The Proficiency-Motivation Divide: Insights from a Senior High Chemistry Needs Assessment

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ABSTRACT

A needs assessment serves as a critical strategic framework for informing pedagogical innovation and guiding curriculum development. In this context, the study evaluated the chemistry proficiency of Grade 11 learners across selected community high schools, identified their least mastered learning competencies and associated topic domains, assessed their motivation toward learning chemistry, and examined the relationship between proficiency and motivation. Results revealed a substantial gap in conceptual mastery: of the 371 participants, 238 learners (64.1%) were classified in the "needs improvement" category, while only 24 learners (6.5%) attained a "proficient" rating. These findings indicate that the majority of students experience pronounced difficulties in comprehending foundational chemistry principles, particularly in core areas such as scientific investigation, substances and mixtures, and differentiating elements from compounds. Moreover, complex and abstract domains, including the periodic table of elements, chemical bonding, chemical reactions, and quantitative processes such as the mole concept and gas laws, remain largely unmastered. Despite these challenges, learners exhibited noteworthy motivation, with 121 respondents (32.3%) reporting high motivation and only 4.0% indicating low motivation; notably, no students fell into the "very low" category. This pattern suggests that students retain a resilient intrinsic drive to engage with the subject matter even when confronted with cognitive challenges. Nevertheless, statistical analysis revealed no significant relationship between chemistry proficiency and motivation, implying that intrinsic drive alone is insufficient to surmount the inherent complexities of the chemistry curriculum. These findings underscore the necessity for targeted instructional interventions and scaffolded pedagogical strategies designed to bridge conceptual gaps and promote deeper understanding.

Keywords: Chemistry Proficiency, Chemistry Motivation

INTRODUCTION

The quality of science education in the Philippines continues to be a significant concern, as evidenced by both global and local performance benchmarks. The 2022 PISA results indicate stagnant achievement in science, while National Achievement Test (NAT) scores, such as a mean percentage score of 34.0, fall considerably below the Department of Education's expectations (1). Chemistry, in particular, is perceived as a challenging subject due to its abstract concepts and mathematical rigor. Students often struggle to perceive its relevance in daily life, contributing to low academic performance (2).

Research suggests that these gaps largely result from a reliance on traditional, rote-based teaching methods that fail to cultivate inquiry, critical thinking, and problem-solving skills, which are essential for 21stcentury science education (3). Chemistry's cumulative nature necessitates mastery of both qualitative concepts and quantitative problem-solving skills, including stoichiometry and the mole concept. Deficiencies in foundational knowledge impede learners' ability to integrate new concepts, thereby intensifying learning difficulties. A needs assessment conducted at the beginning of Grade 11 enables educators to identify specific areas of conceptual struggle and to design targeted interventions to address gaps effectively.

Equally critical is the role of motivation in chemistry learning. Motivation influences students' engagement, persistence, and willingness to tackle challenging topics. In Grade 11, when learners are contemplating future academic and career trajectories, low motivation or high chemistry anxiety may deter otherwise capable students from pursuing scientific pathways. Assessing motivational constructs, including selfefficacy, intrinsic interest, and perceived value, provides insights into psychological factors that may hinder academic performance.

The interaction between proficiency and motivation establishes a complex feedback loop that shapes the learning experience. Students who are proficient but lack motivation may underperform due to disengagement, whereas highly motivated students with insufficient proficiency may become frustrated by repeated failures. Therefore, a dual-focused needs assessment provides a holistic view of learners' strengths and weaknesses, informing interventions that are both remedial and confidence-building. In the context of Lanao del Sur and surrounding municipalities, where schools often face limited laboratory facilities and inadequate learning resources (4), assessing chemistry proficiency is especially critical. By diagnosing these gaps, educators can propose localized solutions that enhance instructional delivery and promote meaningful learning experiences.

