Identifying Conceptual Gaps: An Analysis of Least Mastered Competencies in Balancing Chemical Equations

Cheira M. Tarayao, Eve Joyce E. Ablin, Christine Joy C. Llaneras, Cathniel L. Verallo, Edna B. Nabua

Department of Science and Mathematics Education, School of Graduate Studies - Chemistry, Mindanao State University – Iligan Institute of Technology

ABSTRACT

The study aimed to assess senior high school learners' conceptual understanding in balancing chemical equations by determining their scores on a needs assessment and identifying the least mastered competencies. Data were collected from 50 purposively selected students from Iligan City East National High School using a 30-item validated multiple-choice questionnaire aligned with the Department of Education's Most Essential Learning Competencies (MELCs). Quantitative methods, including mean, frequency, and standard deviation, were used for analysis. Findings revealed that 10% of learners scored within the "Did Not Meet Expectation" range, 70% in the "Fairly Satisfactory" range, and 20% in the "Satisfactory" range, with no learners achieving higher performance levels, indicating that no learner met the minimum required benchmarks for passing. Analysis of topic-specific performance showed that "Applying Law of Conservation of Mass in Chemical Equations" was the least mastered competency, with a mean percentage score (MPS) of 58.10%, which falls under the "Low Mastery" level. These findings confirm significant gaps in foundational chemistry knowledge and emphasize the need for strategic instructional support and targeted intervention to enhance learner understanding in these critical areas of chemistry.

Keywords: Balancing, Chemical Equations, least mastered competencies, Chemistry

INTRODUCTION

Balancing chemical equations is a fundamental skill in chemistry, representing the Law of Conservation of Mass and serving as a cornerstone for advanced topics like stoichiometry. Despite its importance, many students find this topic abstract and difficult to master, often confusing coefficients with subscripts. Given the history of poor performance by Filipino learners in national and international science exams, a needs assessment was developed to systematically identify the gap between current student performance and desired mastery levels.

The main objective of this study was to determine the learners' level of conceptual understanding in balancing chemical equations. Specifically, it aimed to determine learner scores and identify the least mastered competency among Grade 11 Senior High School students.

Research Methodology

This study employed a quantitative descriptive research design involving the collection and analysis of numerical data from a needs assessment to identify least mastered competencies. The study was conducted at Iligan City East National High School – Sta. Felomina.

The respondents were 50 Grade 11 STEM students selected through purposive sampling. The primary research instrument was a 30-item validated multiple-choice questionnaire aligned with the Department of Education's Most Essential Learning Competencies (MELCs). The instrument had an acceptable reliability coefficient of 0.751 using Cronbach's alpha. Data analysis utilized mean, frequency, and mean percentage score (MPS), interpreted using the DepEd's Mastery Level Scale.

The data collected from the 50 Grade 11 learners were analyzed using descriptive statistics to evaluate their conceptual understanding. Before analysis, the instrument's internal consistency was confirmed with a Cronbach's alpha of 0.751, indicating acceptable reliability.

The following tables present the interpretation of data gathered in this study. To determine learners' level of mastery, the Department of Education's (DepEd) Mastery Level Scale, based on the Mean Percentage Score (MPS), was utilized. Additionally, summary scores were interpreted using DepEd's performance index system.

Table 1. Mastery/ Achievement Level

Mean Percentage Score (MPS)	Descriptive Equivalent
96-100%	Mastered
86-95%	Closely Approximating Mastery
66-85%	Moving Towards Mastery
35-65%	Average
15-34%	Low
5-14%	Not Mastered

