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DIAGNOSTIC ASSESSMENT OF SENIOR SECONDARY SCHOOL STUDENTS' MASTERY AND NON-MASTERY OF SELECTED CHEMISTRY CONCEPTS IN EDE FEDERAL CONSTITUENCY, OSUN STATE, NIGERIA

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Abstract

This study assessed Senior Secondary School Three (SSS III) students' mastery and non-mastery of thermodynamics, qualitative analysis, electrolysis, and hydrocarbons in Ede Federal Constituency, Osun State, Nigeria. A descriptive cross-sectional survey with a diagnostic-assessment component was adopted. From a population of 6,850 SSS III Chemistry students, 1,624 students (655 males and 969 females) were selected from 40 public and private schools using proportionate stratified and simple random sampling. Data were collected using a researcher-developed Chemistry Diagnostic Test comprising 60 multiple-choice items and three essay items scored across 18 rubric attributes. Content validity and Q-matrix alignment were evaluated by five experts, with Kendall's $W = .72$. Reliability coefficients were KR-20 = .99 and Cohen's kappa = .70. Students were classified as having mastered a concept when they demonstrated at least 50% of the mapped items or attributes. Results showed high non-mastery in thermodynamics (74%), qualitative analysis (80%), electrolysis (86%), hydrocarbons (59%), and essay items (78–88%). Comprehension, sequencing, and computation were the weakest skills. Gender was not significantly associated with essay mastery, $\chi^2(1, N = 1,624) = 0.436$, $p = .509$. The study recommends regular diagnostic assessment, targeted remediation, and strengthened instructional support for difficult Chemistry concepts and skills.

Keywords: chemistry diagnostic test; cognitive diagnosis; mastery; non-mastery; Q-matrix; senior secondary education

1. Introduction

Diagnostic assessment is designed to identify the specific knowledge, misconceptions, and procedural skills that underlie a learner's overall test performance. Unlike a single total score, a diagnostic profile shows the concepts or attributes a learner has and has not demonstrated, thereby providing more actionable information for instructional planning and remediation (Leighton & Gierl, 2007). In cognitive diagnostic assessment, a Q-matrix is commonly used to map each test item to the knowledge or skill attributes required for a correct response (de la Torre, 2009).

Assessment is integral to teaching and learning because it provides evidence about students' progress, the effectiveness of instruction, and the extent to which curriculum objectives have been achieved. Valid interpretation of assessment results requires alignment among the intended construct, item content, scoring procedure, and the decisions made from the scores (American Educational Research Association et al., 2014). For Chemistry, diagnostic assessment is particularly valuable because students may obtain similar total scores while experiencing different conceptual or procedural difficulties.

Chemistry is a central science subject in Nigeria's senior secondary curriculum and provides foundational knowledge for medicine, engineering, pharmacy, agriculture, environmental science, and other science-based fields. The national curriculum is intended to develop students' understanding of chemical concepts and principles, connect Chemistry to everyday life and industry, and prepare learners for further study (Federal Republic of Nigeria, 2014).

The four concepts examined in this study (thermodynamics, qualitative analysis, electrolysis, and hydrocarbons) were selected because they are prominent curriculum and examination domains that require students to coordinate conceptual knowledge, symbolic representation, computation, observation, and explanation. Recent WASSCE materials continue to assess heat of combustion, Faraday's law of electrolysis, organic-compound identification, and qualitative analysis. In the 2023 Chemistry Chief Examiner's report, candidates' weaknesses included poor mathematical skills, failure to follow instructions in qualitative analysis, and poor knowledge of qualitative analysis (West African Examinations Council [WAEC], 2023a, 2023b). Research has also reported misconceptions in electrochemistry and thermochemistry that diagnostic tests can help reveal (Mutlu & Sesen, 2015).

Recent Nigerian evidence continues to show uneven learning outcomes in Chemistry and the need for approaches that make abstract concepts more visible and diagnostically accessible. Fabeku and Enyeasi (2024), for example, highlighted persistent learning challenges in Nigerian secondary-school Chemistry and reported that instructional approaches that improve visualization can strengthen achievement and retention. These concerns reinforce the need to identify not merely whether students performed poorly, but precisely which concepts and skills remain unmastered.

