

Laboratory Resource Availability and Students' Engagement in Science

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ABSTRACT

This study investigates the relationship between the availability of laboratory resources and student engagement levels among Grade 12 STEM students at Dologon National High School. A quantitative approach was employed, utilizing a structured survey administered to 66 students to assess their access to laboratory resources, frequency of participation in laboratory activities, and levels of engagement. The results indicated that students perceived adequate access to laboratory resources, with an overall mean score of 3.88 categorized as "agree." Additionally, student engagement was evaluated through behavioral (mean = 4.35), emotional (mean = 3.79), and cognitive engagement (mean = 4.07), yielding an overall engagement mean of 4.07, also classified as "agree." A moderately strong correlation ($r = 0.49$) was found between the availability of laboratory resources and student engagement, suggesting that increased access to resources positively influences student involvement in science activities. These findings align with existing literature emphasizing the importance of well-equipped laboratories in fostering student participation and interest in STEM education. The study highlights that while students demonstrate strong behavioral engagement, there is potential for improvement in emotional engagement to enhance overall learning experiences. Ultimately, the research advocates for educational institutions to prioritize equitable access to laboratory resources and implement strategies that foster an engaging learning environment, thereby preparing students for future challenges in the scientific field.

Keywords: Laboratory Resources, Student Engagement, STEM Education, Access Equity, Behavioral Participation

INTRODUCTION

The availability of laboratory equipment influenced students' learning experiences and outcomes. Laboratories served as vital venues for hands-on activities, especially in science education. These spaces enabled students to put theoretical principles into practice, establishing a stronger connection to the topic. This type of practical learning was essential for improving critical thinking, problem-solving abilities, and scientific reasoning.

When students had access to well-equipped laboratories, they were more likely to participate actively in their education, resulting in a more comprehensive understanding of scientific concepts. The ability to work directly with tools and materials not only improved their learning but also fostered curiosity and excitement for the subject. Moreover, a well-resourced laboratory atmosphere was critical for creating significant educational experiences that prepared students for future challenges in the world of science. This study aimed to explore the relationship between the accessibility of laboratory resources and student engagement levels among Senior High School Grade 12 STEM students at Dologon National High School. The study investigated whether students had equitable access to these resources, the frequency of their participation in laboratory activities, and the degree of engagement and enthusiasm they exhibited during these sessions.

Addressing this problem was essential due to the growing emphasis on STEM education as a vital component of modern curricula. The issue arose from persistent disparities in educational resources, which could lead to unequal learning opportunities among students^[1]. In many educational settings, factors such as funding limitations, lack of infrastructure, and insufficient materials contributed to inequitable access to laboratory

resources^[2]. This inequity hindered students' ability to engage meaningfully with scientific concepts, thereby affecting their overall learning outcomes^[3]. By examining these issues, this study sought to illuminate the gaps in resource availability and its impact on student engagement, ultimately advocating for more equitable educational practices.

The problem was multifaceted. First, it sought to determine if all students had equitable access to laboratory resources, which was essential for fostering an inclusive educational environment^[4]. Second, it examined how often students engaged in hands-on laboratory activities during their science sessions, as regular participation was linked to deeper learning experiences^[5]. Thirdly, the study assessed the level of enthusiasm and engagement that students demonstrated during these activities; these factors were critical for motivating students to pursue careers in science^[6].

Despite the recognized importance of laboratory experiences in enhancing student learning outcomes, significant gaps remained in understanding how resource availability influenced engagement levels. Previous studies indicated that while laboratory activities could foster critical thinking and problem-solving skills, disparities in access to resources could lead to unequal learning opportunities among students. For instance, research showed that a positive laboratory environment correlated with increased student motivation and achievement; however, many schools faced challenges such as inadequate facilities or insufficient materials that hindered effective learning experiences^[2]. This gap highlighted the need for targeted investigations into how resource allocation impacted student engagement across different demographics.

The variables under consideration included laboratory resource availability, and engagement levels. The relationships among these variables were expected to be interdependent; for example, equitable access to resources might enhance participation rates, which in turn could lead to higher engagement levels during laboratory sessions. Understanding these dynamics provided valuable insights into how educational institutions could optimize their science curricula to better support student learning.

A review of literature revealed several relevant studies that underscored the significance of laboratory activities in promoting student engagement. For example, [5] found that inquiry-based laboratory classes significantly increased student interest and learning outcomes compared to traditional methods. Furthermore, [2] demonstrated that pre-laboratory activities could enhance student engagement by fostering collaboration and confidence. Locally, a study conducted by [6] highlighted how practical classes improved conceptual knowledge and technical skills among high school students. These findings collectively emphasized the importance of providing adequate laboratory resources and implementing engaging teaching strategies to enhance student learning experiences.

