Assessment of Science Resource Utilization and Its Effect on Grade 11 Earth and Life Science Student Performance

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ABSTRACT

This descriptive-correlational study assessed the availability, functionality, and extent of utilization of science instructional resources in Earth and Life Science, and examined their relationship to students' summative test performance, in response to persistent Philippine concerns over inadequate and underutilized science resources in secondary education. The study was conducted at Usmad National High School, Argao, Cebu, during the first quarter of School Year 2025–2026. An adapted questionnaire was administered to 31 Grade 11 respondents selected through purposive sampling, and data were analyzed using frequency, percentage, weighted mean, and Pearson product-moment correlation tested at $\alpha = 0.05$. All 28 science resources across eight categories were available (100%) and functional (100%); however, the overall weighted mean utilization rate was 87% ("partially utilized"), with the Crystal Structures Set showing the lowest utilization at 64% ("not utilized"). Overall, 87.08% of students achieved mastery or exceeding mastery in the summative test, with geologic hazards yielding the highest achievement (61.29% exceeding mastery) and plate tectonics/folds and faults the lowest (48.39%). A statistically significant moderate-to-strong positive relationship was found between resource utilization and summative test scores ($r = 0.67$, $p < 0.001$, $t = 4.82$), leading to rejection of the null hypothesis. The top challenges students encountered were lack of skills or knowledge to use resources effectively, technical difficulties, and a preference for more hands-on activities. The findings demonstrate that full availability and functionality of science resources do not, by themselves, translate into effective learning; deliberate and skillful utilization is what ultimately drives student achievement. The study recommends the development of enhanced laboratory exercises targeting the assessed competencies, prioritizing plate tectonics and metamorphism, sustained teacher professional development on underutilized equipment, structured student orientation, and inquiry-driven, contextualized laboratory activities relevant to local geological hazards.

Keywords: Descriptive-Correlational Study, Earth And Life Science, Instructional Resources, Science Resource Utilization, Student Performance

INTRODUCTION

Instructional resources are vital tools in the teaching and learning process. They facilitate the transfer of knowledge, promote student engagement, and support the comprehension of complex concepts. When used effectively, these materials empower educators to deliver lessons that are both meaningful and impactful, ultimately contributing to improved student achievement (Al-Busaidi, 2016).

In Earth and Life Science, a discipline encompassing geology, meteorology, and environmental science, the need for dynamic, multi-sensory instructional resources becomes even more pronounced. Despite their recognized importance, disparities in the availability and functionality of instructional materials persist, often due to limited funding, inadequate infrastructure, varying teacher preparedness, and geographic constraints (Akinsola, 2012). Research consistently shows that both the quality and availability of instructional resources significantly influence student performance in summative assessments (Bernard et al., 2004). Availability refers to whether resources are present and accessible, while functionality pertains to how effectively these resources support instructional goals.

Several Philippine studies reinforce these concerns. De Vera (2020) identified inadequate laboratory facilities and insufficient learner materials as key barriers among junior high school students. Cudal, Tabalba, and Paglinawan (2024) found that science resource availability in the Division of Bukidnon was rated low, with limited integration into teaching practices, while Mangarin and Macayana (2024) explored systemic issues behind the scarcity of laboratory equipment in Philippine schools. Beyond mere availability, however, the functionality of resources — how well they engage learners, clarify abstract concepts, and support inquiry-based instruction — plays a critical role in shaping educational outcomes.

In response to these concerns, the present study explored the availability, functionality, and extent of utilization of instructional resources in the teaching-learning delivery of Earth and Life Science, and investigated how these factors relate to students' summative test scores at Usmad National High School, Argao, Cebu, during the first quarter of School Year 2025–2026. By identifying patterns and gaps in resource use, the study aims to inform the development of enhanced laboratory exercises for Grade 11 Earth and Life Science.

Objectives of the Study

This study assessed the utilization of science resources, their relationship to students' summative test scores, and the challenges students encountered in Earth and Life Science at Usmad National High School during the first quarter of School Year 2025–2026. Specifically, it sought to answer: (1) What is the status of availability, functionality, and extent of utilization of science resources in the teaching-learning delivery of Earth and Life Science? (2) What are students' summative test scores in the first quarter on five identified competencies (rock-forming minerals, metamorphism, plate tectonics/folds and faults, stratified rocks, and geologic hazards)? (3) Is there a significant relationship between resource utilization and summative test scores? (4) What challenges do students encounter in utilizing science resources? and (5) What Enhanced Laboratory Exercises in Earth and Life Science Grade 11 may be crafted based on the findings?