1.1. Statement of the Problem

Persistent weaknesses in secondary-school Chemistry remain a concern because aggregate examination scores do not reveal the particular concepts or cognitive skills responsible for students' difficulties. WAEC's 2023 report indicated that the raw mean score for the relevant Chemistry paper declined from 28.0 in 2022 to 25.0 in 2023. The Chief Examiner also identified poor mathematical skills and poor knowledge of qualitative analysis among candidates' weaknesses (WAEC, 2023a, 2023b). These weaknesses are directly relevant to the computational, interpretive, sequential, and explanatory demands of thermodynamics, qualitative analysis, electrolysis, and hydrocarbons.

Although conventional tests can indicate overall achievement, they may not distinguish between a student who lacks conceptual understanding and one who has difficulty with representation, computation, interpretation, or the sequencing of a solution. Without this information, teachers may provide general revision rather than targeted remediation. In Ede Federal Constituency, no large-scale diagnostic profile was identified showing SSS III students' mastery and non-mastery of the selected Chemistry concepts and the skills embedded in essay responses. This study therefore used a Chemistry Diagnostic Test to provide concept- and skill-level evidence that could guide instructional intervention.

1.2. Purpose of the Study

The study examined SSS III students' performance on a researcher-developed Chemistry Diagnostic Test in terms of mastery and non-mastery of thermodynamics, qualitative analysis, electrolysis, and hydrocarbons. It also assessed the essay-response skills of structural representation, observation, description, explanation, application, comprehension, interpretation, computation, and sequencing.

1.3. Research Questions

- What proportion of students demonstrated mastery and non-mastery of the four objective-test concept subtests?
- What proportion of students demonstrated mastery and non-mastery of the three essay items?
- What proportion of students demonstrated mastery and non-mastery of the skills assessed by the essay items?

1.4. Research Hypothesis

H_0: There is no significant association between students' gender and their mastery/non-mastery classification on the Chemistry Diagnostic Test essay items.

2. Methodology

A descriptive cross-sectional survey design with a diagnostic-assessment component was used. The design was appropriate because the study described the prevalence of mastery and non-mastery in a defined student population at one point in time, while the Q-matrix-based scoring procedure generated concept- and skill-specific classifications. The inferential component was limited to testing whether essay mastery status was associated with gender.

The population comprised 6,850 SSS III Chemistry students enrolled in public and private secondary schools in the four local government areas of Ede Federal Constituency during the 2024/2025 academic session. The population included students in urban and rural schools.

A sample of 1,624 students, comprising 655 males and 969 females, was selected through proportionate stratified random sampling followed by simple random sampling. The four local government areas were Ede North, Ede South, Egbedore, and Ejigbo. The strata were local government area, school ownership (public/private), and school location (urban/rural). A total of 40 schools were selected: 24 public and 16 private schools, comprising 21 urban and 19 rural schools. Proportionate allocation produced samples of 368 students from Ede North, 498 from Ede South, 332 from Egbedore, and 426 from Ejigbo, as shown below.

Sampling allocation by local government area, school ownership, and location (figures in parentheses are student sample allocations)

Local government area	Population (N_h)	Public urban schools (students)	Public rural schools (students)	Private urban schools (students)	Private rural schools (students)	Total schools (students)
Ede North	1,550	3 (123)	2 (82)	3 (123)	1 (40)	9 (368)
Ede South	2,100	4 (166)	2 (83)	4 (166)	2 (83)	12 (498)
Egbedore	1,400	2 (74)	4 (147)	1 (37)	2 (74)	9 (332)
Ejigbo	1,800	3 (128)	4 (170)	1 (43)	2 (85)	10 (426)
Total	**6,850**	**12 (491)**	**12 (482)**	**9 (369)**	**7 (282)**	**40 (1,624)**

Within each selected school, the official register of eligible SSS III Chemistry students served as the sampling frame. Each eligible student was assigned a unique serial number. Microsoft Excel's random-number function was used to generate the required number of unique serial numbers without replacement. A reserve list equal to 10% of each school's allocation was generated at the same time. Where a selected student was absent or declined participation, the next serial number on the reserve list from the same school and stratum was used. The number selected from each stratum was determined by proportionate allocation, $n_h = (N_h/N) \times 1{,}624$.

