	9(24.3%)	14(37.8%)	11(29.7%)	3(8.1%)
3. Understanding chemistry will benefit me in my career	2(5.5%)	7(18.9%)	14(37.8%)	7(18.9%)	7(18.9%)
4. Knowing chemistry will give me career advantage.	0%	10(27%)	10(27%)	9(24.3%)	8(21.6%)
5. Learning chemistry will help get a good job.	1(2.7)%	7(18.9%)	12(32.4%)	12(32.4%)	5(13.5%)
Self Determination	***0- Never (%)***	***1- Rarely (%)***	***2- Sometimes (%)***	***3- Often (%)***	***4- Always (%)***
1. I study hard to learn chemistry.	0%	1(27%)	11(29.7%)	8(21.6%)	8(21.6%)
2. I prepare well for chemistry tests and labs.	0%	8(21.6%)	13(35.1%)	9(24.3%)	7(18.9%)
3. I spend a lot of time learning chemistry.	0%	10(27%)	19(51.4%)	6(16.2%)	2(5.4%)
4. I use strategies to learn chemistry well.	0%	31(35.1%)	12(32.4%)	10(27%)	2(5.4%)
5. I put enough effort into learning chemistry.	0%	7(18.9%)	14(37.8%)	12(32.4%)	4(10.8%)
Self-Efficacy	***0- Never (%)***	***1- Rarely (%)***	***2- Sometimes (%)***	***3- Often (%)***	***4- Always (%)***
1. I am sure I can understand chemistry.	1(2.7%)	8(21.6%)	15(40.5%)	11(29.7%)	2(5.4%)
2. I believe I can earn grade 90 and above in chemistry.	1 (2.7%)	11 (29.7%)	12 (32.4%)	10 (27%)	3 (8.1%)
3. I believe I can master chemistry knowledge and skills.	1 (2.7%)	11(29.75%)	12 (32.4%)	10(27%)	3(8.1%)

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4. I am confident I will do well in chemistry labs and projects.	0%	6(16.2%)	21(56.8%)	9(24.3%)	1 (2.7%)
5. I am confident I will do well on chemistry tests.	0%	10 (10.27%)	19(51.4%)	8(21.6%)	0%
Grade Motivation	***0- Never (%)***	***1- Rarely (%)***	***2- Sometimes (%)***	***3- Often (%)***	***4- Always (%)***
1. Scoring high on chemistry tests and labs matters to me.	0(0%)	7(18.9%)	15(40.5%)	6(16.2%)	9(24.3%)
2. I think about the grade I will get in chemistry	0(0%)	8(21.6%)	15(40.5%)	8(21.6%)	6(16.2%)
3. It is important that I get a grade of 90 and above in chemistry	0(0%)	7(18.9%)	11(29.7%)	8(21.6%)	11(29.7%)
4. Getting a good chemistry grade is important to me.	0(0%)	7(18.9%)	8(21.6%)	11(29.7%)	11(29.7%)
5. I like to do better than other students in chemistry tests.	1(2.7%)	9(24.3%)	10(27%)	7(18.9%)	10(27%)

Intrinsic Motivation: Respondents display moderate levels of intrinsic motivation, with "sometimes" being the most frequent response for statements like enjoyment of chemistry, curiosity about discoveries, and finding chemistry meaningful. However, fewer respondents expressed that they "always" find chemistry enjoyable or relevant to life, suggesting room for improvement in fostering interest.

Career Motivation: The data indicates a fair belief in the career relevance of chemistry, as most respondents chose "sometimes" or "often" for statements like using chemistry in their career or gaining career advantages through chemistry knowledge. However, few respondents consistently selected "always," showing potential to better connect chemistry to career aspirations.

Self-Determination: Responses in this category suggest that while students are somewhat determined (e.g., studying hard, preparing for tests, and using strategies), the majority only "sometimes" or "rarely" demonstrate behaviors indicative of strong self-determination. For example, many rarely or never use effective learning strategies.