METHODOLOGY

This study employed a descriptive-correlational research design to evaluate the chemistry proficiency and motivation of Grade 11 learners from selected high schools in Lanao areas. The respondents comprised 180, 86, and 105 students from three different community senior high schools, in particular which were purposively chosen to represent the student population, with the results serving as a benchmark for instructional planning and improvement in chemistry education in the locality.

Research Instruments

The Chemistry Proficiency Test assessed students' mastery of Grade 7 to Grade 10 chemistry topics, including scientific investigations, solutions, substances and mixtures, elements and compounds, acids and bases, metals and non-metals, particulate nature of matter, atomic structure, periodic table of elements, electronic structure of matter, chemical bonding, varieties of carbon compounds, mole concept, gases, biomolecules, and chemical reactions. The instrument underwent content and face validation by science education experts, and a pilot test produced a reliability coefficient (Cronbach's alpha) of 0.877. The items were reduced from 100 to 62 after item analysis. Student performance was categorized using the following scale: 85–100% as highly proficient, 70–84% as proficient, 55–69% as developing, 40–54% as beginning, and below 40% as needs improvement.

The Chemistry Motivation Questionnaire (CMQ) was adapted from Huda and Rohaeti's Chemistry Motivation Questionnaire II (5). The instrument's construct validity was established through Confirmatory Factor Analysis, with fit indices indicating an acceptable model ($x^2/df = 1.38$, GFI = 0.95, CFI = 0.99, RMSEA = 0.066, NFI = 0.96, AGFI = 0.93). Reliability analysis yielded a Cronbach's alpha of 0.920 within the scope of this study. Motivation levels were categorized as very high (81–100%), high (61–80%), medium (41–60%), low (21–40%), and very low (0–20%) based on the adapted scoring system of Pratiwi et al. (6).

Data Collection Procedure

Data collection commenced following ethical approval and informed consent from participants. The validated instruments were administered during scheduled school hours under standardized conditions. The Chemistry Proficiency Test provided baseline measures of content knowledge, while the CMQ assessed students' interest and drive in chemistry. The researcher with hired assistants supervised the sessions to clarify procedural queries and ensure consistency in administration.

Data Analysis

Descriptive statistics, including frequency counts, percentages, and Mean Percentage Scores (MPS) were used to describe students' proficiency and motivation levels. MPS was computed for each learning competency by dividing the total number of correct responses by the total possible score and multiplying by 100. Mastery levels were interpreted as follows: 0.80–1.0 as very easy/highly mastered, 0.60–0.79 as easy/well mastered, 0.40–0.59 as moderate/developing, 0.20–0.39 as difficult/low mastery, and 0.0–0.19 as very difficult/least mastered.

Furthermore, the difficulty index was calculated as the proportion of students correctly answering each item, with values interpreted as 0.81–1.0 very easy, 0.61–0.80 easy, 0.41–0.60 moderate, 0.21–0.40 difficult, and 0.0–0.20 very difficult. The findings complemented the MPS results in identifying the least mastered competencies. Finally, Spearman's rank correlation coefficient (rho) was used to examine the relationship between chemistry proficiency and motivation, given the ordinal nature of the data.

RESULTS AND DISCUSSION

Levels of Students' Proficiency in Chemistry

Table 1 presents the frequency distribution and corresponding percentages of respondents across the various levels of chemistry proficiency.

The analysis of chemistry proficiency among Grade 11 students reveals a pronounced disparity in performance, with the majority of learners clustered in the lowest category. Specifically, 238 students (64.1% of the sample) were classified as "Needs Improvement," indicating that more than six out of ten students struggle to grasp foundational chemical concepts and their applications. In contrast, only 24 students each fell into the "High Proficient" and "Proficient" categories, representing a combined 13% of the population. This distribution highlights a highly skewed proficiency curve in which a minority of learners demonstrate mastery of the subject matter.

