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Students' Laboratory Activities and Academic Performance in Science at Abra De Ilog Cluster, Division of Occidental Mindoro

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Abstract

This study aimed to examine the relationship between laboratory engagement and academic performance of Grade 10 students in Earth Science and Physics across five public schools in the Abra de Ilog Cluster. The study employed a descriptive quantitative design supported by qualitative interviews with 238 randomly selected students and 10 participants for semi-structured interviews. Validated survey questionnaires and interview guides were used as instruments. The study found that students had moderate to high levels of engagement in laboratory activities, with the highest rating in properly cleaning and storing equipment (Mean=3.72) and the lowest in troubleshooting minor equipment issues (Mean=3.03). The overall composite mean was 3.49, indicating moderate engagement. In terms of academic performance, students scored high in Earth Science while Physics performance was negatively affected by incomplete electromagnetism and motion kits. The Pearson r correlation revealed a significant positive relationship between laboratory engagement and academic performance. The major challenges encountered by students included lack of dedicated laboratory rooms (3 schools), outdated or incomplete equipment, limited time, lack of safety gear, low confidence in handling tools, unequal group participation, and overcrowded learning spaces. Based on the findings, 20 enhancement activities were proposed to address these challenges, including equipment orientation workshops, safety simulations, peer-led tutorials, contextualized science projects, and reflective journaling. The study concludes that laboratory engagement significantly contributes to improved academic performance, and addressing resource limitations, safety concerns, and capacity-building gaps is essential for enhancing science education in rural schools.

Keywords: *laboratory engagement, academic performance, Earth Science, Physics, Grade 10 students, rural schools, science education, laboratory challenges, Abra de Ilog Cluster, enhancement activities*

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INTRODUCTION

Science education plays a critical role in developing students' abilities to think logically, solve problems, and connect theoretical knowledge to real-world applications. Laboratory activities are an essential part of science instruction, as they provide hands-on experiences that strengthen conceptual understanding and foster scientific inquiry. However, limitations in resources, facilities, teacher training, and time allocation often affect the quality of laboratory instruction, especially in rural and resource-constrained areas.

In the Philippines, despite reforms such as the K to 12 curriculum and continuous DepEd efforts to improve science facilities, national assessments including PISA (2018), TIMSS (2019), and the 2024 National Achievement Test reveal persistent low performance in science. These challenges become more evident in rural districts such as the Abra de Ilog Cluster, where some schools lack dedicated laboratories, functional equipment, and consistent opportunities for students to conduct experiments.

This study examines the relationship between Grade 10 students' laboratory engagement and their academic performance in Earth Science and Physics. It also seeks to identify the challenges students encounter during laboratory activities and develop enhancement strategies suited for resource-limited schools.

The study aimed to answer the following questions:

1. How may the extent of students' engagement in Science be assessed as to:
    1.1 Use of laboratory equipment;
    1.2 Laboratory safety protocols; and
    1.3 Following laboratory manuals.
2. How may the level of students' academic performance in the different areas of Science be assessed as to:
    2.1 Earth Science; and
    2.2 Physics?
3. Is there a significant relationship between the assessments of the extent of students' engagement and their level of academic performance?
4. What challenges are encountered by the students in carrying out the different laboratory activities?
5. Based on the findings, what enhancement activities may be proposed?

METHODOLOGY

Research Design

A descriptive quantitative design was used to measure engagement, performance, and challenges through survey data, supported by qualitative insights from student interviews. This approach allowed both numerical and narrative exploration of laboratory experiences.

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Participants

A total of 238 Grade 10 students were randomly selected from five secondary schools in the Abra de Ilog Cluster:

- Abra de Ilog National High School – 140
- Biga National High School – 18
- Cabacao National High School – 50
- Camurong National High School – 17
- Pambuhan Village Indigenous People High School – 13

Additionally, 10 students participated in semi-structured interviews to provide further context on laboratory challenges.

Research Instruments

1. Survey Questionnaire
   A validated Likert-scale instrument assessed:
   - Students' Engagement in Science
   - Level of Student's Academic Performance
   - Challenges in laboratory work

2. Interview Guide

Questions focused on resource availability, safety concerns, confidence in laboratory skills, and time constraints.