Self-Efficacy: Self-efficacy levels are mixed. Most respondents believe they can "sometimes" understand and excel in chemistry, with a lower percentage expressing consistent confidence in mastering the subject or excelling in tests and projects.

Grade Motivation: Respondents show higher motivation toward achieving good grades, with many indicating that scoring high and earning grades of 90 and above is important to them. However, a significant number only "sometimes" or "rarely" consider their grades.

Overall, the data suggests a need for interventions aimed at increasing student engagement and commitment.

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Incorporating interesting and relevant chemistry topics could enhance students' interest and enjoyment. Emphasizing the practical applications of chemistry and its connections to potential career pathways may further motivate students in their academic pursuits. Offering targeted support in study strategies and fostering confidence in problem-solving can also improve student outcomes. Additionally, encouraging students to value their academic performance may help boost their motivation to achieve higher grades.

Another important aspect being focused on the study is assessing the conceptual knowledge of the Grade 10 learners in Fourth Quarter Chemistry topics. To evaluate this, an achievement test was conducted, and data were interpreted using the descriptions in Table 3.

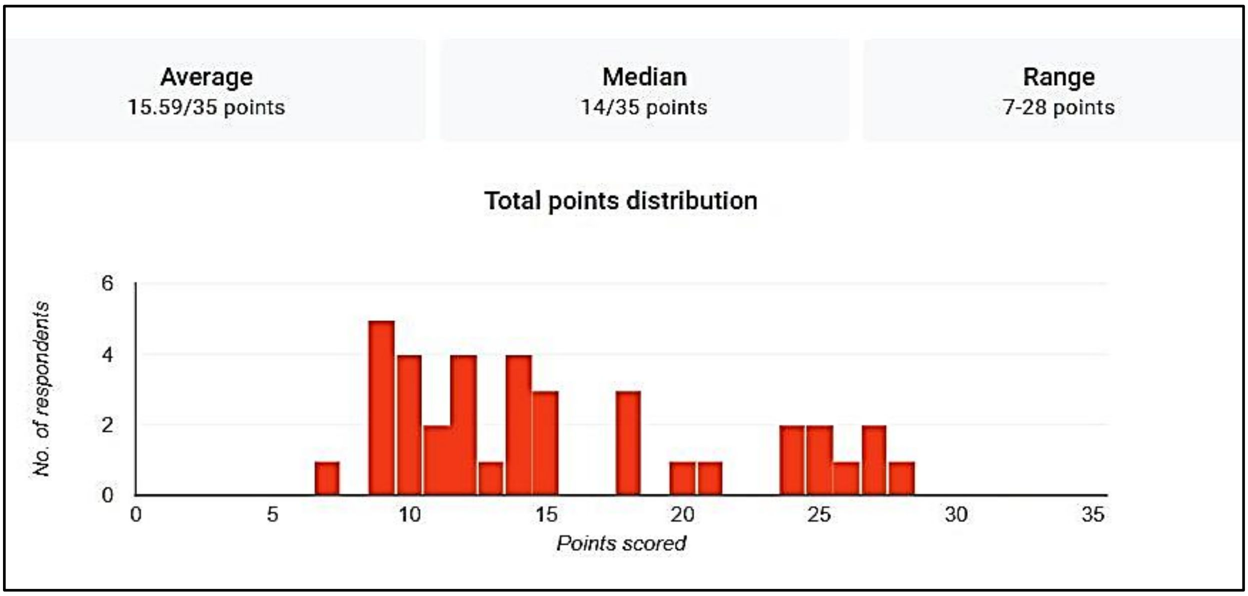

Figure 1. Total Points Distribution

Figure 1, shows the points distribution of the respondents on the achievement test. The scores range from 7 to 28 points. Most of the respondents got scores of 9, and the average is 16. Figure 1 revealed that the scores of the respondent are concentration in the left side of the graph (low scores).

Furthermore, Table 6 shows the performance and interpretation of the respondents, as well as their percentage scores. Most of the scores obtained by the learners are less than 75%.

This implies that they failed the achievement test based on the interpretation shown in the table below.