LITERATURE REVIEW

Theory and Definition

The study is anchored on DepEd Order No. 42, s. 2016 (Guidelines on the Selection, Adoption, and Use of Learning Resources), DepEd Order No. 025, s. 2023 (Guidelines on the Procurement and Quality Assurance of Textbooks and Teacher's Manuals), and DepEd Order No. 44, s. 2015 (Guidelines on the Use of Instructional Materials in Schools), together with Experiential Learning Theory (Kolb, 1984), Constructivist Theory (Piaget, 1973; Vygotsky, 1978), and Inquiry-Based Theory (Dewey, 1900).

Experiential Learning Theory holds that knowledge is created through the transformation of experience, supporting the idea that students learn best through hands-on investigation, reflection, and application (Kolb, 1984; Kolb & Kolb, 2017). Constructivist theory emphasizes that knowledge is actively constructed by learners through experience and social interaction (Piaget, 1973; Vygotsky, 1978), favoring inquiry-based classrooms over rote memorization. Inquiry-Based Theory views learning as an open-ended process in which students form questions, design experiments, analyze data, and construct explanations (National Research Council, 2000). Together, these frameworks support the proposition that the availability, functionality, and extent of utilization of science resources may influence students' summative test performance, and they inform the design of the proposed Enhanced Laboratory Exercises in Earth and Life Science for Grade 11 Senior High School.

CONCEPTUAL FRAMEWORK

Figure 1 presents the conceptual framework of the study. The legal bases (DepEd Order Nos. 42 s. 2016, 025 s. 2023, and 44 s. 2015) and the theoretical bases (Experiential Learning, Constructivist, and Inquiry-Based theories) jointly informed the assessment of science resource availability, functionality, and utilization, and their relationship to students' summative test scores on five Earth and Life Science competencies and students' challenges in resource utilization, which in turn informed the proposed Enhanced Laboratory Exercises in Earth and Life Science Grade 11 Senior High School.

Legal Bases	Theoretical Bases
• Guidelines on the Selection, Adoption, and Use of Learning Resources (DO 42, s. 2016) • Guidelines on the Procurement and Quality Assurance of Textbooks and Teacher's Manuals (DO 025, s. 2023) • Guidelines on the Use of Instructional Materials in Schools (DO 44, s. 2015)	• Experiential Learning Theory (Kolb, 1984) • Constructivist Theory (Piaget, 1973; Vygotsky, 1978) • Inquiry-Based Theory (Dewey, 1900)

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Summative test scores in the first quarter Earth and Life Science on the following competencies: (1) identifying common rock-forming minerals using their physical and chemical properties; (2) describing the physical and chemical changes in rocks due to changes in pressure and temperature (metamorphism); (3) explaining how the movement of plates leads to the formation of folds and faults; (4) describing how layers of rocks (stratified rocks) are formed; and (5) describing the various hazards that may happen in the event of earthquakes, volcanic eruptions, and landslides; and students' experiences and challenges encountered in the utilization of science instructional resources in Earth and Life Science activities.

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Enhanced Laboratory Exercises in Earth and Life Science Grade 11 Senior High School

Figure 1. Conceptual Framework of the Study

METHODOLOGY

Research Design

This study employed a descriptive-correlational research design (Creswell, 2014). The descriptive component characterized the inventory level of availability, functionality, and extent of utilization of science instructional resources, as well as students' summative test scores across five competencies and the challenges encountered in resource utilization. The correlational component determined the nature and strength of the relationship between resource utilization and summative test scores.

Population and Sample

The study was conducted at Usmad National High School, Barangay Usmad, Argao, Cebu, a public secondary school established in 1981 and currently compliant with the K to 12 and MATATAG curricula. The respondents were all 37 Grade 11 students of the school (16 male, 21 female), selected through purposive sampling for convenient and faster administration of the research questionnaire.

Research Instrument

The study used a research-based questionnaire adapted from Wordu and Botimi-Slaboh (2023), comprising three parts: (1) the inventory level of availability, functionality, and extent of utilization of science resources for first-quarter Earth and Life Science; (2) students' summative test scores on the five identified competencies, drawn from the Department of Education's standardized summative test (SLHT/SLM); and (3) students' experiences and challenges in utilizing science resources. The instrument was administered in English, the medium of instruction.