This study aimed to investigate existing gaps in resource availability and understand how these gaps affected student engagement within STEM education at Dologon National High School. By focusing on equitable access to laboratory resources and analyzing participation frequency alongside levels of enthusiasm during lab sessions, this research sought to provide insights that could inform educational policies aimed at enhancing student experiences in science education. Specifically, this study sought to:

1. Assess the accessibility of laboratory resources for Senior High School STEM students.
2. Evaluate the frequency of student participation in laboratory activities during science sessions.
3. Analyze the levels of engagement and enthusiasm exhibited by students during these activities.

This study aimed not only to contribute to existing literature but also to inform educational policies that promoted equitable access to laboratory resources, thereby enhancing student engagement in science education.

Research Design

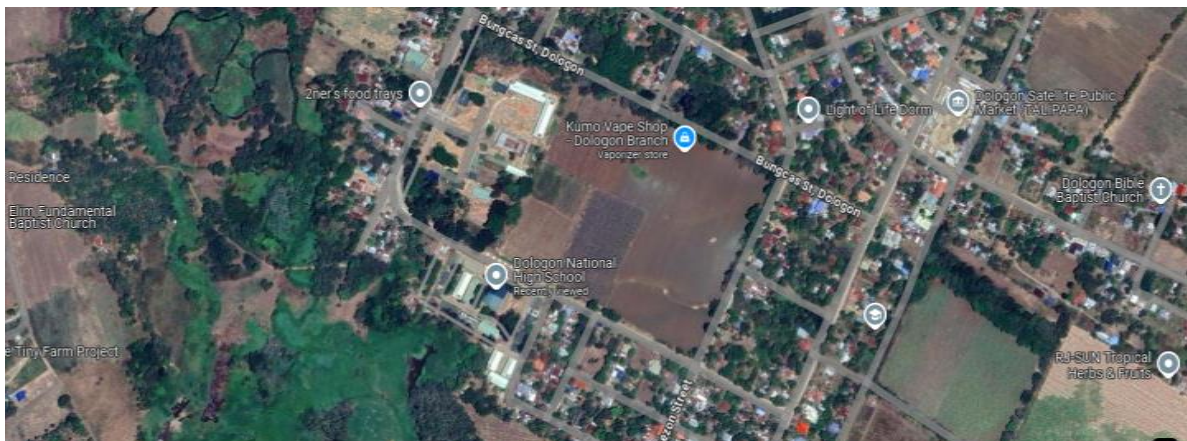
The research design for this study employed a quantitative approach, utilizing a structured survey to assess the relationship between laboratory resource availability and student engagement in science among Senior High

School Grade 12 STEM students. The survey consisted of three sections: one measured the accessibility of laboratory resources, another evaluated the frequency of student participation in laboratory activities during science sessions, and a third assessed the levels of engagement and enthusiasm exhibited by students during these activities. This design aimed to systematically quantify the impact of laboratory resources on student engagement, providing a clear framework for understanding how resource availability influenced participation and enthusiasm in scientific learning environments.

Locale of the Study

The locale of this study was Dologon National High School, situated in the barangay of Dologon within the municipality of Maramag, Bukidnon, Philippines. This area was geographically positioned at approximately 7.8577° N latitude and 125.0502° E longitude, with an elevation of about 277 meters (909 feet) above sea level. The school served as an educational center for the local community, providing STEM programs that were essential for fostering scientific engagement among students. The strategic location within Bukidnon allowed for access to various resources and facilities that may have influenced the availability of laboratory resources for science education.

Figure 1. Dologon National High School Map (maps.google.com)



Participants of the Study

The research participants for this study consisted of a total of 66 Grade 12 STEM students from Dologon National High School. This specific group provided an in-depth overview of student engagement within the STEM program at this grade level. By focusing exclusively on Grade 12 students, the study aimed to capture their experiences and perceptions regarding laboratory resource availability and its impact on their engagement in science activities.

Research Instrument

The research instrument for this study was a structured survey designed to gather quantitative data on laboratory resource availability and student engagement in science among STEM students at Dologon National High School. The survey consisted of carefully crafted questions divided into three main sections: the first assessed the accessibility of laboratory resources, the second evaluated the frequency of student participation in laboratory activities during science sessions, and the third measured the levels of engagement and enthusiasm exhibited by students during these activities. The survey utilized a combination of Likert scale items to facilitate easy response collection and ensure clarity in measuring students' perceptions and experiences. This instrument aimed to provide reliable and valid data that contributed to understanding the relationship between laboratory resources and student engagement in scientific learning environments.