Table 1. Frequency and Percentage of the Levels of Students' Proficiency in Chemistry

Levels	Frequency	Percentage
High Proficient	24	6.50%
Proficient	24	6.50%
Developing	47	12.7%
Beginning	38	10.2%
Needs Improvement	238	64.1%
Total	371	100%

Intermediate performance levels further underscore this imbalance. The "Developing" and "Beginning" categories accounted for 12.7% and 10.2% of students, respectively. When combined with the "Needs Improvement" group, a striking 87% of learners fell below the "Proficient" threshold. These findings reflect critical conceptual gaps and suggest that current instructional approaches are insufficient to support students in achieving higher levels of chemistry understanding. The abstract and cumulative nature of chemistry content may exacerbate these difficulties, as students lacking a solid conceptual foundation often resort to rote memorization rather than meaningful learning (7, 8).

The data also suggest structural and pedagogical constraints contributing to low proficiency. Traditional teaching methods, limited laboratory access, and insufficient instructional resources continue to impede the development of conceptual understanding, particularly in complex topics such as chemical reactions and molecular modeling (9). Early struggles in grasping foundational content can trigger a cascading effect of underperformance, further entrenching students in lower proficiency levels.

Consequently, the findings highlight the urgent need for targeted, remedial instructional strategies. Personalized interventions, including technology-enhanced learning, virtual simulations, and inquiry-based models, may help students bridge conceptual gaps and achieve higher-order scientific literacy (10, 11). Addressing these factors,

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including resource limitations, abstract content challenges, and instructional design shortcomings is essential to improve overall chemistry proficiency and create a more balanced distribution of learner outcomes.

Students' Least Mastered Learning Competencies with the Corresponding Topics in Chemistry

To complement the findings on overall chemistry proficiency presented in Table 1, Table 2 illustrates students' Mean Percentage Scores (MPS) across 26 learning competencies, categorized by specific topic domains.

The data reveal a pronounced nonuniformity in performance, with scores ranging from a low of 24.0% in "Doing Scientific Investigation" to a high of 57.3% in the "Periodic Table of Elements." The majority of competencies fall within the "Very Low" or "Low" interpretation categories, indicating pervasive difficulties across foundational and procedural chemistry concepts. Only two competencies, "Periodic Table of Elements" (57.3%) and selected aspects of "Chemical Reactions" (56.0%) attained a "Moderate" interpretation, corresponding to a "Developing" mastery level. These findings suggest that while students demonstrate some understanding of descriptive or categorical content, they encounter substantial challenges with analytical and procedural tasks.

The data further highlight a significant mastery gap that mirrors broader systemic challenges in chemistry education. Highly abstract topics, such as the "Mole Concept" (35.2%) and "Electronic Structure of Matter" (37.8%), require elevated levels of mathematical reasoning and visualization, yet the prevalence of the "Least" mastery level across eleven competencies underscores the insufficiency of current instructional strategies in meeting these cognitive demands. Consequently, students' progress through the curriculum with incomplete mastery of prerequisite knowledge, limiting their ability to engage with more advanced scientific concepts.

The observed difficulties can, in part, be attributed to the cognitive transition from macroscopic observations to microscopic or symbolic representations. Consistent with prior research, students frequently struggle with abstract chemistry concepts due to limited hands-on laboratory experiences that connect theoretical principles to practical inquiry (12). The low performance in scientific investigation exemplifies this gap, reflecting deficiencies in procedural fluency and independent experimental skills, which are essential for achieving higher levels of conceptual mastery.

Table 2. Students' Mastery Level of Learning Competencies with the Corresponding Topic Domains in Chemistry

Learning Competency (LC)	Topic Domain	Mean Percentage Score (MPS)	Interpretation	Mastery Level
1	Doing Scientific Investigation	24.0%	Very Low	Least
2	Solutions	40.7%	Low	Beginning
3	Substances and Mixtures	37.0%	Very Low	Least
4	Elements and Compounds	37.5%	Very Low	Least
5	Acids and Bases	29.9%	Very Low	Least
6	Metals and Non-metals	42.2%	Low	Beginning
7	Particulate Nature of Matter	47.5%	Low	Beginning
8		47.7%	Low	Beginning
9	Atomic Structure	40.2%	Low	Beginning

