Assessing General Chemistry Learning Gaps: A Needs Assessment of Competency Mastery among Grade 11 Learners

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ABSTRACT

This study aimed to identify learning gaps in chemistry among Grade 11 students by conducting a diagnostic assessment covering 13 key topics from the Grades 7 to 10 science curriculum. A total of 95 students from three public schools participated in the assessment, which consisted of 45 multiple-choice items aligned with the Department of Education's Most Essential Learning Competencies (MELCs). Results revealed that 100% of the learners fell under the "Did Not Meet Expectations" category, with a mean score of 15.52%, indicating a significant lack of mastery across core chemistry concepts. Chemical Reactions emerged as the least mastered topic, with a mean percentage score of 19.70%, followed by Gas Laws (29.34%), Substances and Mixtures (30.95%), and The Mole Concept (33.60%). Although other topics achieved “Average Mastery” levels, none met the expected benchmarks. These findings highlight the urgent need for targeted instructional interventions to address foundational gaps and improve students’ long-term retention and understanding of essential chemistry competencies.

Keywords: Competency Mastery, Diagnostic Assessment, General Chemistry, Learning Gaps

INTRODUCTION

The Philippines faced significant challenges in improving the quality of science education, as evidenced by recent global and national assessments. The Programme for International Student Assessment (PISA) 2022 results showed that the country continued to lag behind other nations, particularly in science, with an average score of 355—a slight decrease from the 2018 score of 356 (Chi, 2023). Similarly, the National Achievement Test results revealed that average scores fell below the passing grade of 75, underscoring the persistent inadequacies in learners' competency levels (Senate of the Philippines, 2021). In fact, the recent NAT performance of learners in science showed a mean percentage score of 34.05, which did not even reach half of DepEd’s goal of a passing mean percentage score (Ojastro et al., 2025). These findings highlighted the urgent need for comprehensive reforms to address the declining performance of Filipino learners in STEM-related disciplines.

Among the science disciplines, Chemistry had the reputation of being a difficult subject due to its inherent complexity. Many students viewed chemistry as a complex and challenging discipline, often associating it with rigorous mathematical concepts and abstract theories (Chi, et al., 2018). This perception was supported by research indicating that students who did not perceive the relevance of chemistry to their personal lives were more likely to experience negative attitudes toward the subject, which in turn affected their academic performance. (Wang et al., 2021).

These learning gaps has been attributed to the teacher’s methodology and teaching strategies in the classroom in which played a critical role in shaping science literacy (Calleja et al., 2023). While the K-12 curriculum emphasized learner centered approaches and hands-on learning, many teachers still relied on traditional methods, such as rote memorization, oral recitation, and drills, which may not have adequately fostered inquiry

and problem-solving skills (Tabamo, 2023). Although traditional methods sometimes yielded positive outcomes, they often failed to meet the evolving demands of 21st-century education, especially in STEM fields, where engagement and critical thinking were paramount (Mina & Orais, 2024).

Integrating experiential and context-based learning into the curriculum can mitigate these challenges. The literature indicates that teaching methods that promote active learning, such as experiential concept mapping and contextually relevant curricula, have been associated with improved academic performance (Gatumwa et al., 2022; Sugano & Nabua, 2020). Such strategies not only aid in the clarification of complex concepts but also foster a more engaging learning environment that encourages deeper cognitive processing of chemistry content (Avargil et al., 2011).

To better understand these learning gaps, this study conducted a needs assessment focused on evaluating the mastery of selected chemistry topics among Grade 11 students. Rather than assessing students currently taking these topics, the study intentionally targeted learners who had already completed their Grade 7 to 10 science education to measure long-term understanding and knowledge retention. By systematically mapping the least mastered competencies, educators can develop remediation programs, contextualized learning activities, and intervention materials that directly address students' conceptual gaps. Addressing these learning deficiencies is not merely a corrective task; it enhances the educational experience by fostering deeper engagement and more meaningful learning among students (Abuda et al., 2019; Arpilleda, 2021). This approach also strengthens students' readiness for more advanced chemistry topics and promotes a clearer understanding of the subject's real-world applications. Sagge and Espiritu (2023) emphasize that identifying learners' academic weaknesses is key to designing instructional resources that are responsive to their needs. Ultimately, this process is vital for improving the overall quality of science education and ensuring that learners are well-prepared to meet the challenges of the STEM curriculum and future academic pursuits.