Validity and Reliability

The instrument's content validity rests on its adaptation from the previously developed questionnaire of Wordu and Botimi-Slaboh (2023), which had established item coverage for assessing the availability, functionality, and utilization of science instructional resources. Prior to administration, the adapted items were reviewed for content

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and face validity by the study's thesis advisory committee to ensure alignment with the Grade 11 Earth and Life Science curriculum competencies and the local school context.

Data Collection

Upon approval, the questionnaire was administered to the Grade 11 respondents, with the researcher assisting students in completing it.

Ethics Statement

The researcher sought permission from the Public Schools District Supervisor and the school principal, with the recommending approval of the research adviser, prior to the conduct of the study.

Data Analysis

Frequency and percentage were used to determine the availability and functionality of science resources and to describe the distribution of students across performance levels. Weighted mean was used to assess the extent of utilization of resources, rated on a three-point Likert scale (3 = Fully Utilized, 2 = Partially Utilized, 1 = Not Utilized). Mean was used to compute average summative test scores per competency. Pearson product-moment correlation, tested via t-test at $\alpha = 0.05$, was used to determine the relationship between resource utilization and summative test scores. Ranking was used to analyze students' challenges in resource utilization.

RESULT

Status of Availability, Functionality, and Extent of Utilization of Science Resources

Table 1. Status of Availability, Functionality, and Utilization of Science Resources in Teaching-Learning Delivery of Earth and Life Science

Category / Resource	Available	Functional	Utilization	Verbal Desc.
A. Earth Science Equipment (9 items)	✓	✓	87% (avg)	PU
Rock Samples Box (3 rock types)	✓	✓	70%	PU
Globe, Celestial / Terrestrial	✓	✓	87% / 80%	PU
Landform Demonstration Kit	✓	✓	90%	PU
Earth Internal Structure Model	✓	✓	94%	PU
Seismograph / Tectonics Detector	✓	✓	93% / 87%	PU
Volcano Cross Section	✓	✓	90%	PU
Compass, Magnetic	✓	✓	90%	PU
B. Life Science Equipment (2 items)	✓	✓	94% (avg)	PU
Compound Microscope	✓	✓	90%	PU
Compound Microscope, 4 objectives	✓	✓	98%	PU
C. General Lab Glassware (3 items)	✓	✓	89% (avg)	PU
D. Heating & Measurement Equip. (4 items)	✓	✓	86% (avg)	PU
E. Safety Equipment (3 items)	✓	✓	92% (avg)	PU

Category / Resource	Available	Functional	Utilization	Verbal Desc.
F. Physics & Optics Equipment (4 items)	✓	✓	86% (avg)	PU
G. Basic Laboratory Accessories (1 item)	✓	✓	87%	PU
H. Chemistry Models (1 item)	✓	✓	64%	NU
Crystal Structures Set (graphite, diamond, NaCl, CO_2)	✓	✓	64%	NU

Legend: PU = Partially Utilized; NU = Not Utilized.

Table 1 presents the inventory of 28 science instructional and laboratory resources across eight categories: Earth Science Equipment (9 items), Life Science Equipment (2), General Laboratory Glassware (3), Heating and Measurement Equipment (4), Safety Equipment (3), Physics and Optics Equipment (4), Basic Laboratory Accessories (1), and Chemistry Models (1). All 28 resources were reported as 100% available and 100% functional, indicating that the school maintained a complete and operationally ready inventory of science materials for Earth and Life Science instruction.

Despite this complete availability and functionality, the overall weighted mean utilization rate was 87%, described verbally as “partially utilized.” Life Science Equipment recorded the highest utilization (94% mean), led by the compound microscope with four objectives (98%), while Chemistry Models recorded the lowest, with the Crystal Structures Set rated as “not utilized” at only 64%. Earth Science Equipment averaged 87% utilization, with the Earth Internal Structure model at 94% and the Rock Samples Box at 70%. Safety Equipment (92%), Physics and Optics Equipment (86%), and Laboratory Glassware (89%) all showed relatively high but partial utilization.