10	Periodic Table of Elements	57.3%	Moderate	Developing
11		36.2%	Very Low	Least
12	Electronic Structure of Matter	37.8%	Very Low	Least
13		42.3%	Low	Beginning
14	Chemical Bonding	37.7%	Very Low	Least
15		40.9%	Low	Beginning
16		38.3%	Very Low	Least
17		35.3%	Very Low	Least
18	Variety of Carbon Compounds	37.8%	Very Low	Least
19		43.9%	Low	Beginning
20	Mole Concept	35.2%	Very Low	Least
21		44.1%	Low	Beginning
22	Gases	37.2%	Very Low	Least
23		40.4%	Low	Beginning
24	Biomolecules	41.0%	Low	Beginning
25	Chemical Reactions	39.0%	Very Low	Least
26		56.0%	Moderate	Developing

On the other hand, topics such as the "Periodic Table of Elements" demonstrated relatively higher performance, likely because of their visual and categorical nature. Research indicates that interactive digital tools and visualization software can significantly enhance student engagement and understanding in such systematically organized topics (13). This contrast suggests that learners perform better when content is tangible, structured, or visually scaffolded, whereas abstract concepts involving complex calculations or invisible molecular interactions impose higher cognitive loads. Overall, the variation in MPS across competencies underscores the need for differentiated instructional strategies that address both conceptual and procedural challenges in chemistry education.

The findings on the least mastered learning competencies are further corroborated by the item difficulty indices, which ranged from 0.18 to 0.39 across the same topic domains, indicating that students consistently struggled with these concepts. Such low p-values suggest that these competencies represent authentic cognitive challenges rather than isolated lapses in attention or effort. To address these persistent gaps, contemporary literature frequently advocates for pedagogical shifts toward scaffolded instruction and inquiry-based learning approaches.

Continuous formative assessment, in particular, is emphasized as a critical tool for identifying misconceptions early, thereby preventing the entrenchment of "Least Mastered" skills (14). Targeted instructional interventions that prioritize the competencies identified as most difficult, specifically scientific investigation and the mole concept can help to bridge foundational gaps and balance curriculum progression. Achieving substantial improvements in Mean Percentage Scores necessitates a multifaceted approach that integrates conceptual clarity with practical, hands-on applications, enabling learners to transition from "Beginning" toward "Consistent" mastery.

Levels of Students' Motivation in Chemistry

The frequency and the corresponding percentage of the levels of respondents' motivation in Chemistry is shown in Table 3.

The results indicate a generally high level of motivation among students, with 32.6% classified as having high motivation, 31.8% as medium, and none falling within the very low category. This distribution suggests that learners possess a combination of intrinsic interest and extrinsic incentives, alongside a strong belief in their ability to comprehend and master chemical concepts. When students perceive personal relevance in the subject matter, their intrinsic motivation remains resilient even in the face of abstract or complex topics. Consequently, the data reflect a student cohort that finds both intellectual satisfaction and enjoyment in the processes of discovery inherent in Chemistry.

Table 3 Frequency and Percentage of Levels of Students' Motivation in Chemistry

Levels	Frequency	Percentage
Very High	117	31.5%
High	121	32.6%
Medium	118	31.8%
Low	15	4.0%
Very Low	0	0.0%
Total	371	100%

Moreover, students' motivation is reinforced by extrinsic considerations, particularly the anticipation of enhanced career opportunities and the validation associated with academic achievement. This aligns with prior research indicating that Filipino students frequently associate performance in Chemistry with future financial security and professional pathways (15). While extrinsic motivators are often considered secondary to intrinsic drives, the findings suggest that this interplay of internal curiosity and external goals constitutes a robust motivational framework, sustaining student engagement and persistence in learning.