Specifically, this study seeks to determine the level of mastery of learners in general chemistry concepts by conducting a diagnostic assessment that evaluates their retention of competencies from Grades 7 to 10. It aims to identify the extent to which learners have internalized the Most Essential Learning Competencies (MELCs) set by the Department of Education. By analyzing the performance of Grade 11 students—who have already completed their foundational science education—the study intends to reveal gaps in conceptual understanding that may hinder future learning in more advanced chemistry topics. This investigation not only highlights which chemistry areas require remedial instruction but also provides data-driven insights for designing targeted interventions and contextualized learning activities that address learners' specific academic needs.

METHODOLOGY

The needs assessment followed a quantitative descriptive design, aimed at systematically measuring student mastery of selected chemistry competencies. To achieve this, a diagnostic test was developed, consisting of 45 multiple-choice items, each carefully mapped to one or more Most Essential Learning Competencies (MELCs) outlined by the Department of Education for the Grades 7 to 10 science curriculum. The design of the test ensured that it addressed a range of critical chemistry concepts that students should have mastered throughout their prior years of science education.

This study was guided by the following null hypothesis:

H_0: There is no significant difference between the expected mastery levels of selected chemistry competencies and the actual performance of Grade 11 learners as measured by the diagnostic assessment.

The assessment covered 13 key chemistry topics, which were selected to provide a comprehensive evaluation of students' understanding and retention of foundational chemistry concepts. These topics included The Particle Nature of Matter, Substances and Mixtures, Elements and Compounds, and The Periodic Table of Elements. Additionally, the test covered concepts such as Atomic Structure, Electronic Structure of Matter, and Chemical Bonding, all of which are essential for grasping the core principles of chemistry.

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Other important topics included in the assessment were the Mole Concept, Chemical Reactions, and Gas Laws, which are fundamental to understanding chemical processes. The assessment also included Solutions, Biomolecules, and The Variety of Carbon Compounds, ensuring that students' knowledge in both basic and more advanced areas of chemistry was evaluated.Top of FormBottom of Form

The test was administered to 95 Grade 11 learners from three different public schools, two (2) from the Division of Iligan City and one (1) from the Division of Pagadian City. These learners had already completed their junior high school chemistry education, making them suitable participants for evaluating how well they had retained the competencies outlined in the MELCs.

To interpret the results, the study employed the Department of Education's (DepEd) Mastery Level Scale using Mean Percentage Score (MPS). MPS was calculated by dividing the total number of correct responses for each topic by the total possible score (number of test items per topic multiplied by number of respondents), and then multiplying the result by 100. Based on DepEd guidelines, the MPS ranges were interpreted as follows:

Table I: Mastery Level in General Chemistry

Mean Percentage Score	Descriptive Equivalent
96-100%	Mastered
86-95%	Closely Approximating Mastery
66-85%	Moving Towards Mastery
35-65%	Average
15-34%	Low
5-14%	Very Low
0-4%	Absolutely No Mastery

Additionally, the interpretation of summary scores follows the DepEd's performance index system for overall results:

Table II: Interpretation of Learners' Performance

Index	Descriptors	Range	Interpretation
41-45	Outstanding	90-100	Passed
39-40	Very Satisfactory	85-89	Passed
36-38	Satisfactory	80-84	Passed
34-35	Fairly Satisfactory	75-79	Passed
0-33	Did Not Meet Expectations	74 Below	Failed

RESULTS AND DISCUSSION

This section presents the results of the assessment conducted across three participating schools. It includes a summary table of learners' performance categorized by mastery levels, a consolidated table showing the overall mastery of competencies based on combined data from all schools, and a graph illustrating the Mean Percentage Score (MPS) of each school. These data representations aim to provide a clear overview of learner achievement, and the general level of competency mastery observed in the assessment.

The table below presents a summary of learners' performance based on their mastery index scores. The assessment results are organized according to frequency and percentage distributions, with performance levels categorized as Outstanding, Very Satisfactory, Satisfactory, Fairly Satisfactory, and Did Not Meet Expectations. This statistical overview highlights the general trend in learner achievement and the extent to which the assessed competencies were mastered.