Data Gathering Procedure

The data gathering procedure for this study involved administering a structured survey to the Grade 12 STEM students at Dologon National High School. Initially, informed consent was obtained from students to ensure

ethical compliance. The survey was distributed in a controlled setting, such as during a designated class period, to maximize response rates and minimize distractions. Students were instructed on how to complete the survey, emphasizing the importance of honest and thoughtful responses. Once completed, the surveys were collected and securely stored for analysis. This systematic approach aimed to ensure the reliability and validity of the data gathered regarding laboratory resource availability and student engagement in science.

Statistical Techniques

The statistical techniques employed in this study utilized a correlational approach to examine the relationships between laboratory resource availability and student engagement in science. Data collected from the structured survey were analyzed using SPSS software, which facilitated the computation of correlation coefficients to determine the strength and direction of associations between variables. Specifically, Pearson’s correlation was used to assess the relationships among the accessibility of laboratory resources, frequency of participation in laboratory activities, and levels of student engagement. This analysis aimed to provide insights into how variations in laboratory resource availability may have influenced student participation and enthusiasm, thereby contributing to a deeper understanding of factors that enhanced engagement in scientific learning environments.

RESULTS AND DISCUSSIONS

Table 1 Descriptive Analysis of Laboratory Resource Availability

Indicators	Mean	Descriptive Analysis	Qualitative Interpretation
Access to Equipment	3.73	Agree	Adequate access
Availability of Materials	3.79	Agree	Adequate access
Support and Guidance	4.13	Agree	Adequate access
Overall Mean:	3.88	Agree	Adequate access

Legend:

Range	Descriptive Rating	Qualitative Interpretation
1.00-1.49	Strongly Disagree	Significant deficiency
1.50-2.49	Disagree	Insufficient access
2.50-3.49	Neither	Neutral perspective
3.50-4.49	Agree	Adequate access
4.50-5.00	Strongly Agree	Abundant resources

The findings presented in table 1 reveal that students at Dologon National High School perceive their access to laboratory resources as adequate. Specifically, the mean scores indicate a perception of adequate access to equipment (3.73), materials (3.79), and support and guidance (4.13). The overall mean score of 3.88 further emphasizes this positive outlook, suggesting that the availability of resources significantly contributes to enhancing student engagement in science education.

These results align with existing literature that underscores the critical role laboratory resources play in fostering student interest and participation in STEM fields. Research by [5] supports these findings, demonstrating that inquiry-based laboratory classes significantly enhance student interest and learning

outcomes compared to traditional methods. This enhancement in engagement is likely influenced by the adequate access to equipment and materials, as indicated by the mean scores in table 1.

Additionally, [2] found that pre-laboratory activities promote collaboration and confidence among students, which are essential components of emotional and cognitive engagement. The perceived adequacy of support and guidance (4.13) in table 1 likely facilitates such collaborative efforts, further contributing to students' overall engagement levels.

Locally, [6] highlighted the impact of practical classes on improving conceptual knowledge and technical skills among high school students. The findings from table 1 suggest that adequate access to laboratory resources is instrumental in providing these practical experiences, thereby enhancing students' understanding of scientific concepts.

Collectively, these studies underscore the necessity of providing adequate laboratory resources to facilitate meaningful educational experiences that motivate students to pursue careers in science. The positive perceptions reflected in table 1 reinforce the idea that resource availability is crucial for engaging students effectively in their science education journey.

Table 2 Descriptive Analysis of Students' Engagement in Science

Indicators	Mean	Descriptive Analysis	Qualitative Interpretation
Behavioral Engagement	4.35	Agree	Moderate Engagement
Emotional Engagement	3.79	Agree	Moderate Engagement
Cognitive Engagement	4.07	Agree	Moderate Engagement
Overall Mean:	4.07	Agree	Moderate Engagement

Legend:

Range	Descriptive Rating	Qualitative Interpretation
1.00-1.49	Strongly Disagree	Minimal engagement
1.50-2.49	Disagree	Low engagement
2.50-3.49	Neither	Neutral engagement
3.50-4.49	Agree	Moderate engagement
4.50-5.00	Strongly Agree	High engagement

Table 2 provides a descriptive analysis of students' engagement in science, highlighting key indicators of behavioral, emotional, and cognitive engagement. The mean score for behavioral engagement is notably high at 4.35, indicating a strong level of active participation in science-related activities. Emotional engagement, with a mean score of 3.79, reflects a moderate level of interest and enthusiasm among students towards science. Cognitive engagement, measured at 4.07, suggests that students are actively involved in understanding and applying scientific concepts.