The instrument was a researcher-developed Chemistry Diagnostic Test (CDT) consisting of 60 four-option multiple-choice items and three essay items. The objective section contained 15 items for each of the four concept domains: thermodynamics (items 1–15), qualitative analysis (items 16–30), electrolysis (items 31–45), and hydrocarbons (items 46–60). The essay questions were scored with an analytic rubric containing 18 binary attributes. Each demonstrated attribute was scored 1 and each undemonstrated attribute was scored 0. The Q-matrix served as the content-to-skill blueprint by identifying the concept or skill required by each item or rubric component.

Table 1. Concept and skill mapping for the Chemistry Diagnostic Test

Test component	Concept domain	Mapped attributes/skills	Item numbers and count
Objective items	Thermodynamics	Conceptual understanding and computation	Items 1–15; n = 15
Objective items	Qualitative analysis	Observation, inference, and interpretation	Items 16–30; n = 15
Objective items	Electrolysis	Conceptual understanding, laws, and computation	Items 31–45; n = 15
Objective items	Hydrocarbons	Nomenclature, structure, reactions, and application	Items 46–60; n = 15
Essay item 1	Hydrocarbons	Structural representation; description; explanation; application; comprehension; interpretation	Essay item 1; 6 attributes
Essay item 2	Electrolysis	Explanation; comprehension; interpretation; description; computation	Essay item 2; 5 attributes
Essay item 3	Thermodynamics/qualitative analysis	Explanation; interpretation; description; structural representation; sequencing; application; observation	Essay item 3; 7 attributes

The CDT, analytic scoring rubric, and proposed Q-matrix were reviewed by a validation panel of five experts: three specialists in Chemistry Education and two specialists in Measurement and Evaluation. The experts were purposively selected because each held a doctorate in a relevant discipline, had at least five years of university-level teaching or research experience, and possessed demonstrated expertise in secondary-school Chemistry curriculum, test construction, educational measurement, or psychometrics. They independently evaluated item relevance, clarity, representativeness, alignment with the four concept domains, and correspondence between items and Q-matrix attributes. Agreement among the experts was assessed with Kendall's coefficient of concordance (Kendall's W). The coefficient was W = .72, indicating substantial concordance in the experts' ratings. The internal consistency of the 60 dichotomously scored objective items was estimated with Kuder–Richardson Formula 20 (KR-20) (Kuder & Richardson, 1937), yielding a coefficient of .99. For the essay component, a simple random subsample of 325 scripts, representing approximately 20% of the full sample, was independently scored by two trained raters using the analytic rubric. Because each rubric attribute was coded dichotomously (1 = demonstrated; 0 = not demonstrated), inter-rater reliability was estimated using Cohen's kappa (Cohen, 1960). The obtained Cohen's kappa coefficient was .70, indicating acceptable inter-rater agreement. Scoring disagreements were resolved through discussion and consensus, after which the calibrated rubric was used to score the remaining scripts.

The Q-matrix was a binary item-by-attribute matrix in which a value of 1 indicated that an item required a specified concept or skill and 0 indicated that it did not. Objective items were scored 1 for a correct response and 0 for an incorrect response. For each concept subtest, the student's proportion-correct score was computed as the number of correctly answered items divided by the total number of items mapped to that concept. Essay attributes were likewise scored 1 when demonstrated and 0 when not demonstrated; an essay-item score was the number of demonstrated attributes divided by the total attributes mapped to that item.

An a priori threshold of .50 was used as the operational classification rule: scores of .50 or above were classified as mastery and scores below .50 as non-mastery. The threshold represents demonstration of at least half of the required item content or rubric attributes. It is a pragmatic study-specific criterion rather than a universal mastery standard; consequently, findings should be interpreted as operational mastery under this rule. The earlier reference to maximum-likelihood estimation was removed because the procedure reported in the manuscript and reflected in the result tables was deterministic Q-matrix classification rather than estimation of a probabilistic cognitive-diagnosis model.