This table presents the classification of learners' mastery levels. MPS was computed by dividing the total number of correct responses per topic by the total possible score (i.e., number of test items per topic multiplied by the number of respondents), and then multiplying the result by 100.
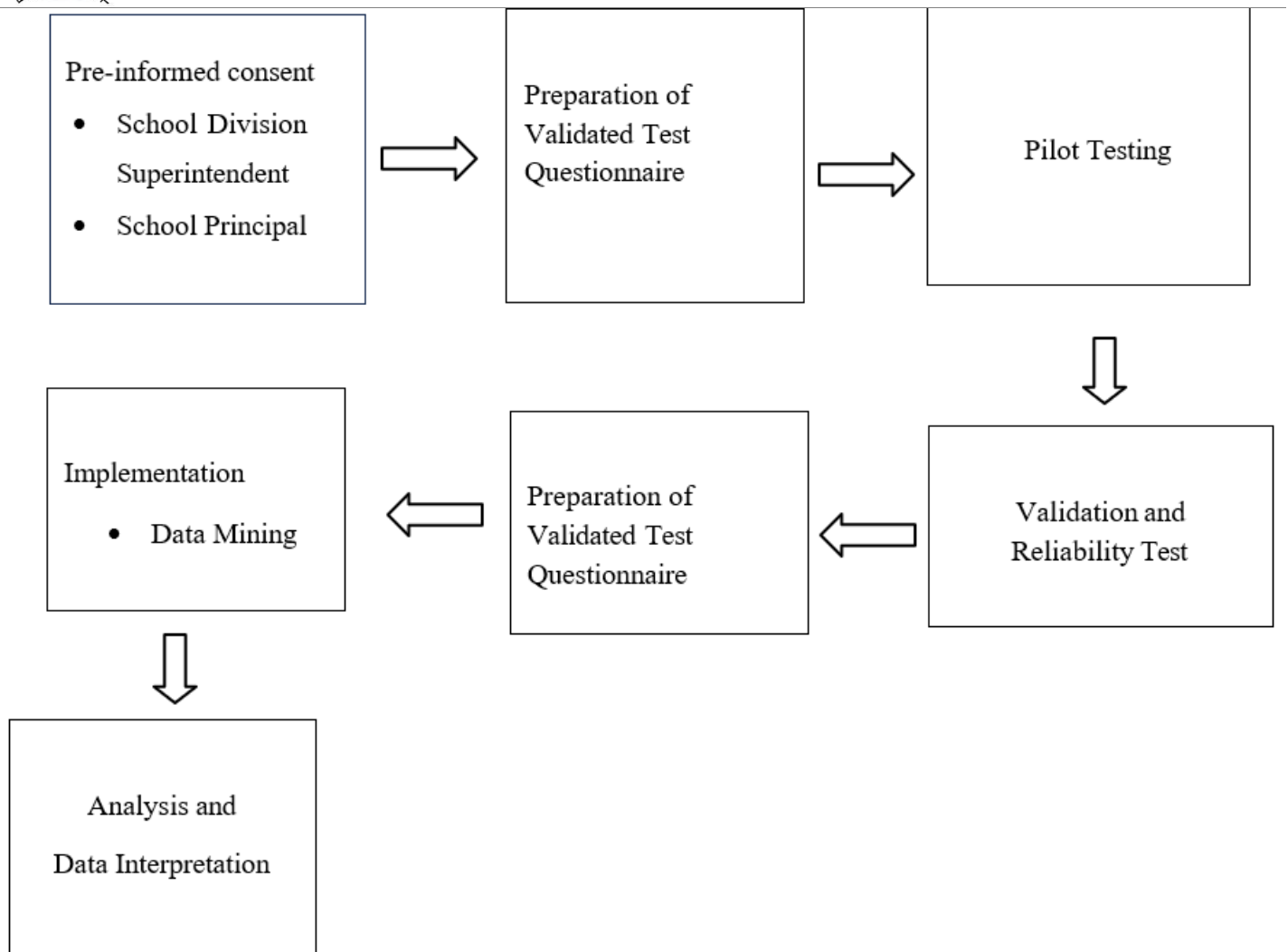
Table 2. Interpretation of Learner's Performance

Index	Description	Range	Interpretation
27-30	Outstanding	90-100	Passed
24-26	Very Satisfactory	85-89	Passed
19-23	Satisfactory	80-84	Passed
15-19	Fairly Satisfactory	75-79	Passed
0-14	Did Not Meet expectation	74 Below	Failed

This table provides a summary interpretation of learners' overall performance based on the DepEd's performance index.

Data Collection Procedure

The study followed these steps:

RESULTS AND DISCUSSION

The assessment results for the 50 learners showed that none achieved "Outstanding" or "Very Satisfactory" levels. Most scores clustered in the lower ranges: 70% were in the "Fairly Satisfactory" range, 20% in the "Satisfactory" range, and 10% "Did Not Meet Expectation" (failed). The overall mean score was 18.58, indicating a generally low level of mastery.

The topic-specific analysis of mastery levels is presented in the table below.

Rank	Topic	MPS	Descriptive Equivalent
1	Applying the Law of Conservation of Mass in Chemical Calculations	58.10	Low Mastery
2	Balancing Chemical Equations	62.17	Low Mastery
3	Laws of Chemical Reactions and Conservation	62.52	Low Mastery
4	Parts and Symbols in a Chemical Equation	64.86	Low Mastery

Table 1. Overall Mastery of Competencies

The lowest mastery was observed in the topic **"Applying the Law of Conservation of Mass in Chemical Calculations"** (MPS of 58.10%). Learners struggled with identifying reactants and products, confusing subscripts and coefficients, and applying the conservation law to justify atom counts.

CONCLUSION

This study sought to assess Senior High School learners' conceptual understanding in Balancing Chemical Equations by (1) determining their scores on a needs assessment and (2) identifying the least mastered competencies. Using a 30-item validated multiple-choice questionnaire aligned with the Department of Education's Most Essential Learning Competencies (MELCs), data were collected from 50 purposively selected students from Iligan City East National High School in Iligan City, Lanao del Norte. Quantitative methods, including statistical tools such as mean, frequency, and standard deviation, were employed to analyze the assessment results.

that no learner met the minimum required benchmarks for passing. This result fulfilled the first objective, which was to determine the learners' performance scores.

In relation to the second objective, analysis of topic-specific performance showed that "Applying Law of Conservation of Mass in Chemical Equations" exhibit as the least mastered competency, with a mean percentage score of only 58.10%, classified under the "Low Mastery" level. This was followed by "Balancing Chemical Equation" and "Laws of Chemical Reactions and Conservation" consecutively with a mean percentage score of 62.17 % and 62.52% which also fell within the same mastery category.

These findings confirm significant gaps in foundational chemistry knowledge and support prior studies highlighting the abstract nature of balancing chemical equations and related concepts.

The results emphasize the need for strategic instructional support and targeted intervention to enhance learner understanding in these critical areas of chemistry. Addressing these gaps can contribute to improved academic performance and better preparation for more complex chemistry topics in future learning process.

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed to address these conceptual gaps:

- Science teachers should implement structured remedial instruction focusing on the identified least mastered competencies.

- Teachers should integrate concrete and contextualized instructional materials such as particle representations and visual models to address the abstract nature of the concepts.

- Formative assessment strategies (quizzes, diagnostic tests) should be used to provide timely feedback and modify instruction.

- Future research can use larger samples or experimental designs to evaluate specific instructional interventions.

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