Table 6. Performance of Grade 11 Students in the Achievement Test

Respondents	Scores	Percentage	Interpretation
MSU-MCHS 01	24	69 %	FAILED
MSU-MCHS 02	12	34%	FAILED
MSU-MCHS 03	15	43%	FAILED
MSU-MCHS 04	14	40%	FAILED
MSU-MCHS 05	15	43%	FAILED
MSU-MCHS 06	9	26%	FAILED
MSU-MCHS 07	11	31%	FAILED

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MSU-MCHS 08	15	43%	FAILED
MSU-MCHS 09	14	40%	FAILED
MSU-MCHS 10	24	69%	FAILED
MSU-MCHS 11	9	26%	FAILED
MSU-MCHS 12	15	43%	FAILED
MSU-MCHS 13	21	60%	FAILED
MSU-MCHS 14	10	29%	FAILED
MSU-MCHS 15	20	57%	FAILED
MSU-MCHS 16	12	34%	FAILED
MSU-MCHS 17	14	40%	FAILED
MSU-MCHS 18	10	29%	FAILED
MSU-MCHS 19	7	20%	FAILED
MSU-MCHS 20	27	77%	PASSED
MSU-MCHS 21	18	51%	FAILED
MSU-MCHS 22	12	34%	FAILED
MSU-MCHS 23	9	26%	FAILED
MSU-MCHS 24	24	69%	FAILED
MSU-MCHS 25	10	29%	FAILED
MSU-MCHS 26	18	51%	FAILED
MSU-MCHS 27	13	37%	FAILED
MSU-MCHS 28	9	26%	FAILED
MSU-MCHS 29	12	34%	FAILED
MSU-MCHS 30	14	40%	FAILED
MSU-MCHS 31	25	71%	FAILED
MSU-MCHS 32	18	51%	FAILED
MSU-MCHS 33	18	51%	FAILED
MSU-MCHS 34	9	26%	FAILED
MSU-MCHS 35	28	26%	FAILED

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MSU-MCHS 36	10	80%	PASSED
MSU-MCHS 37	27	29%	FAILED
Overall	**15**	**44%**	**FAILED**
Interpretation : 75%-100% Passed			Below 75% Failed

Table 7. Mastery Level of Grade 10 Learners on Fourth Quarter Topics in Chemistry

Learning Competency	Item Placement	Frequency of Error	Mean and %	No. of Correct Responses	Mean and %	Mastery Level
GAS LAWS: 1. Prove that gases have the following properties: mass, volume, temperature and pressure.	1	18	15 41%	19	22 59%	Nearly Mastered
	2	13		24		
	3	16		21		
	4	13		24		
2. Investigate the relationship between volume and pressure at constant temperature of a gas	5	20	18 49%	17	19 51%	Least Mastered
	6	15		22		
	7	20		17		
3. Investigate volume and temperature at constant pressure of a gas	8	15	19 51%	22	18 49%	Not Mastered
	9	15		22		
	10	26		11		
	11	20		17		
4. Determine the relationship among temperature, pressure , and volume of gases at constant number of moles.	12	25	20 54%	12	17 46%	Not Mastered
	13	13		24		
	14	16		21		
	15	23		14		
	16	22		15		
CHEMICAL REACTIONS 1. Write Chemical equations	17	21	22 59%	16	15 41%	Not Mastered
	18	22		15		
	19	22		15		
	20	24		13		
2. Apply the principles of	21	26	21	11	16	Not

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conservation of mass to chemical reactions.	22	23	57%	14	43%	Mastered
	23	14		23		
3. Classify reactions according to the different types	24	26	23	11	14	Not Mastered
	25	25	63%	12	37%	
	26	18		19		
4. Identify the factors that affect reaction rates according to collision theory	27	18	22	19	15	Not Mastered
	28	26	60%	11	40%	
	29	27		10		
	30	17		20		
BIOMOLECULES: Recognize the major categories of biomolecules such as carbohydrates, lipids, nucleic acids and proteins.	31	20	23	17	14	Not Mastered
	32	21	62%	16	38%	
	33	25		12		
	34	28		9		
	35	20		17		
Mean Percentage Score					46%	Not Mastered