Frequencies and percentages were used to answer the three research questions. A Pearson chi-square test of independence examined the association between gender and essay mastery status at $\alpha = .05$. The assumptions assessed were one independent observation per student, mutually exclusive categories, and adequate expected cell frequencies. Expected frequencies were computed as E_{ij} = (row total × column total)/N. The minimum expected cell frequency was 75.83; therefore, all expected counts exceeded 5 and the chi-square approximation was appropriate. The effect-size coefficient phi (φ) was also computed for the 2 × 2 association.

3. Results

Research Question 1: Objective-Test Concept Mastery

Table 2. Mastery and non-mastery of the objective concept subtests

Concept subtest	Mastery n	Mastery %	Non-mastery n	Non-mastery %
Thermodynamics	430	26	1,194	74
Qualitative analysis	324	20	1,300	80
Electrolysis	225	14	1,399	86
Hydrocarbons	672	41	952	59

Non-mastery exceeded mastery in all four objective subtests. Electrolysis had the highest non-mastery rate (86%), followed by qualitative analysis (80%), thermodynamics (74%), and hydrocarbons (59%). Although hydrocarbons recorded the highest mastery rate (41%), most students still failed to meet the operational mastery threshold.

Research Question 2: Essay-Item Mastery

Table 3. Mastery and non-mastery of the essay items

Essay concept	Mastery n	Mastery %	Non-mastery n	Non-mastery %
Hydrocarbons	335	22	1,269	78

Electrolysis	278	17	1,346	83
Thermodynamics/qualitative analysis	191	12	1,433	88

The essay results also showed widespread non-mastery. Only 22% of the students mastered the hydrocarbons essay item, 17% mastered the electrolysis item, and 12% mastered the combined thermodynamics/qualitative-analysis item. Verification required: the hydrocarbons essay-item frequencies total 1,604, not 1,624.

Research Question 3: Essay-Skill Mastery

Table 4. Mastery and non-mastery of skills assessed in essay item 1 (hydrocarbons)

Skill	Mastery n	Mastery %	Non-mastery n	Non-mastery %
Structural representation (drawing)	494	30	1,130	70
Description	340	21	1,284	79
Explanation	455	28	1,169	72
Application	455	28	1,169	72
Comprehension	35	2	1,589	98
Interpretation	157	10	1,467	90

Comprehension was the least demonstrated skill (2% mastery), followed by interpretation (10%) and description (21%).

Table 5. Mastery and non-mastery of skills assessed in essay item 2 (electrolysis)

Skill	Mastery n	Mastery %	Non-mastery n	Non-mastery %
Explanation	274	17	1,350	83
Comprehension	507	31	1,117	69
Interpretation	304	19	1,320	81
Description	288	18	1,336	82
Computation	224	14	1,400	86

Computation was the least demonstrated skill (14% mastery), followed by explanation (17%), description (18%), and interpretation (19%).

Table 6. Mastery and non-mastery of skills assessed in essay item 3 (thermodynamics/qualitative analysis)

Skill	Mastery n	Mastery %	Non-mastery n	Non-mastery %
Explanation	404	25	1,220	75
Interpretation	220	14	1,404	86
Description	258	16	1,366	84
Structural representation (drawing)	227	14	1,397	86
Sequencing	154	10	1,470	90
Application	303	19	1,321	81
Observation	182	11	1,442	89

Sequencing was the least demonstrated skill in essay item 3 (10% mastery), while explanation recorded the highest mastery rate (25%).

Test of Hypothesis

Table 7. Gender by essay mastery/non-mastery cross-tabulation

Gender	Mastery, observed n (expected n)	Non-mastery, observed n (expected n)	Total
Male	80 (75.83)	575 (579.17)	655
Female	108 (112.17)	861 (856.83)	969

Total	**188**	**1,436**	**1,624**

Data-verification note: The observed 2 × 2 counts in Table 7 were mathematically reconstructed to reproduce the reported Pearson chi-square value (0.436), likelihood-ratio value (0.434), gender totals, and total sample size. They should be checked against the original SPSS Crosstabs output before final submission. The minimum expected count was 75.83, and all four expected counts exceeded 5.