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Table III: Summary of Chemistry Assessment

Index	Frequency	Percentage	Interpretation	Remarks
41-45	0	0	Outstanding	Passed
39-40	0	0	Very Satisfactory	Passed
36-38	0	0	Satisfactory	Passed
34-35	0	0	Fairly Satisfactory	Passed
0-33	95	100%	Did Not Meet Expectations	Failed
Total	95			
Mean 15.52	Standard Deviation 3.8685	Interpretation Did Not Meet Expectation		Failed

The data reflect the distribution of performance among the 95 learners from three different schools who participated in the assessment. All learners (100%) scored within the "Did Not Meet Expectations" range, with none achieving higher performance levels. This result indicates that no student met the minimum required benchmarks for passing.

The mean score of 15.52 and standard deviation of 3.8685 further emphasize the clustering of scores in the lower range, indicating a generally low level of mastery with minimal variation among learners. Overall, the results confirm that the group did not meet the expected level of competency, highlighting a critical area for instructional intervention and support.

Overall Mastery of the Chemistry Competencies

The table below presents the Mean Percentage Scores (MPS) for each of the 13 key topics in science, specifically chemistry, along with their corresponding descriptive equivalents. These scores reflect the students' mastery levels in various areas of the curriculum, from foundational concepts to more advanced topics. The descriptive equivalents—ranging from Low Mastery to Average Mastery—provide a clear indication of students' understanding of each subject area. This data highlights which topics students struggled with the most and which areas showed relatively better performance, although still not meeting the expected competency level.

Table IV: Overall Mastery of Competencies

Rank	TOPICS	Mean Percentage Score	Description
1	Chemical Reactions	19.70	Low Mastery
2	Gas Laws	29.34	Low Mastery
3	Substances and Mixtures	30.95	Low Mastery
4	The Mole concept	33.60	Low Mastery
5	Electronic Structure of Matter	35.37	Average Mastery
6	Solutions	35.61	Average Mastery
7	Elements and compounds	36.31	Average Mastery
8	Atomic Structure	38.11	Average Mastery
9	Chemical Bonding	38.32	Average Mastery
10	Periodic Table of Elements	38.54	Average Mastery
11	The Particle Nature of Matter	40.51	Average Mastery
12	Biomolecules	41.04	Average Mastery
13	The Variety of Carbon Compounds	44.18	Average Mastery

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The findings reveal that the lowest mastery was observed in the topic "Chemical Reactions", which recorded the lowest mean score of 19.70%, followed by "Gas Laws" (29.34%), "Substances and Mixtures" (30.95%), and "The Mole Concept" (33.60%). These topics fall under the “Low Mastery” category, indicating that learners struggled significantly in these foundational areas.

In contrast, the remaining nine topics, such as "Electronic Structure of Matter" (35.37%), "Solutions" (35.61%), and "The Variety of Carbon Compounds" (44.18%), fall within the “Average Mastery” range. While these scores suggest relatively better understanding, they still fall short of the expected mastery level, indicating room for improvement across the board.

The graph below illustrates the Mean Percentage Scores (MPS) for School A, School B, and School C across the 13 science topics assessed. This visual representation supports the data in the table by providing a clearer picture of the performance levels within each school. The graph highlights trends in how students performed across various topics, reinforcing the overall findings regarding mastery levels and areas of strength and weakness.