Students' Summative Test Scores

Table 2. Students' Summative Test Scores in the First Quarter of Earth and Life Science by Competency

Competency	Exceeding Mastery f (%)	Mastery f (%)	Partial Mastery f (%)	Insufficient Evidence f (%)
1. Identifying common rock-forming minerals	18 (58.06)	10 (32.26)	2 (6.45)	1 (3.23)
2. Describing physical/chemical changes (metamorphism)	16 (51.61)	11 (35.48)	3 (9.68)	1 (3.23)
3. Explaining plate movement — folds and faults	15 (48.39)	12 (38.71)	3 (9.68)	1 (3.23)
4. Describing formation of stratified rocks	17 (54.84)	9 (29.03)	3 (9.68)	2 (6.45)
5. Describing geologic hazards	19 (61.29)	8 (25.81)	2 (6.45)	2 (6.45)
Overall Performance	**17 (54.83)**	**10 (32.25)**	**2 (6.45)**	**2 (6.45)**

Table 2 shows the distribution of students' performance levels across five competencies. Overall, 17 students (54.83%) achieved exceeding mastery and 10 (32.25%) achieved mastery, indicating that 87.08% of the 31 respondents met or exceeded performance standards, while 2 students (6.45%) showed partial mastery and 2 (6.45%) showed insufficient evidence.

Performance varied across competencies, with describing geologic hazards yielding the highest exceeding-mastery rate (61.29%), followed by identifying rock-forming minerals (58.06%), describing stratified rocks

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(54.84%), and describing metamorphism (51.61%). Explaining how plate movement leads to folds and faults recorded the lowest exceeding-mastery rate (48.39%).

Relationship Between Resource Utilization and Summative Test Scores

Table 3. Pearson Correlation Between Science Resource Utilization and Students' Summative Test Scores

Variables	r-value	Computed t	df	Critical t	p-value	Interpretation	Decision
Resource Utilization & Summative Test Scores	0.67	4.82	29	2.045	0.000*	Moderate-to-strong positive	Reject H_0

*p < 0.05, significant; correlation interpretation per Cohen (1988).

The Pearson product-moment correlation analysis yielded r = 0.67, indicating a moderate-to-strong positive relationship between science resource utilization and summative test scores. The computed t-value of 4.82 exceeded the critical t-value of 2.045 at 29 degrees of freedom ($\alpha = 0.05$), leading to the rejection of the null hypothesis. An r-value of 0.67 indicates that resource utilization accounts for approximately 45% of the variance in test scores ($r^2 = 0.45$).

Students' Challenges in Utilizing Science Resources

Table 4. Students' Challenges Encountered in the Utilization of Science Resources in Earth and Life Science Activities

Challenge	Rank
Lacked necessary skills/knowledge to use resources effectively	1
Encountered technical difficulties using resources	2
Preferred more hands-on activities and experiments	3
Resources not engaging and relevant to learning	4
Resources not easy to understand and use	5
Insufficient access to necessary resources	6
Resources did not help understand concepts better	7
Resources were outdated or inaccurate	8

The most significant challenge identified was students' lack of necessary skills or knowledge to use science instructional resources effectively (Rank 1), followed by technical difficulties in using the resources (Rank 2), and a preference for more hands-on activities and experiments (Rank 3).

DISCUSSION

This finding suggests systemic inefficiencies in science education delivery: when laboratory equipment, models, and specimens are underutilized, opportunities for students to engage with scientific concepts through observation and hands-on interaction are missed, potentially diminishing comprehension, interest, and performance (Rabanes & Paglinawan, 2025). The notably low utilization of the Crystal Structures Set may reflect reduced emphasis on chemistry-related content or limited teacher familiarity with integrating molecular models into Earth and Life Science instruction. Maximizing the utilization of available resources is therefore crucial for enhancing teaching strategies and fully leveraging existing investments in science education infrastructure (Cabusor & Antonio, 2025).

The strong performance on geologic hazards may be attributed to the real-world relevance of earthquakes, volcanic eruptions, and landslides in the Philippine context, reinforced by disaster-preparedness education (Mabeza et al., 2021). The comparatively lower performance on plate tectonics reflects the abstract, three-dimensional reasoning required to understand tectonic forces and structural deformation (Kastens & Ishikawa, 2006), suggesting that physical models, animations, and interactive simulations may be needed to strengthen this competency.

This finding aligns with constructivist learning theory (Piaget, 1973; Vygotsky, 1978): when instructional resources are available, functional, and actively utilized, students have greater opportunities for hands-on exploration and inquiry-based learning, facilitating deeper conceptual understanding. It also underscores that availability and functionality alone are insufficient — effective pedagogical integration and consistent utilization are equally essential (Rabanes & Paglinawan, 2025), consistent with similar findings by Cudal, Tabalba, and Paglinawan (2024) and Lazaro and Paglinawan (2025) in the Philippine context, making resource utilization a meaningful, though not sole, predictor of academic performance (Hattie, 2009).