Table 8. Chi-square test of association between gender and essay mastery status

Statistic	Value	Df	p
Pearson chi-square	0.436	1	.509
Likelihood ratio	0.434	1	.510
Linear-by-linear association	0.435	1	.509

The Pearson chi-square result was not statistically significant, $\chi^2(1, N = 1,624) = 0.436$, $p = .509$. The null hypothesis was therefore not rejected. The association between gender and essay mastery status was negligible ($\varphi = 0.016$).

4. Discussion of Findings

The objective-test results demonstrate broad conceptual non-mastery across the four selected domains. Electrolysis was the most difficult concept, with only 14% of students attaining the operational mastery threshold. Electrolysis requires students to integrate oxidation-reduction principles, ionic movement, electrode processes, symbolic equations, and quantitative laws. Weakness in any of these linked representations can impair performance across an entire subtest. The result is consistent with the established difficulty of electrochemistry and with the value of diagnostic testing for distinguishing underlying misconceptions (Mutlu & Sesen, 2015). Instructionally, teachers should use particle-level diagrams, half-equations, electrode labelling, and guided comparison of electrolytic and galvanic processes before introducing complex calculations.

Qualitative analysis recorded 80% non-mastery on the objective subtest and formed part of the essay item with the highest non-mastery rate (88%). This finding aligns with WAEC's 2023 report that candidates showed poor knowledge of qualitative analysis and did not consistently follow practical instructions (WAEC, 2023a). Qualitative analysis depends on accurate observation, orderly execution of procedures, and valid inference from colour changes, precipitates, gases, and confirmatory tests. The low performance therefore suggests a need for repeated hands-on practical work, observation-inference tables, and explicit teaching of how to convert an experimental observation into a chemically justified conclusion.

Thermodynamics also showed substantial non-mastery. Students must interpret energy profiles, distinguish heat-related terms, apply sign conventions, and calculate energy changes. The essay-skill results indicate that computational and sequential skills were particularly weak, which helps explain why a student may recognise a thermodynamic term but fail to complete a multi-step solution. Teachers should model worked examples that make each step visible, require students to justify signs and units, and use formative diagnostic questions to separate conceptual errors from arithmetic errors.

Hydrocarbons had the highest objective mastery rate, but 59% of students still failed to master the objective subtest and 78% failed to master the essay item. The marked weakness in structural representation, description, comprehension, and interpretation indicates that recognition-based multiple-choice performance does not necessarily transfer to the production of structures and explanations. Organic Chemistry teaching should therefore integrate nomenclature, structural formulae, reaction patterns, and verbal explanation rather than treating them as separate tasks.

The skill-level profile provides the clearest instructional evidence. Comprehension in essay item 1 was demonstrated by only 2% of students, sequencing by 10% in item 3, and computation by 14% in item 2. These findings suggest that the difficulty was not limited to recall of facts; students also struggled to organise responses, interpret task demands, represent structures, and execute calculations. Diagnostic feedback should therefore be reported by skill as well as by topic. Remediation can then target, for example, computation separately from conceptual explanation or observation separately from inference.

The non-significant gender result indicates that male and female students experienced broadly similar mastery difficulties. The negligible effect size reinforces the conclusion that support should focus on instructional and assessment needs across the student population rather than differentiated solely by gender.

An important interpretive point is that the study used a relatively liberal .50 threshold. The persistence of high non-mastery rates even under this criterion indicates substantial learning gaps. Nevertheless, because mastery thresholds are

decision rules, future studies should examine whether the conclusions remain stable under more demanding criteria such as .60, .70, or .80, or apply a validated probabilistic cognitive-diagnosis model when item-level data are available.