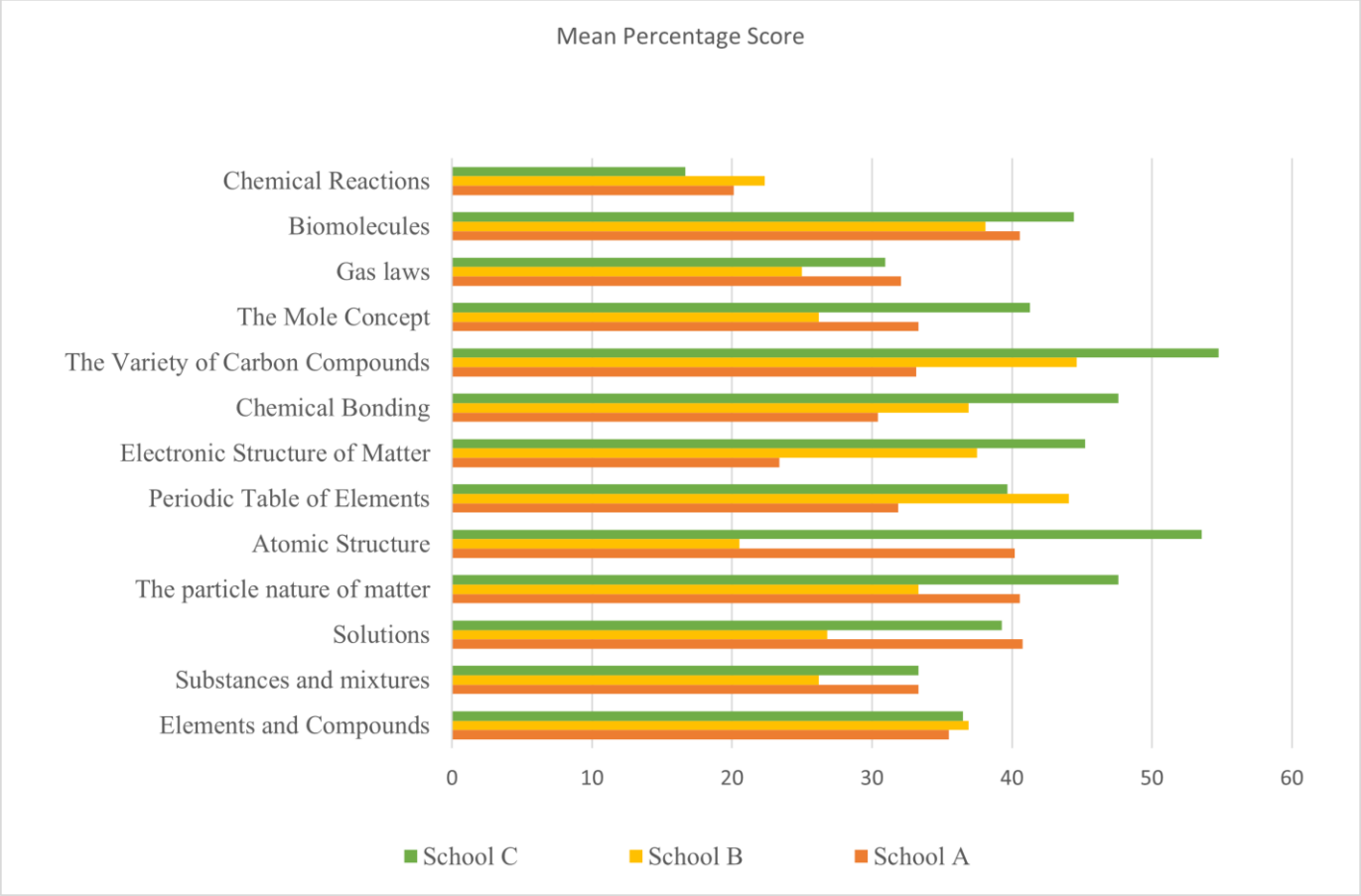

Figure 1: Learners’ Competency in Chemistry

The graph presents the mean percentage scores of three schools—School A, School B, and School C—across thirteen chemistry topics. This visual representation supports the previously presented table, highlighting Chemical Reactions as the lowest-performing topic across all three schools, with all scores falling well below mastery level. Gas Laws, The Mole Concept, and Substances and Mixtures also consistently reflect low performance, reinforcing the earlier conclusion that learners struggle with these abstract or computation-heavy concepts. In contrast, topics like The Variety of Carbon Compounds, Biomolecules, and Elements and Compounds show relatively better performance, particularly for School C, which scored highest in several topics. School A, while generally consistent, showed more modest performance across most topics. Meanwhile, School B demonstrated considerable variation, performing well in some areas (e.g., Periodic Table of Elements) but lower in others (e.g., Chemical Reactions and Solutions).

Overall, the graph affirms the table's ranking and descriptive equivalents, with the majority of topics falling within the "Average Mastery" range. However, it also highlights persistent learning gaps that call for targeted instructional interventions. The performance discrepancies across schools may point to differences in teaching strategies, access to learning resources, or student support systems—factors worth exploring in future research or program development.

CONCLUSION

The assessment results highlighted substantial learning gaps in chemistry among Grade 11 learners. All 95 students (100%) did not meet expectations in the pre-assessment, with a mean score of 15.52% and no learners reaching satisfactory performance levels. Among the thirteen chemistry topics evaluated, Chemical Reactions emerged as the least mastered, with a mean percentage score of only 19.70%. This was followed by Gas Laws (29.34%), Substances and Mixtures (30.95%), and The Mole Concept (33.60%), all of which were categorized under "Low Mastery."