The first challenge finding suggests that despite full resource availability, the educational value of these materials may not be realized due to students' limited familiarity or competence in using them, highlighting the need for structured orientation, guided practice, and teacher support (Mapa et al., 2020). Technical difficulties — whether from malfunctioning equipment, improper setup, or compatibility issues — can disrupt learning and reduce motivation, echoing barriers documented during pandemic-era online learning (Barrot et al., 2021; Bazie et al., 2024). Students' preference for more hands-on activities reflects a desire for experiential, inquiry-based learning, consistent with findings that Filipino students rate hands-on laboratory experiences more favorably than virtual labs in terms of engagement and motivation (Bugarso et al., 2024).

CONCLUSION

All 28 science instructional and laboratory resources across eight categories at Usmad National High School were fully available (100%) and functional (100%); however, their utilization remained partial overall (87%), with the Crystal Structures Set the least utilized (64%, “not utilized”). Despite partial utilization, the majority of Grade 11 students demonstrated strong performance in the first-quarter summative test, with 87.08% achieving mastery or exceeding mastery. Performance was strongest in describing geologic hazards and weakest in explaining plate movement and the formation of folds and faults, indicating that competencies involving abstract tectonic processes require more targeted instructional support.

The Pearson correlation analysis established a statistically significant moderate-to-strong positive relationship between science resource utilization and summative test scores ($r = 0.67$, $p < 0.001$), confirming that the extent to which science resources are actively used in teaching and learning meaningfully influences student academic performance. The top challenges identified — lack of skills to use resources effectively, technical difficulties, and preference for more hands-on activities — collectively indicate that availability and functionality alone are insufficient to maximize learning outcomes. Bridging this gap requires deliberate instructional planning, teacher capacity building, and structured laboratory exercises that fully engage students in inquiry-based, hands-on science learning.

Contributions/Impact On Society

These structured laboratory exercises serve as practical tools to bridge the gap between resource availability and effective pedagogical utilization. By demonstrating that full resource availability and functionality do not by themselves guarantee learning gains, the study offers school administrators and division-level planners an evidence base for redirecting investment toward teacher capacity building, structured student orientation, and inquiry-based pedagogical integration — ensuring that existing science education infrastructure translates into measurable improvements in student mastery.

RECOMMENDATIONS

Based on the findings, the following are recommended: (1) implement enhanced laboratory exercises targeting the five assessed competencies, prioritizing plate tectonics and metamorphism, where performance was

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relatively lower; (2) provide science teachers with sustained professional development on integrating underutilized equipment such as the Crystal Structures Set and other chemistry models into competency-aligned lessons; (3) establish a systematic resource-utilization monitoring plan to identify barriers such as curriculum misalignment, time constraints, and insufficient teacher preparation; (4) provide students with structured orientation and guided practice sessions at the start of each quarter to build competence and confidence in using science instructional resources; (5) prioritize inquiry-driven, hands-on, contextualized laboratory exercises relevant to local geological hazards; and (6) ensure equitable and sustained investment in science education infrastructure, including maintenance, curriculum alignment, and purposeful integration into daily instruction.

Research Limitation

This study was limited to 31 Grade 11 respondents at a single public secondary school, Usmad National High School, selected through purposive rather than random sampling, which constrains the statistical generalizability of the findings. The assessment of student performance was likewise confined to five competencies within the first quarter of one school year, and the descriptive-correlational design establishes association rather than causation between resource utilization and summative test scores.

Future Research

Future research may replicate this study across multiple schools or divisions using probability sampling to strengthen generalizability, employ experimental or quasi-experimental designs to test the effectiveness of the proposed Enhanced Laboratory Exercises, and investigate additional variables — such as teacher preparedness, instructional strategy, and student motivation — that may mediate or moderate the relationship between science resource utilization and academic performance.

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Author Contributions

Agnes E. Villamor: Conceptualization, methodology, investigation, data curation, formal analysis, writing — original draft. **Francis E. Villamor.:** Data curation, formal analysis, writing — review & editing. **Hedeliza A. Pineda:** Supervision, validation, writing — review & editing. **Robert Jay N. Angco:** Validation, writing — review & editing, project administration.

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