The overall mean score of 4.07 categorizes students' engagement as "agree," leading to the qualitative interpretation of moderate engagement across all dimensions. This indicates that while students are actively participating and demonstrating interest in science, there remains potential for enhancing their emotional and cognitive connections to the subject.

These findings are consistent with existing literature on student engagement in STEM education. Research by [7] emphasizes that high behavioral engagement, as indicated by the mean score of 4.35 in table 2, is crucial for achieving effective learning outcomes, as it fosters a sense of ownership in the learning process. Furthermore, the emotional engagement score of 3.79 suggests that while students demonstrate moderate interest and enthusiasm towards science, there is potential for improvement in this area to enhance their overall engagement^[8]. The cognitive engagement mean of 4.07 indicates that students are actively involved in understanding and applying scientific concepts; however, strengthening emotional connections could further elevate their cognitive engagement levels. These results suggest that while students exhibit strong behavioral engagement, enhancing emotional aspects is essential for fostering a more comprehensive and sustained interest in science subjects.

Table 3 Correlation Analysis on Availability of Laboratory Resources and Students’ Engagement in Science

Pearson R	Significance	
Variables	Academic Achievement	
Availability of Laboratory Resources	.491**	0.00
Student’s Engagement in Science	.491**	0.00

** Correlation is significant at the 0.01 level (2-tailed)

Table 3 illustrates the relationship between the availability of laboratory resources and student engagement in science. The Pearson correlation coefficient of .491 indicates a moderately strong and significant correlation between these two variables, with a significance level of 0.00. This suggests that as access to laboratory resources increases, student engagement in science also tends to rise.

These findings align with existing literature that underscores the importance of resource availability in fostering student engagement in STEM education. For instance, research by [2] emphasizes that adequate laboratory supplies are essential for promoting active involvement and motivation among students. Similarly, [5] found that inquiry-based laboratory experiences significantly enhance student engagement and learning outcomes.

The moderate correlation identified in this study suggests that increasing access to laboratory facilities could lead to higher levels of student engagement, reinforcing the necessity for educational institutions to prioritize resource allocation within their science programs. By investing in laboratory resources, schools can create more enriching educational experiences that motivate students to actively participate in science, ultimately supporting their academic achievement and interest in STEM careers.

Summary

The study examined into how the availability of laboratory resources affects student participation in science among Grade 12 STEM students at Dologon National High School. The descriptive analysis revealed that students thought they had reasonable access to laboratory resources, with mean ratings of 3.73 for equipment access, 3.79 for material availability, and 4.13 for help and guidance. The total mean of 3.88 indicated a positive appraisal of resource availability, emphasizing its importance in enhancing student participation in science education^[2]. These findings are consistent with earlier research that has highlighted the importance of well-equipped laboratories in improving student involvement and passion for STEM disciplines^[5].

In terms of student engagement, the research revealed high levels of behavioral engagement (mean = 4.35), moderate emotional engagement (mean = 3.79), and cognitive engagement (mean = 4.07), for an overall mean of 4.07, indicating moderate engagement. This shows that, while students are actively participating in science activities, there is room for emotional engagement to improve their overall learning experience^{[7],[8]}. The correlation study found a moderately substantial association (correlation coefficient = 0.49) between laboratory

resource availability and student engagement, implying that enhanced resource access is related with higher levels of student interest in science.

CONCLUSIONS

The study's findings highlight the importance of laboratory resource availability in increasing student involvement in science education. Students at Dologon National High School reported having adequate access to laboratory resources, which is consistent with their active involvement and enthusiasm in science activities. This is consistent with prior studies highlighting the importance of resource-rich environments in supporting meaningful learning experiences and instilling excitement for scientific inquiry^[2]. Despite positive evaluations of resource availability, there is still a need to increase emotional engagement among students in order to improve their overall educational performance.

Moreover, even though Dologon National High School may face challenges related to limited laboratory resources, it is noteworthy that science teachers have been trained to utilize alternative equipment effectively to conduct laboratory activities. This adaptability ensures that students continue to engage meaningfully with scientific concepts despite resource constraints, reinforcing the importance of teacher training and innovative teaching strategies in maintaining high levels of student engagement^[6].

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