Data Collection Procedure

Permissions were obtained from school administrators. Surveys were distributed with parental consent. Interviews were conducted individually in secure settings to ensure confidentiality. Ethical guidelines under the Data Privacy Act of 2012 were strictly observed.

Data Analysis

- Weighted Mean & Composite Mean - Measured levels of engagement and performance
- Ranking Method – Identified the most common laboratory challenges
- Pearson r Correlation – Determined the relationship between engagement and academic performance
- Thematic Analysis – Interpreted interview responses

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RESULTS

1) Student Engagement in Laboratory Activities

Findings reveal moderate to high engagement among students.
Highest engagement: Cleaning and storing equipment properly (Mean = 3.72, Highly Engaged)
Lowest engagement: Troubleshooting minor equipment issues (Mean = 3.03, Moderately Engaged)
Overall Composite Mean: 3.49 (Moderately Engaged)

2) Students' Academic Performance

Performance in Earth Science and Physics was generally high, although disparities existed:

- Earth Science performance remained strong despite limited physical resources.
- Physics performance was negatively affected by incomplete electromagnetism and motion kits.

3) Relationship Between Engagement and Performance

The Pearson r test revealed a significant positive correlation between laboratory engagement and academic performance. Students who actively participated in experimental tasks tended to achieve higher science grades.

4) Challenges Encountered

The following challenges emerged as most common:
1. Lack of dedicated laboratory rooms (3 schools without labs)
2. Outdated or incomplete laboratory equipment
3. Limited time for conducting experiments
4. Safety concerns due to lack of protective gear
5. Low student confidence in handling tools
6. Unequal participation within laboratory groups
7. Overcrowded learning spaces

DISCUSSION

The results demonstrate that laboratory engagement significantly contributes to improved academic performance in science subjects. Hands-on exposure allows students to visualize concepts, practice scientific processes, and develop confidence in experimentation. However, the study highlights systemic barriers that limit effective laboratory instruction.

The challenges in the Abra de Ilog Cluster mirror national and international assessments that point to resource limitations, inadequate facilities, and instructional gaps as major contributors to low science literacy. Students' limited exposure to laboratory tasks also stems from overcrowded classes, lack of safety equipment, and outdated manuals not aligned with current MELCs.

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To address these issues, enhancement activities must focus on improving safety, accessibility, teacher training, and the usability of laboratory manuals. Low-cost, context-based solutions can greatly benefit rural schools.

Proposed Enhancement Activities

1. ***LabStart:*** Equipment Orientation and Troubleshooting Workshop
2. ***SafeLab:*** Laboratory Safety Simulation and Drill Program
3. ***Manual Mastery:*** Laboratory Manual Interpretation and Application Sessions
4. ***SciConnect:*** Real-Life Science Integration Projects
5. ***LabFlow:*** Time and Resource Management in Earth Science Labs
6. ***TeachBack:*** Peer-Led Physics Tutorials and Feedback Circles
7. ***Concept-to-Context:*** Science Simulation Lab
8. ***Data Decode:*** Scientific Data Interpretation
9. ***LabTalk:*** Science Communication and Presentation Skills Training
10. ***PeerLab:*** Collaborative Laboratory Mentoring Program
11. ***LabLog:*** Reflective Science Journaling
12. ***Feedback Forward:*** Laboratory Performance Review Sessions
13. ***LabDesign:*** Student-Led Experimental Planning
14. ***Physics in Action:*** Motion Lab Challenge
15. ***Skill Sprint:*** Timed Physics Problem-Solving Challenges
16. ***Energy Explorers Workshop:*** Discovering Renewable and Non-Renewable Energy
17. ***Circuit Builders Club:*** Creating and Testing Simple Electrical Circuits
18. ***Rock and Mineral Exploration Fair:*** Identifying and Classifying Earth Materials
19. ***Disaster Preparedness Simulation: Practicing*** Response to Natural Hazards
20. ***Earth Science Field Immersion:*** Exploring Soil, Water, and Coastal Processes

CONCLUSION

This study concludes that laboratory engagement plays a significant role in improving academic performance in Earth Science and Physics. Students in Abra de Ilog demonstrate strong potential when provided with hands-on learning opportunities. Addressing resource shortages, improving safety, and strengthening teacher and student capacities are essential steps toward enhancing science education in rural settings.