Although students generally report high self-efficacy, nuances in their responses indicate slightly lower confidence in executing complex laboratory procedures or navigating abstract mathematical concepts in Chemistry. This suggests that while learners are motivated and confident in traditional assessments, they may benefit from targeted scaffolding in practical and cognitively demanding tasks. The observed moderate variability in self-efficacy underscores the need for instructional strategies that reinforce competence in both conceptual reasoning and hands-on application, thereby sustaining motivation and facilitating deeper learning outcomes.

Relationship between Students' Proficiency and Motivation in Chemistry

Table 4 presents the Spearman's rho coefficient and corresponding p-value, evaluating the correlation between students' chemistry proficiency and their motivation. This analysis provides insights into whether the motivational constructs such as intrinsic interest, career orientation, and self-efficacy are associated with observed proficiency across the curriculum.

Table 4. Spearman's rho Correlation and p Value on the Relationship between the Students' Proficiency and their Motivation in Chemistry

Correlation Coefficient	p-Value	Interpretation
0.040	.447	Not significant

The Spearman's rho coefficient of 0.040 indicates a negligible, virtually nonexistent positive correlation between students' proficiency in Chemistry and their motivation toward the subject. Such a correlation, being extremely close to zero, suggests that proficiency levels and motivation are largely independent variables in this cohort. In practical terms, a student's performance in Chemistry does not reliably predict their motivation, nor does a high level of motivation necessarily translate into higher achievement. The associated p-value of 0.447 exceeds the conventional alpha threshold of 0.05, confirming that the observed correlation is statistically nonsignificant and likely attributable to random variation rather than a true underlying relationship in the population (16).

This finding aligns with prior research in STEM education, which demonstrates that academic motivation and achievement may operate on distinct trajectories. Highly motivated students can still experience low proficiency when confronted with abstract and cognitively demanding content, such as molecular geometry, stoichiometry, or the mole concept (17). Nevertheless, students with moderate proficiency may exhibit minimal intrinsic interest, particularly if instructional strategies emphasize rote memorization over conceptual understanding. The decoupling of motivation and performance observed in this study underscores the influence of pedagogical context: when classroom practices prioritize recall and standardized assessments rather than active engagement, students' motivational drive does not necessarily translate into measurable proficiency (18).

Furthermore, the inherent cognitive demands of Chemistry such as spatial reasoning, quantitative problem-solving, and abstract conceptualization can constrain the translation of motivation into performance. Students may possess a high interest in Chemistry or its applications, yet lack the foundational skills required to succeed in complex topics. This cognitive bottleneck partially explains why the correlation between motivation and proficiency is near zero; the affective drive to learn exists, but the necessary skill set to achieve mastery is inadequately developed.

These findings highlight the critical pedagogical implication that motivation alone is insufficient to ensure academic success in Chemistry. Educators are encouraged to design instructional strategies that bridge the gap between students' intrinsic interest and their actual performance. Approaches such as inquiry-based learning, scaffolded problem-solving, and contextualized applications can enhance the alignment between a student's "utility value" of Chemistry and their "attainment value," fostering an environment in which motivation and proficiency mutually reinforce one another rather than functioning independently.

CONCLUSION

The study reveals a pronounced disparity between students' motivation and their proficiency in Chemistry. Despite a substantial proportion of students demonstrating moderate to high motivation and none reporting very low motivation, the majority remain in the "Needs Improvement" category in terms of proficiency. This indicates that learners are psychologically prepared and willing to engage with Chemistry, yet the complexity and abstract nature of the curriculum frequently surpass their current cognitive and conceptual readiness.

Moreover, the absence of a statistically significant relationship between motivation and proficiency suggests that the challenges are largely content-specific. Foundational competencies, including scientific investigation, substances and mixtures, the mole concept, chemical reactions, and other core principles, remain poorly mastered. These deficits impede the acquisition of advanced skills, creating a cumulative barrier to academic success. Consequently, the primary pedagogical task is to transform existing student motivation into measurable proficiency through targeted instructional interventions that address both conceptual understanding and practical application.

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