Legend: Not mastered (50 % below), Least mastered (51- 74%), Nearly Mastered (75- 79%), Mastered (80-100%)

Table 7 shows that many students have not mastered many chemistry competencies included in their grade 10 Fourth Quarter Topics, with many competencies falling below 50% correct response rate. Only in the area of demonstrating that gases possess the following properties: mass, volume, temperature, and pressure (59%) is categorized as "Nearly Mastered". Although these scores are slightly higher, significant gaps in understanding remain, particularly in identifying and applying foundational concepts in chemistry.

Competencies such as investigating the relationship between volume and pressure at constant temperature of a gas (51%) and determining the relationship among temperature, pressure, and volume of gases at a constant number of moles (49%) showed minor improvement but still did not reach mastery levels. Areas requiring attention include investigating the relationship between volume and temperature at constant pressure of a gas (46%), competencies in chemical reactions such as writing chemical equations (41%), applying the principles of conservation of mass to chemical reactions (43%), classifying reactions according to their different types (37%), identifying the factors that affect reaction rates according to collision theory (40%), and competencies in biomolecules such as recognizing the major categories of biomolecules—carbohydrates, lipids, nucleic acids, and proteins (38%), which all falls under the "not mastered level".

These results emphasize the need for targeted teaching strategies that incorporate hands-on activities and promote conceptual understanding to address knowledge gaps and improve students' comprehension of both the theoretical and practical aspects of the Grade 10 Fourth Quarter chemistry topics, as research have indicated that chemistry poses unique challenges for learners due to its abstract and multidisciplinary nature (Johnstone, 1991). According to Rosal (2022) learners perceive chemistry as a complex subject resulting in low academic performance. According to Taber (2002), students frequently struggle to connect macroscopic observations with microscopic models and symbolic notations, a skill crucial for mastering topics like stoichiometry and gas laws. In the Philippine context, Bernardo (2015) observed that students' difficulties are further compounded by limited exposure to laboratory experiments, which are essential for understanding the practical applications of theoretical principles. Stoichiometry, which involves the quantitative relationship between reactants and products in a chemical reaction, is widely recognized as a challenging topic for Grade 10 students. Studies by Wu ,Hsin-Kai and Krajcik (2006) highlight that students often struggle with the mathematical aspects of stoichiometry, such as balancing equations and performing mole conversions. In the Philippine setting, many students lack the foundational mathematical skills necessary to perform stoichiometric calculations, resulting in low achievement levels in this area. As stated in the study of Bayarcal and Tan (2023) that students still require support with problem-solving despite the beautiful picture of mathematics instruction.

CONCLUSION

The findings indicate that many Grade 10 students are struggling to master key chemistry competencies outlined in the Fourth Quarter Topics, with several areas showing a response rate below 50%. Despite slight improvements in certain areas, such as the understanding of gas properties (59%), the overall performance remains below mastery levels. Specific competencies, including investigating the relationships between various gas properties and understanding chemical reactions, continue to pose challenges for students. Notably, areas like classifying reactions, identifying factors that affect reaction rates, and recognizing biomolecules show particularly low mastery, underscoring persistent gaps in foundational chemistry knowledge. To address these challenges and enhance students' comprehension, it is crucial to adopt targeted teaching strategies that emphasize active learning and conceptual understanding. Practical activities, such as laboratory experiments and interactive simulations, can help students visualize and apply theoretical concepts, making them more tangible and easier to grasp. Additionally, providing more opportunities for practice in critical areas like chemical reactions, reaction rates, and the properties of gases will help reinforce key ideas and strengthen students' problem-solving skills. Regular formative assessments and focused feedback can also guide both students and teachers in identifying areas of improvement and tracking progress over time. For long-term improvement, curriculum designers should consider gradually integrating chemistry topics such as gas laws, chemical reactions, and biomolecules, while maintaining a balance between theoretical knowledge and practical applications, to lay a strong foundation for students' success in STEM careers.

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