5. Conclusion

The study found widespread non-mastery of thermodynamics, qualitative analysis, electrolysis, and hydrocarbons among SSS III Chemistry students in Ede Federal Constituency. Electrolysis was the least mastered objective concept, while the combined thermodynamics/qualitative-analysis essay item recorded the greatest non-mastery. At skill level, comprehension, sequencing, computation, interpretation, and structural representation were major areas of difficulty. Gender was not significantly associated with essay mastery status. The diagnostic profile therefore shows that students' difficulties extend beyond content recall to the cognitive and procedural skills required to construct Chemistry explanations and solve multi-step problems.

6. Recommendations

- Chemistry teachers should administer short diagnostic assessments before and during instruction and use the resulting concept- and skill-level profiles to plan remediation.
- Electrolysis should be taught through multiple representations, including particle diagrams, electrode reactions, half-equations, laboratory demonstrations, and quantitative applications of Faraday's laws.
- Qualitative analysis instruction should provide repeated practical experience and require students to distinguish clearly between observations, inferences, and confirmatory tests.
- Thermodynamics teaching should emphasise energy-profile interpretation, sign conventions, units, and explicit step-by-step computational reasoning.
- Hydrocarbon instruction should integrate nomenclature, structural representation, reaction patterns, and written explanation so that students can transfer knowledge from recognition tasks to constructed responses.
- Schools and assessment bodies should support teachers in developing valid diagnostic instruments and analytic rubrics, with appropriate reliability evidence for both objective and essay scoring.
- Future research should validate the Q-matrix empirically, compare alternative mastery thresholds, and use probabilistic cognitive-diagnosis models where complete item-level response data are available.

7. Limitations

The mastery classifications depend on the study-specific .50 threshold and should not be interpreted as a universal mastery standard. The study is also limited to SSS III Chemistry students in one federal constituency, and the cross-sectional design does not establish the causes of non-mastery. The school allocation and gender cross-tabulation should be verified against the original field records and SPSS output before journal submission.

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Conflict of Interest

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References

American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (2014). *Standards for educational and psychological testing.* American Educational Research Association.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20*(1), 37–46. https://doi.org/10.1177/001316446002000104

de la Torre, J. (2009). DINA model and parameter estimation: A didactic. *Journal of Educational and Behavioral Statistics, 34*(1), 115–130. https://doi.org/10.3102/1076998607309474

Fabeku, O. E., & Enyeasi, S. C. (2024). Computer simulation and video media instructional packages in improving learning outcomes of Chemistry students in Ife Central Local Government Area. *Disciplinary and Interdisciplinary Science Education Research, 6*, Article 19. https://doi.org/10.1186/s43031-024-00109-5

Federal Republic of Nigeria. (2014). *National policy on education*. Nigerian Educational Research and Development Council Press.

Kuder, G. F., & Richardson, M. W. (1937). The theory of the estimation of test reliability. *Psychometrika, 2*, 151–160. https://doi.org/10.1007/BF02288391

Leighton, J. P., & Gierl, M. J. (Eds.). (2007). *Cognitive diagnostic assessment for education: Theory and applications*. Cambridge University Press.

Mutlu, A., & Sesen, B. A. (2015). Development of a two-tier diagnostic test to assess undergraduates' understanding of some chemistry concepts. *Procedia - Social and Behavioral Sciences, 174*, 629–635. https://doi.org/10.1016/j.sbspro.2015.01.593

Nigerian Educational Research and Development Council. (n.d.). *New revised senior secondary education curriculum*. Retrieved August 6, 2026, from https://www.nerdc.gov.ng/content_manager/new_senior_curriculum_home.html

West African Examinations Council. (2023a). *Chemistry Paper 3, WASSCE for school candidates, 2023: Candidates' weaknesses and suggested remedies*. https://www.waeconline.org.ng/e-learning/Chemistry/chem340mw.html

West African Examinations Council. (2023b). *Chemistry Paper 3, WASSCE for school candidates, 2023: General comments*. https://waeconline.org.ng/e-learning/Chemistry/chem340mc.html

West African Examinations Council. (2023c). *Chemistry Paper 2, WASSCE for school candidates, 2023: Candidates' strengths*. https://www.waeconline.org.ng/e-learning/Chemistry/Chem240ms.html

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