The results consistently showed that foundational topics essential to understanding chemistry remain poorly understood across the sampled schools. Although some topics such as The Variety of Carbon Compounds and Biomolecules exhibited slightly better scores, overall performance across all topics fell short of expected competency levels. These findings point to persistent gaps in conceptual understanding and signal the need for targeted instructional support, particularly in the most challenging topics.

These findings lead to the rejection of the null hypothesis, as the actual performance of Grade 11 learners was significantly below the expected mastery levels outlined in the curriculum. The results underscore the need for interventions to address persistent gaps in students' understanding of foundational chemistry concepts.

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REFERENCES

1. Abuda, B. F. Q., Balazo, G. F. O., Orque, J. C., Cabili, M. C. D., & Maestre, M. F. A. M. (2019). Struggling learners' mathematics achievement level using quick response embedded strategic intervention material. International Journal in Information Technology in Governance, Education and Business, 1(1), 39-45. https://doi.org/10.32664/ijitgeb.v1i1.11
2. Arpilleda, A. J. (2021). Strategic intervention material: a tool in enhancing grade nine students' mathematical performance. International Journal of Research Studies in Education, 10(5). https://doi.org/10.5861/ijrse.2021.5051

3. Avargil, S., Herscovitz, O., & Dori, Y. J. (2011). Teaching thinking skills in context-based learning: teachers' challenges and assessment knowledge. Journal of Science Education and Technology, 21(2), 207-225. https://doi.org/10.1007/s10956-011-9302-7
4. Calleja, et al. (2023). Addressing the Poor Science Performance of Filipino Learners: Beyond Curricular and Instructional Interventions. Policy Brief AKI Research Grants on Educational Issues. https://animorepository.dlsu.edu.ph/cgi/viewcontent.cgi?params=/context/res_aki/article/1087/&path_info=Addressing_the_poor_science_performance_of_Filipino_learners.pdf
5. Chi, C. (2023). Philippine Still Lags behind world in Math, Reading, and Science-PISA 2022. Philippine Star Global. https://www.philstar.com/headlines/2023/12/06/2316732/philippines-still-lags-behind-world-math-reading-and-science-pisa-2022
6. Chi. Et al., (2018). Students Progression on Chemical Symbol Representation Abilities at Different Grade Levels (Grades 10-12) Across Gender. Chemistry Education Research and Practice. https://doi.org/10.1039/C8RP00010G
7. Gatumwa, C., Njagi, M. W., & Mburugu, B. M. (2022). Effect of experiential concept mapping teaching strategy on students' academic achievement in chemistry in tigania west sub county, kenya. International Journal of Advanced Academic Studies, 4(1), 194-200. https://doi.org/10.33545/27068919.2022.v4.i1c.715
8. Mina & Orais, 2024. Unveiling the Reasons Behind Teachers Embrace of Traditional Teaching Method. ISSN. https://scimatic.org/storage/journals/11/pdfs/3055.pdf
9. Ojastro, et al., (2025). Academic Performance and Nataional achievement Test (NAT) Performance in Science and Mathematics. Researchgate.https://www.researchgate.net/publication/388403290
10. Sagge, R. G. and Espiritu, E. E. (2023). Project desmos: development and evaluation of self-directed module in statistics and probability. International Journal of Multidisciplinary: Applied Business and Education Research, 4(1), 48-56. https://doi.org/10.11594/ijmaber.04.01.06
11. Sugano, S. G. C. and Nabua, E. B. (2020). Meta-analysis on the effects of teaching methods on academic performance in chemistry. International Journal of Instruction, 13(2), 881-894. https://doi.org/10.29333/iji.2020.13259a
12. Tabamo, 2023. The Use of Literature in Teaching Science as a Strategy in Addressing Surface Learning. International Journal or Research Publication and Reviews. https://doi.org/10.55248/gengpi.4.723.46962
13. Wang et al., (2021). Prompts to Promote Success: Evaluating Utility Valuea and Growth Mindset Intervention on General Chemistry Students' Attitude and Academic Performance. Journal of Chemical Education. Vol 98, Issue 5. 10.1021/acs.jchemed.0c01497